

HEALTH IMPLICATION OF INDUSTRIAL POLLUTION AND FARM HOUSEHOLDS WILLINGNESS TO RELOCATE FROM CEMENT FACTORIES IN OGUN STATE NIGERIA

Adeleke, E. A.; Ahungwa, G. T. and Yussuf, I.

Department of Agricultural Economic and Extension,
Federal University Dutse, Jigawa State, Nigeria,

*Corresponding Author's email: manleke4real@gmail.com ;

Phone number +2348034756368.

ABSTRACT

Industrial pollution has significant adverse effects on human health and wellbeing, which entails substantial economic consequences. This study investigated health implications of industrial pollution and farm household willingness to relocate away from industrial area in Ogun State, Nigeria. Primary data were obtained in a cross sectional survey of 220 farm households, drawn by multistage sampling technique in the study area. A pre-tested questionnaire was used to obtain data on farm household socio-economic characteristics, prevalent illness, willingness-to-accept incentive to relocate home and farm from factories precinct. Data were analyzed using descriptive statistic, Cost-of-illness analysis, student t-test statistic and random effect logit. Findings showed that majority (95.4%) of the farm household heads were male, with a mean age, household and farm sizes of 50 years, six persons and 1.03ha respectively. The farm household threshold or mean willingness-to-accept incentive to relocate home and farm from the factories precinct was ₦659536.76k. Price of land ($\beta = 0.00012$, $p < 0.01$). Age ($\beta = 0.20$, $p < 0.01$), and level of education ($\beta = 1.9889$, $p < 0.01$) of the farm household heads increased the likelihood of farm household to relocate. Test of difference of two means showed that mean cost-of-illness in the immediate precincts was ₦10659.09K and was significantly ($df = 61$, $p < 0.05$) higher than the mean cost-of-illness in the remote precinct of ₦5972.63. This study concluded that industrial pollution is negatively affecting farm households' health and recommends that farm household located close to the cement factories should be relocated away from such cement factories.

Keywords: Pollution, Farm households, willingness-to-accept, cost-of-illness Ogun State Nigeria.

INTRODUCTION

Economic developments, such as large industrial plant or civil construction, may have environmental and health consequences. (McCarthy, 2002). Cement industry is the major source of particulate matter, Sulphur-dioxide (SO₂) Nitrogen-dioxide (NO₂) and Carbon-monoxide (CO) emissions (Mehraj and Bhat, 2012). CO for instance interacts with the hemoglobin in the blood stream and reduces its ability to carry oxygen (Srinivasan, 2013). Sulphur-dioxide cause spasm in low concentration, damage cilia of respiratory system in high concentration and Nitrogen Oxides causes pulmonary irritation (Srinivasan, 2013). Air pollution causes diseases to the respiratory organs ranging from common cold, bronchitis, asthma, and lung cancer. (Mehrah and Bhat, 2012). The health effects vary greatly from person to person. High-risk groups such as the elderly, infants, pregnant women, and sufferers from chronic heart and lung

diseases are more susceptible to air pollution (Srinivasan, 2013). Children especially are at greater risk because they are generally more active outdoors and their lungs are still developing (Srinivasan, 2013).

Cement dust contains heavy metals like chromium, nickel, cobalt, lead and mercury which constitutes pollutants hazardous to the biotic environment, with impact for vegetation, human health, animal health and ecosystem (Baby *et al.*, 2008). A degraded environment reduces the quality of life for all citizens, but the impact is particularly pronounced on the poor and vulnerable groups, as it is they who suffer the most from degraded access to clean water, air and sanitation, as well as from climate shocks. (Srivastava *et al.*, 2010) Migration as a demographic process can be associated with environmental hazards in several ways. On the one hand, proximate environmental hazards might influence residential decision-making by shaping the

desirability of particular locales. In this case, we might consider environmental hazards as factors shaping migration. On the other hand, migration can represent an exacerbating force with regard to environmental hazards as a result of increasing population density in vulnerable locales. (Hunter, 2005) deforestation, land degradation, erosion, desertification, and climate change are examples of environmental change potentially playing a role in migration decision-making processes.

Tijani *et al.*, (2005) reported that residents near cement factory suffer from air-laden air, cracking of wall of structure as well as soil and water pollution from cement dust. The severity of air pollution differs and is dependent on proximity to cement industry, Children are the most severely affected (Srinivasan, 2013) and the cost of illness, in the areas relative to the cement factory, is higher than other areas (Srinivasan, 2013). Adekunle *et al.*, (2015) analyzed the effect of externalities of cement on technical efficiency of cassava base farmer in Ewekoro local Government Area of Ogun State using stochastic production frontier. It was reported that inefficiency of the farmers was significantly influence by numbers of illness episodes and location. Akinbode *et al.*, (2011) investigated the effect of disease burden on technical efficiency among lowland rice farming households in North Central Nigeria using cost of illness. An average cost of illness ₦12,411.12 was incurred during the rice production cycle, and an average of 17 man-day's were lost due to illness. The cement industry in Nigeria constitutes a major source of air pollution. All the companies producing cement release higher levels of particles than permitted by both the Federal Environmental Protection Agency Guidelines and the Standards of the World Health Organization (Admson *et al.*, 1996). Ogun State has about 158 industrial establishments which generate 5,470 tons of solid waste per year, 2,799 tons of effluent per year and 2,265 tons of hazardous waste per year. The air in Ogun State is polluted by 1,608 tons of particulate per year, 1,500 tons of sulphur- dioxide per year, 3,012 tons of nitrogen oxide per year, 12,531 tons of carbon monoxide per year and 2,227 tons of Volatile Organic Compounds.(VOC's) (Admson *et al.*,

1996). the air emission from the cement factories endangers live, about 63,838 persons are exposed to the cement dust in and around both cement factories in Ogun State (Adamson, 1996).

In the light of the above, the study aimed at describing the prevalent illness among farm households around cement factories in Ogun State and their willingness to relocate home and farm away from cement factories with specific emphasis on describing the socio-economic characteristics of farm households and the prevalent illness and pollution coping strategies of those living around cement factories, and to estimate the economic burden of ill-health associated with industrial pollution as well as the farm households willingness to accept incentives to relocate away from industrial pollution.

Research Hypothesis

- H₀ : There is no significant difference between cost of illness of farm households in immediate and remote precincts of cement factories in Ogun State Nigeria
- H_A: There is significant difference between cost of illness of farm households in immediate and remote precincts of cement factories in Ogun State Nigeria

METHODOLOGY

The study area

The study was carried out in selected farming communities around cement factories in Ogun State. The state has a total population of 5,217,000 according to National Bureau of statistics (NBS, 2013).. The state is blessed with minerals resources such as Kaolin, Feldspar, Mica, Granite, Glass Sand, Clay, Limestone, Kaolin and Gypsum. There are three cement factories in Ogun State: Larfarge cement factories in Ewekoro and Sagamu and Dangote cement factory located in Ibese in Yewa North Local Government Area. Farming is the primary occupation of the indigenes of this area, trading activities is also common among the people.

Sampling techniques

The study used multistage sampling procedure to select the farming communities around the three cement factories. Stage 1:

Farming communities around each of the three cement factories were stratified into two precincts: Those within 8km away from the cement factories as immediate precinct and those located above 8km away from cement factories as remote precinct (Otaru *et al.*, 2013). Stage 2 : Four farming communities located within each of the precincts were selected amounting to 24 communities, In the third stage an average of 9 households were selected from each of the 24 communities in proportion to the size of each communities. Stage 3: Involved selection of one household from the residential building which is expected to yield 220 households.

Analytical techniques

Both descriptive and inferential statistics were used for this study, the specific methods for each objective is stated as follow: The socio economic characteristics of the respondents as well as the prevalent illness and coping strategies with pollution were analyzed using descriptive statistics. The

economic burden of ill- health associated with industrial pollution among the farm households living around cement factories was estimated with Cost-of-illness analysis. The farm households willingness to accept incentives to relocate away from industrial pollution was analysed with random effect logit model

Model Specification

Cost of illness Analysis

Cost of illness was used to estimate the economic burden of ill-health associated with industrial pollution on households around cement factories. Household costs of illness include out-of-pocket payments made by the households for the treatment of diseases and the opportunity costs for time used by the patients and/or caregivers during the illness episode. The cost of illness was calculated following Sauerborn *et al.* (1996); Akinbode *et al.*, (2011) as follows;

Financial cost of illness

$$F = \sum_{i=0}^n (F_{id} + F_{fi} + F_{tri} + F_{li}) \dots \dots \dots (1)$$

Time cost of illness;

$$T = \sum_{i=0}^n [(T_{si} * a_{si} * w)] + (T_{ci} * a_{ci} * w) \dots \dots \dots (2)$$

Economic cost of illness;

$$E = \sum_{i=0}^n (F_i + T_i) \dots \dots \dots (3)$$

Where :

F= total financial costs of health care during the last twelve months (in Naira)

F_{id}= financial cost of drugs, herbs etc (in Naira)

F_{fi} = financial cost of medical consultancy (in Naira)

F_{tri} = financial cost of travel (in Naira)

F_{li} = financial costs of feeding (in Naira)

T = total time costs (days of forgone production)

T_{si} = time costs of the sick person (days of forgone production)

T_{ci} = Time costs of the caretaker(s) (days of forgone production)

w = daily wage rate (in Naira)

n = number of illness episodes

a_{ci} = Man-days of labour

Test of Difference between two means

Student T-test statistic was used to compare whether there is significance difference in cost of illness of farm households in immediate and remote precincts of cement factories, the Z- values was computed as follow:

$$t = \frac{\bar{X}_1 - \bar{X}_2}{\sqrt{\frac{S_1^2}{n_1} + \frac{S_2^2}{n_2}}} \dots\dots\dots(4)$$

Where:

$\bar{X}_1$ = Mean cost of illness in immediate precinct.

$\bar{X}_2$ = Mean cost of illness in remote precinct.

S_1^2 = Standard deviation of the cost of illness among farm households in the immediate precinct.

S_2^2 = Standard deviation of the cost of illness among farm households in the remote precinct.

n_1 = Total number of farm households in the immediate precinct.

n_2 = Total number of farm households in the remote precinct.

Table 1: Showing attributes and their levels in designing choice experiment

Attributes	Explanation	Levels
Mode of payment	mode of compensation	Cash only Kind only Land and cash building and cash
Fate of home and heritage	leaving home and heritage intact or not	Intact Wipe off
Price	Rate of payment	₦150000 ₦225000 ₦ 300000 ₦375000 ₦ 450000

The Null hypothesis is rejected if the absolute value of the calculated Z- statistics is greater than the critical value at 1%, 5%or 10%, otherwise we fail to reject H_0

Willingness to accept to relocate

The farm households' willingness to accept incentives to relocate away from the industrial area was estimated using choice experiment and analyzed within the framework of Random Effect Logit Model ,Given the attribute and the levels presented in Table 1, choice sets were generated using orthogonal design procedure in Statistical Package for Social Scientist (SPSS) version 16.0.

This study adopted the random utility framework to explain individual farm households' preferences for alternatives state of settlements. Farm households are asked to choose among alternatives states of relocating, each with different levels of mode of payment, fate of home and heritage and rate of payment characteristics, the responses are then used to elicit the value people place

on environmental characteristics. Using choice experiment the study considers the attributes associated with each state of relocating presented in the choice sets. The alternative j represents a specific state of relocation with a change in environmental quality, with the conditional indirect utility level V_j for farm household i as expressed as:

$$U_{in} = V_{in} + \varepsilon_{in} + \mu_n \dots \dots \dots (5),$$

Where U_{in} is the deterministic component and the error term

ε_{in} is the random error term that includes random variation across discrete choices,

while μ_n is the random error term across respondents and is constant for each individual.

This means that ε_{in} is the error term due to difference among observations and

μ_n is the error term due to differences among respondents - termed person-specific variation.

Person-specific variation is present when there is some unobserved utility parameter that makes two otherwise identical individuals answer differently to the same choice. The μ_n thus captures the between-subject variability - also known as

heterogeneity among individuals (Greene 2003). The random effect logistic model representing the probability of a farm household i choosing alternative j over all others alternative takes the form

$$p(ij) = \ln \left\{ \frac{P(Y_{ijl}=1 | x_{ijl}, u_j, v_l)}{P(Y_{ijl}=0 | x_{ijl}, u_j, v_l)} \right\} = \alpha_1 + \sum_{k=1}^k \beta_k x_{kijl} + u_j + v_l \dots \dots \dots (6)$$

$$u_j \sim N(0, \sigma u^2), v_l \sim N(0, \sigma v^2) \quad j=1, 2, \dots, j \quad i=1, 2, \dots, n_j \quad l=1, 2, \dots, L$$

The dichotomous logistic random effect model has a binary outcome ($Y=0$ or 1) and regresses the log odds of the outcome probability on various predictors to estimate

the probability that $Y=1$ happens given the random effects.

Given that U_{ij} is linear and additive in the attributes, the utility function becomes

$$(U_{ij}) = Y = v(\alpha + \beta_1 R_1 + \beta_2 R_2 + \dots \beta_n R_n + \beta_a S_1 + \beta_b S_2 + \dots + \beta_m S_k) \dots \dots \dots (7)$$

Where Y = farm household willingness to accept to relocate ($Y=1$ or 0)
 α is the intercept which can be separated into alternative specific constants (ASC), and
 β_1 through β_n are vectors of coefficients attached to relocation attributes (R_1 through R_n) and

β_a through β_m are coefficients associated with farm household socioeconomic characteristics (S_1 through S_m) that are assumed to influence utility.

R_1 = Cash only (Cash only = 1, otherwise = 0)

R_2 = Kind only (Kind only = 1, otherwise = 0)

R₃ = Cash and building (Cash and building =1, otherwise = 0)

R₄ = Land and cash (Land and cash =1, otherwise = 0),

R₅ = home and heritage intact (home and heritage intact =1 or 0 = otherwise)

R₆ = home and heritage cleared (home and heritage cleared =1 or 0 = otherwise)

R₇ = Price (Naira value)

S₁ = Age (years)

S₂ = Marital status (married=1 otherwise=0)

S₃ = Education level (years)

S₄ = Mode of land acquisition(dummy)

WTA was computed by dividing the constant term and each coefficient (other than the coefficient on the payment amount variable) by the negative value of the payment coefficient following Ekin *et al.*, (2006); Cameron (1988)

$$\text{Marginal WTA} = - \left(\frac{\beta_{\text{attribute}}}{\beta_{\text{incentive}}} \right) \dots \dots \dots (8)$$

RESULTS AND DISCUSSION

Analysis of Socio-economic Characteristics of Farm Households

The socio-economic attributes of the farm households (Table 2) in the study area revealed that the mean age of the farm household heads was 50 years, where majority of the farm household heads (67.4%) were within the age bracket 41-60 years. This implies that majority of the farmers are aged, while only few of the farm household heads (20.9%) are in the economic active age bracket 30-40 years, implying that youth involvement in farming activities is relatively low in the Area. Majority of the farm households head (95.4%) were male with an average family size of six persons, This large family size implies availabilities of family labor to the farmers which is expected to boost their productivity. The literacy level of most of the households heads was relatively moderate, with 33% of the household heads having primary education, 37.5% of the household heads had post primary education and 31.3% of the household heads having no formal education. Majority of the respondents (90.9%) were married and (8.6 %) were single. The average farm size was 1.03ha this implies farm households are operating on a low scale level.

Analysis of Perceived Prevalent Illnesses among Farm Households

Survey findings in Table 3, showed that 71.3% of the farm households interviewed does not suffer illness attributable to air pollution in the past three months. Also 15.4 % of the Farm Households reported that they suffer headache and catarrh due to dust emanating from cement factories. Moreover 2.4% of the farm households reported suffering from fever. 3.6% of the Farm Households reported they suffered chest pain attributable to inhaling the cement dust, 4.1% of the farm households indicated they suffered skin rashes and 3.2% of the farm households indicated they suffered eye irritation due to cement dust. However an average of 25 days were lost to illness, 4 days were lost to Cough and Catarrh, 6 days were lost to fever, 7 days were lost to chest pain and 4 days were lost to skin rashes and eye irritation.

Analysis of Coping Strategies with Industrial Pollution among Farm Households around Cement Factories

The survey findings in Table 4, showed that 83.2 % of the farm households interviewed does not take any action in coping with industrial pollution, 4.1% of the farm households stay indoor to reduce exposure to cement dust during days of limestone blasting, 1.4 % of the farm households wear goggle and spectacles to prevent eye irritation, 3.6% wear nose cover to prevent inhaling cement dust, 5 % of the farm households indicated that they drink

milk to neutralize effect of the cement dust on their health, 2.7% of the farm households

indicated they use palm oil in neutralizing the effect of cement dust pollution.

Table2: Distribution of Farm Households by Socio-economic Characteristics

Demographic variables	Characteristics	Frequency	Percentage
Gender	Male	210	95.4
	Female	10	4.6
	Total	220	100
Age	30-40	46	20.9
	41-50	69	31.3
	51-60	77	35.1
	Above 60	28	12.7
	Total	220	100
	Mean	50	
Marital status	Single	19	8.6
	Married	200	90.9
	Widow	1	0.5
	Total	220	100
Education Level	No formal	74	33.6
	Primary	78	35.4
	Secondary	67	30.5
	Tertiary	1	0.5
	Total	220	100
Household size	1-5	127	57.7
	6-10	84	38.2
	11-15	9	4.1
	Total	220	100
	Mean	6 persons	
Farm size	0.4-1.2ha	182	82.7
	1.6-2.4ha	38	17.3
	Mean	1.03ha	

Source: Field Survey 2016.

Table 3: Distribution of Prevalent Illnesses among Farm Households

Source: Field Survey 2016.

Prevalent Illness	Frequency	Percentage	Days lost by sick person	Days lost by caregiver	Total days lost
None	157	71.3	0	0	0
Cough and catarrh	34	15.4	3	1	4
Fever	5	2.4	4	2	6
Chest pain	8	3.6	5	2	7
Skin rashes	9	4.1	3	1	4
Eye irritation	7	3.2	2	2	4
Total	220	100	17	8	25

Table 4: Distribution of farm households by coping strategies with industrial pollution

Coping strategies	Frequency	Percentage
No action taken	183	83.2
Staying indoor during blasting days	9	4.1
Wearing goggle	3	1.4
Wearing nose cover	8	3.6
Drinking milk	11	5
Using palm oil	6	2.7
TOTAL	220	100

Source: Field Survey, 2016

Analysis of Cost of Illness Among Farm Households Living Around Cement Factories

Cost of illness is the means of evaluating economic burden of illness, the mean financial cost of drugs among farm households in the immediate precincts is ₦2806.81 compared to ₦1060.52 cost of drugs in the remote precincts. This implies farm households in immediate precincts spent more on drugs. The mean cost of medical test in the immediate precinct is ₦556.81 compare to ₦736.84 mean cost of test in the remote precincts, mean cost of feeding during days of illness in the immediate precinct

is ₦634.89 as against ₦410.52 spent on feeding in the remote precinct (Table 4). The mean cost of transportation to clinic is ₦359.09 in the immediate precinct of cement factories while that of remote precincts is ₦268.42. The indication of the higher financial cost of illness in the immediate precincts is that there are more illness episode due to their proximity to cement factories. The mean time cost of the sick person in the immediate precincts is ₦4802.27 compare to ₦2489.21 in the remote precincts this implies that days lost to illness by sick farm household members in the immediate precinct

is more than the remote precincts, this has a negative impact on their production efficiency. The mean time cost of care giver for sick

household members in the immediate precincts is ₦1500 which is higher than ₦1007.10 mean time cost of care giver in the remote precincts.

Table 5: Distribution of farm households by cost of illness

Description	Immediate precincts			Remote precincts		
	Amount	Mean	Percentage	Amount	Mean	Percentage
Financial cost of drug	123500	2806.81	64.4	20150	1060.52	63.5
Financial cost of test	24500	556.81	12.8	14000	736.84	17.3
Financial cost of feeding	27900	634.89	14.6	7800	410.52	13
Financial cost of transport	15800	359.09	8.2	5100	268.42	6.2
Total financial cost	191700	4653.81	100	81000	2476.31	100
Time cost of sick person	211300-	4802.27	89.2	47295	2489.21	74.4
Time cost of care givers	66000	1500	10.8	19135	1007.1	26.6
Total Time Cost	277300	6302.27	100	66430	3496.31	100
COI=F cost + T cost	469000	10659.09		113480	5972.63	

N=44 in immediate precinct N= 19 in remote precinct.

Source: Field Survey 2016.

Analysis of test of difference of two means cost of illness

An average household incurred Cost of illness of ₦10659.09K in the immediate precincts of the cement factories and ₦5972.63K in the remote precinct within the period covered by

the study (Table 5). The test of difference of the two means rejected the null hypothesis (at 5% level) and it was concluded that cost of illness in the immediate precinct is higher than cost of illness in the remote precincts as at the period of this study

Table6: difference of two means between households average COI in the precincts

Variables	Mean	Standard deviation	No of observation	T-value	Decision
Immediate precinct	10659.09	6257.668	44	2.11	Reject H_{01}
Remote precinct	5972.63	4128.705	19		
Variables	Mean	Standard deviation	No of observation	T-value	Decision
Immediate precinct	10659.09	6257.668	44	2.11	Reject H_{01}
Remote precinct	5972.63	4128.705	19		

Source: Field Survey 2016.

4.5 Analysis of random effect logistic regression of farm households willingness to accept incentives to relocate away from cement factory area

The result of random effect logit of farm households willingness to accept to relocate farm and home from cement factory vicinity as presented in Table 7, revealed that farm household mean willingness to accept to relocate was ₦659536.76. farm households are willing to accept ₦301825, if they will be allowed access to their current home and heritage after they have relocated. The farm household are willing to accept ₦403616.7, if

they will not be allowed access to their current home and heritage after they have relocated to a new place. Price of land, significantly ($p < 0.01$) contributed to an increase in likelihood of farm households to relocate. This implies that the higher the price for the land the higher the likelihood to relocate. In addition, age and level of education of the farm households significantly ($p < 0.01$) contributed to an increase in likelihood of farm households to relocate. This implies that as the age and level of education increases, farm household likelihood to relocate also increases. This is in line with the findings of Srinivasan(2013).

Table 7: Random effect logit analysis of household willingness to accept incentive to relocate

Variables	Coefficient	Standard Error	T-ratio	MWTA
Cash only	1.0109	0.7513	1.35	-84242
Kind only	0.1779	0.7604	0.23	-14825
Cash and building	-0.547	0.7687	0.71	45583.3
Land and Cash	-0.9094	0.768	1.18	75783.3
Home and heritage intact	-3.6219	0.7847	4.62	301825
Home and heritage wipe off	-4.8434	0.7774	6.23	403617
Price	1.20E-05	7.30E-07	17.02	
Age	0.2	0.0579	3.46	
Education	1.8998	0.647	2.94	
Mode of land Acquisition	-0.2251	0.196	1.15	
Constant	2.9213	1063.15	0	
Log likelihood	-1214			
TMWTP (₦)				659,537

Source: Field Survey 2016.

CONCLUSION AND RECOMMENDATION

Based on findings of this study it is concluded that industrial pollution has negative implication on the health of farm households dwelling around cement factories in that cost-of -illness of farm households increases relative to proximity to cement factories. It is therefore recommended that farm household located close to the cement factories should be relocated away from cement factories.

REFERENCES

- Adekunle C.P, Ashaolu O.F, and Obinka C.A (2015) "Effect of Industrial Externalities on Technical Efficiency Among Cassava -Based Farming Households in Ewekoro Local Government Area, Ogun State" *Nigerian Journal of Agriculture, Food and Environment* 11(4)82-89.
- Adamson K.Y, Longe E.O Oyebeun F. Idialu P.(1996) "Toward an environmental action plan for Ogun State" Federal Environmental Protection Agency, World bank assisted Project.
- Akinbode S. O. , Dipeolu, A. O. and Ibrahim D. A. (2011). Effect of Disease Burden on Technical efficiency among Lowland farming Households in North Central Nigeria *World journal of Agricultural science* 7(3)359-367
- Amal Mohammed Abdel- Rahman(2012) "Effect of Cement Dust Pollution on the yield and quantity of Ficus Carica L.fruit " *Journal of life science* 6(2).
- Baby, S., Singh, N. A., Shrivastava, P., Nath, S. R., Kumar, S. S., Singh, D. and Vivek, K.(2008). "Impact of dust emission on plant vegetation of vicinity of cement plant." *Environmental Engineering and Management Journal* 7(1): 31-35.
- Cameron, T. A. (1988). "A New Paradigm for Valuing Non-Market Goods Using Referendum Data: Maximum Likelihood Estimation by Censored Logistic Regression." *Journal of Environmental Economics and Management* 15 (3): 355-379.
- Ekin, B. Melinda, S. and Gyovai, A. (2006). Using a Choice Experiment to Estimate Farmers' Valuation of Agro biodiversity on Hungarian Small Farms, *Environmental & Resource Economics* 34:439-469
- Federal Environmental Protection Agency FEPA Act (1990) Section 38.
- Federal Environmental Protection Agency (Report), (1992), Biological Diversity in Nigeria.
- Greene, W. H. (2003). *Econometric Analysis*, 5 edn, Person Education, Inc., New Jersey, USA.
- Hunter, G. (2005). Effects of Air Pollution on Agricultural Crops. Ministry of Agriculture, Air Pollution on Agricultural Crops, Ontario, Canada.
- Mehraj S.S and Bhat G.A (2012). "Cement Factories, Air Pollution and consequences" Department of Environmental science and Centre of research development, University of Kashmir, Indian.
- McCarthy, M., Biddulph, J .P Utley, M. Ferguson, J. and Gallivan, S. (2002) "A health impact assessment model for environmental changes attributable to development projects" *J Epidemiol Community Health* 2002;56:611-616.
- NBS(2013) National bureau of statistics population figure, retrieved 2013.
- Nigerian Environmental Study Team(1991) "Nigeria's Threatened Environment: A National Profile".
- NRC (2000) Toxicological effects of methyl mercury, Committee on the toxicological effects of ethyl mercury, Board on Environmental Studies and Toxicology, Commission of Life Sciences, National Research Council, National Academy Press, Washington DC.

- Olaoye O. J., Adekoya B. B., Ezeri G. O, Omoyinmi G. K and Ayansanwo T. O. 2007. Fish Hatchery Production Trends in Ogun State: 2001- 2006. J. Field Aquat.Stud. Aquafield, 3: 29-40.
- Otaru, A.J., Odigure, J.O., Okafor, J.O. Abdulkareem, A.S (2013) "Model Prediction of Particulate Dispersion from a Cement Mill Stack: Case Study of a Cement Plant In Nigeria" *Journal of Environmental Science, Toxicology And Food Technology (IOSR-JESTFT)*3(2) : 97-110
- Ryan H. Dwight, Linda M. Fernandez, Dean B. Baker, Jan C. Semenza and Betty H. Olson(2005) Estimating the economic burden from illnesses associated with recreational coastal water pollution— a case study in Orange County, California" *Journal of environmental management*
- Sauerborn, R.A Nougara, M. Hein and H.J Diesfeld (1996)," Seasonal variation of Households Cost of illness in Burkina Faso" *Social Science and Med*,43(3):281-290.
- Srinivasan S. (2013) "Socio- economic impact of air pollution on dwellers of and around the industrial area in Tamilnadu, India" *Ethopian Journal of Business and Economics* 3(1)16-22.
- Srivastava, D.K ; Kavi, Kumar. C ; Bhujanga , R. Brijesh; P.B Sengupta(2010) "Integrating Pollution-abating Economic Instruments in Goods and Service Tax (GST) regime" Project Funded by British High Commission, New Delhi.
- Tijani A.A, Ajobo O, Akinola A.A (2005) "Cement Production Externalities and Profitability of Crop Enterprises in Two Local Government Areas of Ogun State Nigeria" *Journal of social Science*11(1):43-48.
- WHO (World Health Organization). (2005). Air quality guidelines global update. Report on a working group meeting, Bonn, Germany, 18 – 20 October, 2005.

NEWSPAPER READERSHIP OF AGRICULTURAL EXTENSION AGENTS IN ADAMAWA STATE, NIGERIA

Ndaghu, A. A. and Adamu, U.

¹Department of Agricultural Economics and Extension, Modibbo Adama University of Technology, Yola, Nigeria

²Department of Agricultural Technology, Adamawa State Collage of Agriculture, P.M.B. 2088, Ganye, Nigeria

Corresponding author: Email: mrndaghu@yahoo.com ; +2348032576119

ABSTRACT

Newspaper as one of the mass media is a veritable source of agricultural information. It helps in updating the knowledge of agricultural extension agent on improved farm practices as well as provides information on farmers' production problems. This study assessed newspaper readership among agricultural extension agents in Adamawa State, Nigeria. Specifically, the study identified respondents' socio-economic characteristics, types of newspapers read and respondents' constraints in newspaper readership. Data were collected from 140 respondents selected using systematic random sampling technique. Descriptive statistics was used to analyse the data. Result revealed that 78% of the respondents were male, 52.1% were within the age of 51-59 years and 91% were married. Also, 49% had household size of 6-10 persons, 78% acquired higher education, 86% read newspapers at least once a month, mostly from relations/friends (37%). The most regularly conveyed news items were on Climate Change (36.43%), fish farming (33.57%), and agricultural financing (29.29%) Daily Trust (81.43%), Vanguard (62.86%) and Leadership (29.29%) were respondents' most read newspapers. High cost of Newspapers (100%), non-availability of newspapers (46.42%), and lack of relevant contents (30%) were respondents' major constraints to newspaper readership. Since newspaper reading is common among the respondents, Newspaper editors and other stakeholders in gate keeping activities should create agricultural and food security contents while agricultural extension outfits should provide for regular purchase of newspapers in offices to enhance extension agents' access to Newspapers.

Keywords: Agricultural Extension Agents, Agricultural Information and Newspaper

INTRODUCTION

Agricultural production is important for the economic survival of developing nations of the world of which Nigeria is one. Nigeria is fortunate to have abundant fertile soil along with climate suitable for agricultural production. Currently, Nigeria has 75 percent of its land suitable for agriculture, but only 40% is cultivated and there is also a supply of human resources that could benefit from having the agricultural sector to work in. However, to move forward, the country must increase the low productivity of current agricultural sector, engage competition within the sector, develop domestic policies and increase funding (Ayodele, *et al.*, 2013).

Most of the agricultural production in the country comes from the efforts of small-scale resource-poor farmers who depend largely on traditional farming systems for their agricultural production (Ani, 2006). As a means to improve local production and reduce importation of food and other agricultural products, Nigerian Farmer should be given adequate extension service opportunity. Agricultural extension served as a channel

through which farmers' problems can be identified for research and modification of agricultural policies to benefit the rural communities (Ogunremi and Olatunji, 2013).

The process of increasing the efficiency of agricultural production through agricultural modernization depends mainly on the extent to which extension agent persuade farmers to incorporate modern agricultural production technologies into their farming operations (Ani and Kwaghe, 1997). In order to use this production technology, farmers must become aware of the existence of such practices, and persuade to adopt the technologies. The knowledge, skills and the ability of the agricultural extension agent therefore, could be the means of getting farmers abreast with modern agricultural production technology.

According to Adereti and Ajayi (2005), the concern of extension as an educational process is to help farmers make a decent living by mastering the best way to handle farms in order to improve their production. Farmers need adequate information on the latest technologies. Research has shown that farmers'

information exposure is one of the important factors influencing their adoption behaviour. In order to achieve this objective, the extension agents must be equipped to first comprehend the latest technology before disseminating it to the farmers through the various means, which include the mass media: radio, television and print media such as newspapers.

Access to agricultural information is a prerequisite for effective agricultural development. Agricultural information could be accessed through several sources such as agricultural extension agent, the mass media, extension bulletin, Global System for Mobile Communication (GSM) and the internet among other sources of agricultural information. The newspaper is one of the mass media that serves as a variable source of agricultural information. The newspapers in particular help in updating the knowledge of agricultural extension agent on current agricultural technology as well as get information on problems faced by farmers. It serves as catalyst for accelerating and sustaining campaigns on innovations and better ways of performing agricultural operations. Reading newspapers increase ones knowledge of current happenings around the world. Agricultural Extension Agents are change agents and newspapers are vehicle of change.

In the opinion of Olusoji, (2012), Newspapers are important because they carry current information and they keep the readers informed of events and happenings within and outside their immediate environments. Newspapers are useful for education, recreation, entertainment and relaxation. The newspapers play a vital role in human affairs. Its importance has not been diminished even by the existence of other media such as the internet, radio or television. It readership greatly influences the spread of education. This in turn sharpens ones perception and arouses curiosity about events around us and those in distance lands and also makes ones conscious of the necessity to maintain and sustain ones reading status.

Agricultural extension is one of the means available to help alleviate poverty and improve food security. Agricultural extension means a continued service that

extends the farmers basic education mainly to rural population employed within the agricultural sector. It involves systematic and organized communication with farming communities and among farmers' in order to give them a helping hand. Its objectives are particularly oriented to a better insight into farming practices, clear formulation of farmer's wishes and identification of their problems and looking for solutions (Havrland, *et al.*, 2000).

Extension agent provides leadership in determining, implementing, and evaluating educational programs which are designed to solve social, economic, and environmental problems in agriculture and natural resources. The agent is an educator, an information provider, a needs assessor, a problem solving resource for clientele, and networks with the agricultural industry, specialists, Extension agents and agency representatives. (Virginia Cooperative Extension 2014)

Several studies were conducted on Agricultural Extension Services. In Adamawa State for instance, the studies were mainly on radio, television and internet access and utilization by extension agents without recourse to newspapers readership among extension agents despites availability of agricultural information and technologies in the newspaper which needs to be harnessed and transferred to farmers to put into practice in order to improve on their agricultural production. Hence, the objectives of the study were to;

- i. describe the socio-economic characteristics of the respondents in the study area
- ii. examine the newspaper readership among agricultural extension agents;
- iii. identify the types of newspapers read by the respondents;
- iv. identify the types of information sourced by the respondents from newspaper; and
- v. identify the constraints to newspaper reading among the respondents in the study area.

METHODOLOGY

The study was conducted in Adamawa State, Nigeria. The State is located in North –eastern Nigeria. It lies between latitudes 7° and 11° N of the equator and longitudes 11° and 14° E of the Greenwich Meridian (Adebayo, 1999). Data for the study were obtained from primary sources using structured questionnaires which were administered to 140 respondents drawn proportionate to the size of the ADP zone. Purposive and random sampling techniques were used in selecting the respondents for the study. Three out of the four Agricultural zones namely; Mayo Belwa, Guyuk and Gombi were selected for the study. Descriptive statistics involving the use of frequencies and percentages was used to analyse the data.

Table 1: Distribution of Sampled Respondents

ADP zone	Extension agents	Sample
Gombi	64	40
Mayo-Belwa	96	60
Guyuk	64	40
Total	224	140

Source: Field survey, 2015

ANALYSIS AND DISCUSSION OF RESULTS

Socioeconomic Characteristics of the Respondents

Socio-economic status is the position that an individual occupies with reference to the prevailing average standards of cultural possession, effective income, material possessions and participation in the group activities of the community (Ogunremi and Olatunji, 2013). According to Lee and Wei (2008), people with lower socio-economic status receive information slower than people with higher socio-economic status. They do so because; they are less educated compare to people with higher socio-economic status and may have less time to spend on reading information. The socioeconomic characteristics of the respondents are discussed below:

Age

Age plays a very significant role in newspaper reading (Pew, 2007). Table 2 shows the distribution of respondents by age. The result of analysis in the Table shows that majority (52.1%) of the respondents were between 51 and 59 years of age. Young people represent only 12.2% of the respondents. The mean age is 48.32, this implies that, by virtue of their age and nature of their work, majority of the respondents should have cultivated newspaper-reading culture. This finding agrees with that of the Joint National Readership Survey (JNRS) (2013) which reported 84% of adult population regularly read newspapers.

Table 2: Age Distribution of the Respondents

Source: Field survey, 2015

Age	Frequency	Percentage
<30	6	4.3
30-40	11	7.9
41-50	50	35.7
51-59	73	52.1
Total	140	100.0
Mean age	48.32	

Source: Field survey, 2015

Gender

The distribution of the respondents according to their gender as shown in Table 3 revealed that majority (78%) of the respondents were male, while only 22% were female. This indicated that most of the extension agents in the area are men. This is as expected and can be attributed to socio-cultural factors which avails more opportunities to the males than females in the formal sector. This agrees with the findings of (FAOSTAT, 2012), which estimated that globally only 15 % of extension agents are women

Table 3: Distribution of Respondents According to Gender

Gender	Frequency	Percentage
Female	31	22.1
Male	109	77.9
Total	140	100.0

Source: Field survey, 2015

Marital status

The study showed that, majority of the respondents were married, while about 9% were single as shown on Table 4. This indicates that, married people constitute bulk of the extension agents in the area. This may be due to the fact that they are civil servants, so they have what it takes to support a family. This corroborate with the findings of Ogunremi and Olatunji, (2013) which revealed that 88.5% were married.

Table 4: Distribution of the Respondents' Marital Status

Marital Status	Frequency	Percentage
Single	12	8.6
Married	128	91.4
Total	140	100.0

Source: Field survey, 2015

Household size

The distribution of the respondents by household size as presented in Table 5 shows that most of the respondents (49%) have household size of about 6-10 persons, while about 31% have household size of 11-15 persons. The mean household size is 9.95. This showed that majority of the respondents have relatively large household size which may affect their income in terms of buying newspapers.

Table 5: Household Size of the Respondents

Household Size	Frequency	Percentage
1-5	19	13.6
6-10	68	48.6
11-15	44	31.4
16-20	7	5.0
>20	2	1.4
Total	140	100.0
Mean Household Size	9.945	

Source: Field survey, 2015

Educational attainment

Education is among the key determinants of newspaper reading (Lee & Wei 2008). This is because, the act of reading newspapers is entire for literate persons who can read and comprehend what is in the news. Being extension agents, all the respondents are educated as can be seen on Table 6. Majority (77%) holds a diploma/NCE while the rest had

degree/HND. This implies that all the respondents have ability seek for relevant information from newspapers by virtue of their educational attainment.

Table 6: Distribution of the Respondents by Educational Attainment

Educational level	Frequency	Percentage
Diploma/NCE	109	77.9
Degree/HND	31	22.1
Total	140	100.0

Source: Field survey, 2015

Working experience

Years of experience of an individual has bearing with the extent at which such an individual patronize the newspaper media (Akande, *et al.*, 2014). The distribution of the respondents according to their years of experience on extension related work as shown in Table 7, indicated that majority (about 78%) of the respondents have over 20 years of experience on the job. Respondents with less than 10 years of experience constituted only about 14%. The mean working experiences of the respondents is (24.93%). This implies that most of the respondents have the relevant practical experience on extension service delivery and having more information from newspapers may be transferred to the farmers easily and also efficiently.

Table 7: Distribution of the Respondents by their Working Experience

Experience (Years)	Frequency	Percentage
<10	19	13.6
10-20	12	8.6
21-30	51	36.4
31-35	58	41.4
Total	140	100.0
Mean working experience	24.93	

Source: Field survey, 2015

Respondents' access to agricultural trainings

Apart from the requisite entry requirements of being extension agents, the importance of on the job trainings cannot be over emphasized. Trainings avail the agents the opportunity to refresh their knowledge

and also acquire new extension related ideas. Table 8 shows the distribution of respondents according to the number of Agricultural related trainings they were able to access during the course of their work. The table indicated that majority (about 76%) of the respondents had accessed agricultural training at least twice. Similarly, 9% of the respondents have never attended any of such trainings.

Table 8: Distribution of the Respondents by the Number of Training Received

Training (Number)	Frequency	Percentage
0	13	9.3
1	27	19.3
2	57	40.7
3	20	14.3
4	23	16.4
Total	140	100.0

Source: Field Survey, 2015

Newspaper Readership among the Respondents

Commonly accessed newspapers among the respondents.

The distribution of commonly accessed newspapers by the respondents in the study area as shown in Table 9 revealed that Daily Trust (81.43%), Vanguard (62.86%) and Leadership (29.29%) are the most widely read newspapers by the respondents.

Table 9: Newspapers being accessed by the Respondents

Newspapers	Frequency	Percentage
Vanguard	88	62.86
Guardian	32	22.86
Daily Trust	114	81.43
Tribune	28	20.00
Leadership	41	29.29
Punch	24	17.14
The Graphic	2	1.429
Polity	1	0.71
Sunday Mirror	2	1.42
The Telegraph	2	1.42
Desert Herald	1	0.71
Periscope	1	0.71

Source: Field survey, 2015

Frequency of newspaper reading by the respondents

Agriculture is becoming increasingly information sensitive (Padre and Tripp, 2003) hence, access to information has become a pre-requisite and a valuable resource for agricultural development (Awojobi and Adeokun, 2012). The development of a reading habit is influenced by regular access to newspapers (JNRS, 2013). Table 10 shows the distribution of the respondents based on their frequency of newspaper reading per month. The table indicated that majority (about 86%) do read newspapers at least once in a whole month. However, only about 31% of the respondents have a habit of daily newspaper reading. Similarly, about 14% of the respondents do not read any newspaper in a whole month. This is in line with the findings of Olusoji (2012), who made similar findings on newspaper reading among civil servants in Ekiti State. The finding shows that 186 (93%) of the respondents read newspapers, whereas 14 (7%) do not read newspapers. However, there is the need to encourage frequent newspaper reading culture among the respondents.

Table 10: Frequency of Respondents' Newspaper reading

Times	Frequency	Percentage
Never	19	13.57
Occasionally	31	22.14
Monthly	20	14.29
Weekly	27	19.29
Daily	43	30.71
Total	140	100

Source: Field survey, 2015

Source of respondents' newspapers

Frequency of newspaper reading depends on access to the newspapers. Table 11 shows the respondents' sources of newspapers. The table indicated that, majority (37%) of the respondent access newspapers from relatives/friends and also from their offices (33%). Similarly, about 18% of the respondents do purchase newspapers. This can be attributed to the high cost of newspapers. Surprisingly, in this technologically advanced age, the rate of newspaper access from the internet is relatively low (7%) among the respondents. This may be attributed to the age of the respondents or low ICT literacy among them.

Table 11: Respondents' Sources of Newspaper

Source	Frequency	Percentage
Vendors' Table	8	6.61
Internet	9	7.44
Library	1	0.83
Office	40	33.06
Purchase	18	14.88
Friends/Relations	45	37.19
Total	121	100

Source: Field Survey, 2015

Type of Information Sourced from Newspapers

People read newspapers for different reasons. The opinion of the respondents was sought regarding their agriculture related information needs from newspapers and their responses are presented in Table 12 and 13. Foremost among such information needs are; agricultural financing (50.00%), pest and disease management (48.57%), and fish farming (37.86%). Other includes; community development initiatives, agricultural marketing, livestock production among others. However, in terms of access to such information from newspapers, the most readily available items includes; Climate Change (36.43%), fish farming (33.57%), and agricultural financing (29.29%). One clear implication of this finding is that, there is relative paucity of agriculture related items in newspaper contents. This finding is in consonance with that of Ifeanyi-Obi and Agumagu (2008) who reported low coverage of agriculture news in some Nigerian newspapers. This calls for more coverage of agriculture related news by publishers to promote agricultural productivity in the country.

Table 12: Respondents' Information Needs from Newspapers

Needs	Frequency	Percentage
Community Development Initiatives	35	25.00
Soil Fertility & Protection	19	13.57
Agricultural Finance	70	50.00
Livestock production	45	32.14
Fish Farming	53	37.86
Agricultural Marketing	41	29.29
Food Storage techniques	19	13.57
Climate Change	8	5.71
Pest & Disease Management	68	48.57

Source: Field Survey, 2015

Table 13: Information Accessed by Respondents from Newspapers

Needs	Frequency	Percentage
Community Dev. Initiatives	35	25.00
Soil Fertility & Protection	19	13.56
Agric. Finance	41	29.29
Livestock prod.	27	19.29
Fish Farming	47	33.57
Agric. Marketing	28	20
Food Storage	7	5.00
Climate Change	51	36.43
Pest & Disease Management	8	5.71

Source: Field Survey, 2015

Constraints to Respondents' Newspaper Readership

The distribution of constraints faced by respondents is presented In Table 7. High cost of papers was ranked topmost (100%) among the constraints to newspaper reading by the respondents. Non-availability of newspapers in some areas was ranked second (46.42%) followed by lack of relevant content of the newspaper (30%) as third. Others include, busy schedule and lack of interest in reading newspapers. This finding gives credence to a similar finding by Ifeanyi-Obi and Agumagu (2008), Awojobi, and Adeokun (2012) who reported the issue of

lack of relevant newspaper content among the constraints to newspaper reading.

Table 14: Constraints to Respondents' Newspaper readership

Constraints	Freq.	Constraints rate
Non availability of papers	67	46.42
High cost of papers	140	100.00
Lack of Relevant Content	42	30.00
Lack of time to Read	11	7.86
Lack of Interest in Reading	23	16.43

Source: Field Survey, 2015

CONCLUSION

Agricultural extension agents in the study area are predominantly male who are educated, married and have a house size between 6- 10 people. Agricultural extension agents in the study area do read newspapers at least once in a whole month, mostly from relatives/friends. The most commonly read newspapers among the respondents were Daily Trust, Vanguard and Leadership. The most commonly information sourced by the respondents from the newspapers was on Climate Change, fish farming and agricultural financing. The major constraints to newspaper readership among the respondents in the area were high cost of papers, non-availability of newspapers in some areas and lack of relevant content of the newspapers. Finally, Newspaper reading is common among the respondents and more can be done to encourage it.

RECOMMENDATIONS

Based on the findings made, the following recommendations are proffered towards promoting newspaper readership among the respondents in the study area:

- i. To address the issue of high cost of newspapers, there is the need for the government to encourage ICT literacy among the respondents since online version of newspapers is relatively cheaper. Alternatively, purchase of newspapers in offices should be enhanced so that extension agents will be able to access them.

- ii. It is also important for publishers to more prominently feature local and people-oriented stories that will attract the average reader to the newspaper and keep them reading through the issue as this will encourage newspaper readership among extension agents.
- iii. For newspapers to make significant contribution to the dissemination of agricultural information for enhanced agricultural production it is necessary for them to carry regular agriculture related contents boldly on the front page of their newspapers.

REFERENCES

- Adebayo, A. A. (1999). " *Climate 1 and 11 " Adamawa State in Maps*, Adebayo A.A and Tukur , A.L (eds) Department of Geography , Federal University of Technology, Yola, Paraclete Publisher, Yola.Pp23, 26
- Adereti, F. O and Ajayi, A.O. (2005). Concepts and Basic Principles of Agricultural Extension in Adedoyin, S.F.(ed)Agricultural Extension in Nigeria, AESON 2.(1): 13-20.
- Akande, O. T., Oyeniya, J.O. and Aduba, J, J. (2014). Utilization of Nigerian Daily Newspapers as source of obtaining information among educated people in Ilorin Metropolis of Kwara State, Nigeria. *International Journal of Academic Research in Education and Review*, 2(5), 106-117.
- Ani, A. O. (2006) Effect of Desertification on cassava Production Potentials in the North Eastern Nigeria. *Journal of Agricultural Research and Policies*. 1 (1) pp 37- 41
- Ani, A.O and Kwaghe, P.V. (1997): Sources of Information on Improve Farm Practice: A Study of Farmers in Umuahia Zone of Abia State Nigeria, AGROSEARCH: *Journal of Agriculture, Food and Environment*, 3(1 &8), 1-10.
- Awojobi, E.A. and Adeokun, O.A. (2012). Content Analysis of Agricultural Issues Reported in Two Nigerian Daily Newspapers. *Library Philosophy and Practice (e-journal)*. Paper 800.
- Ayodele, O. S., Obafemi, F. N. and Ebong, F. S. (2013). Challenges facing the achievement of the Nigeria vision. *Global Advanced Research Journal of Social Sciences*, 27:143-157

- FAOSTAT, (2012) FAO 2011 Annual Report. www.fao.org. Retrieved March 28, 2018.
- Havrland, B. and Kapila, F. P. (2000). Technological aspect of extension service in developing countries. Institutes tropical and subtropical agriculture. Czech University of Agriculture. Prague. 33:3-9
- Ifeanyi-Obi, C. C. and Agumagu , A.C. (2008). Agricultural News Coverage in Selected Nigerian Newspapers (2005 and 2006). *The Social Sciences*, 3: 578-582.
- Joint National Readership Survey (JNRS) (2013). Adult Population Regularly Read Newspapers retrieved from News brand Ire land online on 3rd march, 2014.
- Lee, T. T. And Wei, L. (2008). How Newspaper reading Affects Political Participation" *Newspaper Research Journal*, 29(3), 8-23
- Ogunremi, J. B. and Olatunji, S. O. (2013). Perception of Agricultural Extension Agents on the Privatization of Service Delivery towards the Rural Fish Farmers in Ondo State, Nigeria. *Resources and Environment* , 3(4): 87-90 DOI: 10.5923/j.re.20130304.05
- Olusoji, A. O. (2012). Newspaper reading in the Civil Service: Case Study of Ekiti State Civil Servants. *Online Journal of African Affairs*, 1 (1), 4-9.
- Ola, C.O. and Ojo, R. J. (2006). Creating electronic access to newspaper information in Nigeria: The information aid network (IFAnet) experience. In: Igbeka, J. U. and Ola, C.O. (2010) Use of Newspapers by Nigerian University Students: The case of Delta State University. *Library Philosophy and Practice (e-journal)*.5 (12):358
- Padre, S., and Tripp, R. (2003). Reforming farm journalism: The experience of Adike Parthrike in India Agricultural Research and Extension Network (AGREN). *Network Paper No. 128. London: Overseas Development Institute* London, P: 10.
- Pew Research Centre (2007). Daily Newspaper Readership by Education. Retrieved from Pew research centre Journalism & Media on march, 2014
- Virginia Cooperative Extension (2014) Extension Agent, Agriculture and Natural Resources. Retrieved from <http://www.ext.vt.edu/employment/agentanr.html> Retrieved 13 August, 2014.

INFORMATION NEEDS OF FARMERS IN SONG LOCAL GOVERNMENT AREA, ADAMAWA STATE, NIGERIA

Akeweta, J. N., Tata, L. A. and Nandi, J. A.

Department of Agricultural Economics and extension
Federal University of Kashere, PMB 0182 Gombe State

ABSTRACT

Information plays a vital role in agricultural development; for the agricultural sector to be fully developed and for the agricultural innovation to reach the rural farming households, appropriately and timely information need to be comprehensively deplored to the farmers. The study sought to explore the information needs of farmers in Song Local Government Area. Specifically, the study identified respondents' socio economic characteristics, information needs, sources of information and the challenges experienced in accessing the needed information. The sampling technique used was multistage, the sample size is 150, primary and secondary source of data collection was employed. Descriptive statistic was used. Result reveals that majority (64%) of the respondents were within the age of 28-37years and were in their active age range. Almost one third (30.7%) of the respondents had no formal education, (48.7%) had primary education. Majority (60.7%) of the respondents were male, 56.7% were married, 26.0% were widows/widowers and 17.3% were single. All the respondents (150) reported that they need information on agricultural input regularly, 125 said they need information on agricultural credit regularly, 130 said they needed information on health regularly while 93 reported that they need information on agricultural marketing regularly. Information to be disseminated to rural farmers should be timely and those that will be relevant and pertinent to their agricultural activities. Also, the development of environmental messages to create public awareness campaigns through the use of radio messages and posters should be enhanced.

Key Words: Information Needs, Song Local Government Area, Rural Farming Household

INTRODUCTION

Agriculture is a sector that relies heavily on timely and appropriate information dissimulation in order to thrive; the sector depends on continuous flow of innovative information on improved practices. Aina (1991) and Kaniki (1995) opined that each agricultural information user usually have specific information needs based on their peculiarity. Some farmers need information such as sources of credit facilities, issues on land-ownership and marketing of agricultural produce.

Food and agricultural Organization (FAO, 2001), reported that in most developing countries, the wide adaptations of research results by majority of the farmers are limited and this is attributed to inadequate flow of information to the farmers especially those living in the rural areas. The role of information in improving agricultural development cannot be over emphasized because information is vital for increasing food production, improving marketing and distribution (Oladele, 2006). In this present information age, it is knowledge that has been accumulated and applied that will drive development and create unique prospects for economic growth and for poverty decline.

Information is viewed as a tool for individual or societal development. Iwe (2003) is of the view that information as an important input in rural development programmes. The performance of the agricultural sector in Nigeria is unsatisfactory, and one of the reasons is the low level of information among agricultural scientist in the country, lack of free access to electronic technology and ineffective use libraries. According to Saleh and Lasisi (2011), information is classified into agricultural, educational economics, health, political, among others classifications. They also said that the information need of the farmers are not the same but varies base on the environment, sex, educational level, and most importantly, it is based on the agricultural activities of the farmers.

In the study of macro level of the role played by the mass media in promoting social change and development, it was found out that in most respects, mass communication was a far less important source of information and influence than interpersonal communication in the adoption of new agricultural and health practices. Also in stressing the importance of interpersonal traditional media in rural development, Ugboajah (1986) points out that radio are more appropriate and important for the oral and communalistic cultures of rural dwellers in Africa, sources of political information among rural community in Nigeria, Okigbo (1990) found that radio was the highest source of information, when compared with other sources as relatives, traditional rulers, political candidates and other means of communication. It is worthy to note that the findings also showed that radio was closely followed in importance by relatives as a source of information. Okigbo's findings are similar to those of Sobowale and Sogbanmu (1984) in their study of innovation adoption among rural fishermen in Nigeria. The findings also showed the importance of interpersonal communication sources, which are extension workers and relatives. This complementarily between mass media and interpersonal channels as sources of information for rural population was also demonstrated in Fisher's (1990) study of community radio as a tool for development.

Statement of Problem

Even though agriculture is the main stead of the Nigeria economic, information that is needed to improve the sector and bring about increase in food productions is in most cases not made available to those that need it in order to improve production, research result that are to be make available to the rural farmers do not get to them and even when it does, it gets to them late and distorted, also the extension agents who are saddle with the responsibility of taking information to the rural farmers are found wanting, though it is said that information is power, it is worthless and cannot solve problems if it is not used or

applied effectively, so the question here is how will the farmers use information that is not available to them? It is against this background that the study provided answers to the following research questions:

1. What were the socio economic characteristics of the famers in the study area?
2. What was the information needs of the respondents?
3. What were respondents' sources of agricultural information?
4. What challenges did the respondents experienced in accessing information they needed?

Objectives of the study

The general objective of the study was to assess the information needs of farmers in Song Local Government Area were to;

- i. identify the socio economic characteristics of the respondents ;
- ii. identify respondents' information needs, and
- iii. assess respondents' sources of agricultural information
- iv. identify the challenges respondents experienced in accessing agricultural information they needed

MATERIALS AND METHODS

Song Local Government is located on longitude 12° 35' E to 12° 41' E and latitude 9° 44' to 10° 12' N of the equator. It shares boundaries with Gombi to the East, Maiha local government to the South-east, Girei and Fofure local government to the West and Shelleng to the North, (Adebayo, 1999).

The vegetable cover of the area is characterized with Guinea Savannah which consist of mainly trees, shrubs and grasses.

The area has a warm climatic condition throughout the year with an annual average temperature of 28 ° C, the hottest month is April with maximum temperature of 40 ° C says Adebayo, 1999. Song has two distinct seasons which are the dry and the rainy seasons. The rainy seasons is associated with heavy rains and it starts from March to October while the dry season starts from

November to March, during which the harmattan (N.E winds) prevails. The rainfall of 1100mm annually is recorded. The relative humidity varies from 20-30% (low) around January to march and becomes high 80% in August (Adebayo and Tukur, 1999).

The target populations for the study were rural farmers in Adamawa State. Multistage sampling technique will be used to draw sample for the study, the following stages was used:

Stage 1: The study area was stratified in to the 11 wards

Stage 2: Random selection of one village from each of the 11 wards

Stage 3: Three unit were selected from each of the selected 11 wards

Stage 4: Some of the farmers were purposefully selected to make up the 150 respondents for the study from the selected unit.

RESULTS AND DISCUSSION

Respondents' Socio Economic Characteristics

Table 1 shows that majority (64%), of the respondents were within the age range of 28-37 years, this is an indication that majority of the respondents were in their active age with strength and ability to work if the necessary information are made available. The table also shows that almost a third (30.7%) of the respondents has no any formal education, 48.7% attained primary level of education and are mostly illiterates, this means that about 79.4% cannot read and write well. The implication of this is that use of printed media as sources of agricultural information to the respondents are limited and negligible. For this group of farmers the best source of information may be the use of demonstration plots which by design supposed to be carried out by the agricultural extension workers but unfortunately, in recent times, extension workers are not sent to the rural areas. Majority (60.7%) of the respondents were male.

Table 1: Distribution of the respondents' Socio-economic Characteristics

Age group	Frequen cy	Percentage (%)
18- 27	22	14.7
28 - 37	96	64.0
38- 47	17	11.3
48-60	15	10.0
Total	150	100
Educational attainment		
Non formal education	46	30.7
Primary	73	48.7
Secondary school	22	14.6
Tertiary	09	6.0
Total	150	100
Sex		
Male	91	60.7
female	59	39.3
Total	150	100
Marital Status		
Married	85	56.7
Widow/Widower	39	26.0
Single	26	17.3
Total	150	100

Source: field survey 2016

Respondents' Information Needs,

The table shows that all of the respondents have need for information on how, where and when agricultural inputs (such as improved seeds, fertilizer, herbicide, insecticide) can be available to them, 83.3% of the respondents opined they will be informed on where and how they can access agricultural loan to boost their production with little or no interest rate, such respondents will access it and use it to improve on their agricultural production. Also 9.3% that it's not all the time they needed information on credit because it is not always that they needed credit while 7.3% of the respondents did not need any information on credit because even they get such information, they hardly meet the conditions for getting the loan even if they are interested. On information on agricultural marketing, 62% of the respondents said they needed information on the transport system,

daily market price trend which will enable them to know when to sale their farm product in order to maximize profit. This is also the view of Olaniyi and Adewale (2014), “having timely and relevant information, especially marketing information on transport availability, new marketing opportunities and the market prices of farm input and output is fundamental to an efficient and productive agricultural economy”. Majority (86.7%) of the respondents indicated that, they needed information on health and available health service facilities.

Health they say is wealth, for farmers to be able to produce maximally, they need to be healthy, and hence, there is need for the farmers to be informed on their health status and about health services close to them.

Table 2 Distribution of Respondents’ Information Needs

Type of information needed	Regularly	Sometimes Not needed	
Information on input	150	-	-
Agricultural credit	125	14	11
Agricultural marketing	93	11	46
Health information	130	20	-

Source: field survey 2016

Respondents’ Sources of Information

Radio was the channel of information dissemination to most (88.6%) of the respondents. This may be for the fact that radio is the major source through which the respondents accessed information. This is also the view of Okigbo (1990) who reported that radio is ranked as the highest source of information, when compared with other sources among rural dwellers in south eastern part of Nigeria. Anifowose (2013) asserted that radio remains a medium of communication usually employed by the development officers or experts for the dissemination of relevant agricultural messages, especially for rural audience. The second major source of information to the rural farmers is friends and family members (72.7%), GSM (49.3%) and Television (35.3%). Information from the newspapers (8.0%) was very low because majority of the rural farmers cannot read very

well, this was made clear from the findings of Van and Fortier, (2000) which opined that there is a shortcomings of traditional print and library methods in providing such agricultural information to rural farmers who are generally illiterate and relatively remote from sources of information. while only very few(4.0%) accessed information from extension services due to the fact that the extension agents were not readily available.

Majority of the respondents (78%) had low level of information. This results shows that most of the farmers were not well informed on ways through which they can improve their agricultural production that explained why their output was low. Even among those that said they had access to information. According to Ugboajah (1986), mass communication was a far less important source of information and influence in the adoption of new agricultural and health practices.

Table 3: Distribution of respondents’ sources of information

Channels	F(%) of users
Radio	133 (88.7%)
Extension	6 (0.04%)
Friends & Family	109 (72.7%)
TV	53 (35.3%)
News papers	12 (8.0%)
GSM	74 (49.3%)
Total	387*

Source: field survey 2016

*Multiple responses

Distribution of respondents’ challenges experienced in accessing information

Channel through which respondents accessed the needed information were scaled, and messages sent through wrong channels was the major constraint. Some of the information disseminated to the rural communities is in written form, which makes it difficult to access by those with low or no literacy skills. Also, even though radio was the most common source of information available to the respondents, it was not a sufficient source of information because farmers learnt better through demonstration, hence, though radio was easily accessible, it was not considered too good a channel. This finding corroborates Oreglia (2013) who posited that radio was a

passive channel for agricultural information dissemination and was found to be a weak source for agricultural information (Mings et al. 2014). Wrong timing was the second most serious (92.7%) challenge the respondents faced in accessing agricultural information. Most (88%) of the respondents reported that the cost of accessing information through some channels were too high, especially information accessed through radio, Television, phone calls and print materials. Akinola, et al. (2010), concur that the cost of purchasing a radio and television sets, cost of purchasing printed media such as newspapers, magazines, bulletins are factors militating against the effectiveness of mass media communication channels. Electricity poses as the fourth most serious (73.3%) problem of accessing information among the respondents. According to Khan (2010) "Many developing countries also lack sufficient electricity supplies, especially in rural and remote areas. Lack of infrastructural facilities especially electricity is one of the factors militating against the effectiveness of mass media communication channels (Akinola, et al. 2010). The implications of this result is that the needed information do not reach the end users at the right time and in the right form, this will in turn affect the productivity of the farmers.

Table 4: Distribution of respondents challenges faced in accessing information

Challenges	F (%)
Expensive	132 (88%)
Electricity	110 (73.3%)
Wrong timing	139 (92.7%)
Wrong channel	150 (100%)
Accessibility	49 (32.7%)
Total	580*

Source: field survey 2016

*Multiple responses

Summary and Conclusion

The study shows that majority 64% of the respondents were in their active age of 38-47 years. Most (30.7%) of the respondents have non-formal education and less than half (48.7%) attained primary school level of education. This result rules out the use of print media as a source of information

among the respondents. This finding appropriates the use of demonstration farms as a viable option information dissemination among the respondents. Information in the rural area is not available due to the fact that extension workers are rarely available especially in recent time, extension workers are not sent to the rural area to educate the farmers. Majority (60.7%) of the respondents were male and 56.7% married.

The cost of purchasing radio and television sets, cost of purchasing print materials such as newspapers, magazines, bulletins as well as insufficient and unstable electricity supply. Wrong timing of agricultural programs and low levels of literacy among the farmers were the major factors that affected the respondents' information accessibility.

RECOMMENDATION

Based on the study the following recommendations were made:

1. Since most of the respondents can hardly read, demonstration methods should be used to disseminate information on new agricultural technology to the respondents.
2. The information that will be aired or disseminated to rural farmers should be released on time and be based on their information needs.
3. The extension workers should be trained and re trained, they should also be encouraged to accept posting to rural areas

REFERENCES

- Adebayo, A.A (1999). Climate I and II (Sunshine, Temperature, Evaporation and Relative Humidity: in Adebayo, A.A and Tukur, A.I (1999), Adamawa State in Maps, Paraclate Publisher Yola, Nigeria. Pp. 15-30
- Adebayo, A.A and Tukur, A.I (1999). Adamawa State in Maps, paraclate Publisher Yola, Nigeria. Aina, L. O. (1991). The Informal Sector and the Environment in Nigerian Towns.

- Research Journal of Environmental and Earth Science 3 (1), pp. 61-69
- Akinola, O.; Ogunwale, A.B. and Okunade, E.O. (2010). Factors Militating Against the Effectiveness of Mass Media, Communication Channels on Maize Farmers in Ogbomosho Agricultural Zone of Oyo State. Proceeding of the 44th Annual Conference of Agricultural Society of Nigeria held in Ladoko Akintola University of Technology Ogbomosho, from 1214 April, 2010, Oyo State, Nigeria, pp. 1887-1891
- Anifowose ,B.O (2013) Exploring Radio as a Means for Disseminating Development Messages Department of Communication and Language Arts, University of Ibadan ,Ibadan,OyoState.1-9pp
- Fisher, H (1990). 'Community Radio as a Tool for Development'. *Media Development* No.4, pp. 19-23.
- Food and Agricultural Organization (2001), Reports of Food and Agricultural Organization of United Nation, International Journal of Agriculture and Biology, 3(1): 222 in Rural China. ICTD 2012, December 7-10, 2013, Cape Town, South Africa.
- Iwe, J.I (2003). Libraries and Information in Sustainable Rural Development in Nigeria Information Development 19 (3), Pp. 169 – 177
- Kahn, S. (2010). Communication accepted for inclusion in Thomson Reuters and New Online Submission System. Journal of the Asian Media Information and Communication Center 3 (20), pp. 45-50
- Kaniki, A. M. (1995). Agricultural Information User Populations and Critical Tasks In: Aina, L.O, Kaniki, I.O and Ojiambo, J.B (eds) Agricultural Information in Africa, Third World Information Services Ltd., Ibadan, pp. 56-70
- Mings, M., Kimura, K., Beschorner, N., Davies, R., Zhang, G. (2014). Information and Communications in the Chinese Countryside: A Study of Three Provinces. A World Bank study.
- Oreglia, E. (2013). When technology doesn't fit: Information Sharing Practices among Farmers Study.
- Okigbo, C. (1990). "Sources of Political Information in a Rural Nigerian Community'. *Africa Media Review* .Vol. 4, No. 3, pp.49-61.
- Olaniyi, O A and Adewale, J G (2014). Women farmers' perception and utilization of marketing information on cassava in Ogun State, Nigeria. *Journal of Agricultural Extension*. 18(1): 25-37.
- Oladele O.I (2006), Multilinguality of farm broadcast and Agricultural information access in Nigeria, *Nordic Journal of African studies* 15(2): 199-205
- Pew Research Centre, (2007). Daily Newspaper Readership by Education. Refrieved from PEW Research centre, Journalism and Media. March, 2014.
- Saleh A, and Lasisi F. (2011), Information needs and Information seeking behavior of the rural women in Borno State, Nigeria
- Sobowale, I. and Sogbanmu, M. (1984). 'Innovation Adoption among Rural Fishermen in Lagos State, Nigeria'. *African Communication Review*. Vol. 1 & 2, pp. 25-30.
- Ugboajah, F. (1986). Communication as Technology in Rural Development. *Africa Media Review*, Vol.1, No.1, pp. 1-19.

ANALYSIS OF FERTILIZER USE AND GROUP PARTICIPATION AMONG CROP FARMERS IN KOGI STATE, NIGERIA

^aAyo, F. A.*, ^bOlubunmi, A. O. and ^bAbdulazeem, M. L.

^aDivision of Agricultural Colleges, Kabba College of Agriculture, Ahmadu Bello University, Kabba, Nigeria.

^bDepartment of Agricultural Economics and Farm Management, University of Ilorin, Nigeria.

*Corresponding Author e-mail/Mobile: fatismaone@yahoo.com / +234 8032845920

ABSTRACT

Fertilizer use is very important in crop production as adequate and proper application of fertilizer enhances crop yield. However, farming households generally do not use appropriate quantity and quality of fertilizer for several reasons. Considering this fact, the study assessed fertilizer use level and group participation among farming households in Kogi State, Nigeria. Primary data was collected from 352 farming households using systematic random sampling technique. Descriptive statistics and t-test were used to analyse the data. Result showed that there was high (64%) participation in agricultural groups and household members belonged to two different groups on the average. Majority (85%) of the households used fertilizer at an average application rate of 120.74kg/ha. There was a significant difference ($p < 0.01$) between quantity of fertilizer used by the household members in groups and those used by households that are not in groups. Households that are not in groups should be encouraged to join groups. The existing agricultural groups should be strengthened through the provision of fertilizer and credit facilities to the respondents.

Key words: Fertilizer use, Group Participation and Crop farmers.

INTRODUCTION

Agriculture is no doubt the main source of livelihood for many in Nigeria and in most African countries. According to the World Bank (2014), agriculture has provided food, security and employment for over 70% of the world's poor who live in the rural areas.

However, it has been established that Nigerian Agriculture faces problem of low production. The decline in agricultural production is reflected in the poor yield of most crops (Nwakor et al., 2010). This is as a result of continuous cultivation without adequate plan for replenishment of the depleted soil nutrients. The depletion of soil nutrient and degradation of land poses serious challenges to the production of enough food and other agricultural products to sustain livelihoods in the rural areas and meet the need of the urban population (World Bank 2014). Therefore, adding nutrients to the soil is crucial to sustainable agriculture, as this would compensate for depletion of nutrients through crops grown.

Hence, the importance of fertilizer in crop production cannot be overemphasized.

However, the average land holding and yield per hectare is generally low in the study area, this is due to inadequate supply of fertilizer and other farm inputs, as well as lack of access to micro-credit (Kogi State Ministry of Agriculture, 2014).

Furthermore, Social interaction has been established to be a good avenue for sharing information, information about fertilizer use and access to fertilizer inclusive (Abdul, et al., 2011). Involvement in associations may also contribute to learning and training in sustainable agriculture practices. For instance, a farmer may learn new techniques and know-how, obtain informal training from others who have already adopted such practices, and even obtain help implementing various practices. Group participation is therefore crucial for increased crop production by promoting farmers' access to information about fertilizer and fertilizer usage as well as access to fertilizer. Considering the importance of fertilizer in enhancing agricultural productivity, the

Nigerian government over the years has embarked on several policies to encourage the use of fertilizer. The latest of which was the acquisition of fertilizer and improved seed by farmers through the Growth Enhancement Scheme (GES) in order to increase their crop yield. Despite these attempts, there have been inadequacies in fertilizer usage among farming households in the country in general and Kogi State in particular. Ayinde *et al.*, (2009) pointed out that farmers are yet to adopt the optimum fertilizer rate, the various reforms and policies introduced by the Federal Government to encourage the use of fertilizer notwithstanding. Many farmers are not using the recommended fertilizer rate of 200kg/ha (FFD, 2011). This study therefore, attempts to assess the level of fertilizer usage and group participation among farming households in Kogi State.

MATERIALS AND METHODS

The study was conducted in Kogi State Nigeria. Survey method of data collection was used in generating primary data from 352 farming households selected across the State using a four-stage random sampling technique. Two out of the four agricultural development project (ADP) zones in the state were randomly selected in the first stage. Secondly, two blocks from each of the selected agricultural zones were also selected at random. In the third stage, four cells (50%) were equally selected from each of the blocks making a total of sixteen cells selected from the two selected zones. Lastly, a total number of 352 contact farmers were randomly selected across the zones to give a sample size of 352 farm households based on proportional allocation. The distribution of the sample is as shown in table 1. Data were analyzed using frequency, percentage, mean, chart and t-test.

Table 1: Distribution of Respondents

Zones	Blocks ^a	Cells ^a	Farming Households ^a	Sample size ^b
A	1. Ifeolukotun	1. Ejuku	486	32
		2. Ponyan	648	42
		3. Ifeolukotun	524	34
		4. Iyamoye	454	29
	2. Kabba	1. Okebunkun	209	14
		2. Okoro Gbede	246	16
		3. Iyara	662	43
		4. Kabba	1346	87
C	1. Kotonkarfe	1. Koto	150	10
		2. Okparake	120	8
		3. Orehe	80	5
		4. Gegu Beki	130	8
	2. Adavi	1. Osara	120	8
		2. Abobo	80	5
		3. Aku	100	6
		4. Zagondaji	80	5
Total				
2	4	16	5435	352

Source: ^a: KSADP, 2015; ^b: Calculated by Author using equation (4)

RESULTS AND DISCUSSION

Farming Households Participation in Agricultural Groups

Table 2 describes farming households' participation in agricultural

groups. Households sampled were distributed according to membership in groups, that is, whether they belonged to a group or are not a group member.

Table 2: Distribution of Respondents' Participation in Agricultural Group.

Group characteristics	Frequency	Percentage	n = 352
Group participation			
Participation	224	63.64	
Non-participation	128	36.36	
Type of group			
Government funded group	141	40.06	
Agric based mutual support group			
Agricultural cooperatives	32	9.09	
	51	14.49	
Most important group to Households			
Government funded group	139	39.49	
Agric based mutual support	30	8.52	
Agric cooperatives	49	13.92	
No of groups households belong			
1			
2	153	43.47	
3	31	8.81	
	40	11.36	
Membership in group outside community			
Members	57	16.19	
Non members	167	47.44	
No of Household members in groups			
1-2	136	38.64	
3-4	68	19.32	
Above 4	20	5.68	

Source: Field survey, 2015.

A large proportion (64%) of the farming households belonged to one agricultural group or another. Also, 36 % of the household heads sampled were not members of any group or association.

Those who belonged to agricultural groups were mostly (40%) members of government funded groups like Fadama Users Group (FUG), National Special Programme for Food Security (NPFFS), Root and Tuber Expansion Programme (RTEP). A Few (9%) of the respondents belonged to agricultural- based mutual support groups like the Cassava Growers Association while others (14%) were members of agricultural cooperatives. Also, 16% of farming households had members who belong to groups outside their community. Those who belonged to groups had advantage over those who do not. This was because information gathered during the survey revealed that, most of the times; farmers in the study area enjoy benefit from government and banks only if they are identified with a particular group. For example, it was found out that the State government in conjunction with the Bank of Agriculture issued credit facility worth of ₦100,000 to individual farmers to aid agricultural production in the State. But beneficiaries were drawn from registered agricultural groups. Farmers who are not in groups do not enjoy this type of offer.

A large proportion (39%) of the respondents had between 1 and 2 members of their households belonging to groups while just about six percent had greater than four members belonging to groups. For farming households that have members in agricultural groups, an average of two members of such households belongs to one group or another.

Government funded groups appeared to be the most important groups to the households, as claimed by majority (40%) of respondents in groups. While a few (2%) of the respondents do not consider any group as the most important to them, some others (14%) considered agricultural cooperative groups as the most important group to them of all the groups they belonged to.

The households belonged to a minimum of a group and maximum of three different groups with household members belonging to two different groups on the average. Majority (43.47%) of the respondents belonged to only one type of group.

The Reasons for Participation and Non-participation in Groups

The farm households have various reasons for participation and non-participation in groups. The reasons are presented in table 3.

Table 3: Distribution of Respondents' Reasons for Participation and non-Participation in groups

Reasons	Frequency	Percentage
Reasons for Participation (n=224)		
Access to inputs and government incentives	100	44.64
Link and connection	64	28.57
Information and knowledge	35	15.63
Credit and savings	25	11.16
Reasons for non participation(n=128)		
Lack of awareness/ information	26	20.31
Non belief in group	48	37.50
Lack of interest	54	42.18

Source: Field survey, 2015.

A large proportion (64%) of the respondents participated in various groups for several reasons. The reasons included access to input supply and government incentives like fertilizer and loan for production and processing activities (45%), link and connections with corporate organizations and other farmers (28.57%) as well as access to credit and savings (11.16%). Those who do not belong to any group also had their reasons as well. Less than half of the farming households (42%) were not interested in any group due to personal

reasons. Others (57.81%) attributed their non participation to lack of belief in groups (37.50%) and lack of adequate information and awareness (20.31%).

Description of the Level of Fertilizer Use among the respondents.

Figure 1 describes the respondents' use of fertilizer, while type and quantity of fertilizer used as well as the various sources of the fertilizer among the respondents are discussed in table 4.

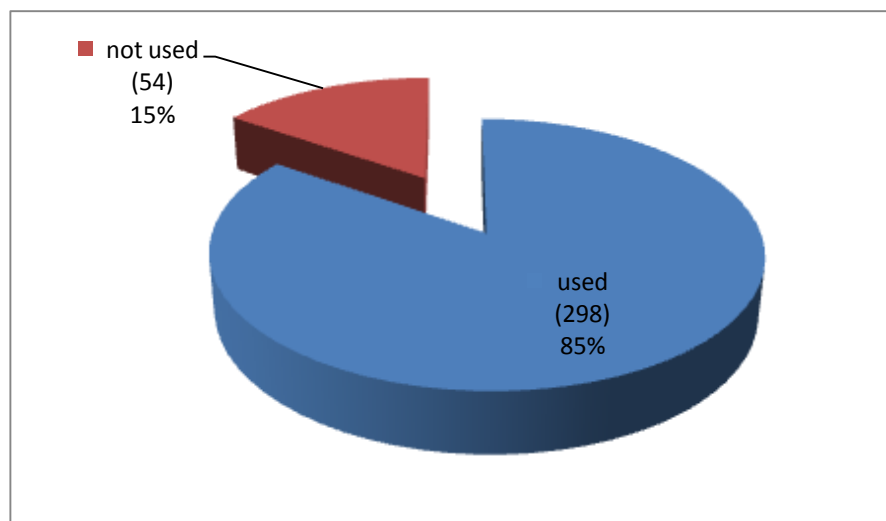


Figure 1: Distribution of Respondents' fertilizer use

Result presented in figure 1 shows that majority (85%) of the respondents used fertilizer. This may be connected to the fact that a large proportion of the respondents were group members. This finding is similar to Mohammed, Ekenta and Ayanlere (2014) who found that most male farmers in Yagba East area of Kogi State used fertilizer. Similarly, majority of maize farmers in Ijumu area of the State used fertilizer (Ayanlere *et al.*, 2014).

Table 4: Distribution of Respondents' based on types, quantities and sources of fertilizer used

	Frequency	Percentage	n= 352
Types of fertilizer used			
None	54	15.34	
NPK	179	50.85	
NPK and Urea	111	31.53	
Urea	8	2.27	
Fertilizer use intensity(kg/ha)			
< 100	182	51.70	
100-200	131	37.22	
201-300	17	4.83	
301-400	10	2.84	
401-500	3	0.85	
>500	9	2.56	
Sources of fertilizer			
None	54	15.34	
Input traders/Openn	115	32.67	
market	140	39.77	
ADP/Fadama	29	8.24	
Other farmers	14	3.98	
Farmers association			

Source: Field survey, 2015

The two major types of fertilizer used in the area were NPK 15: 15: 15 and Urea. Highest proportion (50.85percent) of the respondents used NPK fertilizer. Average quantity of fertilizer used was 120.74kg per hectare. Quantity used varied among households and, ranged from minimum of 0kg for those that did not use fertilizer at all to a maximum of 518.52kg per hectare. The proportion of respondents who used the recommended fertilizer rates (200kg/ha to 500kg/ha depending on the type of crop) by FFD (2011) was low. This conforms the findings of Ayanlere, *et al.*, (2014) that, maize farmers in Ijumu Area of Kogi State Nigeria used an average of 166.39kg/ha/season of fertilizer, which they observed was far below the recommended quantity of eight to 10 bags of 50kg per hectare rate for maize based cropping system. Sources of fertilizer included the open market, ADP, other farmers and farmers associations. Majority (40%) sourced fertilizer through ADP while a few others (8.24%) sourced from other farmers. This may be as a result of the fact that many of the household heads were registered under the Growth Enhancement Support Scheme (GESS) of the federal government. Moreover, information gathered revealed that some farmers who were beneficiaries of the scheme collected the fertilizer and sold same to other farmers and input traders.

Inadequacies in Respondents' Level of Fertilizer Use

Table 6 shows the distribution of respondents' in groups and those not in groups based on quantity of fertilizer used.

Table 5: Fertilizer use based on level of Group Participation

Quantity of fertilizer Used (kg)	Households In groups Freq. (%)	Households without group participation Freq. (%)
< 99.99	95 (42.41)	83 (64.84)
100-199.99	69 (30.80)	17 (13.28)
200-299.99	36 (16.07)	13 (10.16)
300-399.99	16 (7.14)	11 (8.59)
≥ 400	8 (3.57)	4 (3.13)
Total	224 (100)	128 (100)
Mean $\pm$ std. dev.	331.30 $\pm$ 66.39	176.42 $\pm$ 71.32

Source: Field Survey 2015

Result indicates that mean fertilizer use among households in groups was higher (331.30 $\pm$ 66.39) compared to those not in

groups (176.42 $\pm$ 71.32). Higher proportions (78%) of those who used less than 200kg/ha recommended rate were those not in group.

Table 6: t-test results comparing Fertilizer use levels of Respondents in Groups and non members of Group

Quantity	Mean	Std error	t-value	p-value
Group members	331.30	32.56		
Non-members	176.42	26.60	3.68*	0.000

Significant level at 1% (p < 0.01)

Source field survey, 2015

The t- test result in Table 6 also confirms that there is significant difference between the quantities of fertilizer used by the

household members in groups and by those not in groups.

Table 7: Summary of Fertilizer use level among The Respondents

Level of Use	Frequency	Percentage	Min	Max	Mean	Std. dev
Inadequate	210	59.66	33.33	175	75.20	44.72
Adequate	49	13.92	200	200	200	0
Did not use	54	15.34	0	0	0	0
Excessive use	39	11.08	214.29	518.52	434.67	429.63

Source: Field Survey, 2015

Table 7 presents the general description and summary of the inadequacies in the level of fertilizer usage among farming households in the study area. About 14 percent of the farming households used the minimum recommended fertilizer rate of 200kg/ha, and were thus considered as using fertilizer adequately. The rest of the households (86%) were not using fertilizer adequately as about 60 percent used below the minimum recommended rate from as low

as 33.33kg/ha to 175kg/ha. About 15 percent did not use at all while 11.08 percent used above the recommended rate with minimum of 214.29kg/ha and maximum of 518.52kg/ha. Start your discussion with those who did not use fertilizer at all, then those whose use was inadequate, to adequate and then those whose use was in excess

CONCLUSION AND RECOMMENDATIONS

Respondents who were not in groups need to be encouraged to join groups so that they can also enjoy the benefits from groups. This could be achieved through Government and community support to the groups in the area of fertilizer supply, credit supply, improved seeds supply as well as herbicides and insecticides supply.

To derive maximum benefit from use of fertilizer, farmers should be adequately informed, enlightened and advised by extension agents on proper application of fertilizer based on crop specific needs and farming systems adopted by the farmers. This could be achieved through adequate extension services and trainings organized by the groups.

ACKNOWLEDGEMENTS

I wish to thank the management of Ahmadu Bello University Zaria, for giving me the opportunity to benefit from the staff training Tertiary Education Trust fund (TET fund) for the PhD research titled "Analysis of Social Capital and Fertilizer Usage in Small-Scale Crop Production in Kogi State, Nigeria" out of which this manuscript was extracted.

REFERENCES

- Abdul B., Munasib, A. & Jeffrey, L. J. (2011). The effect of social capital on the choice to use sustainable agricultural practices *Journal of Agricultural and Applied Economics*, 43(2), 213–227.
- Ayanlere, A.F., Mohammed, A.B., Dutse, F., Abdullahi, M. and Muhammad-Lawal, A. (2012): An Assessment of the Economics of Maize-Cowpea Cropping System in Oyun Area of Kwara State, Nigeria. *Biological and Environmental*

Sciences Journal for the Tropics, 9(1), 39-43.

- Ayinde, O.E., Adewumi, M.O. and Omotosho, F.I. (2009). Effect of fertilizer policy on crop production in Nigeria. *The Social Sciences*, 4(1), pp53-58. Retrieved from Medwell journals online

<http://207.56.205.141/new151detail.php?id=5&jid=Tss&theme=5&issue no=19>

- Federal Fertilizer Department (FFD), (2011). *Fertilizer use and management practices for crop in Nigeria*. 4th edition. Abuja: Federal Ministry of Agriculture and Rural Development.
- Kogi State Ministry of Agriculture (2014). An overview of Kogi State Ministry of Agriculture and Water Resources. www.kogistate.gov.ng/media/5252c39eade07

- Mohammed, A.B., Ekenta, C.M., and Ayanlere, A.F. (2014). Analysis of gender factors and profitability of yam production in Yagba East local government area of Kogi State Nigeria. *Journal of Sustainable Environmental Management*, 6, pp26-33.

- Nwakor, F.N., Ifenkwe, G.E., Onummadu, F.N and Ekwe, K. C. (2010). Determinants of Adoption of Improved Cassava Varieties (TME419 and NR8082) among Farmers in Abia State. *The Nigerian Agricultural Journal*, 41(1), 93-99

- World Bank, (2014). Agriculture and rural development data. The World Bank. Retrieved from www.data.worldbank.org/.../agric-and-rural-development-

ANALYSIS OF FACTORS INFLUENCING ADOPTION OF QUALITY PROTEIN MAIZE (QPM) BY FARMERS IN BILLIRI LOCAL GOVERNMENT AREA OF GOMBE STATE, NIGERIA.

Tata, L. A^a, Sani, M. H^b, A.A.Ibrahim^c, Iroegbute U.K^a and ^aAkweta, J. N.

^a Department of Agricultural Economics and Extension, Federal University of Kashere, Gombe, Nigeria.

^b Department of Agricultural Economics and Extension, Abubakar Tafawa Balewa University, Bauchi

^c Department of Agricultural Extension, University of Maiduguri.

*Corresponding Author: e-mail: libnahtata@gmail.com +2348024690008

ABSTRACT

The study was to analyze the factors influencing farmers' adoption of quality protein maize farmers in Billiri LGA Gombe state. The study area was purposively selected to represent farmers who are actively engaged in quality protein maize production. Structured questionnaires were used to collect data from 105 respondents. Descriptive statistics and regression analysis were used to analyze the data. The result revealed that the respondents were mostly (32.4%) educated. Men had the highest percentage of 86.7% and majorities (78.1%) of them were into farming as their occupation. Sassakawa Global played a major (53.3%) role in disseminating agricultural technologies and served as the major (60%) source of awareness. Most (67.7%) of the respondents were 40 years and above who were mostly (64.8%) small scale farmers with majority (61%) owning 0.5-3 Ha of land largely (77.1%) through inheritance. The study revealed a significant relationship between education (3.37%) and yield of QPM harvested. This shows that decision of adopting QPM was as a result of more yield harvested; the result therefore indicates that it is positive. The highest (90%) constraints identified were in taste, colour, kernel and value (preference factor), credit facilities and ineffective market with a mean average (42.08%). It is therefore recommended that provision of more improved maize seeds, improved and adequate credit facilities and effective markets should be made available through associations, financial institutions, government and non-governmental organizations.

Keywords: Quality, Sassakawa, Small-scale, Adoption, Constraints.

INTRODUCTION

Agriculture is the foundation upon which the economic stability of a nation can be built. Food can only be sufficient for the nation only if farmers are being informed and trained with adequate modern techniques for large scale production through efficient extension service (Daluba, 2013). For farmers to respond positively to new ideas, they must be properly educated on how best to apply the ideas on the farm.

Maize (*Zea mays* L.) is a staple food for large population groups around the world particularly in developing countries. Maize is major source of carbohydrate, protein, vitamins and minerals which provides major source of calories in Nigeria, thus offering to meet African's food needs (Ado and Abdullahi, 2010). Its low nutritional value with respect to protein quality has prompted

agriculturist, nutritionists and policy makers to develop ways of improving its protein quality to produce a good quality variety known as Quality Protein Maize (Abdullahi *et al.*, 2012).

Awareness is not the same as knowledge, though, knowledge requires awareness. For any adoption of a new technology to be successful, farmers must not only know about it but also follow the recommendations provided. The Sasakawa Global 2000 effort in research and extension of quality protein maize resulted in the registration and release of Sammaz 14 (QPM) (Ado *et al.*, 2005) The introduction and dissemination of the quality protein maize by Sasakawa Global 2000 through the state Agricultural Development Programmes (ADPs) made great strides in providing maize with better nutrition to the poor rural

families who cannot afford meat and egg in their daily diet. The main objective of SG2000 is to accelerate the adoption of improved modern food crop production technologies by small scale farmers. Farmers are supported with field demonstrations; testing of improved food crop, water harvesting and conservation tillage (Miko *et al.*, 2001). Quality protein maize grain is a biofortified, non-transgenic food that provides improved protein quality to consumers. It looks and tastes like normal maize but contains a naturally occurring mutant gene that increases the amount of two amino acids (lysine and tryptophan) necessary for protein synthesis in humans (Pixley *et al.*, 2011). The seeds should be introduced to the remote areas where malnutrition rates are high. Extension is a weak instrument when it stands alone but can be powerful if combined with price incentives, input supply, credit, seed multiplication among many others. The major crops grown and consumed in the study area is maize and quality protein maize being an improved variety has shown to be adaptable to the soil having its identified sites spread across all wards. This has prompted the reason for this research to be conducted in Billiri Local Government Area as the case study area.

MATERIALS AND METHODS

The Study Area

The study was conducted in Billiri Local Government Area (LGA) of Gombe State, Nigeria. Billiri Local Government Area is located in the southern part of Gombe State, situated in Guinea savanna ecological zone of Nigeria. The estimated Land area has about 737 km², 285 sq miles and a population of 202,144 inhabitants (National Population Commission-NPC, 2006).

It is bounded in the north by Akko LGA, south by Kaltungo and Shongom LGA, east by Balanga and in the west by Alkalari LGA of Bauchi State (Ministry of Land and Survey, 2003). The vegetation is characterized by shrubs interspersed with

Acacia, *baobab* and fruit trees like mangoes, guava and banana.

Agriculture is the main occupation comprising farming, hunting, processing, gathering, fish farming and rearing. The crops grown are categorized into Food crops and Cash crops. Food crops are maize, cowpea, rice, millet, sorghum millet, sweet potatoes, cassava, leafy vegetables and market garden plants (GSADP, 2008).

Sampling Procedure and Sample Size

A sample size of 105 QPM farmers were randomly selected and used for the study. The study area comprise of ten wards. Ten (10) farmers were selected from each of the nine (9) wards (Bare, Banganje North, Banganje South, Billiri North, Billiri South, Kalmai, Tanglang, Todi and Tudu Kwaya) and fifteen (15) farmers were selected from Tal ward making a total of 105 QPM farmers. Random sampling technique was used to give the respondents equal chance of being chosen.

Method of Data Collection

Primary and secondary data were used in this study. Primary data used were obtained using structured questionnaires. The secondary data were gathered from publications of Sasakawa Global 2001, Agricultural development programme (ADP, Billiri LGA), National Agricultural Seed Council (NASC), Ministry of Lands and Survey, Association of Maize Farmers in Nigeria (MAAN, Billiri branch), journals, internets and agriculture related organizations.

Analytical Techniques

Descriptive statistics such as percentages, frequencies, mean and regression were used to assess the socio-economic characteristics of quality protein maize farmers and the constraints faced by these farmers. Data were also analyzed using regression to determine the effects of some variables on the dependent variable *y* (adoption).

RESULTS AND DISCUSSION

Age distribution of the respondents

Age is one of the important determinants of human reasoning, decision making and responsibilities. Age is measured in years and it represents the physical and mental development of an individual. The age distribution has to do with the age range of the respondents involved in the study. The result in Table 1 showed that majority (67.6%) of the respondents were within the age of 40 years and above. This indicated that most of the farmers are middle aged implying economically active age in the production.

Sex distribution of the respondents

Sex refers to the biological form of human being a male or female. The result in Table 1 indicated that 86.7% of the respondents were male. This is an indication that Quality protein maize production in the study area was mostly undertaken and dominated by male. This is in agreement with Yisa *et al.* (2010) which states that more males were found to be engaged in farming activities than their female counterpart because of its labour intensive nature. It also showed that men are easily contacted by disseminators because their movements are not restricted thereby having the chance of being aware of improved technologies faster than the women.

Marital status of the respondents

Marital status means living singly or a matrimonial relationship involving the respondents whether they are married, divorced or widowed. Furthermore, Table 1 also reveals that majority (95.2%) of the respondents were married. This indicated that married people are largely responsible for the welfare of family and day to day activities. According to Okoye *et al.* (2004) married families' responsibilities must be reflected on farming activities. The study further indicated that because married people are highly respected in the society,

they were mostly contacted through house to house visit, cooperative group meetings by extension agents who passed down the information on improved agricultural technologies which created the awareness on quality protein maize.

Household size of the respondents

Household size refers to the number of persons per household for each of the respondents. Household size is determined by the head of the family, wives, children and relations living with the family. The result in Table 1 revealed the largest (72.4%) household size of the respondents in the study area had between 9 persons and above. The study showed that the relatively large household size reduced the labour demand of the respondents. This goes with the findings of Okoye *et al.* (2004) that farmers with a fairly large household size may employ family labour to reduce cost of production from the use of hired labour.

Education level of the respondents

The level of education of an individual affects his productivity by enhancing his ability to obtain analyze information relevant to his production activities. Table 1 also showed that majority (32.4%) of the respondents attended secondary school. This indicated that most of the respondents were literate, which means they can read and write which made them to easily understand and communicate with their source. This finding is in agreement with Okoye *et al.* (2004) and Ajibefun and Aderinola (2004) that educated farmers are more receptive to improved farming techniques than farmers with low level of education or without education.

Occupation distribution of the respondents

Occupation is the source of livelihood of respondents. The primary occupation refers to the major occupation the respondents are engaged in as a source of livelihood. The result in Table 1 showed that

the highest numbers (78.1%) of respondents were engaged in farming. This indicated that the respondents spend most of their time farming which makes it the main source of livelihood in the study area. According to Mark (2011) and Abdullahi *et al.* (2012), agriculture is the major occupation for self reliance and income generation in the Nigeria's rural areas.

Distribution of respondents according to years of experience

Experience means practical involvement in an activity. The respondents' years of experience in QPM cultivation refer to the number of years the respondents were engaged in farming activities. The results in Table 1 revealed that majority (84.8%) of the respondent had 15 years and above showing how long they have been cultivating QPM. Yisa *et al.* (2010) observed that years of experience in farming are related with farmers' ability to process and use information relevant to their needs. Hassan and Nhemachena (2008) pointed that, it is faming experience that matters most than the age of farmer when it comes to adoption of improved practices.

Distribution of respondents according to scale of farming

The scale of farming refers to level at which the respondents operate their farming activities as whether it is peasant, small or large scale. From the results in Table 1, most (64.8%) of the respondents operated on small scale indicating that farmers in the study area have moved from using traditional methods to modern agriculture by embracing new technologies have resulted to improved and increased production.

Farm size distribution of the respondents

Farm size refers to actual size of the respondents' farm used for the cultivation of QPM. The basis for the size of farm belonging to the respondents in this study was measured according to what the farmer has

for peasant, subsistence and large scale farming. It indicated that majority (61%) of the respondents had between 0.5-3 hectares (ha) of land and also showed that most of the respondents are small scale farmers who usually depend on the use of energy and crude implements for production activities. Studies according to Daneji (2006), Ibrahim *et al.* (2012) reported that small scale farmers are farmers who cultivates less than 5 ha of land thereby making those farmers producing at subsistence level.

Distribution of the respondents according to land ownership

Land ownership refers to different categories of acquiring a land by the respondents of this study which can be done through inheritance, rent donation or purchase. Based on the results shown in Table 1, majority (77.1%) of the respondents inherited the land used for their farming activities. Going back to respondents according to gender, because men were found to be the majority, it is an implication that male children are normally and traditionally given inheritance to the family's property and land is one of most important so as to subsequently use it to provide food for his own family.

Respondents' source of awareness

A great deal is required to diffuse the new varieties and new management techniques to farmers for sustainable production. This study showed that the village extension agents, Sasakawa Global and others constituting relatives, friends and neighbours were the different source through which information are disseminated to the rural farmers. Table 2 revealed that the majority (60%) of the respondents got their information especially on QPM production from Sasakawa Global 2000. This showed that the Sasakawa Global 2000 plays a vital role in disseminating information on improved technologies to farmers especially in the rural areas. **Seed**

Distribution to Respondents

Seed distribution refers to different ways through which the respondents acquire or get seed for their production activities. Seeds industries provide more and a wide

variety of Improved maize seeds to farmers at affordable prices in good time. Results in Table 2 showed that most (53.3%) of the respondents in the study area get improved Seeds from sasakawa Global 2000.

Table 1: Distribution of the respondents according to socio-economic characteristics

Variables	Frequency	%	Mean
Age (years):			
18 – 27	2	1.92	35
28 – 39	32	30.5	
40 and above	71	67.6	
Total	105	100	
Sex:			
Male	91	86.7	
Female	14	13.3	
Total	105	100	
Marital status:			
Married	100	95.2	
Single	2	1.9	
Others (widowed/divorced)	3	2.9	
Total	105	100	
Household size:			
1 – 4	6	5.7	
5 – 8	23	21.9	
9 and above	76	72.4	
Total	105	100	
Education level:			
Primary	18	17.1	
Secondary	34	32.4	
Tertiary	28	26.7	
Religious knowledge	12	11.4	

Adult education	13	12.4
Total	105	100
Occupation:		
Farming	82	78.1
Business	4	3.8
Civil servant	19	18.1
Total		
Farming experience (years):		
5 – 10	3	2.9
11 – 15	13	12.4
16 and above	89	84.8
Total	105	100
Scale of farming		
Peasant	25	23.8
Small-scale	68	64.8
Large-scale	12	11.4
Total	105	100
Farm size (ha):		
0.5 – 3.0	64	61
3.1 – 5.0	31	29.5
5.1 and above	10	9.5
Total	105	100
Land ownership:		
Inheritance	81	77.1
Renting	15	14.3
Purchase	9	8.6
Total	105	100

Source: Field Survey, 2014

Effect of socio-economic characteristics on adoption rate of QPM farmers

The result in Table 2 shows that educational level and number of QPM bags harvested were significantly related to the rate of adoption by QPM farmers. The Educational status showed that the more farmers are educated the more their level of understanding and acceptance of the improved technologies. The result showed

that the level of education and number of bags of quality protein maize harvested were the important determinants found to be significantly QPM adoption. The coefficient of education (X_4) which is 0.478 at 5% level of significance is an indication of positive impact on farmers. The coefficient of number of QPM bags harvested (X_{12}) was 0.961 at 5% level of significance; positively related with the rate of adoption of QPM.

Table 2: Effect of socio-economic characteristics on rate of adoption of QPM

Variables	coefficient	T-value
Constant	-7.865	3.129**
X ₁ (Age)	-0.024	0.069
X ₂ (Sex)	-0.121	-0.251
X ₃ (Marital status)	0.536	1.063
X ₄ (Education level)	0.478	3.371**
X ₅ (Farming experience)	0.167	0.444
X ₆ (Farm size)	-0.350	-1.262
X ₇ (Household size)	0.197	0.671
X ₈ (Land ownership)	-0.248	0.137
X ₉ (Level of awareness of QPM)	0.114	0.137
X ₁₀ (Sources of awareness)	0.139	1.011
X ₁₁ (Contact with sources)	0.126	0.609
X ₁₂ (No. of QPM bags harvested)	0.961	2.910**
X ₁₃ (Labour types)	-0.324	-1.362
R ²	0.300	
R ² adjusted	0.200	
F- ratio	2.996**	
Std. Error	1.62821	

Source: Field survey, 2014.

** = significant at 5%.

Constraints Faced by the Respondents Using QPM

The constraint was measured on a three point scale of high constraint (1), low constraint (2) and not a constraint (3) meaning how respondents were affected Very Seriously, Seriously and Not Seriously respectively. The result in Table 3 showed

that inadequate improved seed, credit facilities, ineffective market and preference factors having the highest mean(42.08). This revealed that certain attributes identified as Very Serious may be the reasons for influencing farmers' decisions that do not adopt improved innovation in Nigeria (Awotide *et al.*, 2010).

Table 3: Distribution of the respondents according to degree of constraints

Variable	Very Serious	Serious	Not Serious
Inadequate improved seed	46 (43.8)	32 (30.5)	27 (25.7)
Inadequate credit facilities	85 (81)	8 (7.6)	12(11.4)
Inadequate number of visits by source	38 (36.1)	45 (42.9)	22 (21)
High cost of production	24(22.9)	72 (68.6)	9 (8.5)
Low productivity due to losses		12 (11.4)	93 (88.6)
Ineffective market	59 (56.2)	10 (9.5)	36 (34.3)
Farm inputs	7 (6.6)	55 (52.4)	43 (41)
Preference factors (colour, taste, kernel)	95 (90)	10 (9.5)	
Mean (average)	42.08	29.05	28.81

Source:Field Survey,2014.

REFERENCES

- Abdullah, A., Sulaiman, M. S., Miko, A. I. and Ismail, I. S. (2012). Assessment of the factors responsible for facilitating Extension Services in Ungogo L.G.A of Kano State Nigeria. *Proceedings of Agricultural Society of Nigeria*, pp 217-222.
- Ado, S. G., Showemimo, F. A., Falaki, A. M., Abdullahi, S. O. and Abdullahi, U. S. (2005). Proposal for registration and release of quality protein maize variety: Sammaz 14 (Obatanpa). Paper Presented to the National Committee on Registration and Release of crop variety and livestock breeds, Ibadan, August 26, P19.
- Ado, S. G., Usman, I. S. and Abdullahi, U. S. (2010). Recent Development in maize Research
- Ajibefun, I. A. and Aderinola, E. A. (2004). Determinant of Technical efficiency and policy implication in Report Preservation at the Bi-annual Research Workshop of African Economy Research Consortium (AERC).
- Awotide, B. A., Diagne, A., Awoyem T. T. and Ojehomon, V. T. (2010). Farm-level Constraints and Adoption of Improved rice varieties in Nigeria. *Journal of Agriculture and Environmental Studies*.1(2): 12-29. Billiri Local Government Area.
- Daluba, N. E. (2013). Evaluation of Role Performance of Extension Service Workers on Farmers' farming practices in Kogi East Agricultural zones of Kogi State, Nigeria. *Comprehensive Research Journal of Agricultural Science*, **1** (2):014-019.
- Daneji, M. I., Tafida, I. and Ali, B. U. (2006). Socio-Economic Determinants of Technology Adoption by Farmers in Mayana zone Kaduna State Agricultural Development Programme. Paper presentation at 31st Annual Conference of Nigeria Society of Animal production held at Bayero University Kano, Nigeria. 12th-15th March, pp185 - 192.
- GSADP (2008). Gombe State Agricultural Development Project. *Annual bulletin and information manual*.
- Hassan, R. and Nhemachena, C. (2008). Determinants of Africa Farmers Strategies for Adaptation of climate change. *African Journal of Resource Economics*, **2**(1): pp 83 -104.
- Ibrahim, I., Amina, O. S., Musa, A. I and Bappah, M. T. (2012). Profitability of Maize Variety (Oba super) by farmers in Ishiagu, Ivo L.G.A Ebonyi State. *Proceedings of 42nd Annual Conference of Agricultural Society of Nigeria*.pp813-816.
- Mark, D. (2011). Farming Future: Lesson from Kwara. Think Africa Press.
- Miko, S., Valencia, J. A. and Falaki, A. M. (2001). Maize for Better Nutrition. The Sasakawa Global 2000. Approaches to Improving Maize Technology Delivery Systems in Nigeria. *Proceedings of National Quality Protein Maize Production Workshop*. SG2000 / IAR/ FMARD/ 4th-5th September.
- NPC (2006). National Population Commission Nigeria. The Census Report of Paddy Rice under Resource Constraints in Ebonyi State. *Proceedings of 38th Agricultural Society of Nigeria (ASN)*, 17th - 21st October, Lafiya Nasarawa State. Pp 337-342.
- Okoye, B. C., Okorji, E. C. and Asumiyha, G. N. (2004). Outlook on Production Economics online.www.fao.org/-/Nigeria.pdt, sighted on 07/02/2008.
- Pixley, K. V., Nuss, E. T. and Tanumihadjo, S. A. (2011). Quality Protein Maize in Africa. American Society for Nutrition.
- Yisa, E. S., Tsado, J. H. and Uzoma, C. A. (2010). Adoption of Improved Technology among Small Scale Cassava Farmers in Lapai Local Government Area, Niger State. *Proceedings of the 24th Annual National Conference of Farm Management Association of Nigeria* 11th-14th October held at Adamawa State University, Mubi Nigeria.

FACTORS INFLUENCING AGRICULTURAL INFORMATION ACCESSIBILITY AMONG MAIZE FARMERS IN KASHERE COMMUNITY, AKKO LOCAL GOVERNMENT AREA, GOMBE STATE, NIGERIA

Panwal, E. F., Jibo, I. M. and Sunday, D.

Department of Agricultural Economics and Extension,
Faculty of Agriculture, Federal University Kashere, PMB 0182, Gombe State
epfomyol59@gmail.com and mijibo2010@gmail.com

ABSTRACT

The study determined factors influencing agricultural information accessibility among maize farmers in Kashere Community, Akko LGA, Gombe State, Nigeria. Purposive and random sampling techniques were adopted to select 125 respondents for the study. Structured interview schedule was used to solicit primary data on respondents' socio-economic characteristic, sources of agricultural information, mode of acquiring agricultural information and factors influencing agricultural information accessibility. Data was analyzed using Mean, percentage and linear regression. Result revealed that, respondents' mean age was 35.3 years while 42.4% and 31.2% were within the age of 26-45 years and 36-45 years respectively. Majority (79.2%) of the respondents were male and 64.8% were married. Agricultural extension agents, interpersonal communication and friends were the sources of agricultural information to 40%, 39% and 21.6% of the respondents respectively. Regression analysis revealed that age ($P=0.044$), Education ($P=0.022$) and occupation ($P=0.000$) significantly influenced agricultural information accessibility among the respondents.

Keywords: Agricultural information, accessibility, factors, farmers, maize farmers

INTRODUCTION

Information is very essential for human and societal development. Agricultural information is conceived as a productive resource potentially limiting and influencing the efficiency of production. According to Agbamu (2006), farmers' sources of information fundamentally shape the kind of decision they make. Access to adequate information is very vital to increased agricultural productivity. Mgbada (2006), Agricultural information (Please change all agricultural information wherever in this work to agricultural information) to improve maize production technologies by farmers are needed in such areas as plant spacing, fertilizer application, weeding, land preparation, access to inputs and credit among other areas of agricultural production. The importance of maize for human, animal and industrial consumption cannot be overemphasized as it touches the lives of a larger percentage of the population of the world. This calls for improved maize farming technologies and other information needed for improved production level.

Agricultural information interacts with and influences agricultural productivity in a variety of ways. It can help in farm decisions regarding land, labour, livestock, capital and

management. Agricultural productivity can arguably be improved by relevant, reliable and useful information and knowledge. Hence, the creation of agricultural information by extension services, research, education programmes and others is now often managed by agricultural organizations that create information systems to disseminate information to farmers so that farmers can make better decisions in order to take advantage of market opportunities and manage continuous changes in their production systems. Therefore, there is a need to understand the functions and use of particular agricultural information systems in order to manage and improve Information system.

Agricultural information is defined by Samuel (2001), as the data for decision-making and as a resource that must be acquired and used in order to make an informed decision. Umali (1994), classified agricultural information into two broad groups: pure agricultural information and agricultural information inherently tied to new physical inventions. Pure agricultural information refers to any information which can be used without the acquisition of a specific physical technology. On the other hand, agricultural inventions or technologies

are those that come in the form of agricultural inputs, management technologies facilitating farm management, marketing and processing equipment.

Rural farmers lack access to knowledge and information that would help them achieve maximum agricultural yield, they are not only grope in the dark but are driven to the urban centres in search of formal employment, as the only option for survival Munyua, (2000).

The lack of access to basic agricultural knowledge and information by farmers in Kashere community which may be as a result of certain constraints has made these farmers to stick to their old traditional methods of farming and animal husbandry, hence resulting in poor crop and livestock productivity. Information and knowledge are very vital in agricultural development of any community and where they are poorly disseminated as a result of certain constraints, the community's agricultural development becomes highly impeded.

In the opinion of Inwieri (2007, rural people (farmers) who are mainly illiterate require access to appropriate information to be able to make decisions and participate fully in the national development processes, including agriculture. This agricultural information therefore is relevant in a social system where farming is dominant activity. The study therefore was designed to determine factors influencing agricultural information accessibility among Maize Farmers in Kashere community, Akko LGA, Gombe State, Nigeria.

Objective of the Study

The broad objective of the study was to determine factors influencing Agricultural information accessibility among maize farmers in the study area.

The specific objectives of the study were to:

- i. identify the socio-economic characteristics of the respondents
- ii. identify the sources of agricultural information among the respondents; and
- iii. determine factors influencing agricultural information accessibility among the respondents..

METHODOLOGY

Kashere is a community in Akko LGA of Gombe State, Nigeria. It is located at an altitude of 431 meters above sea level and its population approximately 77,015 as reported in the 2006 census (National Population Commission, 2006). Its coordinates are 9°46'0" N and 10°57'0" E i 9.76667 and 10.95. The major crops cultivated in Kashere community are maize (zea mays), cowpea(vigna unguiculata), groundnut(Arachis hypogaeal), and sorghum (Sorghu Spp). Kashere community has five major wards, Anguwar Tafida, Santuraki, Tunburi, Malam Waziri and Bubabani. The major occupation of the inhabitants is farming with a few civil servants and business men/women as well as those who engage in petty trading in local and neighbouring markets.

The sampling procedure adopted for the study was purposive and random sampling techniques. Maize producers were selected purposively in the study area and simple random sampling method was used in selecting 25 respondents from each of the five major wards to form the sample size 125 respondents.

Primary data were used for the study; the primary data used were collected using structured interview schedule was administered to solicit primary data from the respondents. Data was collected on respondents' socio-economic characteristics, type of agricultural information accessed, and access to agricultural inputs, the source of information, level of productivity and the factors affecting access to information. Data were obtained for the period of three weeks in May 2017.

Primary data collected was cleaned up,, coded, and then entered into Statistical Package for Social Science (SPSS). Analysis of data was conducted with respect to the objectives of the study using the SPSS. Data were subjected to mean, percentage and multiple regression analysis.

RESULTS AND DISCUSSION

Table 1 revealed that (please let your discussion come before each Table), with a mean age of 35.3 years; 42.4% and 31.2%, of the respondents were within the ages of 26-35 years and 36-45years respectively. This

finding is similar with Daniel (2008) who reported similar mean age of farmers. Majority (79.2%) of the respondents were male and 64.8% were married. This result corroborates Bawa, *et al*, (2014) which revealed that most maize farmers were male and married. Also (44.8%) of maize producers in the study area were formally educated with mean household of 8.01 persons.

During the study, it was also reveals that 40% of the maize producers that obtain their information through formal source are

from extension agents, 9.6% from libraries, 1.6% from research institute and 10.4% from all formal sources. It also reveals that 12.8% of the respondent that get their information from informal source are from family, 21.6% from friends, 7.2% from marketers and 13.6% from colleagues. This indicates that majority of the respondents get their information through extension agents, this is similar with the findings of Bawa *et al*, (2014) in which majority of the respondents source their agricultural information through extension agents.

Table 1:. Respondents' Socio-economic Characteristics

Variable	Frequency	Percentage (%)	Mean
Age			
15-25	16	12.28	35.296
26-35	53	42.4	
36-45	39	31.2	
46-55	15	12	
56-65	-	0.8	
66-75	-	0.8	
Total	125	100	
Sex			
Female	26	20.8	
Male	99	79.2	
Total	125		
Marital status		100	
Single	41		
Married	81	32.8	
Divorced	2	64.8	
Widowed	1	1.6	
Total	125	0.8	
Education		100	
No Ed.	8		
None formal Ed.	37	6.4	
Primary sch. Cert.	56	29.6	
Sec/Higher Ed.	24	44.8	
Total	125	19.2	
Household size		100	
1-10	71	78.9	
11-20	18	20	
21-30	1	0.8	
31&above	25	28.0	
Total	125	100	8.011

Source: Field survey 2017

Table 2 shows that majority i.e. 39% of the maize producers in the study area acquired their agricultural information through interpersonal communication, 30.4% through mass media and 28% from both medium and 20% had no medium. Majority of the maize producer 33.6 % that acquired agricultural information through the mass media channel was via Radio which is the

major mass media tool, 8.8% via television, 9.6% via newspapers and 0.8% via posters/handbills. 32.8% of maize producers who obtained their information through the interpersonal mode were by family/neighbours, 10.4% by extension agents and 7.2 by contact farmers and 3.2 was from opinion leaders. This shows that majority 33.6% of the maize producers in the

study area acquired their agricultural information via radio This is similar to Ariyo et al, (2013) in which radio was found to be more accessible 46.3% and also the major source (60.19%) of agricultural technologies

to the farmers through mass medium and contrast with Muhammad *et al.*, (2006) revealed that a simple majority (54.1%) of the respondents gave 1st preference to television, 25.0% gave 2nd preference to radio.

Table 2: Mode of acquiring agricultural information

Mode	Frequency	Percentage
Mass media	38	30.4
Interpersonal	39	31.2
Both	28	22.4
None	20	16
Total	125	100
Mass media mode distribution		
Television	11	8.8
Radio	42	33.6
Posters/handbill	1	0.8
Newspapers	12	9.6
Interpersonal mode	39	31.2
None	20	16
Total	125	100
Interpersonal mode distribution		
Extension agent	13	10.4
Contact farmer	9	7.2
Friends/neighbours	41	32.8
Opinion leaders	4	3.2
Mass media mode	38	30.4
None	20	16
Total	125	100

Field Survey 2017

Table3 presents multiple regression analysis of factors influencing accessibility of agricultural information among the respondents. The coefficient of determination (R^2) was 0.569. This implies that 56.9% of variations in accessibility of information was influenced by the independent variables (X_1 - X_7). The result revealed that age ($P=0.044$), educational qualification ($P=0.022$), and occupation ($P=0.000$) were statistically significant at 0.05 level of significance.. This means that only age, occupation and educational qualification significantly influenced respondents' accessibility to

agricultural-information. The F-value of 14.696 was significant at 0.01 level.. This implies that the model fits the data used for the analysis. This is contrary to the finding of Kughur et al, (2015), in which R^2 was 0.198, which indicates that 19.80% of the variations in the farmers' accessibility to agricultural information was explained by the variables included in the model and that Out of the seven socio-economic characteristics regressed against farmers' accessibility to agricultural information, only education and annual income were positive and statistically significant.

Table3 Multiple Regression of Factors Influencing accessibility of agricultural-information

Variables	Coefficient	Standard error	t-value	p-value
Constant	0.108	0.163	0.662	0.510
Sex	-0.108	0.074	-1.467	0.146
Age of respondent	-0.009	0.005	-2.050	0.044
Household size	0.012	0.010	1.300	0.197
Education Q.	0.088	0.038	2.329	0.022
Location	0.003	0.026	0.126	0.900
Occupation	0.196	0.038	5.215	0.000***
Farming size	-0.019	0.027	-1.360	0.178
R ²	0.569			
Adjusted R	0.530			
F-statistic	14.696			0.000***

Note: ***Significant at $p \leq 0.01$

Source: Field Survey 2017

CONCLUSION

Majority of the respondents had access to either formal or informal agricultural -information and most of them were married, middle aged with relatively small family size and acquired one form of education or another. Maize production was respondents' major source of livelihood though they had other occupations to augment their sources of income.

Most of the respondents sourced information from formal sources and majority of the agricultural -information from the formal sources were through extension agents and from the informal sources was through friends. Radio was the major mode of acquiring agricultural-information. Age, occupation and educational qualification influenced respondents 'accessibility of agricultural -information.

RECOMMENDATION

Base on the findings and a conclusion above, the following recommendation are as follows:-

- there is need to improve access by creating information centres and provision of various ICT and other Medias such as viewing centres
- the number of extension agents should be increased so as to improve access to formal information
- there should be access to credits facilities and funds to maize producers.

- Provision of inputs to farmers should always be before the onset of rainfall and should be adequate.
- Government policies and programmes on agricultural production should always consider the small-holder farmers and start with bottom top approach.
- Government in planning any agricultural information dissemination programme, age and of farmers should be taken into consideration.

REFERENCES

- Agbamu, J.U., (2006). *Essentials of Agricultural Communications in Nigeria*. First Edition, Malt house Press Limited. Lagos, Nigeria. pp. 47 – 81.
- Voh, J.P. (2000). A Study of Factors Associated With the Adoption of Recommended Farm Practice in a Nigerian Village. *Agricultural administration*. 2: pp. 17-27
- Ariyo, O.C., Ariyo M.O., Okelola O.E., Aasa O.S., Awotide O.G., Aaron A.J. and Oni O.B., 2013. Assessment of the Role of Mass Media in the Dissemination of Agricultural Technologies among Farmers in Kaduna North Local Government Area of Kaduna State, Nigeria. *Journal of Biology, Agriculture and Healthcare*. ISSN 2224-3208. pp. 25-41
- Bawa, D.B., Ani A. O., and Bzugu P.M., 2014. Influence of Sources of Agricultural

- Information on Maize Farmers in Southern Borno, Nigeria. ISSN 2224-3267 (Paper) ISSN 2224-3275 (Online) Vol.31. pp. 26-31
- Blait, S., Calvelo R.M., and Masias, L., (1996). Communication for development for Latin America: a regional experience. FAO, Rome Italy. pp. 15-39
- Inwier, J.W., (2007). Information needs of illiterate female farmers in Ethiopia East local Government Area of Delta State, Nigeria. Library Hi Tech News, 9(10), 12-24.
- Kughur, P.G., Ortindi, P.I. and Katikpo, G. 2015. Factors Affecting Farmers Accessibility to Agricultural Information in Gwer-East Local Government Area of Benue State, Nigeria. International Journal of Information and Communication Technology Research Volume 5 No. 10, October 2015 ISSN 2223-4985.
- Mgbada, J.U., (2006). Effectiveness of Information Sources on Improved Farming Practices to Women Farmers in Enugu state, Nigeria. *Global Approaches to Extension Practice*. 2(1): pp. 67-78.
- Munyua, H., (2000). Cited in: Munyua, H. (N.D.) Information and communication technologies for rural development and food security: lessons from field experiences in developing countries. Sustainable Development Department, Food and Agriculture Organization of United Nation.
- Samuel, G., (2001). The Development of Integrated Management Information System for Agricultural Extension institutions of Developing Countries, The case of Oromia Agricultural Development Bureau of Ethiopia, Shaker Verlag. Germany. [On line]. Available on, http://www.future-agricultures.org/pdf%20files/SG_paper_1.pdf. Accessed March 31, 2008.
- Umali, L.S., Dina L., 1994. Public and private agricultural extension: Beyond traditional frontiers. World Bank Discussion Papers. 236, pp. 15-26.

THE IMPACT OF WOMEN PARTICIPATION IN SMALL AND MEDIUM SCALE AGRICULTURAL ENTERPRISES ON POVERTY REDUCTION IN YOBE STATE; NIGERIA

¹Okpachu, A. S. and ²Moses, J. D.

¹Department of Agricultural Education, Federal College of Education (T), Potiskum

²Department of Agricultural Economics, Adamawa State University, Mubi

ABSTRACT

This study is an attempt to determine the impact of Women participation in Small and Medium Scale Agricultural Enterprises (SMEs) on poverty reduction in Yobe State, Nigeria. The study used interview and questionnaire to elicit information from the respondents. A total of 100 women respondents who participated in various small and medium scale agricultural enterprises were purposively selected for the study. . The study used descriptive statistics and Logit regression model to analyse the data collected .The result from the study shows that women are involved in SMEs to earn income that will enable them take care of their families. The logistic regression shows that SMEs have impacted significantly on women in the study area. The study therefore recommend that women should be enlightened to participate in agricultural SMEs and government should create an enabling environment through the provision of facilities such as farming equipments, land to construct shops and funds to carry out their businesses so that women can venture into SMEs.

Keywords: Women, SMEs, Poverty, Logistic, Agriculture, Enterprises.

INTRODUCTION

In Nigeria, about 70% of the populace live in the rural areas and are engaged in agriculture at small holder levels. However, the growing demands for increased agricultural production in Nigeria offers opportunities for farmers to against the negative impact of traditional agricultural practices and underutilization of inputs towards the new farming order of mechanization tagged 'precision agriculture (Bello, *et al.*, 2015). One way by which this negative impact can be reversed is through the integration of the Small and Medium Scale Enterprises (SME). The small and medium scale enterprises are seen as keys to integrated growth, alleviation of poverty and reduction of unemployment in the country (Khan, 2014). Since small and medium-sized enterprises (SMEs) are the backbone of growth in production, employment and innovation, it is crucial to provide an enabling

environment for agricultural SMEs in Africa. Small and Medium Enterprises (SMEs) occupy a place of pride in virtually every country or state. Due to the significant roles SMEs play in the growth and development of various economies, SMEs have aptly been referred to as "the engine of growth" and "catalysts for socio-economic transformation of any country". SMEs represents a veritable vehicle for the achievement of national economic objectives of employment generation and poverty reduction at low investment cost as well as the development of entrepreneurial capabilities including indigenous technology (Adebisi, Alaneme and Ofuani, 2015).

Nigeria is endowed with vast productive arable land which can be harnessed for the development of SME agricultural projects. It stands to reason that if the country is to show serious commitment to the development of the SMEs in the

agricultural sector, the economy will witness meaningful transformation and prosperity. A dynamic SMEs sub sector in the agricultural sphere is vital and imperative for the overall economic development of the nation. Apart from providing opportunities for employment that enhances poverty alleviation, SMEs help to provide effective means for curtailing rural urban migration and the utilization of local raw materials. It is against this back drop of the positive roles of SMEs in an economy that this paper was conceived.

In Nigeria, there is increasing realization of the critical role of women in agriculture including food production and of the fact that the empowerment of women is necessary for bringing about sustainable development at a faster pace. Various studies have shown that women produce between 60 to 80 percent of the food in most developing countries and are responsible for half of the world's food production (Ireghan, 2009). No country can achieve its potential without adequately investing in and developing the capabilities of women. In the interest of long term development it is necessary to facilitate their empowerment. Given the multiples roles that women are expected to play in the family and the society in general, SME's do provide a critical opportunity for empowerment and poverty reduction amongst rural women.

The need to enhance the growth and development of an economy through the activities of women in the participation of SMEs has gained tremendous support in development literature (International Finance Corporation, 2011; Mahmood and Hanafi, 2013). This is because of the supportive role women played in the

involvement and enhancement of welfare status and poverty reduction. According to Stupnytska, *et al.*, (2014) the greater the involvement of women in SMEs, the more likely the increase in per capital Gross Domestic Product (GDP), increase in the propensity to use their earnings and increased bargaining power to buy goods and services as well as support the development of human capital.

The supportive role of women in SMEs is not well documented. Saikou and Wen-Chi (2008) observed that there is also lack of sufficient research on women's role in small and medium enterprise development. This is even more so in the rural area where there is insufficient information on women participation in SMEs. This paper is significant because it contributes to the existing literature on women in SMEs especially now that there is renewed emphasize by the Nigerian government to anchored on diversification of the economy through the promotion of SMEs and development. This paper focuses on how participation of women in agricultural SMEs can impact on employment generation and poverty reduction in Yobe State.

Conceptual Framework

Small scale enterprises in Nigerian and in other less developed countries have come a long way in contributing significantly to economic growth and development. The preponderance of small scale enterprises in Nigeria is because it requires little capital to set up. Small and medium scale enterprises are found in and around our settlements in both rural and urban communities at our

houses, along the streets, in commercial areas.

There are various definitions of Small and Medium Scale enterprises depending on the authors' perspective. It is a function of the culture and peculiar circumstances of the person attempting the definition. It may depend on the purposes and the policies which govern the SME sector in a particular country. However, the three parameters that are generally applied by most countries, singly or in combination are: capital investment, volume of production or turnover of business. According to Aremu (2010) Small and Medium Scale Enterprises is defined on the basis of employment, Micro/cottage industries ranges between 1-10 workers, small scale industries between 11-100 workers, medium scale industries between 101-300 workers and large scale industries above 301. Ireghan, (2009) noted that "Enterprises employing less than 500 workers are generally regarded as SMEs". Based on the foregoing, the major objectives of SME's is the annexation of resources and overall contribution to the economic well being of developing nations across the globe. In a developing country like Nigeria, the importance of SMEs in the process of social economic development cannot be overlooked. The importance of SMEs in the development of the country has been summarized in Nigeria Third National Development Plan (1975-1980) as the generation of employment opportunities, stimulation of indigenous entrepreneurship, facilitation of effective mobilization of local resources including capital and skill as well as reduction in regional disparities (Emesowum, Mbanasor and Olayimola, 2013).

According to Ireghan (2009), SMEs constitute the very basis of the national economy in terms of development of local technology, stimulation of indigenous entrepreneurship, mobilization and utilization of domestic savings, employment creation, structural balancing of large and small industry sectors in both rural and urban areas, supply of high quality intermediate products thereby strengthening the international competitiveness of manufactured goods, stimulate technological development and innovations, provide the capacity to expand export possibility and substitute import effectively. Discovery has also shown that the expected role contribution by the large scale enterprise to the economy in terms of improvement in the GDP, employment generation, increasing local value added, technological development among others are been resolved by SMEs (Aremu, 2010).

Theoretical Framework

This study was guided by Pearson's gender relations theory, which was developed by Ruth Pearson in (1995). The concept is that the society views all activities that are carried out to be based on social roles and interactions of men and women. The society seems to have ultimate authority on the precise nature of what women and men actually do, and their real contribution on production and reproduction may turn out to prejudice women (Opafunso and Omoseni, 2004). Pearson gender relations theory is appropriate for this study because it emphasizes the various socio-cultural and economic norms which must be considered for women to take the opportunities to

participate in businesses. In traditional setup, the family is headed by a household head; a position often held by a male parent, that is, the patriarchal ideology is thus dominant. The roles assigned to women are narrowly defined. They are expected to be good wives and mothers. Women are seen as subordinates and their involvement in business is less important. Gender related challenges affecting women in business include multiple roles, gender socialization, boys' education preference, access and control of assets. These are related to socio-cultural and economic consideration.

Small Scale Enterprises and Women Welfare

The engine of growth and economic transformation is now on small and medium scale enterprises which have a high potential of generating employment. At various times since the 1970s, the government of Nigeria has designed and introduced measures to promote SMEs in order to support employment generation thereby reducing poverty among the citizens. (Fabiya and Akande, 2015).

Self-employment in small-scale businesses presents a constructive option for income generation. In many developing countries, a high percentage of small-scale businesses that cater for local needs are controlled or owned by women. Women's enterprises tend to be relatively small, have informal structures, flexible, low capital needs, modest educational requirements, low labour intensity, and depend on local raw materials. They are also characterized by their dependence on family labour and limited technical and managerial skills

(Aremu, 2010). Commonly, these enterprises are not registered, maintain no business records and do not have access to credit from formal credit institutions. Rural women are active participants in retail trade and marketing, particularly where trade is traditional and not highly commercialized. In many parts of Nigeria, women market food items such as vegetables, and grains and they account for nearly all local marketing. Through their marketing efforts, women provide valuable links among farmers, intermediaries and consumers. Petty traders, often thought of in the past as non-productive, in fact serves to stimulate the production and consumption linkages in the local economy (Opafunso and Omoseni, 2014).

Women operate a major segment of trade and market enterprises in the informal sector, making about 91% of the labour force in that sector. Their enterprise activities lie mostly within a wide range of informal activities such as agricultural production, food processing, extractive industries, fish smoking, garment/textile, soap making, hairdressing, rural craft and petty trading. IFC, (2011) argues that women usually combine farming activities with a wide variety of agro based processing activities especially in the rural areas. Women play a crucial role in the distribution and marketing of agricultural and many other industrial goods such as textile/garments, foot wears, household provisions, among others. Women who sell the above mentioned goods in large quantities had to commute between community markets and other major market centers in order to get market for their products. Other economic activities women

engaged in are cooked food selling, weaving, and dressmaking. Most of these activities are seasonal in nature. Markets for most activities are in its peak during the harvesting season when there is money in the pockets of the local folks. All these are maneuvering styles adopted by these women in order to cope with situations. The urgency exercised by these women is their ability to actively engage in shaping their own world, rather than their actions being determined beforehand by capital or the intervention of the state (Emesowum, Mbanasor and Olayimola, 2013).

METHODOLOGY

Study Area

The area of study is Yobe State, located in the north-east geopolitical zone of Nigeria and has seventeen Local Government Areas. The State has an estimated population of about 2.5 Million people, with a rich diverse and cultural heritage. There are five major ethnic groups in the state which include the Kanuri, Fulani, karekare, Bade and Hausa. Yobe State Covers a total of 54, 428sq km land area, the state borders Bauchi, Borno, Gombe, Jigawa states and Niger Republic. Annual rainfall ranges from 500mm-1000mm and the rainy season is normally from June to October. The two vegetation zones in the state are the Sahel in the north and the Sudan Savannah in the south. The state has been severely under threat of desert encroachment thereby creating arid and semi-arid conditions.

Sampling Procedures

This study examined the participation of women in small and medium scale

agricultural enterprises in the study area. This study adopted purposive and simple random sampling procedures. Three Local Government Areas namely Potiskum, Nangere and Fika were purposely selected because of their high agricultural activities. Women involved in agricultural enterprises were purposively selected.

Techniques of Data Analysis

Following Adekoya (2014) descriptive and inferential statistics were used in the study. The descriptive statistics included the use of tables and simple percentages while Logit regression was used as part of inferential statistics.

Logit Model

A logit model is a probability function which uses poverty status as a dichotomous dependent variable. The model uses socio-economic variables to determine the factors influencing poverty. The model is implicitly expressed as:

$$P_1 = \frac{1}{1 + e^{-(\beta_0 + \beta_1 X_{11} + \dots + \beta_k X_{1k})}} \dots\dots\dots 1$$

Where P_1 is probability that poverty reduced, β_0 is constant term, β_1 is coefficient to be estimated, X is independent variable and K is number of independent variables

$$\text{Let } Z = \beta_0 + \sum \beta_k X_k \dots\dots\dots 2$$

$$P = \frac{1}{1 + e^{-Z}} \dots\dots\dots 3$$

As Z ranges from $-\infty$ to $+\infty$, P ranges from 0 to 1 and P_1 is non-linearly related to Z_i . The logit of the unknown binomial probabilities, that is, the logarithms of the odds, are modeled as a linear function of the X_j . In estimated form, the model is expressed as:

$$\text{Logit}(P_i) = \ln \frac{P_i}{1-P_i} = \beta_0 + \beta_1 X_{i1} + \dots + \beta_k X_{ik} + U \dots\dots 4$$

The unknown parameters β , are usually estimated by maximum likelihood. Thus, the model is explicitly expressed as:

$$\text{POVSTAT} = \beta_0 + \beta_1 \text{EXPEDU} + \beta_2 \text{EXPFD} + \beta_3 \text{AVINC} + \beta_4 \text{HLTFAC} + \beta_5 \text{CAPBASE} + \beta_6 \text{HHHED} + \beta_7 \text{CLTHSLF}$$

where:

POVSTAT = Poverty status (equal to 0 if poverty has reduced and 1 if poverty has not reduced).

β_0 = Constant term;

β_i = Coefficient of the parameters to be estimated;

EXPEDU = Impact of the business on children education (equal to total annual expenditure on education) (₦);

EXPFD = Expenditure on food (₦);

AVINC = Average Annual income of respondents (₦);

HLTFAC = Access to a health facility (equal to 1 if the family has access to health and 0 if otherwise);

CAPBASE = Business size (capital base of the business);

HHHED = Household head (equal to 1 if headed by a woman and 0 if otherwise);

CLTHSLF = Access to clothing (1 if at least one new cloth involvement in SME, 0 if otherwise).

From the apriori expectation, it is expected that women involvement in small scale businesses should have a significant impact on their welfare. It is thus expected that from the estimated model, the $\beta_3, \beta_4, \beta_5$ and β_7 are expected to be negative while β_1, β_2 and β_6 are expected to be positive. This is because increases in $\beta_3, \beta_4, \beta_5$ and β_7 will increase the probability that poverty will reduce whereas increases in β_1, β_2 and β_6 will reduce the probability of one being poor.

The model was estimated to ascertain the effect of participation of women in SMEs on poverty status of the sampled respondents.

Method of Data Collection

Data was collected using a well structured questionnaire

Method of Data Analysis

Descriptive and inferential statistics were used in the study. The descriptive statistics included the use of tables and simple percentages while Logit regression was used as part of inferential statistics. A logit model is a probability function which uses poverty status as a dichotomous dependent variable. The model use socio-economic variables to determine the factors influencing poverty.

Presentation and Discussion of Results Socio-economic characteristic of the respondents

Tables 1 present the socioeconomic characteristics of respondents in the study area. The table shows that 20% of the respondents were between 21- 30years, 25% fall within 31 – 40years, 35% were within 41 – 50years and 20% are within the 51 – 60years age bracket, this result indicate that majority (80%) of the respondents are still in their prime productive age. The household size reveals that 86% of the respondents have a family size of between 1 to 20 persons, the large household size may mean availability of cheap labour. The table further reveals that the experience of the respondents in their various enterprises, 91% of the respondents

has between 1 to 15 years experience in their various enterprises.

The average farm size holding in the study area is 0.98 hectares. This is an indication that the land cultivated by farmers is still within small scale which largely affects their productivity. The result further reveals that majority of the respondents (83%) did not progress beyond primary school. Education also enhances the adoption and application of innovation. The result also shows that 30% of the respondents are involved in crop production enterprise, 23% participate in animal production, 17% are engaged to agro-allied enterprise and 30% are involved in marketing enterprise, meaning that the respondent engaged in poverty reduction activities in the study area.

Regression Estimate of the impact of SMEs on Poverty status

The results from Table 2 indicate that the EXPENDU i.e coefficient of the variable of education of the sampled respondents is negative (-0.787) correctly signed and statistically significant at 10% level of significance. This implies that level of education of the respondents has influence on the probability of a sampled respondents being non-poor. The Exp. (β) of 0.916 indicates that a unit change (increase) in expenditure on education of the sampled respondents from SMEs would reduce their likelihood of being poor by 91.6%. The parameter estimate for the expenditure on food (EXPFD) with income generated from SME is negatively correlated (-0.780) and statistically significant at 5% level of confidence. This implies that the number of times a household spends on food in a day with income obtained from SMEs, indeed does have influence on the odds or probability of a respondent being non-poor. The Exp (β) or odds ratio of 0.197 indicates that the odds or probability of a sampled respondent being non-poor can be explained by a 19.7% unit increase in the expenditure on food the respondent undertakes. The

results from Table 2 further indicate that the coefficient of the AVINC (Average income of the respondents) carry a negative sign and statistically significant at 10 percent level of confidence. This implies that average annual income has influence on the probability of a sampled respondent being non-poor. The Exp. (β) of 0.300 indicates that a unit change in the Average Annual Income of the respondents from SMEs would reduce their likelihood of being poor by 30%. The parameter estimate of HLTFAC (Health Facility accessed) of the respondent carry a positive sign (0.020) which is different from the apriori expectation, but it is statistically significant at 10% level of significance. This implies that access to 'improved' health facilities by a respondent will tend to increase her poverty status. This may be due to the fact that 'improved' health facilities in the study area are in short supply and very expensive, and hence access to them will rather impoverish those patronizing them. This implies that respondents who visit 'improved' health facilities for medical attention will be left with little income which will make them absolutely poor.

The Exp (β) of 0.002 indicates that the odds of a sampled respondent being non-poor are a minimal 0.2%. Table 2 also indicates that the Capital Base (CAPBASE) of a sampled respondent carry a negative sign (-0.699) and statistically significant at 10% level of significance. This implies that an increase in the capital base of a respondent involved in SMEs can reduce poverty. The Exp (β) of 0.050 indicates that a unit change in CAPBASE can reduce poverty by 5%. The parameter estimate of HHHED (i.e Household Head is positive sign and statistically significant at 5% level of significance. Even though economics theory is not explicit about this position, but the research assumed a household head that is a woman would have a positive relationship with the respondents' poverty status. The Exp (β) of 0.223 indicates that a unit change in the HHHED to a woman would increase her poverty by 22.3%. Thus,

given that the likelihood ratio is 170.823 and its P-value at classification cut-off of 0.5, we observe very clearly that likelihood ratio (170.823) is greater than 0.5. Therefore, we reject the null hypothesis that all β 's are not significantly different from zero, that is, the

participation of women in SMEs have significantly alleviated poverty in Yobe State. The Nagelkerke R^2 of 0.800 (80.1%) shows that participation of respondents in SMEs tends to influence their poverty status.

Table 1: Socio-economic characteristics of the respondents

Variable	Frequency	Percentage	Mean
Age			
21 – 30	20	20	41
31 – 40	25	25	
41 – 50	35	35	
51 – 60	20	20	
Household Size			
1 – 10	49	49	12
11 – 20	37	37	
21 – 30	14	14	
Experience			
1 – 5	44	44	8
6 – 10	32	32	
11 – 15	15	15	
16 – 20	9	9	
Farm Size (Hectares)			
0.1 – 1.0	56	56	0.98
1.1 – 2.0	39	39	
2.1 – 3.0	5	5	
Educational Level			
Quranic Education	54	54	
Primary	29	29	
Secondary	13	13	
Tertiary	4	4	
Types of Enterprise			
Crop Production	30	30	
Animal Production	23	23	
Agro-Allied Enterprise	17	17	
Marketing Enterprise	30	30	

Source: Field Survey

Table 2: Regression Estimate of impact of SMEs on Poverty status of respondents

Variables	β	SE	p-value	Exp (β)
EXPEDU	-0.787	0.165	0.050*	0.916
EXPPFD	-0.780	0.755	0.040**	0.197
AVINC	-0.991	0.556	0.055*	0.310
HLTFAC	0.020	0.507	0.070*	0.021
CAPBASE	- 0.699	0.581	0.097*	0.050
HHHED	0.203	0.086	0.018**	0.0223
Constant	-53.483	0.701	0.997	
Log-likelihood	170.819			
R ²	80			

Source: Field Survey, 2016 ** Significant at 5%, and * Significant at 10%

CONCLUSION AND RECOMMENDATIONS

The study concludes based on the findings that women participation in agricultural SMEs has significantly reduced poverty in Yobe State. This is because women involved in agricultural SMEs earn income that is used to take care of their families. Based on the findings of this study, it is therefore recommended that efforts should be made to involve women in agricultural SMEs to encourage other women through provision of financial resources to help them establish their own small businesses. Gender sensitivity is essential when carrying out programmes, training and workshops in rural settings. More research should be conducted on rural women's poverty and female farmers' relationship with their husbands in farm productions. There is the need to ensure involvement of full participation of women who are poor and are less educated in agricultural business.

REFERENCES

- Adebisi, S.A; Alaneme, G.C and Ofuani, A.B (2015) Challenges of Finance and the Performance of Small and Medium Enterprises (SMES) in Lagos State, Developing Country Studies Vol.5, No.8, 2015 Pp 46-58
- Adekoya, O. A. (2014). Analysis of Farm Households Poverty Status in Ogun State Nigeria. *Asian Economic and Financial Review* (3): 325 – 340.
- Aremu, M.A. (2010). Small and Medium Scale Enterprises as a Means of Employment Generation ND Capacity Building in Nigeria, A paper Presented at the International Conference on Management and Enterprise Development on, "Intellectual and New Strategies for Sustainability Development of the Third World" Held at Conference Center, University of Ibadan, Ibadan, Nigeria, October 5 – 8, pp. 39-48 Elson, Diane; Pearson, Ruth (27 September 2013). "Keynote of Diane Elson and Ruth Pearson at the Gender, Neoliberalism and Financial Crisis Conference at the University of York". *Soundcloud*. Retrieved 27 November 2013.
- Bello, S., Bello, M. B. and Saidu M. (2015). Small Scale Enterprises (SMEs) and Agricultural Transformation: The Nigeria Experience. *Science Journal of Business and Management* 2015; 3(5-1): 11-15
- Elson, D., Pearson, R. (2013). "Keynote of Diane Elson and Ruth Pearson at the

- Gender, Neoliberalism and Financial Crisis Conference at the University of York". *Soundcloud*. Retrieved 27 November 2013.
- Emesowum, C. E.; J. A. Mbanasor and S. A. Olayimola (2013). Analysis of factors affecting performance of agribusiness-SMEs in Imo State, Nigeria: policy issues for Agricultural transformation. Proc. of the 47th Annual Conf. of Agricultural Society of Nigeria, Ibadan 2013. Pp 518-521.
- Fabiyi, E. F and Akande, E. K.(2015) Economic Empowerment for Rural Women in Nigeria: Poverty Alleviation through Agriculture. *Journal of Agricultural Science*. 7 (9) 76 - 81
- International Finance Corporation (2011) Strengthening access to finance for women -owned SMES in developing countries. 2121 Pennsylvania Avenue, N.Y Washington D.C 20433
- Ireghan, C. (2009). Small Scale Business Development in Nigeria., in Ireghan, C. (ed.) *The Place of Small and Medium Scale Business in the development of a nation State*. Nigeria: Lagos, Kaycee Publishers, pp. 79.
- Khan, A.S (2014) The SME Missing Middle Problem in Developing Countries and its Link to Lack of Financing: The Case of Bangladesh. Unpublished Masters of Arts in International Development and Global Studies. School of International Development and Global Studies, Faculty of Social Sciences120 University. Ottawa, Ontario, Canada.
- Mahmood, R and Hanafi , N (2013) Entrepreneurial Orientation and Business Performance of Women-Owned Small and Medium Enterprises in Malaysia: Competitive Advantage as a Mediator. *International Journal of Business and Social Science* Vol. 4 No. 1; January Pp 82-90
- Opafunso, O. Z. and Omoseni, O. A. (2014). The Impact of Small and Medium Scale Enterprises on Economic Development of Ekiti State, Nigeria. *Journal of Economics and Sustainable Development*. 59 (16) 121 – 129)
- Saikou, E. and Wen-Chi, H (2008). Small and Medium Enterprise for Women Entrepreneurs in Taiwan. *World Journal of Agricultural Sciences* 4 (S) IDOSI Publications, Pp884
- Stupnytska, A., Koch, K., Macbeath, A., Lawson, S. and Matsui, K. (2014). Giving Credit where it is Due. How Closing the Credit Gap for Women Owned SMEs can Drive Global Growth. Global Market Institute.

PHYTOCHEMICAL ANALYSIS OF WILD SPIKENARD (*Hyptis suaveolens* L. Poit) WHOLE PLANT POWDER AS A BIOPESTICIDE FOR THE CONTROL OF STORAGE INSECT PESTS

¹Oaya, C. S., ²Malgwi, A. M., ²Umar, I. and ³Samaila, A. E.

¹Department of Agricultural Technology, Adamawa State College of Agriculture, P. M. B. 2088, Ganye, Adamawa State-Nigeria.

²Department of Crop Protection, Modibbo Adama University of Technology, P. M. B. 2070, Yola, Adamawa State-Nigeria.

³Department of Agronomy, Federal, University of Kashere PMB 0182 Gombe – Gombe State

ABSTRACT

Phytochemical analysis of Wild Spikenard (Hyptis suaveolens L. Poit) whole plant powder as a biopesticide for the control of storage insect pests on stored produce was carried out in the Laboratory of Department of Chemistry, Modibbo Adama University of Technology, Yola, Adamawa State, Nigeria in 2015. This was to determine the chemical constituent of H. suaveolens whole powder and also the texture, colour and weight of the extract, organoleptic properties and the fluorescence under ordinary and ultra-violet light when subjected to various reagents such as acetone, petroleum, ether, ethanol, distilled water, methanol and chloroform. The study determined the phytochemicals present in Wild Spikenard (H. suaveolens) whole plant powder. Phytochemical analysis revealed the presence of constituents like phenols, tannins, flavonoids, glycosides, alkaloids, aldehydes, ketones, proteins and terpenoid. However, saponins and steroids were not present.

Key words: Phytochemical, Spikenard, Insect, Pest, Powder, Biopesticide.

INTRODUCTION

The extent of post-harvest crop losses and the need to shift emphasis from the excessive use of conventional synthetic insecticides for the control of *Caryedon serratus* on some host plants in store prompted this work. Moreover, the need to phase out ozone depleting pesticides has open a new window for searching alternative pesticides of plant origin to control insects and other pests of agricultural sector (Ahmedani *et al.*, 2007; Jada *et al.*, 2013). Several methods of insect pests control have been employed by farmers and researchers have identified some efficient and effective control of the insect pests (Adebowale and Adedire, 2006). Some of these methods range from store hygiene, physical and cultural control methods and the use of inert materials. Chemical control appeared to be the most effective and efficient control method (Oaya *et al.*, 2011) but it has tremendous adverse effect to man, the livestock and the environment (Adedire and Lajidire, 2000). Chemical related pesticides against insect

pests are not only limited because of the health and environmental concern related to them but also due to their high costs and scarce availability in rural areas (Adda *et al.*, 2011).

Against this background, a curious search for natural-product based agrochemicals which are biodegradable, eco-friendly, sustainable and save to humans and the environment was intensified (Jadhau and Jadhau, 2006). There is also the need for cheaper and safer alternative control practices. Over the years, farmers have learned to curtail insect population through the use of plant materials. The potential advantages of botanical insecticides over synthetic ones have been highlighted by Prakash *et al.* (2008); Oaya and Malgwi (2014). Many plants have been tested or identified as interesting botanical pesticides in Sub-Saharan Africa (Kossou *et al.*, 2001; Oparaeke *et al.*, 2005; Sinzogan *et al.*, 2006; Oparaeke *et al.*, 2006; IITA, 2006; Okereke *et al.*, 2007; Aboubakary *et al.*, 2008; Adda *et al.*, 2011; Oaya *et al.*, 2012; Oaya *et al.*, 2013 and

Malgwi and Oaya, 2014) and are potentially useful in pest control programs taking into account both the needs of increased food and preserving the health of a growing population (Adda et al., 2011).

Hyptis suaveolens (L.) Poit, a potential anti-feedant plant product belongs to the family laminaceae (Raja et al., 2005). Ethnobotanical studies conducted in Kenya on *Hyptis suaveolens* showed that, the plant can repel mosquitoes effectively when burned overnight in rooms (Abagli and Alavo, 2011). Duke (2007) also in his phytochemical and ethnobotanical database refers to the plant as insect repellent. *Hyptis suaveolens* is used for some ethnobotanical applications in rural communities (Koumauglo et al., 1993; Kossou et al., 2001; Edeoga et al., 2006 and Oaya et al., 2013) and the plant is readily available close to villages, along roadsides, on farm steads etc (Adda et al., 2011). It is established that, *Hyptis suaveolens* Poit contain some compounds that can control insects and nematodes (Oyedunmade, 1998; Musa et al., 2009). The leaves of *Hyptis suaveolens* (L) Poit have been utilized as a stimulant, carminative, sudoritic, galactagogue and as a cure for parasitic contagious disease (Siddiqui et al., 2009). Crude leaf extract is also used as a relief to colic and stomachache. Leaf and twigs are considered to be antispasmodic and used in antispasmodic baths and anti-inflammatory, anti-fertility agents (Ladan et al., 2009).

This work considered not only the use of leaves in powder form but the whole *Hyptis* plant (leaves, seeds, stems and roots) ground into powder form. The knowledge of chemical constituent of the plant is desirable because such information aided in determining the quantity or the dosage of application which has been a major limitation to the use of bio-pesticides especially in the rural communities. This knowledge was also instrumental in evaluating the effect of *Hyptis suaveolens* L. Poit whole powder on the survival and reproductive potential of *Caryedon serratus* Olivier on stored groundnut and tamarind, in the search for alternative control method

instead of the use of expensive, toxic, harmful and imported synthetic insecticides. This work was carried out to determine the phytochemical constituents of whole plant powder of *Hyptis suaveolens* (L.) Poit to be used as biopesticide for the control of storage insect pests such as *Caryedon serratus* Olivier, *Callosobruchus maculatus* Fab., *Sitophilus zeamays* etc.

MATERIALS AND METHODS

Description of the Study Area

The phytochemical analysis of the plant material, *H. suaveolens* (whole powder) was carried out in the Laboratory of the Department of Chemistry, Modibbo Adama University of Technology, Yola, Adamawa State-Nigeria. The University is located in Sangere Village, Girei Local Government Area, within longitude 9° 14" North and Latitude 12° 13" East of the equator in the Northern Guinea Savannah agro- ecological zone of Nigeria (Adebayo, 1999).

Collection and Preparation of Plant Material, Wild Spikenard (*H. suaveolens*)

The plant material used was the Wild Spikenard (*H. suaveolens*) and it belongs to the family Laminaceae. The plant material is readily available in Nigeria. It was collected from the vicinity of the main campus of Adamawa State College of Agriculture, Ganye, Adamawa State-Nigeria. The whole plant (leaves, seeds, stems, roots and flowers) was shade dried until all the water molecules evaporated and the plant organs well dried for grinding. The dried whole plant was mechanically powdered and sieved using 0.02mm mesh and stored in an air-tight container with proper labeling which was later used for further phytochemical analysis or qualitative test for the identification of various plant constituent and Laboratory test for insecticidal potentials of the whole powder. The shade dried Wild Spikenard (*H. suaveolens*) whole and the prepared powder kept in a container are presented on plates I and II respectively.



Plate I:

Shade dried *H. suaveolens* L. Poit whole plant

Plate II:

H. suaveolens L. Poit whole plant powder

Phytochemical Analysis of Wild Spikenard (*H. suaveolens*) Whole Powder

Phytochemical analysis of whole plant powder of Wild Spikenard, *H. suaveolens* was carried out in the Laboratory. Whole plant powder of *H. suaveolens* with different chemical reagents such as acetone, petroleum ether, ethanol, methanol, chloroform and distilled water were subjected to various qualitative tests to determine the presence or absence of phytochemical constituents like glycosides, tannins, phytosterols, steroids, alkaloids, saponins, flavonoids, ketones in *H. suaveolens* whole plant powder. The phytochemical constituents were detected by the usual prescribed method as reported by Reddy *et al.* (1999) and Okwu (2004). Fluorescence analysis was also carried out for the whole powder and for extract using standard procedures as reported by Harbone (1998). The methods are described below:

Preparation of Plant Extracts

Five gram (5g) of dried powdered plant material, *H. suaveolens* was taken in a beaker and 200 ml of distilled water was added. The mixture was heated on a hot plate with continuous stirring at 30-40°C for 20 minutes. Then the water extract was filtered through filter paper and the filtrate was used for phytochemical analysis. The water extract was kept in a refrigerator when not in use (Yadav and Agarwala, 2011).

Preparation of Solvent Extract

Crude plant extract was prepared by Soxhlet extraction method as reported by Yadav and Agarwala (2011). About 20g of powdered plant material, *H. suaveolens* was uniformly packed into a thimble and extracted with 250ml of different solvents separately. Solvents used were: methanol, petroleum ether, chloroform, distilled water, acetone and ethanol. The process of extraction continues for 24 hours or till the solvent in siphon tube of an extractor become colourless. After that

the extract was taken in a beaker kept on hot plate and heated at 30-40°C till all the solvent got evaporated. Dried extract was kept in refrigerator at 4°C for future use.

Qualitative Phytochemical Analysis

The extract was tested for the presence of bioactive compounds by using the following standard methods as suggested by Harbone (1998) and Sofawora (1993).

Test for Proteins

Crude extract of the plant material, *H. suaveolens* whole plant powder mixed with 2ml of the reagents, white precipitate appeared which turned red upon gentle heating that confirmed the presence of protein.

Test for Phenols and Tannins

Crude extract of the plant material, *H. suaveolens* whole plant powder was mixed with 2ml of the reagents solution. A dark blue-green or black coloration indicated the presence of phenols and tannins.

Test for Flavonoids

Crude extract of the plant material, *H. suaveolens* whole plant powder was mixed with 2ml of the reagents. Pink scarlet color appeared after few minutes which indicated the presence of flavonoids.

Test for Alkaloids

Crude extract of the plant material, *H. suaveolens* whole plant powder was mixed with 2ml of the reagents. An intense yellow color was formed which turned colorless on addition of few drops of diluted acid which indicated the presence of alkaloids.

Test for Glycosides

Crude extract of the plant material, *H. suaveolens* whole plant powder was mixed with 2ml of the reagents in a test tube. The mixture was cooled in ice. A color change from violet to blue to green indicated the presence of steroidal nucleus, which is a glycone portion of glycoside.

Test for Terpenoids

Crude extract of the plant material, *H. suaveolens* whole plant powder was dissolved on 2ml of the reagents and allowed to evaporate to dryness. A grayish colour indicated the presence of terpenoids.

Test for Aldehydes

Crude extract of 2ml of the plant material, *H. suaveolens* whole plant powder was mixed with the reagents in a tilted test tube. A silver mirror on the surface of the test tube is a positive test for aldehydes.

Test for Ketones

Crude extract of 2ml of the plant material, *H. suaveolens* whole plant powder was mixed with the reagents. The test tube was stopped and shaken vigorously. A positive test resulted from a brown colour of the mixture disappearing and a yellow iodo-form solid precipitating out of the solution indicating the presence of ketones.

The phytochemical analysis was instrumental for determining the dosage of application or the quantity of plant material whole powder used for the control of the groundnut bruchid, *C. serratus* on shelled groundnut seeds and tamarind whole pods in the store.

RESULTS

Phytochemical Analysis of Wild Spikenard (*Hyptis suaveolens*)

The phytochemical analysis of Wild Spikenard (*H. suaveolens*) whole powder extract was carried out in the Laboratory of the Department of Chemistry, Modibbo Adama University of Technology, Yola in 2015. This was to determine the chemical constituent of *H. suaveolens* whole powder and also the texture, colour and weight of the extract, organoleptic properties and the fluorescence under ordinary and ultra-violet light when subjected to various reagents such as acetone, petroleum, ether, ethanol, distilled water, methanol and chloroform. The results are presented in Tables 1, 2, 3, and 4 respectively.

Texture, colour and weight of extract obtained from Wild Spikenard (*H. suaveolens*) whole powder

The result of texture, colour and weight of extract obtained from *H. suaveolens* whole plant powder is presented in Table 1. The result showed the texture, colour and the weight of extracts of plant material in various solvents. *H. suaveolens* whole plant powder exhibited various textures, colours and weights when tested or treated with some

reagent. Sticky texture and dark colour were observed when the whole plant extract was treated with acetone, petroleum ether, ethanol and distilled water while the *H. suaveolens* whole plant extract treated with methanol and chloroform also gave sticky texture but dark brown colour. The highest weight in grams of the plant material whole extract was observed in distilled treated extract (0.95) followed by petroleum ether treated extract (0.70) and the least was seen in methanol treated extract (0.20) as presented in Table 1.

Table 1: Texture, Colour and Weight of Solvent Soluble Extracts Obtained from Wild Spikenard *H. suaveolens* Plant Extract

Reagents	Texture	Colour	Weight (g)
Acetone	Sticky	Dark Green	0.60
Petroleum Ether	Sticky	Dark Green	0.70
Ethanol	Sticky	Dark Green	0.25
Distilled water	Sticky	Dark Green	0.95
Methanol	Sticky	Dark Brown	0.20
Chloroform	Sticky	Dark Brown	0.60

Flourescence analysis of Wild Spikenard, *H. suaveolens* whole powder under ordinary and ultra-violet light.

H. suaveolens whole plant powder was treated with various chemical reagents and had exhibited various colours under ordinary and ultra-violet light. When the whole powder was analyzed alone, the colour was brown black under the ordinary light and dull brown under the ultra-violet light. The colour was greenish brown and dark brown respectively in an aqueous solution under ordinary and ultra-violet light. Moreover, the reagent aqueous residue gave dark brown colour under ordinary and ultra-violet light respectively. Consequently, the reagent alcoholic extract gave dark brown and brown black colour under ordinary and ultra-violet light. Similarly, alcoholic residue gave brown black and dark brown colours under ordinary and ultra-violet light. Also, chloroform extract of whole plant powder of *H. suaveolens* produces dark brown colours under day light or ordinary and ultra-violet light. Brown black and greenish brown colours were observed in

H. suaveolens whole powder treated with chloroform residue as presented in Table 2.

Phytochemical constituent of Wild Spikenard (*H. suaveolens*) whole powder.

Phytochemical characteristics of whole plant powder of Wild Spikenard (*H. suaveolens*) were tested and it is presented in Table 3. The result revealed the presence of medicinally active compounds in *H. suaveolens* whole powder extracts. From the table, it could be deduced that, alkaloid, tannins, flavonols, terpenoids, phenols, proteins, glycosides, ketones and aldehydes were present when *H. suaveolens* whole powder extract was subjected to various reagents such as petroleum ether, ethanol, methanol, chloroform and distilled water except in acetone. However, saponins and steroids were not present in the plant material whole powder extract treated with various reagents.

The results as presented in Table 3 showed that, tannins were present in all the powder treated with various reagents except in acetone solution. Similarly, aldehydes,

ketones, terpenoids and phenols were also present in *H. suaveolens* whole plant powder treated with various chemical reagents except in acetone solution and distilled water. Moreover, alkaloids, flavonols, glycosides and proteins were absent in four of the *H. suaveolens* whole powder treated reagents

(acetone, petroleum ether, chloroform and distilled water) but were present in the remaining as shown in Table 3.

On the other hand, two chemical constituents namely saponins and steroids were absent in all the *H. suaveolens* whole plant powder treated reagents as shown in Table 3 below.

Table 2: Fluorescence Analysis of Wild Spikenard, *H. suaveolens* Whole Powder under Ordinary and Ultra-violet Light.

Sample	Ordinary Light (Day Light)	Ultra-Violet Light
Dry Powder	Brown Black	Dull Brown
Aqueous	Gold Brown	Dark Brown
Aqueous Residue	Dull Brown	Dark Brown
Alcoholic Extract	Dark Brown	Brown Black
Alcoholic Residue	Brown Black	Dark Brown
Chloroform Extract	Dark Brown	Dark Brown
Chloroform Residue	Brown Black	Greenish Brown

Table 3: Phytochemical Analysis of Solvent Extracts from Wild Spikenard, *H. suaveolens* Whole Plant Powder.

Phyt. Constituent	Acetone	Petroleum Ether	Ethanol	Distilled Water	Methanol	Chloroform
Alkaloids	-ve	+ve	+ve	-ve	+ve	-v
Tannins	-ve	+ve	+ve	+ve	+ve	+v
Saponins	-ve	-ve	-ve	-ve	-ve	-v
Flavonols	-ve	-ve	+ve	-ve	+ve	+v
Aldehydes	-ve	+ve	+ve	+ve	+ve	+v
Ketones	-ve	+ve	+ve	+ve	+ve	+v
Steroids	-ve	-ve	-ve	-ve	-ve	-v
Terpenoids	-ve	-ve	+ve	+ve	+ve	+v
Glycosides	-ve	-ve	+ve	-ve	+ve	+v
Phenols	-ve	+ve	+ve	-ve	+ve	+v
Proteins	-ve	-ve	+ve	+ve	+ve	+v

+ve: Constituent Present; -ve: Constituent Absent.

DISCUSSION

Phytochemical Constituent of Wild Spikenard, *H. suaveolens* Whole Powder

Plants have been a major source of pesticides and cure for human diseases since time immemorial. It is no wonder that the world's one-fourth population that is 2 billion people are dependent on traditional and plant based pesticides and medicines. Nature has bestowed upon us a very rich botanical wealth and a large number of diverse types of plants

growing wild in different parts of the world. Although hundreds of plant species have been tested for chemical properties; the vast majority have not been adequately evaluated (Balandrin *et al.*, 1985 and Niranjana *et al.*, 2011).

Phytochemical analysis conducted on the extract of whole powder of Wild Spikenard, *H. suaveolens* using reagents such as acetone, petroleum ether, ethanol, distilled water, methanol and chloroform revealed the

presence of chemical constituents which are known to exhibit or demonstrate insecticidal as well as pesticidal properties (Sofowora, 1993). The chemical analysis of Wild Spikenard, *H. suaveolens* whole powder showed the presence of phytochemicals such as phenols, tannins, flavonoids, glycosides, proteins, terpenoids, alkaloids, aldehydes and ketones.

Phenols, sometimes called phenolics, are a class of chemical compounds consisting of a hydroxyl group (-OH) bonded directly to an aromatic hydrocarbon group. The simplest of the class is phenol also called carbolic acid C_6H_5OH . Phenol was found in petroleum ether, ethanol, methanol and chloroform when *H. suaveolens* powder was subjected to phytochemical analysis. Phenolic compounds are classified as simple phenols or polyphenols based on the number of phenol units in the molecule (Khoddami, 2013; Amorati and Valgimigli, 2012; Robbins and Rebecca, 2003). The phenolic compounds are among the largest and most ubiquitous group of plant metabolites. They possess biological properties such as anticarcinogen inhibitory effects as well as cell proliferation activities (Yadav and Agarwala, 2011). Several studies have agreed and described the antioxidant and insecticidal properties of plants which are rich in phenolic compounds (Brown and Rice-Evans, 1998; Han *et al.*, 2007).

Organisms that synthesize phenolic compounds do so in response to ecological and physiological pressures such as pathogen and insect attack, Ultra Violet radiation and wounding (Khoddami, 2013) and they can function as antioxidants (Klepacka, 2011). As they are present in food consumed in human diets and in plants used in traditional medicine of several cultures, their role in human health and disease is a subject of research (Mishra and Tiwari, 2011). According to them, some phenols are germicidal and are used in formulating disinfectants and others possess estrogenic or endocrine disrupting activity.

Tannin was also present in *H. suaveolens* whole powder extract when it was subjected to various chemical processes. It was found in reagents such as petroleum ether, ethanol, distilled water, methanol and chloroform. Haslam (2007) reported that, tannin (or tannoid) is an astringent, polyphenolic biomolecule that binds to and precipitates proteins and various other organic compounds including amino acids and alkaloids. Tannin binds to proline rich protein and also interferes with protein synthesis (Yadav and Agarwala, 2011). The tannin compounds are widely distributed in many species of plants, where they play a role in protection from predation and perhaps also as pesticides and in plant growth regulation (McGee, 2004). Flavonoids in the same vane were present and are portrayed as hydroxylated phenolic substances known to be synthesized by plants in response to microbial infection and they have been found to show pesticidal activities and influence against wide array of microorganisms *in-vitro*. This is in agreement with Marjorie (1996) who suggested that, the activity of flavonoid is probably due to their ability to complex with extracellular and soluble proteins and also complex with bacterial cell wall. Yadav and Agarwala (2011) also reported that, flavonoids are effective antioxidant and pesticides that show strong anticancer activities.

The *H. suaveolens* whole powder extracts also contain alkaloids. Alkaloid was found in reagents such as petroleum ether, ethanol and methanol. They have been associated with medicinal uses for centuries and one of their common biological properties is their cytotoxicity, which is the state of being toxic to cells. This is in consonant with Okwu (2001) who reported that, alkaloids contain some analgesic antispasmodic and antibacterial properties. Andreas (2009), in his findings found out that, alkaloids are any of the large class of organic, nitrogen-containing ring compounds of vegetable origin and sometimes

synthesized, some of which are liquid but most of which are solid. According to him, they have a bitter taste, that are usually water-insoluble and alcohol-soluble, that combine with acids without the loss of a water molecule to form water-soluble hydrochlorides, hydrobromides, or the like. They usually exhibit pharmacological action as nicotine, morphine, or quinine. György *et al.* (2002) reported that, prior to the development of a wide range of relatively low-toxic synthetic pesticides, some alkaloids such as salts of nicotine and anabasine were used as insecticides. Their use was limited by their high toxicity to humans.

Glycoside was also present in *H. suaveolens* whole powder extract treated with some reagents. Glycoside was present in methanol, ethanol and chloroform. The chemical constituent is known to lower the blood pressure according to reports by Nyarko and Addy (1990). Glycoside is a molecule in which a sugar is bound to another functional group via a glycosidic bond. Glycosides play numerous important roles in living organisms (Brito-Arias, 2007). Many plants store chemicals in the form of inactive glycosides. These can be activated by enzyme hydrolysis (Brito-Arias, 2007) which causes the sugar part to be broken off, making the chemical available for use. Many such plant glycosides are used as medications and pesticides. In animals and humans, poisons are often bound to sugar molecules as part of their elimination from the body (Lindhorst, 2007).

Aldehydes were present in petroleum ether, ethanol, distilled water, and chloroform. Proteins were found in methanol, distilled water, methanol and chloroform. Ketones were also found in petroleum ether, ethanol and distilled water. Terpenoids were present in ethanol, distilled water, methanol and chloroform. Flavonoids were also found in reagents such as ethanol, methanol and chloroform. These chemical properties were present in considerable proportion or amount. This agrees with Elamathi *et al.*

(2012) who reported that although some therapeutic benefits can be traced to specific plant compounds, many herbs contain dozens of active chemical constituents that together combine to give the plant its therapeutic value.

CONCLUSION

The excessive damage caused by storage insect pests such as groundnut bruchid, *C. serratus*, *C. maculatus*, *Sitophilus zeamays* etc to stored products, the need for empirical knowledge of the chemical constituents of the plant material, Wild Spikenard (*H. suaveolens*) whole powder, the risk and the hazards associated with continues use of synthetic insecticides, the need for a shift of emphasis to the use of insecticides of plant origin that are safe, biodegradable, eco-friendly, sustainable, economically and viable, prompted this work. The results of this work revealed that the plant material, Wild Spikenard (*H. suaveolens*) whole plant powder contain certain phytochemicals namely; tannins, phenols, flavonoids, aldehydes, alkaloids, glycosides, terpenoids, proteins and ketones which might have accounted for its reported insecticidal potentials.

REFERENCES

- Abagli, A. Z. and Alavo, T. B. C. (2011). Essential Oil from Bush mint *Hyptis suaveolens*, is as Effective as DEET for Personal Protection against Mosquito Bites. *The Open Entomology Journal*, 5:45-48
- Aboubakary, A., Ratnadass, A. and Mathiew, B. (2008). Chemical and Botanical Protection of Transplanted *Sorghum* from Stem Borer (*Sesamia cretica*) Damage in Northern Cameroun. *Journal of SAT Agricultural Research*, 6:1-5.

- Adda, C., Atachi, A., Hell, K. and Tamo, M. (2011). Potential Use of the Bushmint, *Hyptis suaveolens* for the Control of Infestation by the Pink Stalk Borer *Sesamia calamistis* on Maize in Southern Benin, West Africa. *Journal of Insect Science*, 1. (33): 1-13.
- Adebayo, A. A. (1999). Climate II In: Adebayo, A. A. and Tukur, A. L. (eds) 1999 *Adamawa State in Maps*. Pp. 23-25. Paraclete Publishers, Jimeta Yola.
- Adebowale, K. O. and Adedire, C. O. (2006). Chemical Composition and Insecticidal Properties of the Underutilized *Jatropha curcas* Seed Oil. *African Journal of Biotechnology*, 5(10): 901-906.
- Adedire, C. O. and Lajidire, L. (2000). Toxicity and Oviposition Deterancy of some Plant extracts on cowpea Storage Bruchid *Calosobruchus maculatus* Fab. *Journal of Plants Diseases and Protection* 106, 547 -651.
- Ahmedani, M. S., Khaliq, A. and Haque, M. I. (2007). Scope of Commercial Formulations of *Bacillus thuringiensis* Berliner as alternative to Methyl Bromide against *Trogoderma granarium* Evert larvae. *Pakistan Journal of Botany*, 39 (3): 800-812.
- Amorati, R. and Valgimigli, L. (2012). "Modulation of the antioxidant activity of phenols by non-covalent interactions". *Organization of Biomolecular Chemistry* 10 (21): 4147-58. doi:10.1039/c2ob25174d. PMID 22505046.
- Andreas, L. (2009). [*Molecular, clinical and environmental toxicology*](#). Springer. p. 20. [ISBN 3-7643-8335-6](#).
- Balandrin, M. F., Klocke, J. A., Wurtele, E. S. and Bolinger, W. H. (1985). Natural Plant Chemicals: Sources of Industrial and Medicinal Materials. *Science*, 228: 1154-1160.
- Brito-Arias, Marco (2007). Synthesis and Characterization of Glycosides. Springer. ISBN 978-0-387-26251-2.
- Brown, J. E. and Rice-Evans, C. A. (1998). Luteolin Rich Artichoke Extract Protects Low Density Lipoprotein from Oxidation In-vitro. *Free Radical Resource*, 29: 247-255.
- Duke, J. A. (2007). *Duke's Phytochemical and Ethnobotanical and Databases* (<http://www.ars-grin.gov/cgi-bin/duke/ethnobot.pl>).
- Edeoga, H. O., Omasun, G. and Uche, L. C. (2006). Chemical Composition of *Hyptis suaveolens* and *Ocimum gratissimum* Hybrids from Nigeria. *African Journal of Biotechnology*, 5(10): 892-895.
- Elamathi, R., Kavitha, R., Kamalakannan, P., Deeper, T. and Sridhar, S. (2012). Preliminary Phytochemical and Antimicrobial Studies on the Leaf of *Ecbolium viride*, *World Journal of Medical Pharmaceutical and Biological Science*, 2(1): 05-10.
- György, M., Nádasy, N. and Andriská, I. (2002). [Pesticide chemistry](#), Elsevier, 2002, pp. 21-22 [ISBN 0-444-98903-X](#).
- Han, X., Shen, T. and Lou, H. (2007). Dietary Polyphenols and their Biological Significance. *International Journal Mol. Science*, 950-988.
- Harbone, J. B. (1998). Phytochemical Methods. In: A Guide to Modern Techniques of

- Plant Analysis, *Chapman and Hall Ltd., London*, 38:324-331.
- Haslam, E. (2007). "Vegetable tannins—Lessons of a phytochemical lifetime". *Phytochemistry*. 68 (22–24): 2713–2721.
[doi:10.1016/j.phytochem.2007.09.009](https://doi.org/10.1016/j.phytochem.2007.09.009).
[PMID 18037145](https://pubmed.ncbi.nlm.nih.gov/18037145/).
- IITA (International Institute of Tropical Agriculture) (2006). Research Highlights. *Annual Report*, 2006.
- Jada, M. Y., Oaya, C. S. and Stephen, S. N. (2013). Effect of Fig Tree (*Ficus sycomorus*) Root Exudates on Root-Knot Nematode (*Meloidogyne javanica*). *Journal of Agriculture and Veterinary Science*, Volume 3, Issue 5.
- Jadhau, K. B. and Jadhau, L. D. (2006). Use of Vegetable Oils, Plant Extracts and Synthetic Products as Protectants from Pulse Beetle, *Callosobruchus maculatus* in Stored Grain. *Journal of Food Science Technology*, 21: 110-113.
- Khoddami, A. (2013). "Techniques for analysis of plant phenolic compounds". *Molecules* 18 (2): 2328–75.
- Klepacka, J. (2011). "Phenolic Compounds as Cultivar- and Variety-distinguishing Factors in Some Plant Products". *Plant Foods Hum Nutr*. 66 (1): 64–69.
[doi:10.1007/s11130-010-0205-1](https://doi.org/10.1007/s11130-010-0205-1).
PMC 3079089. PMID 21243436.
- Kossou, K. D., Gbenounou, G., Ahanchede, A., Ahohouendo, B., Bauraima, Y. and Vanttuis, A. (2001). Indigenous Cowpea Production and Protection in Benin. *Insect Science and its Application*, 21 (2):123-125.
- Koumauglo, H. K., Akpagana, K., Glitho, I. A., Addae-Mensah, I., Maudachirou, M. and Garnean, F. (1993). La Cooperation Sud- Suddans Trois Pay d' Afrique naire: Benin, Togo, Ghana. Actes du Colloque de Chicoutimi Surla Valorisation de la Biomasse Vesetace Parless. *Product Nature Quebec*, 22-25 Aout, 1993, Pp. 97-103.
- Ladan, Z., Amupitan, O. J., Okonokwo, M. E., Aimola, A. I. and Habila, N. (2009). Antimicrobial Potency of *Hyptis spicigera* Leaf Extracts against some Pathogenic Microorganisms. *Journal of Medicinal Plant Research*. 3(11): 905-908.
- Lindhorst, T. K. (2007). Essentials of Carbohydrate Chemistry and Biochemistry. Wiley-VCH. ISBN 978-3-527-31528-4.
- Malgwi, A. M. and Oaya, C. S. (2014). Towards Achieving an Integrated Pest Management for the Control of the Groundnut Bruchid (*Caryedon serratus* Olivier) on Stored Groundnut and Tamarind inYola, Nigeria. *Global Journal of Biology, Agriculture and Health Sciences*, 3(2):96-104.
- Marjorie, C. (1996). Plant Products as Antimicrobial Agents. *Clinical Microbiology Review*, 12:564-582.
- McGee, H. (2004). On food and cooking: the science and lore of the kitchen. New York: Scribner. p. 714. ISBN 0-684-80001-2.
- Mishra, B. B. and Tiwari, V. K. (2011). "Natural products: an evolving role in future drug discovery". *Eur J. Med. Chem*. 46 (10): 4769–807.

- doi:10.1016/j.ejmech.2011.07.057.
PMID, 21889825
- Musa, A. K., Dike, M. C. and Onu, I. (2009). Evaluation of Nitta (*Hyptis suaveolens* Poit.) Seed and Leaf Extract and Seed Powder for the Control of *Trogoderma granarium* Everts (Coleoptera: Dermestidae) in Stored Groundnut. *American- Eurasian Journal of Agronomy*, 2(3): 176-179.
- Niranjan, S., Ranju, G., Umar, S. S., Priyanka, G. and Gangotri, Y. (2011). Pharmacognostic Studies on the *Achyranthes aspera* Leaves. *International Journal of Comprehensive Pharmacy*, Volume 02, Issue 05, Pp. 1-3.
- Nyarko, A. A. and Addy, M. E. (1990). Effects of Aqueous Extract of *Adenia Cissampeloides* on Blood Pressure and Serum Analyte of Hypertensive Patients. *Phytotherapy Resource*, 4(1): 25-28.
- Oaya, C. S., Kwaji, C. I. and Agwanda, G. A. (2011). Integrated Pest Management (IPM) for *Callosobruchus maculatus* Fab. on Stored Cowpea in Yola , Adamawa State. *International Journal of Agriculture*, 3(5), 51-55.
- Oaya, C. S., Malgwi, A. M. and Samaila, A. E. (2012). Damage Potential and Loss Caused by the Groundnut Bruchid *Caryedon serratus* Olivier [Coleoptera: Bruchidae] on Stored Groundnut and Tamarind in Yola. International Organization of Scientific Research, India. *Journal of Agriculture and Veterinary Science*, Volume 1, Issue 6, Pages 58-62.
- Oaya, C. S., Malgwi, A. M. and Samaila, A. E. (2013). Insecticidal Efficacy of African Rock Fig Leaf Powder (*Ficus congensis* Engl.) Against the Groundnut Bruchid (*Caryedon serratus* Olivier) on Stored Groundnut in Yola. *Journal of Agriculture and Veterinary Science*, volume 2, issue 1, Pp. 24-27.
- Oaya, C. S. and Malgwi, A. M. (2014). Evaluation of the Impact of *Mesostena picca* (Kraatz), a Predator of the Bruchid, *Caryedon serratus* (Olivier) on Stored Groundnut and Tamarind. *Science Journal of Agricultural Research and Management*. Volume 2014, Article ID sjarm 117, 4Pages,2014,dol:10.7237/sjarm/1.
- Okereke, V. C., Wokocha, R. C. and Godwin-Enein, M. I. (2007). Evaluation of *Trichoderma hazarnium*, some Botanicals and Fungicide on *Sclerotium* Wilt of Potted Tomato. *Agricultural Journal*, 2(5): 555-558.
- Okwu, D. E. (2001). Evaluation of Chemical Composition of Medicinal Plants Belonging to Euphorbiaceae. *Pak. Veterinary Journal*, 14: 160-162.
- Okwu, D. E. (2004). Phytochemicals and Vitamin Content of Indegenous Species of South-Eastern Nigeria. *Journal of Sustainable Agricultural Environment*, 6(6) 1: 30-37.
- Oparaeke, A. M., Dike, M. K. and Amatobi, C. I. (2005). Botanical Pesticide Mixtures for Insect Pest Management on Cowpea, *Vigna unguiculata* (L.) Walp Plants. *Agricultural Tropica Et Subtropica*, 28(2): 33-38.
- Oparaeke, A. M., Dike, M. K. and Amatobi, C. I. (2006). Field Activity of Three Mixture

- Levels of Plant Extract Formulations for the Management of Post Flowering Insect Pests of Cowpea, *Vigna unguiculata* (L.) Walp, the Flower Thrips, *Megalurothrips sjostedti* (Trybom). *Journal of Sustainable Agriculture*, 28(4): 45-54.
- Oyedunmade, E. E. A. (1998). Control of Nematode Pests of Cowpea with Mocap (*Ethoprop*), Leaf Residues of Neem (*Azadirachta indica*), Rattle Weed (*Crotalaria retusa*) and Nitta (*Hyptis suaveolens*). *Centerpoint Science Edition*, 8(1): 57-63.
- Prakash, A., Jagadiswari, R. and Nandogobal, V. (2008). Future of Botanical Pesticides in Rice, Wheat, Pulses and Vegetable Pest Management. *Journal of Biopesticides*, 1(2): 154-169.
- Raja, N., Jeyasanker, A., Jeyakumar, V. S. and Ignicimuthu, S. (2005). Efficacy of *Hyptis suaveolens* against Lepidopteran Pests. *Current Science*, 88(2): 220-222.
- Reddy, Y. S. R., Venkatesh, S. and Ravichandra, T. (1999). Pharmacological studies on *Wrightia tinctoria* bark. *Pharmocological Biology*, 37:291-295.
- Robbins, A. and Rebecca, J. (2003). "Phenolic Acids in Foods: An Overview of Analytical Methodology". *J. Agric. Food Chem.* 51: 2866-2887.
- Siddiqui, S., Verma, A., Rather, A. A., Jaben, F. and Meghvansi, M. K. (2009). Preliminary Phytochemical Analysis of some Important Medicinal and Aromatic Plants. *Advance in Biological Research*. 3(5-6): 188-195.
- Sinzogan, A. A. C., Kossou, D. K., Atachi, P. and Van-Huis, A. (2006). Participatory Evaluation of Synthetic and Botanical Pesticide Mixture for Cotton Ball Worm Control. *International Journal of Tropical Insect Science*, 26: 246-255.
- Sodipo, O. A., Akiniyi, J. A. and Ogunbamasu, J. U. (2000). Studies on Certain Characteristics of Extracts of Bark of *Pansinystalia macruceras* (K schemp) picrreExbeille. *Global Journal of Pure and Applied Science*, 6: 83-87.
- Sofawora, A. (1993). *Medicinal Plants and Medicine in Africa*. Spectrum Books Ltd., Ibadan, Nigeria, pp. 191-289.
- Yadav, R. N. S. and Agarwala, M. (2011). Phytochemical Analysis of Some Medicinal Plants. *Journal of Phytology* 3(12): 10-14.

GEOSPATIAL VARIATION IN SOIL EXCHANGEABLE BASES ALONG TOPOSEQUENCES, IN GOMBE STATE, NORTHERN GUINEA SAVANNA ZONE OF NIGERIA

^{*a} Salem, A., ^a Dedan, N. K., and ^b Ibrahim, A. E.

^a Department of Soil Science, Federal University Kashere, Gombe State, Nigeria

^b Department of Horticultural Technology, Federal College of Horticulture Dadin Kowa, Gombe State

^{*}Corresponding Author's E-Mail: salemabdull126@gmail.com

Tel: +2348023585326

ABSTRACT

An assessment was conducted on the variability of soil exchangeable bases along toposequences in Kumo, Kwadon and Baure areas of Gombe State. Three profile pits were dug at the upper, middle and lower slope positions, at each of the selected study locations. The soils were described for their physical and chemical properties. Soil samples collected from identified genetic horizons were analyzed in the laboratory using standard laboratory procedures. The results revealed that the soils texture ranges from clay loam to clay, the soil pH was alkaline in reaction (pH range 7.08 – 7.26). The organic carbon and total nitrogen were low with values ranging from 7.27 – 9.79 and 0.71 – 1.23gkg⁻¹ respectively, while available phosphorus was generally low. Exchangeable cations (Ca, Mg, K and Na) were generally high in contents, with exchangeable calcium (Ca) and Magnesium (Mg) dominating the exchange complexes. It is recommended that, the incorporation of crop residue, addition of organic manures and provision of adequate drainage will improve the physical and chemical properties of the soils, which will in turn enhance sustainable crop production.

Key words: Cation, Exchangeable Bases, Gombe State, Toposequence, Variation

INTRODUCTION

Toposequence is defined as a succession of sites from crest to the valley bottom (Moorman, 1981). Toposequence is now used to replace catena in soil topography relationship studies (King *et al.*, 1983; Okusami *et al.*, 1985). The movement and transformation of nutrients in soils are influenced by climate and topography (Klemmedson and Wienhold, 1991). Sibert *et al.*, (2007) reported significant correlation between topographic indices and soil properties, while Tengoun *et al.*, (2005) concluded that topography is both an internal and external factor in pedogenesis and accounted for about 60% variation in soil properties (Cox *et al.*, 2002).

Differences in soil properties occupying different landscape positions on a toposequence are caused by water and material movement and distribution along a slope. Moorman (1981) stated that different

landscape position influence runoff, drainage, erosion and thus soil genesis.

Generally, variations in soil properties have been found to have significantly influenced soil management and crop production (Fashina, 2003). Soil variability has been seen as a world-wide problem including Nigeria. It does not only cause within field crop growth variability which reduces farmer's yields, but also complicate the interpretation of agronomic experiment (Brouwer, *et al.*, 1993).

Currently there is no existing information on exchangeable bases landscape relationship particularly on soils of the study areas. Therefore, the need to evaluate the content and distribution of exchangeable bases in soils of the study area particularly along a toposequence is very necessary. This will serve as a useful index in assessing the exchangeable bases requirements of soils of the study areas and suggests management practices for optimum and sustainable cropping systems.

MATERIALS AND METHODS

The study area

The study was conducted at Kumo, Kwadon and Baure areas of Gombe state, within latitude $12^{\circ} 30' N$ and Longitude $11^{\circ} 45' E$ of the Guinea savannah ecological zone of Nigeria (Voncir, *et al.*, 2007). The geology of Gombe state is said to be tertiary continental sandstones to the west of the Kerri-Kerri escarpment, young cretaceous estuarine sandstone shales, clays and siltstones at the foot of the scarp, and cretaceous marine shales, limestone and old cretaceous sandstones to the north east of the scarp (BSADP, 1982). The climate is characterized by two distinct seasons, wet and dry seasons. The average annual rainfall is about 900mm per annum, with mean annual temperature, ranging between 30 and $32^{\circ} C$, and a relative humidity of 17 to 19%. The soils are weakly leached ferruginous tropical soils in the eastern plains and sandstone plains to the west, with lithomorphous Vertisols (BSADP, 1982).

Soil sampling and handling

Three profile pits, with dimensions 2m long, 1.5m wide, and 1.5m deep, were dug along a toposequence at each of the three study sites. Soil samples and soil clods were collected from each identified genetic horizon of the nine profile pits, using hand trowel. The collected Soil samples were then properly labeled in polythene bags and taken to the laboratory for analysis.

Laboratory Analysis

In the laboratory, each sample was separately air-dried ground and passed through a 2mm sieve for laboratory analysis as described by Agbenin (1995). Particle size analysis was determined using the Bouyoucos hydrometer method, after dispersing the soil samples with 5% Sodium hexametaphosphate. The bulk density was determined by the clod method (Black and Hartge 1986). Porosity was calculated mathematically from bulk density (Db) and standard particle density (Dp) data, as described by Anderson and Ingram (1998). Soil pH was determined in 1:1 water ratio using a glass electrode pH meter (Page *et al.*,

1982). Determination of organic carbon, and total nitrogen were done by the wet oxidation method and regular micro-kjeldal method respectively. Available phosphorus was determined using the Bray 1 method. The exchangeable bases (Ca, Mg, K and Na), were extracted with 1M ammonium acetate (1M NH_4AOC) solution buffered at pH 7.0 as described by Anderson and Ingram (1998). Potassium and Sodium (K and Na) in the extract were read on Jenway Flame Photometre Model PFP7. The calcium and magnesium (Ca and Mg) were read on VGP, Model 210 bulk scientific atomic absorption spectrophotometer (AAS) at their appropriate wavelengths.

Data analysis

The data generated were subjected to analysis of variance (ANOVA) using Genstat 13th Edition. Means that are significant are separated using LSD, (Harry and Steven, 1995)

RESULTS AND DISCUSSION

Physical Properties

The data on the particle size distribution of the soils studied are presented in Table 1. The sand, silt and clay fractions across locations and toposequences ranged from 12.6 - 32.8, 25.6 - 29.9 and 37.2 - 62.0% respectively. There was an observed statistical difference ($P < 0.05$) in value of sand and clay content across locations with Kumo recording the highest mean sand content of 32.0%, while Baure recorded the highest mean clay content of 62.0% (Table 1.). But generally, the soils of the study areas were predominantly clay in texture. This dominance in clay fraction of the studied soils could be attributed to the nature of the parent material (Brady and Weil, 2013).

The soils investigated had almost equal distribution of bulk density (Db) values ranging between $1.61 - 1.92 \text{ Mg m}^{-3}$ across locations and toposequence (Table 1.). There was no significant ($P > 0.05$) difference in soil Db values between locations and toposequence. The mean values of soil bulk density obtained for this study are within the range reported in an earlier finding by Folorunso and Ahn (1989), who recorded values of 1.50 to 1.80 g/cm^3 , while working on soils in Borno state. Donahue *et al.* (1990),

pointed out that good plant growth is best at bulk densities below 1.40mgm^{-3} for clay, and 1.60mgm^{-3} for sandy soils.

There was an observed statistically significant ($P>0.05$) variation in mean porosity values with respect to locations and toposequences (Table 1.). The mean porosity values obtained for this study ranged from $0.30 - 0.40\text{m}^3\text{m}^{-3}$ across locations and toposequences (Table 1.). The generally low porosity values recorded in this study falls within the range of 0.31 to $0.51\text{m}^3\text{m}^{-3}$, earlier reported by Hassan and Shuaibu (2006), who worked with similar soils, at Walban Deba, Gombe State.

Incorporation of organic manure to the soils will decrease the soil bulk density and ultimately increase the percentage pore distribution, thereby enhancing the soil physical condition for optimum crop production and food security (Hassan and Shuaibu, 2006).

Chemical Properties

Generally, pH is the major driver of soil fertility assessment (Brady and Weil, 2013). The mean pH values of the studied soils between locations and toposequences ranged from $7.08 - 7.33$ (Table 2.), which is similar to those earlier reported by Vongir *et al.*, (2007). The pH values of the studied soils can be classified as slightly alkaline in reaction. This high mean pH values obtained in this study could be attributed to climatic condition and nature of the parent material of the study area (Brady and Weil, 2013). But generally, the mean pH values are similar in all the studied soils.

The mean organic carbon values for the studied soils ranged between $7.34 - 9.79$ and $7.27 - 9.23\text{gkg}^{-1}$ for locations and toposequences respectively (Table 2.). There was also no observed significant ($P>0.05$) difference in mean values of organic carbon content within the studied soils. Generally, the mean organic carbon values in the study areas (Table 2.) were mostly found to be low as per Esu (1991) rating scale. This low value of OC content was equally corroborated by Mustapha *et al.*, 2011, for soils in the savanna zones of Nigeria. Aydinalp (2010), attributed the low level of organic carbon content to the prevailing dry conditions, where the biomass

production is low and the rate of mineralization high.

Total nitrogen means values for the studied soils ranged from $0.71 - 1.23\text{g gkg}^{-1}$ (Table 2.), across locations and toposequences. The distribution of total nitrogen as indicated in Table 2 showed that there was no significant ($P>0.05$) difference between locations or toposequences. The mean content of TN so obtained, from this study like the OC could be rated low according to Esu, (1991) rating scale and this may limit crop production in such soils. The low TN content obtained in this study could partly be ascribed to low OC content of the study area. Kelly and Mays (1989) in their findings reported a high correlation between OC and TN in soils.

Though phosphorus content varies from region to region, this study reveals that the available phosphorus content in most of the soils studied was found to be very low. The P content of the soils in this study (Table 2.) showed no significant ($P>0.05$) difference between locations or toposequences. Brady and Weil (2013) attributed the low value of AP as recorded in this study, to low content in parent materials of most soils, and its propensity to sorption on mineral surface. The medium and high mean values of 16.6 and 20.1mgkg^{-1} respectively, as per Esu, (1991) rating scale obtained at middle slope and Baure village respectively (Table 2), can be attributed to residual application of chemical fertilizer containing phosphorus from the previous farming year. According to Kparmwang *et al.*, (1998), such exceptionally higher values of available phosphorus obtained at the middle slope and Baure village when compared to the other values could be attributed, to the nature of Phosphorus, which is not quite immobile and tends to remain at the surface where it was applied, unless thoroughly ploughed in the soil.

Exchangeable Bases

Calcium (Ca)

The mean content of calcium in the sampled soils as indicated in (Fig. 1 and 2), between location or toposequence, showed no much differences. The mean calcium content between locations and toposequences ranges from $20.2 - 22.9$ and $19.5 - 23.9\text{cmol (+)/kg}$, respectively, with Kwadon and the Lower

slope recording the highest mean Ca content, and dominate the exchange complex (Fig. 1 and 2). The mean value obtained at the lower slope could be attributed to leaching process.

The mean values obtained in this study, for exchangeable calcium content between locations and toposequence (Fig. 1 and 2) were rated high in calcium content, as per Esu (1991), rating scale. From the findings of Havlin *et al.* (1999), the seemingly high value of calcium content obtained in this study may be attributed to inherent calcium content of the soil dictated by the parent material.

The higher values obtained for exchangeable Calcium indicated that Calcium is the dominant cations in the studied soils, as was observed by Kwari and Dada (2000) and Usman *et al.* (2000), who worked on similar soils. Similar observations were also made for savannah soils in general by Muller-Samann and Kotschi (1994).

Magnesium (Mg)

The second most dominant extractable cation on the exchange complex of the studied profiles is magnesium (Mg). The soils of the study areas showed no much difference in the content and distribution of Mg either across locations or toposequences (Fig. 1 and 2). The mean exchangeable Mg content in the soils ranged from 5.43 to 6.29cmol (+)/kg soil across locations and toposequences, with nearly equal distribution of Mg content across locations and toposequences (Fig. 1 and 2), and was rated high (Esu, 1991). This seemingly high value of Mg content obtained in this study could be related to the calcareous nature of the parent material, (Havlin *et al.*, 1999).

Potassium (K)

The potassium content of the studied soils was presented in Fig. 1 and 2. The results indicated no much differences between locations, while the potassium values between toposequences was found to be highly different. The mean potassium value of 1.34 cmol (+)/kg, recorded at the upper slope position, was higher when compared from those obtained at the middle slope (0.60 cmol (+)/kg) and lower slope position (0.41 cmol (+)/kg).

In this study, the mean exchangeable K values between locations and toposequences of the studied soils, have lesser content when compared to Ca and Mg content (Fig. 1 and 2), but generally the K content was rated high (Esu, 1991). Kwari and Dada (2000), in an earlier finding, attributed the high value of K in soils to the amount of clay, they stated that the greatest part of K is said to be bound in primary minerals, which largely make up the clay fraction of the soil, for these reason soil rich in clay are also rich in K (Brady and Weil, 2013).

The value greater than 2cmol (+)/kg of K in soil, indicates a fairly good supply and the response to potash fertilizer is unlikely (Fink and Venkateswarlu, 1982). These levels of exchangeable K obtained in this study are generally adequate to support the production requirements of crops such as wheat, maize, rice, sorghum, and millet. Potassium, being one of the three primary nutrients, apparently its sufficient presence and its availability is a requisite for optimum crop production.

Sodium (Na)

The mean exchangeable sodium content in the soils studied, ranged from 0.52 to 1.48cmol (+)/kg soil and also less in content when compared to Ca and Mg (Fig. 1 and 2) across locations and toposequences, but generally rated high as per Esu (1991), rating scale. Similar values were earlier reported by Vongir *et al.* (2007). Gokhan and Ertugrul (2007), also reported sodium content values ranging from 0.14 to 2.34cmol (+)/kg soil, while working on similar soils.

The exchangeable Na content value at the lower slope (1.48cmol (+)/kg) is much higher to those obtained at the upper (0.52cmol (+)/kg) and middle slope (0.57cmol (+)/kg) (Fig. 1 and 2). This high value of Na content at the lower slope could be attributed to higher leaching losses across the toposequence.

CONCLUSION AND RECOMMENDATIONS

From the results obtained, the physical and chemical properties of the studied soils had very little differences between the three agricultural areas in which the study was undertaken. The values obtained for exchangeable bases were found to be adequate and can support plant growth

and that Calcium and Magnesium are the dominant cations in the studied soils. It was also observed, that the main limiting factors regarding soil productivity are low organic matter content, low total nitrogen, high bulk density and high clay contents that can hinder its workability difficult.

In line with the above findings, it is recommended that good management practices should be adopted for food sufficiency and security. These management

practices should include the provision of adequate drainages, incorporation of crop residue, addition of organic manures, and inorganic fertilizers containing especially N, P, and Finally, proper and periodic monitoring of the physical and chemical properties of such soils is very necessary, so that appropriate preventive measures could be embarked upon as and when due, for optimum agricultural productivity.

Table 1: Physical properties of the soils at the three different locations and toposequences

	Sand (%)	Silt (%)	Clay (%)	Db (Mgm ⁻³)	Texture	Porosity (M ⁻³ M ⁻³)
Location						
Kumo	32.8	29.9	37.2	1.61	CL	0.40
Kwadon	25.3	26.3	48.3	1.92	C	0.30
Baure	12.6	25.6	62.0	1.75	C	0.30
SE±		2.15		0.08		
LSD (P<0.05)	7.13	NS	3.57	NS		0.01
Toposequence						
Upper	26.1	26.3	47.4	1.85		0.30
Middle	23.9	27.4	49.1	1.70		0.40
Lower	20.7	28.1	51.1	1.73		0.40
SE±	1.96	2.40	3.20	0.08		
LSD (P<0.05)	NS	NS	NS	NS		0.01

NS: Not significant, CL: Clay Loam, C: Clay

Table 2: Soil pH, organic carbon (OC), total nitrogen (TN) and available phosphorus (AP) at the three different locations and toposequences.

	pH	OC (gkg ⁻¹)	TN(gkg ⁻¹)	Available phosphorus (mgkg ⁻¹)
Location				
Kumo	7.11	9.79	1.23	3.44
Kwadon	7.26	7.61	0.81	5.75
Baure	7.19	7.34	0.71	20.1
SE±	0.23	2.00	0.18	4.85
LSD (P<0.05)	NS	NS	NS	NS
Toposequence				
Upper	7.33	7.27	0.88	5.68
Middle	7.15	9.23	1.01	16.6
Lower	7.08	8.23	0.86	7.03
SE±	0.16	1.95	0.18	5.43
LSD (P<0.05)	NS	NS	NS	NS

NS: Not Significant

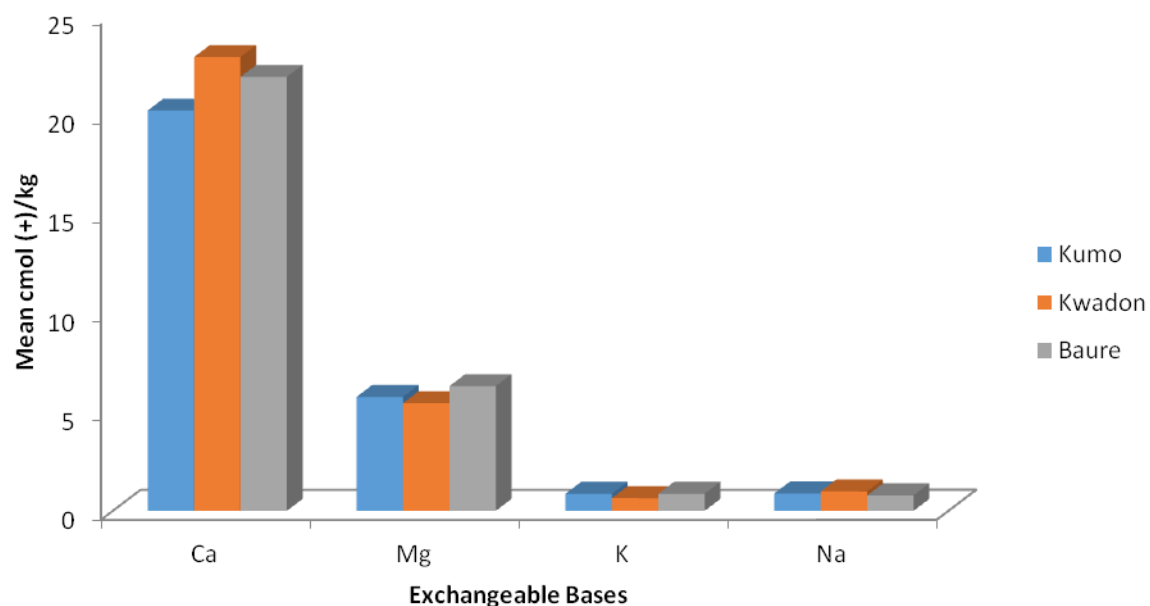


Fig 1: Status and Distribution of Exchangeable bases across locations

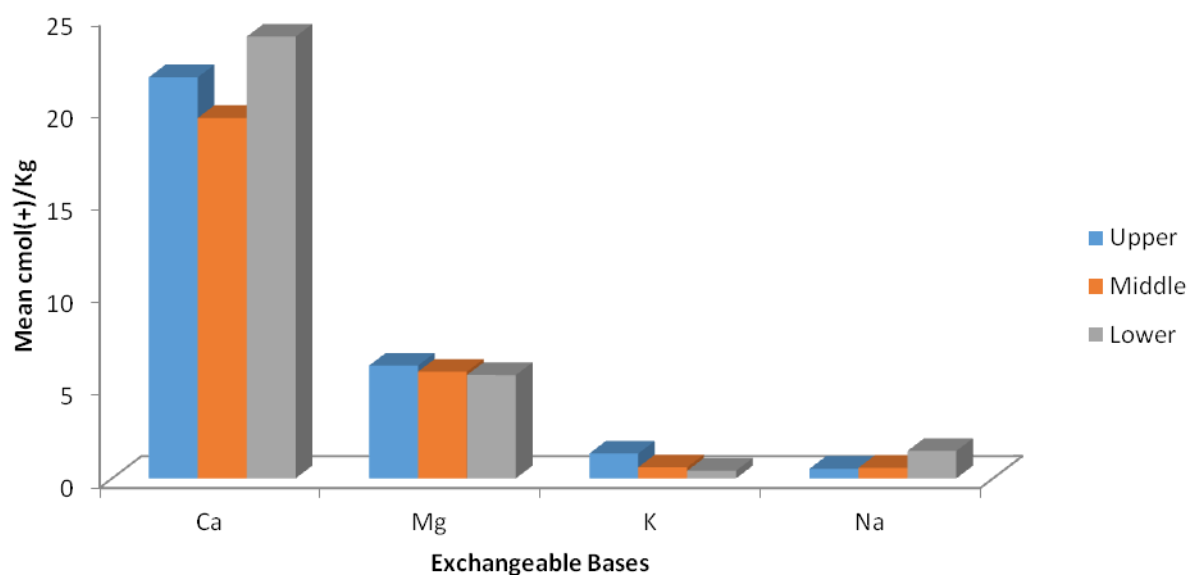


Fig 2: Status and Distribution of Exchangeable bases across toposequences

REFERENCES

- Agbenin, J. O. (1995). Laboratory manual for soil and plant analysis (Selected Methods and data analysis). Department of soil science, ABU Zaria. 140pp.
- Anderson, J. S., and Ingram, J. I. S., (1998). *Tropical Soil Biology and Fertility*. A Handbook of methods (2nd ed) information Press, UK 221pp.
- Aydinalp, C. (2010). Some important properties and classification of Vertisols under Mediterranean climate. *African Journal of Agricultural Research*. 5 (6), pp449-452.
- Black, G. R. and Hartge, K. H. (1986). Particle density. In: Klute, A (ed) Methods of soil Analysis part 1, physical and mineralogical methods. Agron. 9 ASA. INC. Madison. W. E. USA pp 377-382.
- Brady, N. C. and Weil, R. R. (2013). *The Nature and Properties of Soil*. 13th Edn., Macmillan Publishing Co., New York, USA pp 169.
- Brouwer, J., Fussell, L. K. and Herman, L. (1993). Soil and crop growth micro-variability in the West African semi-arid tropics: a possible risk-reducing factor for subsistence farmers. *Agriculture, Ecosystems and Environment* 45:229-238.
- BSADP (1982). Zonal and Development Area Statistics. Bauchi State Agricultural Development. BSADP, Bauchi, Nigeria, pp: 90-100.
- Cox, S. B., Willing, M. R. and Scatena, F. N. (2002). Variations in Nutrient Characteristics of Surface Soils from Luquillo Experimental Forest of Puerto Rico. A Multivariate Perspective. *Plant and Soil*. 247: 189-198.
- Donahue, R. L ; Miller, R. M. and Shickluna, J. C. (1990). Soils: An Introduction to soil and plant growth. Prentice- hall of India. New Delhi. pp 473.
- Esu, I. E. (1991). Detailed soil survey of NIHORT farm at Bunkure, Kano state, Nigeria. Institute of Agricultural Research, Zaria, pp:72.
- Fashina, A. S. (2003). Top soil variation of soil properties in some mapping units in a farm in Southern Nigeria. *Journal of Sustainable Agriculture and Environment* 5(1): 137-146.
- Finck, A. and Venkateswarlu, J. (1982). Chemical properties and fertility management of Vertisols. In: Vertisols and Rice Soils of the tropics. Symposia Papers II, 12th International Congress of Soil Science, New Delhi, India, pp: 61-79.
- Folorunso, O. A. and Ahn, J. O. (1989). Physical Properties of Northern Nigerian Vertisols as the affect Management. In: P. M. Ahn (ed.) Vertisols Management in Africa IBSRAM Proceedings No. 9: 239-249.
- Gokhan, O., and Ertugrul, A. (2007). Characterisation, classification and agricultural Usage of vertisols developed on neogen aged calcareous marl parent materials. *Journal of Biological Environmental Sciences* 1(1): 5- 10.
- Harry, F. and Steven, C. A. (1995). Statistics: Concepts and Applications. Cambridge Univ. Press, Great Britain, pp 853.
- Hassan, A. M. and Shuaibu, M. (2006). Physico-Chemical properties of the soil at Walban-Deba, Gombe state. Proceedings of the 24th annual conference of the horticultural Society of Nigeria, held at Gombe state university, Gombe. Sep. 17th to 22nd 2006. pp 163-168.
- Havlin, J. L., Beaton, J. D., Tisdale, S. L. and Nelson, W. L. (1999). Soil fertility and fertilizers. Pearson education Inc. Singapore pp 499.
- Kelly, J. M. and Mays, P. A. (1989). Root zone physical and chemical characteristics in south eastern Spruce for stands. *Soil Sci. Soc. Am. J.* 53:1248-1255.
- King, G. J., Acton, D. F. and Arnaud, J. S. T. (1983). Soil-landscape analysis in relation to soil distribution and mapping at a site within the Weyburn association. *Canadian Journal of Soil Science*, 63: 657-670.
- Kparmwang, T., Abubakar, A. S., Chude, V.O., Raji, B. A., Malgwi, W. B. (1998). The inherent fertility and management of the microtopographycal land features of the river Galma at Zaria.

- Proceedings of Soil Science Society of Nigeria, held at Bauchi. pp 124- 130.
- Kwari, J. D. and Dada, Y. M. (2000). Characterization and Management of the soils of river anakara Floodplain in Adamawa state, Nigeria. *Journal of Arid Agriculture* 10: 65 75.
- Klemmedson, J. O. and Wiemhold, B. J.(1991). Aspects and Species Influence on Nitrogen and Phosphorus Availability in Arizona Chaparral Soils. *Soils Science Society of American Journal* 55: 1735- 1740.
- Moorman, F. R.(1981). Representative toposequence of soil in southern Nigeria and their pedology. In: Greenland, D. J.(ed). Characterisation of soils in relation to their classification and management for crop production. Clarendon Press. Oxford. pp 10 - 29.
- Muller-Samann, K. M. and Kotschi, J. (1994). *Sustaining growth: Soil fertility management in tropical small holdings* margrafe Verlag pp 486.
- Mustapha, S., N.Voncir, S. Umar and N.A. Abdulhamid, (2011). Status and distribution of some available micronutrients in the Haplic Usterts of Akko Local Government Area, of Gombe State, Nigeria. *International Journal of Soil Science*. 10:1-8.
- Okunsami, T. A., Rust, R. H. and Jou, A. S. R.(1985). Characteristics and classification of some Soils formed on post-cretaceous sediments in Southern Nigeria. *Soil Science* 140:110-119.
- Page, A. L., Miller, R. H., and Kenny, D. R. (1982). *Method of Soil Analysis, part II Agronomy No 9 ASA Madison, Wisconsin, pp 2*
- Sibert, J., Johan, S. and Ramus, S. (2007). Topographycal Influence on Soil Properties in Boreal Forest. *Geodarma*. 141: 138-148.
- Tengoua, E., Tchapnga, H. D., Guenat, E. and Pfeifer, H. (2005). Ground water Fluctuation and Foothlope Ferricrete Soils in the Humid Tropical Zone, Southern Cameroon. *Hydrol Process*. 19: 3097.
- Usman, B. H., Gadu, A. and Opeloye, S. A. (2000). Soil fertility Research for Agricultural Sustainability Physico-chemical properties of some soils from Konduga Local Government Area Borno state, Northeast Nigeria. *Journal of Arid Agriculture* 10: 75-81.
- Voncir, N., Amba, A. A., Haruna, S. G., and Wufem, B. M. (2007). Variability in Properties of vertisols along a toposequence in Gombe, Gombe state, Nigeria. *Journal of League of Researchers in Nigeria*. 8 (1): 12- 17.

EFFECTS OF INCORPORATED LEGUMES, NPK 20-10-10 AND THEIR COMBINATION ON PEARL MILLET (*Pennisetum glaucum*, B. R.) NUTRIENT UPTAKE IN NORTHEASTERN NIGERIA

¹Ibrahim, A. K., ¹Askira, M.S and ²Yakubu, H

¹Department of Soil Science, Federal University, Kashere, Gombe State

²Department of Soil Science, University of Maiduguri, Borno State, Nigeria

ABSTRACT

Two years field experiment was carried out in 2015 and 2016 wet seasons at the Teaching and Research Farm of the Leventist Training School, Tumu to assess the effect of incorporated legumes, NPK 20-10-10 and their combination on nutrient uptake of pearl millet (*Pennisetum glaucum*, B. R.). The experiment was laid out in a Randomized Complete Block Design (RCBD) with three replicates. The treatments consisted of Centrosema; Centro + N₃₀ P₁₅ K₁₅ kg ha⁻¹; Lablab; Lablab + N₃₀ P₁₅ K₁₅ kg ha⁻¹; Mucuna; Mucuna + N₃₀ P₁₅ K₁₅ kg ha⁻¹; Sesbania; Sesbania + N₃₀ P₁₅ K₁₅ kg ha⁻¹; control and N₆₀ P₃₀ K₃₀ kg ha⁻¹ laid out in a RCBD with three replicates. The results revealed that the uptake of N, P and K by both stover and grain of pearl millet were statistically significant ($p \leq 0.05$) due from the combined application of organic and inorganic fertilizers. The highest nutrient uptake was recorded from treatment T₈ (Sesbania + N₃₀ P₁₅ K₁₅ kg ha⁻¹) and the lowest value was obtained from the control. The overall result suggests that combined used of organic and inorganic fertilizer can be used as an alternative option of inorganic fertilization to achieve maximum values of nutrient uptake of pearl millet.

Keywords: Pearl millet, Nutrient, Uptake, Green manure, Legume, NPK

INTRODUCTION

Pearl millet (*Pennisetum glaucum* (L) R. Br.), locally known as Gero in Northern Nigeria belonging to the grass family Graminae. It is an important crop in arid and semi-arid areas of Nigeria. The crop has the potential of producing grain yield for the increasing population in this region under an ideal situation. Globally, Pearl millet is the seventh most important cereal crop (ICRISAT, 2005). According to Gulia *et al.* (2007) Pearl millet is a staple grain for about 90 million people living in the semi-arid tropical regions of Africa and the Indian sub-continent. Its production is constrained by inherent low soil fertility.

An increase in population is causing pressure on land leading to the replacement of traditional shifting cultivation. Most tropical soils are known to suffer structural and fertility constraints. The northern guinea savanna agro-ecological zone of Nigeria, which fall under the tropical environment, have specifically been reported by several researchers to have low clay activity, total nitrogen, soil organic matter content and that consequently the soils have low levels of cation exchange capacity and low buffering capacities

(Odunze, 2003). Intensive cultivation couple with application of sole urea could alter the soil physical and chemical properties by decreasing the soil pH and reducing exchangeable bases contents which lead to soil degradation (Odunze *et al.*, 2012). The soils are therefore of low fertility leading to low crop production. Small scale farmers of the region carry out farming on sandy loam soils that are now degraded because of high land pressure, erosion and lack of good soil management practices for soil fertility management.

The use of integrated soil fertility management strategy with emphasis on utilization of biological nitrogen fixation through the use of leguminous green manure crops may offer a good opportunity for small scale farmers to manage the soil productivity problems and increase crop yields at reasonable and sustainable cost levels (Odunze *et al.*, 2012). The inclusion of legumes in to the cropping system to improve soil nitrogen content can be a practicable alternative to the use of organic or chemical fertilizer alone. Apart from increase in soil N-supply, the soil physical and biological properties are also improved

by the legumes resulting in high and sustainable productivity.

Although it is known that leguminous green manure crops are used as one of the sources of organic fertilizer but its use has not been fully utilized by small scale farmers. Therefore, this study was conducted to determine the effects of leguminous green manure crops on nutrient uptake by pearl millet.

MATERIALS AND METHODS

Field experiments were carried out in the wet seasons of 2015 and 2016 at the Teaching and Research farm of the Leventist Farm, Tumu. The area is located on Latitude 10° 00' 40"N and Longitude 11° 00' 54"E at an altitude of 325m above sea level in the Northern Guinea Savanna ecological zone of Nigeria. The annual rainfall for the duration of the study in 2015 and 2016 was 369.4 and 2183.2mm, respectively. The physical and chemical analysis of the top soil (0-20cm depth) of the experimental field before planting in 2015 were determined by standard procedures as described by Page *et al* (1983). The results showed that the soils was Sandy Loam with the following properties: pH (0.01M CaCl₂), 5.0; organic carbon, 5.4 g kg⁻¹; total nitrogen, 0.04 g kg⁻¹; available phosphorus, 6.8 mg kg⁻¹; and exchangeable cations (cmol kg⁻¹) of Ca²⁺, 2.32; Mg²⁺, 0.50; K⁺, 0.15; and Na⁺, 0.12; and CEC, 4.0 cmol kg⁻¹. The chemical analysis of the incorporated leguminous green manure crops is shown in Table 1.

The experiment consisted of ten treatments laid out in a randomized

complete block design (RCBD) and replicated three times. Each experimental plot measured 4 × 5 m, making a total of thirty plots. The treatments comprised of Centro alone; Centro + N₃₀ P₁₅ K₁₅ kg ha⁻¹; Lablab alone; Lablab + N₃₀ P₁₅ K₁₅ kg ha⁻¹; Mucuna alone; Mucuna + N₃₀ P₁₅ K₁₅ kg ha⁻¹; Sesbenia alone; Sesbenia + N₃₀ P₁₅ K₁₅ kg ha⁻¹; N₆₀ P₃₀ K₃₀ kg ha⁻¹ fertilizer only as a check and Control.

Sowing of Centro, lablab, Mucuna and Sesbenia at two seeds per hole were done at spacing of 37.5cm x 25cm and incorporated in to soil at six weeks after sowing. A week after incorporation, pearl millet variety SOSAT-C-88 were dressed with Apron Star 42 WS at the rate of 10 g sachet per 4 kg seeds for protection against soil and seed borne pests and diseases. The seeds sown at the rate of two seeds per hole at spacing of 25cm on ridges. The seedlings were thinned to one plant per stand at two weeks after sowing (WAS). Compound fertilizer (20-10-10) was applied two weeks after sowing (2WAS) at a rate of N₆₀ P₃₀ K₃₀ kg ha⁻¹ in plots treated with inorganic fertilizer only and N₃₀ P₁₅ K₁₅ kg ha⁻¹ in plot treated with green manure and fertilizer. Weeds were controlled using Paraquat (Gramaxone) at 3 litres ha⁻¹ and hoe weeding was done at 6WAS.

Millet grain and stover samples were taken and their NPK concentrations were chemically determined as described by Marr and Cresser (1983). The Nutrient uptake by stover and grain were calculated by using the formula given below:

$$\text{Nutrient uptake (kg/ha)} = \frac{\text{Nutrient content (\%)}}{100} \times \text{Dry weight (kg/ha)}^{-1}$$

All data collected were subjected to Analysis of Variance (ANOVA) using SAS package version 9.0 Software as described by SAS institute, (2002). Differences between treatment means were compared using Duncan Multiple Range Test (DMRT) at 5% level of probability (Duncan, 1955).

RESULTS AND DISCUSSION

Nitrogen Uptake

Results in Table 2 indicated that the N uptake varied significantly due to renewed application of NPK fertilizer and green manure. In 2015 and 2016 study periods plots treated with Sesbania + N₃₀ P₁₅ K₁₅ kg ha⁻¹ fertilizer recorded significantly higher stover and grain N

uptake. The increase in N uptake could be ascribed to slow and continued supply of the nutrients, coupled with reduced N losses via denitrification and leaching, which may have improved the synchrony between plant N demand and supply from the soil (Tilahun-Tadesse *et al.*, 2013). The differences observed in stover N uptake between the two seasons may be attributed to the quantity and distribution of rainfall between the two seasons. There was a higher quantity of rainfall during the 2016 season than during the 2015 season which might have led to higher N uptake during the 2016 season than the 2015 season. The higher N uptake recorded with Sesbania treatment may be attributed to its higher N content compared to other green manure crops. This study concurs with the findings of (Ngala *et al.*, 2014) who recorded significantly higher NPK uptake in millet amended with combined organic fertilizer with NPK fertilizer than those with organic or NPK fertilizer alone in northeastern Nigeria. The result obtained indicated that millet grown with legume green manure combined with 30kg ha⁻¹ NPK fertilizer had a higher nutritional quality than those with green manure alone or NPK fertilizer alone. However, in a similar study Jacqueline *et al.* (2008) reported that combined application of organic manure plus inorganic fertilizers significantly increased rice stover and grain N uptake. The results reveal that N uptake in millet grain was higher than that of stover. This result is in agreement with the findings of Islam *et al.* (2014) who reported higher N uptake in rice grain than N uptake in rice stover. Adesoji *et al.* (2015) explain that increase in stover N and grain N uptake recorded in plots treated with green manure crops combined with 30kg ha⁻¹ NPK fertilizer showed that both the fixed N and mineralized N from the legumes were available for millet use.

Phosphorus Uptake

P uptake of millet was significantly influenced by various treatments used in this study (Table 3). The highest P uptake in stover and grain was recorded in T₈ (Sesbania + N₃₀ P₁₅ K₁₅ kg ha⁻¹ fertilizer) which was significantly higher than all other treatments. This result was similar to the results obtained by Ngala *et al.* (2014). Sathish *et al.* (2011) reported that combined application of organic and inorganic fertilizer significantly increased stover and grain P uptake, which is in close conformity with the results obtained in this study. The control plots recorded significantly lower P uptake in comparison to all other treatments justifying the need for incorporation of leguminous green manure and inorganic fertilizer.

Potassium Uptake

K uptake varied significantly due to renewed application of inorganic fertilizer and green manure as documented in Table 4. In 2015 and 2016 the highest K uptake in stover and grain of pearl millet were recorded with T₈ (Sesbania + N₃₀ P₁₅ K₁₅ kg ha⁻¹ fertilizer) which was significantly higher than all other treatments. The lowest value of K uptake was recorded in the T₁₀ control plots which were statistically lower than all other treatments. Similar findings were recorded by Bhadoria and Prokash (2003) who reported that rice straw and grain K uptake increased significantly with combined application of organic manure and synthetic fertilizers. Results in this study revealed that incorporation of sesbania green manure in combination with N₃₀ P₁₅ K₁₅ kg ha⁻¹ fertilizer significantly increased millet stover and grain K uptake over control. The result in this study was in agreement with Ngala *et al.* (2014) who reported that application of FYM plus chemical fertilizers significantly increased millet K uptake. Aziz *et al.* (2006) attributed the significant increase in stover and grain K uptake to better root growth in plants.

Table1: Laboratory analysis of the shoot of the green manure crops used in the experiments

Parameters	Description				
	N g/kg	P mg/kg	K cmol/kg	C g/kg	C: N
Centrosema					
2015	1.33	0.38	1.20	18.4	14
2016	1.37	0.33	1.23	20.9	15
Lablab					
2015	2.96	0.49	1.35	29.4	10
2016	3.61	0.53	1.22	38.9	11
Mucuna					
2015	2.07	0.37	1.05	18.6	9
2016	2.74	0.49	0.87	36.3	13
Sesbania					
2015	3.25	0.43	1.25	29.4	9
2016	3.44	0.38	1.36	36.8	11

Table 2: Effects of treatments on Stover and Grain nitrogen uptake of pearl millet

Treatments	Stover N uptake			Grain N uptake		
	2015	2016	Combined Mean	2015	2016	Combined Mean
Centrosema	23.4 ^c	111.2 ^c	67.3 ^c	27.1 ⁱ	21.6 ^c	24.4 ^g
Centro + N ₃₀ P ₁₅ K ₁₅ kg ha ⁻¹	28.7 ^b	162.0 ^b	95.4 ^b	45.2 ^f	35.6 ^b	40.4 ^d
Lablab	23.1 ^c	150.6 ^b	86.9 ^b	30.5 ^h	23.1 ^c	26.8 ^f
Lablab+ N ₃₀ P ₁₅ K ₁₅ kg ha ⁻¹	28.3 ^b	170.4 ^b	99.4 ^b	50.7 ^d	34.5 ^b	42.6 ^d
Mucuna	22.8 ^c	140.8 ^b	81.8 ^b	36.4 ^g	22.5 ^c	29.5 ^e
Mucuna+ N ₃₀ P ₁₅ K ₁₅ kg ha ⁻¹	23.6 ^c	170.4 ^b	97.0 ^b	56.5 ^c	36.7 ^b	46.6 ^c
Sesbania	29.0 ^b	153.9 ^b	91.5 ^b	48.6 ^e	37.8 ^b	43.2 ^d
Sesbania+ N ₃₀ P ₁₅ K ₁₅ kg ha ⁻¹	32.9 ^a	206.6 ^a	119.8 ^a	65.4 ^a	51.1 ^a	58.3 ^a
N ₆₀ P ₃₀ K ₃₀ kg ha ⁻¹	19.1 ^d	163.8 ^b	91.5 ^b	59.8 ^b	50.0 ^a	54.9 ^b
Control	8.73 ^e	70.7 ^d	39.7 ^d	10.9 ^j	9.54 ^d	10.2 ^h
SE±	0.418	9.996	4.350	0.272	1.246	0.926

Means followed by the same letter(s) within a column are not significantly different from each other at 5% level of probability using DMRT

Table 3: Effects of treatments on Stover and Grain Phosphorus uptake of pearl millet

Treatments	Stover P uptake			Grain P uptake		
	2015	2016	Combined Mean	2015	2016	Combined Mean
Centro	9.4 ^d	53.8 ^c	31.6 ^c	5.5 ^g	2.8 ^f	4.2 ^h
Centro + N ₃₀ P ₁₅ K ₁₅ kgha ⁻¹	10.8 ^c	68.2 ^b	39.5 ^b	13.1 ^d	5.7 ^d	9.4 ^e
Lablab	10.4 ^c	75.9 ^b	43.2 ^b	8.0 ^e	4.7 ^c	6.4 ^f
Lablab+ N ₃₀ P ₁₅ K ₁₅ kgha ⁻¹	11.1 ^c	77.7 ^b	44.4 ^b	14.0 ^b	8.0 ^b	11.0 ^b
Mucuna	9.2 ^d	74.5 ^b	41.9 ^b	6.7 ^f	3.0 ^f	4.9 ^g
Mucuna+ N ₃₀ P ₁₅ K ₁₅ kgha ⁻¹	9.2 ^d	79.6 ^b	44.4 ^b	14.0 ^c	4.9 ^e	9.5 ^d
Sesbania	12.0 ^b	71.3 ^b	41.7 ^b	8.0 ^e	4.7 ^e	6.4 ^f
Sesbania+ N ₃₀ P ₁₅ K ₁₅ kgha ⁻¹	13.4 ^a	90.9 ^a	52.2 ^a	16.2 ^a	9.2 ^a	12.7 ^a
N ₆₀ P ₃₀ K ₃₀ kgha ⁻¹	8.1 ^e	65.0 ^b	36.6 ^b	14.5 ^b	6.9 ^c	10.7 ^c
Control	3.9 ^f	31.1 ^d	17.5 ^d	2.6 ^h	0.98 ^g	1.79 ⁱ
SE±	0.195	3.370	2.376	0.107	0.259	0.062

Means followed by the same letter(s) within a column are not significantly different from each other at 5% level of probability using DMRT

Table 4: Effects of treatments on Stover and Grain Potassium uptake of pearl millet

Treatments	Stover K uptake			Grain K uptake		
	2015	2016	Combined mean	2015	2016	Combined Mean
Centro	18.8 ^c	82.0 ^d	44.5 ^c	4.6 ⁱ	3.2 ^d	3.9 ^f
Centro + N ₃₀ P ₁₅ K ₁₅ kg ha ⁻¹	21.7 ^b	101.3 ^c	61.5 ^b	8.0 ^e	6.2 ^b	7.0 ^c
Lablab	17.0 ^c	123.7 ^c	70.4 ^b	6.9 ^f	3.4 ^d	5.2 ^d
Lablab+ N ₃₀ P ₁₅ K ₁₅ kg ha ⁻¹	17.6 ^c	129.7 ^c	73.7 ^b	9.2 ^d	6.0 ^b	7.6 ^b
Mucuna	14.3 ^d	104.6 ^c	59.5 ^b	6.0 ^h	3.1 ^d	4.6 ^e
Mucuna+ N ₃₀ P ₁₅ K ₁₅ kg ha ⁻¹	15.1 ^d	131.8 ^c	73.5 ^b	10.4 ^b	5.6 ^b	8.0 ^b
Sesbania	20.5 ^b	112.6 ^c	66.6 ^b	6.4 ^g	4.2 ^c	5.3 ^d
Sesbania+ N ₃₀ P ₁₅ K ₁₅ kg ha ⁻¹	24.6 ^a	172.0 ^a	98.3 ^a	11.2 ^a	8.3 ^a	9.8 ^a
N ₆₀ P ₃₀ K ₃₀ kg ha ⁻¹	18.3 ^c	149.3 ^b	83.8 ^b	10.2 ^c	5.8 ^b	8.0 ^b
Control	6.63 ^e	38.3 ^e	22.5 ^d	1.8 ^j	0.79 ^e	1.3 ^g
SE±	0.554	6.230	4.557	0.032	0.266	0.186

Means followed by the same letter(s) within a column are not significantly different from each other at 5% level of probability using DMRT

CONCLUSION

From the results of this study, it may be concluded that a combine application of $N_{30} P_{15} K_{15}$ kg ha⁻¹ fertilizer and sesbenia green manure significantly increased the uptake of N, P and K in stover and grain of pearl millet compared with control which showed lowest value of N P K uptake.

REFERENCE

- Adesoji, A. G., Abubakar, I.U. and Labe, D. A. (2015) Influence of Incorporated Legumes and Nitrogen Fertilization on Maize (*Zea mays* L.) Nutrient Uptake in a Semi-Arid Environment. *Journal of Agriculture and Veterinary Science (IOSR-JAVS)*. 8 (3) Ver. II: PP 01-08
- Aziz, T., Rahimatullah, M. A. Maqsood, M. A. Tahir, M. A. Ahmad, I. and Cheema, M. A. (2006). Phosphorous utilization by six Brassica cultivars (*Brassicajuncea* L.) from tri-calcium phosphate; a relatively insoluble P compound. *Pakistan Journal of Botany*, 38 1529 - 1538.
- Bhadoria, P.B.S and Prokash, Y.S. (2003). Relative influence of organic manures in combination with chemical fertilizer in improving rice productivity of lateritic soil. *Journal of Sustainable Agriculture*. 23(1): 77-87.
- Duncan, D.B. (1955). Multiple Ranges and Multiple F-tests. *Biometrics* 11pp 1-42.
- Gulia, S. K., Wilson, J. P., Carter, J. and Singh, B. P. (2007). Progress in grain pearl millet research and market development. In: *Janick, J. and Whipkey, A. (Eds.), Issues and New Crops and New Uses*. ASHS Press, Alexandria. pp. 196 – 203.
- ICRISAT (2005). International Crops Research Institute for the Semi-Arid Tropics. [http://dspace.icrisat.ac.in/dspace/_12/12_2002.pdf] site visited on 6/8/2010.
- Islam, M. R., Hossain, M. B., Siddique, A. B., Rahman, M. T and Malika, M (2014). Contribution of Green manure incorporation in combination with Nitrogen fertilizer in rice production. *SAARC Journal of Agriculture*, 12 (2): 134-142
- Jacqueline, A., Prudente, A., Gilbert, C., Sigua, M., Manoch, K. and Alfredo, D. (2008). Improving yield and nutrient uptake potentials of *Japonica* and *Indica* rice varieties with nitrogen fertilization. *Journal of Agricultural Science* 4(4): 427-434.
- Marr, L. and Cresser, M. S (1983). Environmental chemical Analysis. International Textbook Company, USA. Chapman and Hall, New York. Pp184
- Ngala, A. L., Yakubu, H and Kwari, J. D (2014). Agronomic and Economic evaluation of organic and mineral fertilizers for millet production on a sandy loam soil of northeastern Nigeria. *Agricultural Science Research Journal* 4(5): PP.104-110
- Odunze, A. C., Jinshui, W., Shoulong L., Hanhua Zhu, T. G., Yi Wang, Q. L (2012). Soil Quality Changes and Quality Status: A Case Study of the Subtropical China Region Ultisols. *Br. J. Environ. Clim. Change* 2(1): 37-57
- Odunze, A. C. (2003). Effect of forage legume incorporation on selected soil chemical properties in the Northern Guinea savanna of Nigeria. *J. Sustain. Agric.* 27: 101 – 112
- SAS Institute, Statistical Analysis System (SAS) User's Guide (Version 9.0). (SAS Institute, Inc., North Carolina. USA, 2002)
- Sathish, A., Govinda Gowda, V., Chandrappa, H. and Nagaraja Kusagur (2011) Long term effect of integrated use of organic and inorganic fertilizers on productivity, soil fertility and uptake of nutrients in rice and maize cropping system, *Internat. J. Sci. Nature*, 2, 1, pp. 84-88
- Tilahun-Tadesse, F., Nigussie-Dechassa, R., Wondimu, B and Setegn, G. (2013). Effect of Farmyard Manure and Inorganic Fertilizers on the Growth, Yield and Moisture Stress Tolerance of Rain-fed Lowland Rice. *American Journal of Research Communication*, 1 (4): 275-301.

GERMINATION AND GROWTH PERFORMANCE OF TWO LEAFY VEGETABLES IN RESPONSE TO THE ALLELOPATHIC EFFECTS OF *Azadirachta indica* A. JUSS

*Kolawole, O. S., Abubakar, A., Iliya, D., Memi, G.G. and Ogah, J. J.

¹Department of Biological Sciences,
Federal University of Kashere, Gombe State.

*Corresponding Author: kolawoleopeyemisaheed@gmail.com; +2348060909011

ABSTRACT

Biologically active compounds have been reported to be produced by plants and also their inhibitory effects on other plants. This research was carried out to assess the allelopathic effect of leaf leachate of *Azadirachta indica* A.Juss. (Neem) on the seed germination and growth performances of *Hibiscus cannabinus* L. and *Amaranthus cruentus* L. Thirty (30) experimental plastic containers were filled each with 2.5 kg of loamy soil and randomly allocated to the following regimes: control, 20 g, 40 g, 60 g and 80 g of powdered leaves of *Azadirachta indica* in three (3) replicates for each test crop respectively. It was observed that the response of the *Hibiscus cannabinus* L. and *Amaranthus cruentus* L. grown within different composition of *Azadirachta indica* leafs, were concentration dependent with respect to the germination and growth parameters studied at 2nd WAP. But at 4th-10th WAP, it was observed that all treatments grew well above the control. This indicates that *Azadirachta indica* L. has allelopathic effect on the studied vegetables and therefore it could be used for biological weed control and growth improvement.

Keywords: - Allelopathy, *Amaranthus cruentus*, *Azadirachta indica*, Concentration, *Hibiscus cannabinus*

INTRODUCTION

In an area of land where different plants species grows together in close relationship, interaction is bound to occur. This interaction may range from inhibition, competition, domination, overshadowing, and growth promotion. Researchers have often ignored allelopathy as a possible mechanism in their tree-crop interaction studies (Horsley 1977).

Allelopathy may also play an eminent role in intraspecific and interspecific competition and may determine the type of interspecific association. The role of allelochemicals is well documented (Alagesaboopathi, 2011). Allelopathy is a biological phenomenon where by certain plants produce a biochemically active compounds that have positive or negative effects on neighboring organisms around them (Ogunkunle *et al.*, 2013). Allelopathic interaction involves the production and release of chemical substances (allelochemicals). Such biological phenomenon has been reported by Ogunyemi and Odeweale (2011), Vaithyanathan *et al.*, (2014), all reported the allelopathic effects of *Azadirachta indica* A. Juss. on the germination of different seeds.

According to them, toxic allelochemicals may inhibit shoot/root growth, nutrient uptake, or attack a naturally occurring symbiotic relationship thereby destroying the plant's usable source of a nutrient. The consequent effects may be inhibited or retarded germination rate, reduced root or radicle and shoot or coleoptiles extension, lack of root hairs, swelling or necrosis of root tips, curling of the root axis, increased number of seminal roots, discoloration, reduced dry weight accumulation and lowered reproductive capacity (Ahmed and Shalaby 2012). Plants release allelochemicals into the environment via root exudation, leaching by rainfall, or decomposition of plant residues (Inderjit and Duke, 2003). These allelochemicals are present in almost all plant parts such as leaves, stems, roots, flowers, seeds bark and buds (Weston and Duke, 2003). The leaves has been reported to produced much allelochemicals compare to the roots, stem bark and fruits (Vaithyanathan *et al.*, 2014). *Azadirachta indica* A.Juss. is an arboreal species that originated from India, where it is known as "Neem". This plant is considered to be the "drugstore of the village" by the Indian population because of the large number of

medicinal formulations that can be prepared from it (Isman, 2000). *A. indica* seeds were introduced in Brazil in the 1970s, where it has been used as a phytochemical biopesticide (Martinez, 2002).

Thus this investigation was carried out to study the allelopathic effect of *Azadirachta indica* A.Juss. plant leaves on the germination and growth performance of *Amaranthus cruentus* L. and *Hibiscus cannabinus* L.

MATERIALS AND METHODS

Fresh leaves of *Azadirachta indica* A. Juss were collected from matured tree. In order to get representation of the entire tree canopy, the leaves were taken from the lower, middle and top portions of each tree. However, dry or senescent leaves were avoided. Viable seeds of the test vegetables, *Amaranthus cruentus* L. and *Hibiscus cannabinus* L., were obtained from local farmers in Gombe State. The plant materials and soil sample(s) were collected in June, 2016 at the study area.

The leaves were air dried and grinded into powder using mortar and pestle. The resultant powders were then weighed using an electronic weighing balance each into four different treatments (20g, 40g, 60g and 80g). To

determine whether the experimental seeds were viable, laboratory bioassay of the seeds was carried out in a Petri-dish using distilled water and filter paper to serve as the growth media. All Procedures for the

pot experiment were carried out as modified by Ogunkunle *et al.*, (2013), Sixty experimental pots were used for the study of the allelopathic effects of the leaves of *Azadirachta indica* on *Amaranthus cruentus* L. and *Hibiscus cannabinus* L. The experiment was designed into five treatments and each treatment was replicated three (3) times, making fifteen for the two aforementioned vegetables. Loamy soil was collected on farmlands on the University campus and spread on a clean surface under the sun for two days; this was aimed at destroying all form of germinating seeds present in the soil. 2.5 kg of the loamy soil was then weighed into thirty different experimental pots using electronic weighing balance. Each replication of the five treatments were mixed with the four different regimes (0g, 20g, 40g, 60 g and 80 g) of the powdered leaves prepared as treatments. The mixture in the experimental plastic containers were moistened to saturation with borehole water and left for thorough agglomeration of the powdered leaves with the soil matrices for three days. Twenty seeds of *Amaranthus cruentus* L, and forty seeds of *Hibiscus cannabinus* L were respectively counted and sprayed over the soil in the experimental pots, the top soil was then mixed not exceeding the depth of 1.5 cm. The number of germinated seeds was counted 2WAP and germination percentage was calculated by using the following formula.

$$\text{Germination percentage} = \frac{\text{Total number of seeds sown}}{\text{Number of germinated seeds}} \times 100$$

Measurements of morphological parameters started two (2) weeks after planting (WAP) and lasted for ten (10) weeks with an interval of two weeks. The morphological parameters scored include: Plant height, leaf length and breadth, stem girth and leaf area. The plant height, leaf length and breadth were measured with a standard meter rule while the stem girth was measured with an electronic digital caliper (Titan 23175 model). The leaf area

was calculated according to Pearcy *et al.*, (1989):

$$\text{Leaf Area} = (L \times B) K$$

Where L= length of leaf, B = maximum width and K= 0.72

Data generated were subjected to analysis of variance (ANOVA) to show differences among the means and were separated using Duncan's Multiple Range Test (DMRT) at P<0.05, and finally the results were tabulated.

RESULTS AND DISCUSSION

The results, revealed that the response of the two leafy vegetables (*Amaranthus cruentus* and *Hibiscus cannabinus*) growth within different levels of leaves composition of *Azadirachta indica* are concentration dependent. Statistically, there was significant difference between the treatments. The results of the germination assay revealed that mean germination of the leafy vegetables decrease with increase in concentration (Table 1). The trend was earlier observed by Jadhar and Gayanar (1992) who found the percentage germination, plumule and radicle length of rice and cowpea decreased with increasing concentration of *Acacia auriculiformis* leaf leachates. Adeyemi *et al.* (2015) while working on germination and seedling development of seeds from different *Parkia biglobosa* trees reported that seeds from different *Parkia* populations responded differently to light effect.

The findings of this research show that *Azadirachta indica* possesses certain phytochemicals (allechemicals) that inhibits seed germination and also the growth parameters of the studied plants grown within different composition of the studied plant, the effects observed were all concentration dependant with a significant difference between all treatments. This shows that the leaves of *Azadirachta indica* has allelopathic effects on the studied plant. These findings are in conformity with that of Folarin *et al.* (2015), who reported that the effects of *Vitellaria paradoxa* on some leafy vegetables namely (*Celosia argentea*, *Amaranthus hybridus* and *Amaranthus hypochondriacus*) were concentration dependant. Many researchers have stressed the allelopathic importance of many trees in weeds control and plant improvement such

as *Parkia biglobosa*, *Anacardium occidentale*, *Senna alata* and many more.

In the *Hibiscus cannabinus* and *Amaranthus cruentus*, control treatments were significantly higher than other treatment for all the growth parameters studied at 2WAP while at 4-10 WAP at different intervals the treatments are above the control at $p < 0.05$ (Table 2; Figure 1-6). Folarin *et al.* (2015) reported the allelopathic effects of leaf leachates of *Vitellaria paradoxa* on the growth parameters of *Celosia cruentus*, *Amaranthus cruentus* and *A. hypochondriacus*. Gulzar and Siddiqui (2014) reported the allelopathic effect from aqueous extracts of *E. alba* showed an inhibitory effect on seed germination and seedling growth of test species.

The germination *Amaranthus cruentus* were significantly reduced in all treatments at 2nd -4th WAP except for 20g and 40g (Table 1) which does not significantly differs with the control at 2WAP in terms of stem girth. In terms of leave area there was no any significant different 2nd – 4th WAP in (Table 2), with increasing mass of powder. The allelopathic effects on *Hibiscus cannabinus* also agrees with the trend of concentration dependency except for 4WAP in stem girth of 20g it shows no significant difference with the control in treatment (Figure 3). The results generally show that the allelopathic effects are greatly exerted during the first and second week of planting, however from 4th - 10th WAP, an increase was recorded in the growth indices (Figure 1-6). This findings agree with the findings of Folarin *et al.* (2015), which reported that at 2nd WAP, the allelopathic effects of *Vitellaria paradoxa* was greatly reduced but 4th -8th WAP, the inhibition effects decreases resulting in increase in the growth were possibly due to leaching and mineralization (Ogunkunle, *et al.*, 2013).

Table 1: Allelopathic effects of *Azadirachta indica* leaves on the Germination of *Hibiscus cannabinus* L. and *Amaranthus cruentus* L.

Species	Treatment	Mean Germination	Mean G.%±S.D
<i>Hibiscus cannabinus</i>	Control	18.66	93.3±7.64 ^d
	20g	12.33	61.7±7.64 ^c
	40g	6.67	33.3±11.6 ^b
	60g	2.67	13.3±2.89 ^a
	80g	3.00	15.0±10.0 ^a
<i>Amaranthus cruentus</i>	Control	35.33	88.3±8.78 ^c
	20g	20.67	51.7±11.81 ^b
	40g	6.93	17.3±7.50 ^a
	60g	2.00	5.00±2.50 ^a
	80g	3.00	7.50±2.5 ^{0a}

Means within the column followed by the same letters are not significantly different at $p < 0.05$. *H. cannabinus* n=20, *A. cruentus* n=40, where n is seed number, G=Germination.

Table 2: Allelopathic effects of *Azadirachta indica* leaves on the Leaf area of *Hibiscus cannabinus* L. and *Amaranthus cruentus* L.

Species	Treatment	2WAP	4WAP	6WAP	8WAP	10WAP
<i>Hibiscus cannabinus</i>	Control	6.33±0.52 ^c	10.34±0.69 ^a	21.9±0.61 ^a	24.9±1.03 ^a	27.18±1.86 ^a
	20g	4.17±0.74 ^{ab}	18.08±1.51 ^a	23.8±4.19 ^a	29.1±2.99 ^a	36.37±1.59 ^a
	40g	4.88±0.65 ^b	14.08±1.17 ^{ab}	47.2±3.10 ^b	59.7±7.04 ^c	69.43±12.9 ^c
	60g	3.57±0.95 ^{ab}	7.66±6.73 ^{ab}	45.6±39.8 ^b	52.9±49.0 ^c	72.11±66.6 ^c
	80g	1.68±1.47 ^a	5.95±6.05 ^b	37.61±32.6 ^b	41.7±36.1 ^b	46.10±39.9 ^b
<i>Amaranthus cruentus</i>	Control	0.23±0.06 ^b	0.63±0.20 ^a	1.64±0.89 ^a	7.50±1.78 ^a	8.39±2.41 ^a
	20g	1.02±1.61 ^c	0.71±0.13 ^a	3.64±2.57 ^a	7.93±2.77 ^a	13.43±5.76 ^b
	40g	0.12±0.06 ^{ab}	0.63±0.70 ^a	11.8±7.08 ^b	18.7±1.44 ^a	21.82±1.50 ^b
	60g	0.06±0.06 ^a	0.92±0.19 ^a	7.44±9.88 ^{ab}	9.61±13.0 ^a	10.83±13.5 ^a
	80g	0.03±0.00 ^a	6.50±5.46 ^b	47.1±12.0 ^c	55.8±12.2 ^b	59.59±13.5 ^c

Means within the column followed by the same letters are not significantly different at $p < 0.05$.

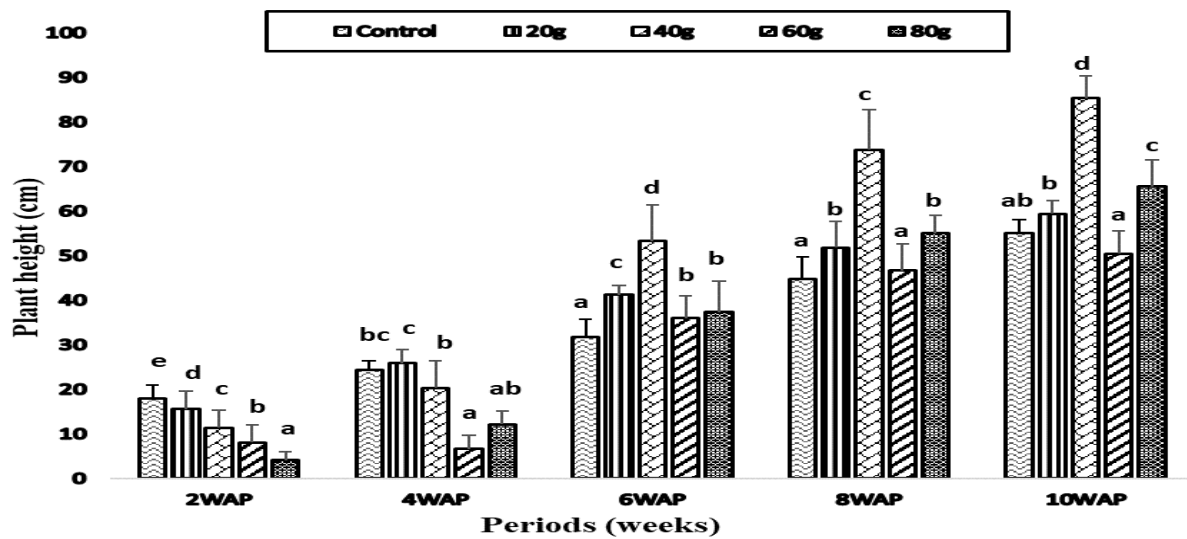


Figure 1: Variations in the plant height of *Hibiscus cannabinus* as influenced by leaf powder of *Azadiracthta indica*

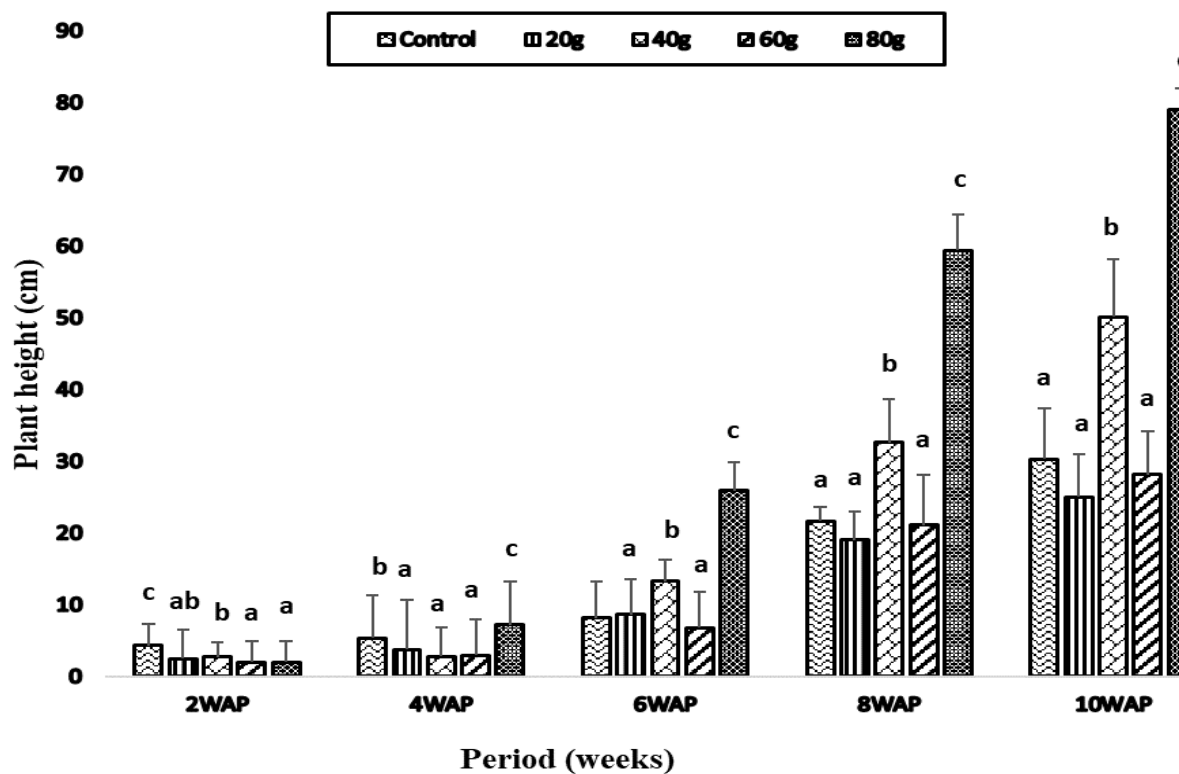


Figure 2: Variations in the plant height of *Amaranthus cruentus* as influenced by leaf powder of *Azadiracthta indica*

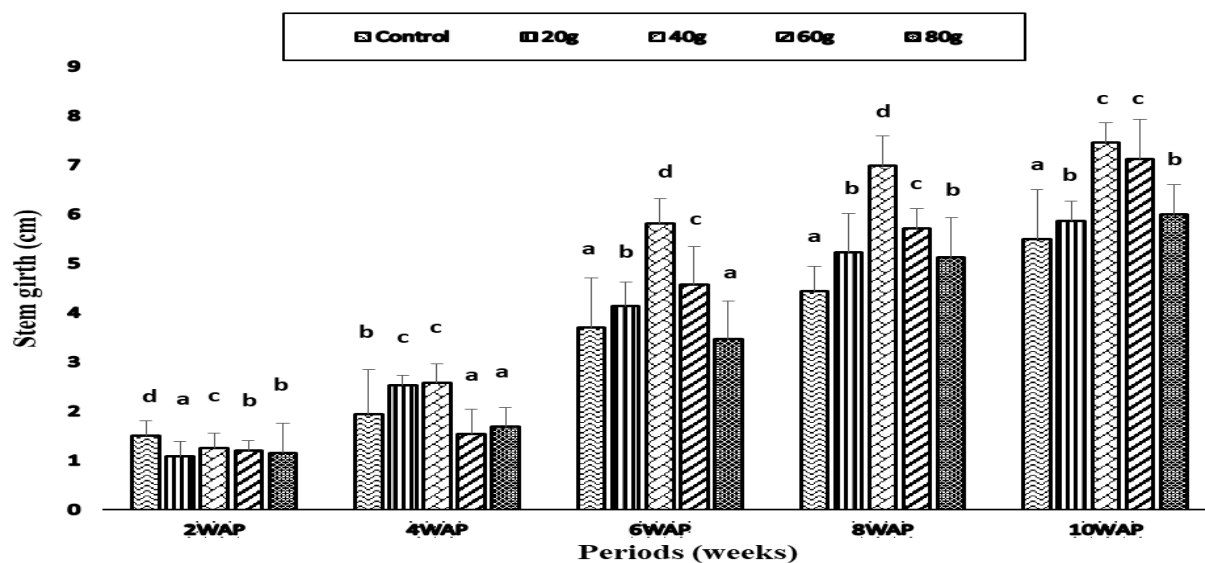


Figure 3: Variations in the stem girth of *Hibiscus cannabinus* as influenced by leaf powder of *Azadirachta indica*

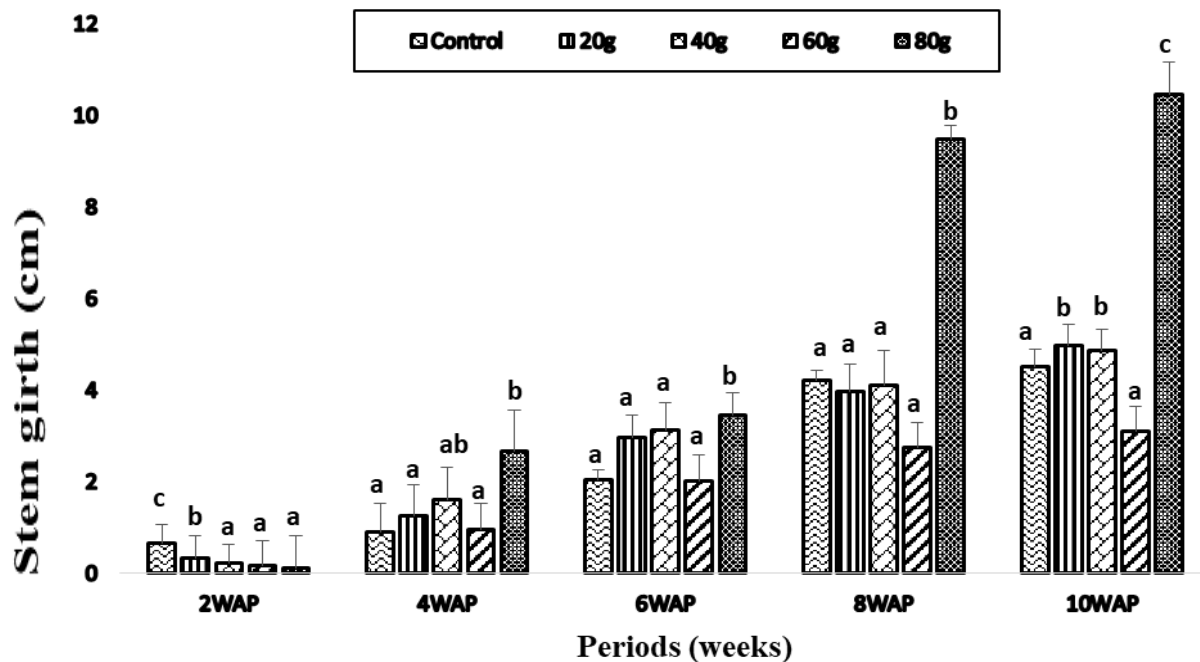


Figure 4: Variations in the stem girth of *Amaranthus cruentus* as influenced by leaf powder of *Azadirachta indica*

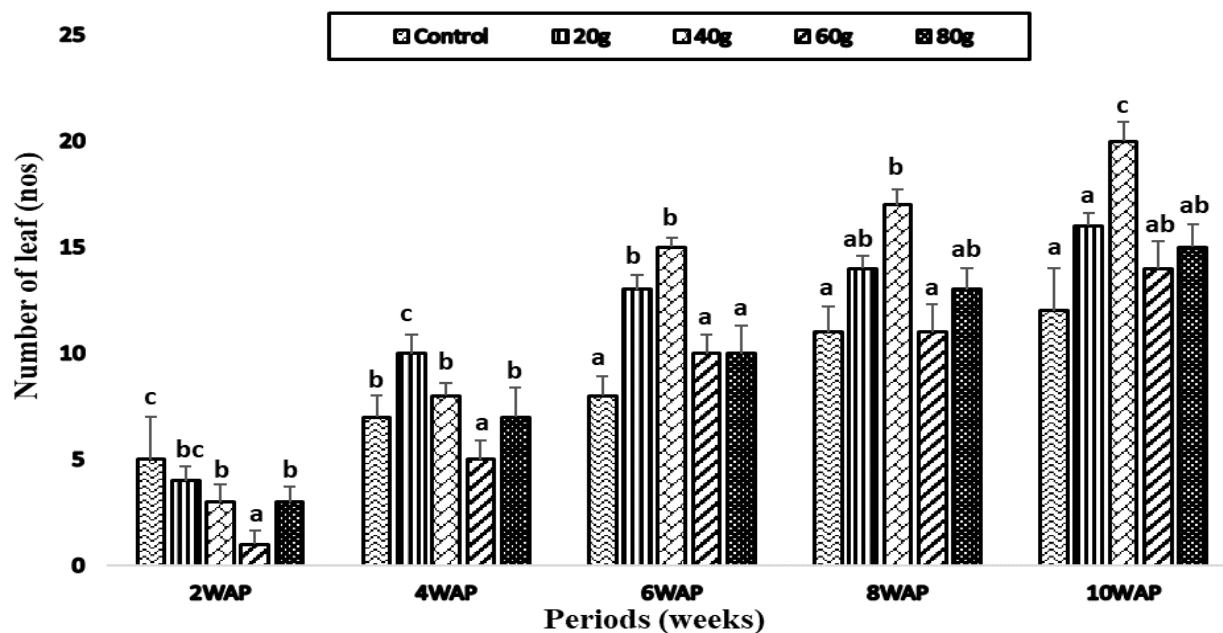


Figure 5: Variations in the plant height of *Hibiscus cannabinus* as influenced by leaf powder of *Azadiracthta indica*

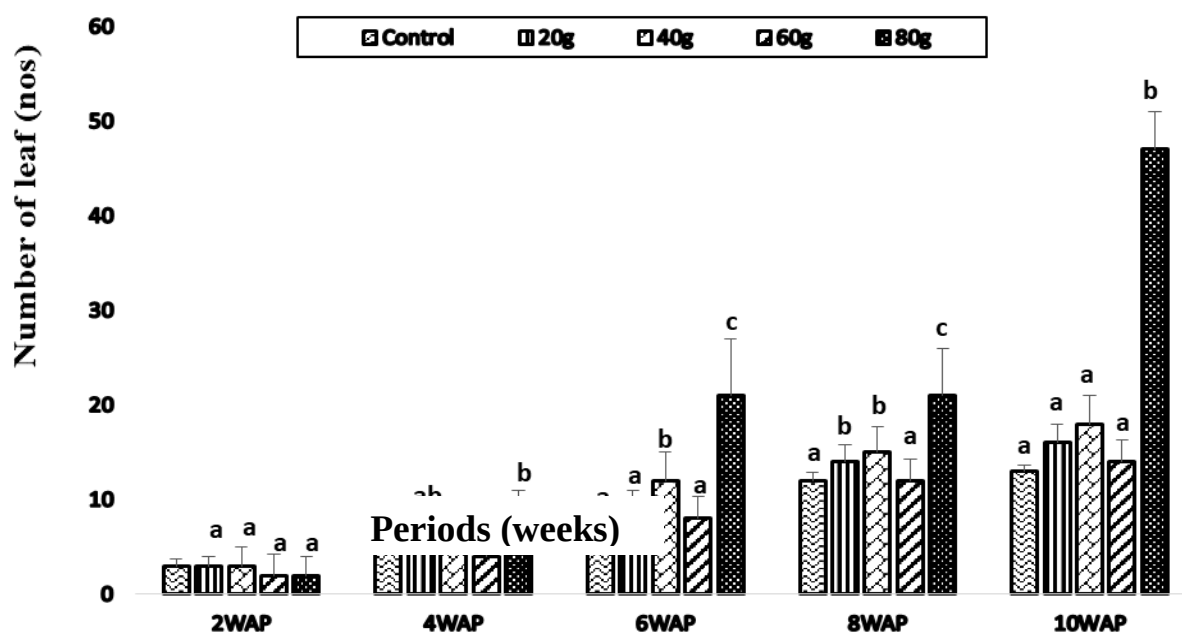


Figure 6: Variations in the number of leaves of *Amaranthus cruentus* as influenced by leaf powder of *Azadiracthta indica*

CONCLUSION

The research indicates that *Azadirachta indica* leaves exhibits strong allelopathic effect and possesses significant growth inhibitory ability on *Hibiscus cannabinus* L. and *Amaranthus cruentus* L. These results suggest that *Azadirachta indica* could have allelochemicals that are useful natural resources for developing biological agrochemicals for farming activities with no detrimental effects to the soil and environment as in the case of synthetic agrochemicals.

REFERENCES

- Adeyemi, C.O, Olorunmaiye, K.S., Orhuamen, E.O and Ogunsola, K.O (2013). Germination and Seedling Development of Seeds from Different *Parkia biglobosa* (Jacq) G. Don Trees. *Notulae Scientia Biologicae*, 5(1): 120-126
- Ahmed, Y. M. and Shalaby, E. A. (2012). Effect of different seaweed extracts and compost on vegetative growth, yield and fruit quality of cucumber. *Journal of Horticultural Science and Ornamental Plants*, 4(3): 233 – 240.
- Alagesaboopathi, C. (2011). Antimicrobial potential and phytochemical screening of *Andrographis affinis* Nees- an endemic medicinal plant from India. *International Journal of Pharmacy and Pharmaceutical Sciences*, 3(2):157-159.
- Folarin, O., Ogunkunle, C., Oyedele, S., and Kolawole, S. (2015). Growth Response of Three Leafy Vegetables to the Allelopathic Effect of *Vitellaria paradoxa*. *Notulae Scientia Biologicae*, 7(4): 460-463.
- Gulzar, A. and Siddiqui, M.B. (2014). Allelopathic effects of aqueous extracts of different parts of *Eclipta alba* (L.) Hassk. on some crop and weed plants. *Journal of Agricultural Extension and Rural Development*, 6(1): 55-60
- Horsley, S.B. (1977). Allelopathic inhibition of black cherry by fern, grass, goldenrod and aster. *Canadian Journal of Forest Research*. 7: 205-216.
- Inderjit, K. and Duke, S.O. 2003. Ecophysiological aspects of allelopathy. *Planta*, 217: 529-539.
- Isman, M.B. (2000). Biopesticides based on phytochemical. In O. Koul, G. S. Dhaliwal, K. Koul (eds). *Phytochemical Biopesticides*. Overseas Publishers Association, Amsterdam. pp. 346-876
- Jadhar, B.B. and Gayanar, D.G. (1992). Allelopathic effects of *Acacia auriculiformis* on germination of rice and cowpea. *Indian Journal of Plant Physiology*, 35: 86-93.
- Musa, D. D., Esson, A. E., Shuaibu, B.U. and Adebola, M.I. (2016). Allelopathic effect of *Senna obtusifolia* on the germination and growth of cowpea (*Vigna unguiculata*) and maize (*Zea mays*). *African Journal of Science and Research*. 1:71-74.
- Ogunkunle, C. O., Kolawole, O. S., Oyedele, S., and Fatoba, P. O., (2013) Variations in Growth Performance of *Amaranthus cruentus* and *Celosia argentea* in Response to Leaf Allelopathy of *Anacardium occidentale*. *International Journal of Phytofuels and Allied Sciences*. 2 (1):17-12
- Ogunyemi, S, and Odewele, F. (2011). The effect of neem (*Azadirachta indica* A. Juss) on seed of *Senna sophora* L. Roxb and *Crotalaria onchroleuca* G. Don. *The African Journal Plant Science and Biotechnology*. 5(1), 63-65.
- Pearcy R.W., Schulze, E.D. and Zimmermann, R. (1989). *Measurement of transpiration and leaf conductance*. Plant Physiological Ecology. Springer Netherlands pp 137-160.
- Vaithiyanathan, T., Soundari, M., Rajesh, M., and Sundaramoorthy, P. (2014). Allelopathic effect of *Azadirachta indica* L. on the germination of *Abelmoschus esculentus* L. *International Journal of Natural Sciences*. 10:12-13
- Weston L.A. and Duke S.O. (2003): Weed and crop allelopathy. *Critical Review in Plant Science*, 22: 367–389.

INDUCTION OF QUANTITATIVE VARIATION IN *PHASEOLUS LUNATUS* (L.) WITH ETHYL METHANE SULPHONATE

Ikani, V.O.

Department of Biology,
Ahmadu Bello University, Zaria, Nigeria
vonuche@gmail.com

ABSTRACT

Mutagenic effectiveness and efficiency of ethyl methane sulphonate was determined at M_2 generation to ascertain the ability of the mutagen to induce beneficial mutants with enhanced agronomic traits. *Phaseolus lunatus* seeds (0.25kg) were treated with four concentrations of ethyl methane sulphonate (0.1, 0.2, 0.3, and 0.4%) and the untreated seeds served as the control (0.0%). The treatments were laid out in a randomized complete block design with three replications. Ethyl methane sulphonate significantly ($p \leq 0.05$) induced beneficial variabilities which was an improvement over the control. Mutagenic effectiveness was concentration dependent as it decreased with an increase in concentration. However, mutagenic frequency, lethality and mutagenic efficiency were concentration independent. At M_2 generation Ethyl Methane Sulphonate induced variabilities on agronomic traits evaluated. Number of days to first flowering was significantly ($P \leq 0.05$) reduced at all four concentrations of the mutagen with 0.3% and 0.4% recording the least number of days to first flowering (50.00). Mutant plants from seeds treated with 0.1% EMS recorded the least number of days to 50% flowering (59.00). Number of pods per plant (10.89) and pod diameter (1.70cm) were highest at 0.4% EMS treatments. The highest 100 seed weight (33.33g) was recorded at 0.1% and 0.2% EMS treatments. Pod length (5.93cm) was also longest at 0.1% EMS. High broad sense heritability was recorded for number of pods per plant (98.63%) and 100 seeds weight (93.63%).

Key words: Ethyl Methane Sulphonate. Mutagenic, Agronomic, Traits, Concentration, Broad-sense heritability.

INTRODUCTION

Several chemical mutagens including Ethyl Methane Sulphonate (EMS) are frequently used to induce mutation in crops (Sharma and Chopra, 2000). Ethylated agents such as EMS have been reported to be more effective and efficient than physical mutagens in crops like Pea (Waghmare and Mehra, 2001), Lentil (Gaikwad and Kothekar, 2004) and Chickpea (Kharakwal, 2009). EMS has been successfully used to develop fenugreek mutants with the ability to produce early maturing mutants with a determinate growth habit, high seed yield, seed quality and adaptation to a short growing season (Basu *et al.*, 2008).

Chemical mutagenesis is a technique used to create artificial variability in plants with the possibility of improving one or two agronomic characters without changing the rest of the genotype. *Phaseolus lunatus* is commonly called lima bean, butter bean, sieva bean, sugar bean, Madagascar bean and

java bean in English, wake rumpa in Hausa (Ikani *et al.*, 2017), ukpa in Igbo (Ikechukwu and Madu, 2010), papala in Yoruba (Adegbehingbe, 2013).

Like other grain legumes, lima beans are relatively rich in protein. They contain about 25% protein in the dry matter, a value comparable to that of peas (*Pisum sativum*) and cowpeas (*Vigna unguiculata*) (Azeke *et al.*, 2011). Immature sprouts, leaves, and pods are consumed in Asia with young leaves and pods steamed and green shelled beans cooked as a vegetable. Lima bean helps restore soil fertility by shedding its many leaves that decay and enrich the soil. Lima bean has not received the benefit of intensive research in Nigeria as devoted to cowpea and soybean improvement (Lyman *et al.*, 1985; Akande *et al.*, 2007). Knowledge of the availability and extent to which the genetic diversity is heritable is essential for effective selection among Lima bean population. Hence, exploiting the available source of

germplasm for desired characters would provide adequate genetic background for Lima bean improvement.

MATERIALS AND METHODS

Seed Source and Mutagenic Treatment

Healthy landraces of *P. lunatus* were obtained from local farmers in Zaria, Kaduna State, Nigeria and landrace identity was confirmed at International Centre for Tropical Agriculture (CIAT), Cali, Colombia. About 0.25kg of healthy dry seeds of *P. lunatus* was pre-soaked in distilled water for 6 hours, then afterwards soaked in freshly varying prepared concentrations of EMS {0.0% (control), 0.1, 0.2, 0.3, 0.4%} for 6 hours. After treatment with the mutagen, the seeds were washed thoroughly for 5 minutes to remove the residual mutagens.

Experimental design and sowing of seeds

Top soil was collected from uncultivated land within the botanical garden in Ahmadu Bello University, Zaria, the soil was treated by heating, allowed to cool then filled into one hundred and fifty (150) polythene bags arranged in a randomized complete block design (RCBD) with three replications for each treatment to raise M₁ and M₂ generation. The polythene bags (51.5 x 38.3cm) were half filled, with each weighing 8.5kg and placed at a spacing of 10 x 90cm. Three seeds were sown in each bag which was later thinned to one per bag 2 weeks after sowing.

Data Collection

Agro- morphological data obtained at M₁ and M₂ were:

Percentage germination

Germination count was taken 2 weeks after sowing, before thinning, and expressed in percentage as follows:

$$\text{Germination (\%)} = \frac{\text{Number of seeds germinated}}{\text{Number of seeds sown}} \times 100$$

Seedling height

Seedling height was taken at 4 weeks after sowing by measuring the height of five randomly sampled plants per treatments from soil surface of the polythene bag to the tip of the apex using a meter rule in centimeters.

Height at Maturity

Plants were considered matured after the emergence of the first flower (Nwadike *et al.*, 2014). The height was determined by measuring the height of five randomly sampled plants per treatments from the soil surface in the polythene bag to the tip of the apex using a meter rule in centimeters.

Days to first flowering

This was determined by counting the number of days from sowing to opening of the first flower.

Number of days to 50% flowering

This was taken per treatment when 50% of the plants in each treatment produced flower.

Number of Pods per Plants

The pods produced by five randomly selected plants in each polythene bag were counted and recorded.

Pod length

The pod length of five randomly selected plants in the polythene bags were determined in centimeter (cm) using a meter rule.

Pod diameter

The pod diameter of five randomly selected plants in the polythene bags were determined in centimeter (cm) using a meter rule.

Number of Seed per Pod

This was determined by counting the number of seeds of ten (10) pods randomly selected per treatment from harvested sampled plants and divided by the total number of pod express in numbers.

Pod weight

The pod weights of 10 dry pods randomly selected from five plants per treatment were determined by using the weighing balance (Sartorius ED2245 model). These weights were added up and divided by the total number of pods; the measurement was made in grammes (g).

Hundred Seed weight

This was determined by measuring the weight of 100 seeds harvested from the five randomly sampled plants per treatment using a weighing balance (Sartorius ED2245 model) and expressed in grammes (g).

Chlorophyll Deficient mutant Determination of *Phaseolus lunatus*

The number of seedlings that showed chlorophyll deficiency was identified at M₂ based on the foliar coloration and recorded based on the report of Kulthe *et al.*, 2013.

Data Analyses

The Mutagenic effectiveness and efficiency were calculated using the formulae suggested by Konzak *et al.* (1965).

$$\% \text{Mutation freq.} = \frac{\text{Chlorophyll mutant at } M_2}{\text{Total No. of plants studied}} \times 100$$

$$\% \text{ Mutagenic effectiveness (Chemical mutagens)} = \frac{\text{Mutation frequency} \times 100}{\text{Concentration} \times \text{Time}}$$

$$\% \text{ Mutagenic effectiveness (Physical mutagens)} = \frac{\text{Mutation frequency} \times 100}{\text{Dose of mutagen} \times \text{Time}}$$

$$\% \text{Mutagen efficiency} = \frac{\text{Mutation frequency}}{\text{Lethality}}$$

Agro-morphological data obtained was subjected to one way analysis of variance (ANOVA) using SAS (2002) version 9.1 to determine the significant effect of the different concentrations of the mutagens (*P*

≤ 0.05) on *P. lunatus* and Duncan's Multiple Range test (DMRT) was used to separate the means where significant.

Variance component estimate was done using SAS version 9.1 to determine variance due to environment and variance due to genotype. Broad sense heritability (H_b) was computed at M₂ using the recommended method of Eckebil *et al.* (1977):

$$H_b (\%) = \frac{\sigma_g^2}{\sigma_{ph}^2} \times 100$$

$$\sigma_{ph}^2 = \sigma_g^2 + \sigma_{e/r}^2$$

Where:

σ_g^2 = variance due to genotype

σ_e^2 = variance due to environment

σ_{ph}^2 = phenotypic variance

r = number of replications

Calculated heritability was categorized by modifying the ranges of Robinson *et al.* (1949) as: 0<30% (low), 30-60% (moderate), >60% (high).

RESULTS

Mutagenic Frequency, Effectiveness and Efficiency of EMS in *P. lunatus*

Phaseolus lunatus treated with 0.4% EMS had the highest mutagenic frequency (7.1%). Lethality in *P. lunatus* was highest (10.0%) at 0.3% and least (0.0%) at 0.2% EMS treatment. Mutagenic effectiveness was highest (6.2%) in *P. lunatus* with 0.1% EMS treatment and least (1.9%) at 0.3% EMS treatment. However, mutagenic efficiency was highest (1.1%) at 0.1% and least (0.0%) at 0.2% EMS treatment (Table 1).

Table 1: Mutagenic Frequency, Effectiveness and Efficiency of EMS in *P. lunatus*

Concentration	Mutagenic frequency (%)	Lethality (%)	Mutagenic effectiveness (%)	Mutagenic efficiency (%)
0.10%	3.7	3.3	6.2	1.1
0.20%	6.7	0.0	5.6	0.0
0.30%	3.5	10	1.9	0.4
0.40%	7.1	6.7	2.9	1.0

Effects of EMS on Agronomic Traits of *P. lunatus* at M₁ and M₂ Generation

The mean performances of traits evaluated at M₁ and M₂ generation of *P. lunatus* treated with four concentrations of EMS are presented in Table 2. The mutant showed better enhancement in most traits compared to the control. Seeds treated with 0.1% EMS showed reduced number of days to first flowering (73.33), and 50% flowering (81.33) while 0.4% showed prolonged days to first flowering (82.33) and 50% flowering (92). Pod length (7.05cm), pod diameter (2.03cm), pod weight (8.70g) and 100 seeds weight (43.33g) were highest with 0.4% EMS treatment. pod length (5.26cm), pod weight (4.33g) and pod diameter (1.41cm) were low with 0.1% EMS. The least 100 seeds weight (28.67g) was with 0.2% EMS.

At M₂ generation ethyl methane sulphonate induced variabilities on agronomic traits evaluated. Traits which

showed variabilities were enhanced (Table 4.4). Number of days to first flowering was significantly ($P \leq 0.05$) reduced at all four concentrations of the mutagen with 0.3 and 0.4% recording the least number of days to first flowering (50.00). Mutant plants from seeds treated with 0.1% EMS recorded the least number of days to 50% flowering (59.00) and 0.4% mutants had the highest number of days to 50% flowering (62.33). Number of pods per plant (10.89) and pod diameter (1.70cm) were highest at 0.4% EMS treatments with the least (8.53 and 1.62cm respectively) at 0.2% EMS. The highest 100 seed weight (33.33g) was recorded at 0.1 and 0.2% EMS treatments and the least (30.33g) in the control treatment, which was closely followed by 30.67g with 0.3% EMS. Pod length (5.93cm) was also longest at 0.1% EMS and shortest in the control (4.92cm), followed by 0.2% EMS (5.35cm) (Table 2).

Table 2: Mean performance of the Agronomic Traits of *Phaseolus lunatus* treated with EMS

	TRT	PGERM	SH	HM	DFF	D50%F	NPPP	PDLT	PDDIA	PDWT	NSPP	100SWT
		(%)	(cm)	(cm)				(cm)	(cm)	(g)		(g)
M ₂ GENERATION M ₁ GENERATION	0.00%	70.00 ^a	26.57 ^{bc}	102.93 ^c	76.67 ^{bc}	84.33 ^{bc}	15.20 ^a	5.27 ^b	1.43 ^b	5.53 ^{bc}	2.53 ^a	29.20 ^{cd}
	0.10%	90.00 ^a	27.27 ^b	116.07 ^{bc}	73.33 ^c	81.33 ^c	14.93 ^a	5.26 ^b	1.41 ^b	4.33 ^c	2.60 ^a	31.17 ^{bc}
	0.20%	86.67 ^a	26.88 ^b	128.54 ^{bc}	75.00 ^{bc}	83.33 ^c	17.13 ^a	5.47 ^b	1.42 ^b	5.97 ^b	2.60 ^a	28.67 ^d
	0.30%	90.00 ^a	24.23 ^c	116.83 ^a	78.67 ^{ab}	87.33 ^b	15.33 ^a	5.30 ^b	1.56 ^b	6.00 ^b	2.53 ^a	32.17 ^b
	0.40%	80.00 ^a	30.07 ^a	138.63 ^b	82.33 ^a	92.00 ^a	15.00 ^a	7.05 ^a	2.03 ^a	8.70 ^a	2.60 ^a	43.33 ^a
	SEM±	7.34	0.78	7.88	1.19	1.04	0.90	0.20	0.06	0.44	0.19	0.67
	0.00%	96.67 ^a	35.20 ^a	96.97 ^a	56.00 ^a	64.67 ^a	5.93 ^b	4.92 ^c	1.51 ^c	4.40 ^b	2.13 ^a	30.33 ^b
	0.10%	90.00 ^a	57.62 ^a	123.97 ^a	51.33 ^b	59.00 ^d	8.93 ^{ab}	5.93 ^a	1.64 ^{abc}	6.27 ^a	2.33 ^a	33.33 ^a
	0.20%	100.00 ^a	64.74 ^a	115.21 ^a	50.33 ^b	61.67 ^{bc}	8.53 ^{ab}	5.35 ^{bc}	1.62 ^{bc}	6.00 ^a	2.53 ^a	33.33 ^a
	0.30%	96.67 ^a	70.66 ^a	112.64 ^a	50.00 ^b	60.33 ^{cd}	9.00 ^{ab}	5.44 ^{abc}	1.69 ^{ab}	5.43 ^a	2.27 ^a	30.67 ^b
	0.40%	93.33 ^a	50.43 ^a	148.53 ^a	50.00 ^b	62.33 ^b	10.87 ^a	5.63 ^{ab}	1.79 ^a	6.33 ^a	2.40 ^a	31.50 ^{ab}
	SEM±	5.43	12.21	16.00	0.48	0.53	0.98	0.16	0.05	0.45	0.22	0.91

NOTE: Means with the same letter within a column under each generation are not significantly different at P>0.05, using DMRT, TRT- treatment, PGERM- percentage germination, SH-seedling height, HM-Height at maturity, DFF-days to first flowering, D50%F-days to 50% flowering, NPPP-number of pods per plant, PDLT-pod length, PDDIA- pod diameter, PDWT-pod weight, NSPP-number of seeds per pod 100SWT-one hundred seeds weight

Genetic variation and Heritability of the M₂ *Phaseolus lunatus*

The estimation of genotypic, environmental, phenotypic variance and broad sense heritability (H^2) for traits

evaluated at M₂ generation of *P. lunatus* treated with EMS are presented in Table 3. In *P. lunatus* mutant, broad sense heritability was 98.63% for number of pods per plant and 100 seeds weight (93.63%).

Table 3: Heritability Estimate of *P. lunatus* Traits Treated with EMS

TRAIT	σ^2_g	σ^2_e	$\sigma^2_{e/r}$	σ^2_{ph}	H^2_b (%)
PGERM	8.33	88.33	29.44	37.77	22.05
SH	40.20	447.17	149.06	189.26	21.24
HM	170.88	767.53	255.84	426.72	40.04
DFF	0.23	0.70	0.23	0.46	50.00
D50%F	0.17	0.83	0.28	0.45	37.78
NPPP	2.89	0.13	0.04	2.93	98.63
PDLT	0.01	0.08	0.03	0.04	25.00
PDDIA	0.01E-1	0.07E-1	0.02E-1	0.03E-1	33.33
PDWT	0.12	0.61	0.20	0.32	37.50
NSPP	0.02	0.12	0.04	0.06	33.33
100SWT	2.50	0.50	0.17	2.67	93.63

Note: heritability category 0<30% (low), 30-60% (moderate), >60% (high)

σ_g^2 - genetic variance, σ_e^2 - environmental variance, σ_{ph}^2 - phenotypic variance, H^2_b -broad sense heritability, PGERM- percentage germination, SH-seedling height, HM-height at maturity DFF-days to first flowering, D50%F-days to 50% flowering, NPPP-number of pods per plant ,PDLT-pod length, PDDIA- pod diameter, PDWT-pod weight, NSPP-number of seeds per pod 100SWT-one hundred seeds weight

DISCUSSION

Mutagenic effectiveness was higher at lower concentrations of the mutagen due to high mutagenic frequency. However, the occurrence of high mutagenic efficiency at lower concentration of the mutagen can also be attributable to minimal lethality at these concentrations. High efficiency at low concentration of mutagens may be due to reduction in biological damage. This finding is in conformity with the reports of Khan and Tagyi (2010) in soybean (*Glycine max*) and

Gnanamrthy *et al.* (2012) in *Vigna unguiculata*.

The statistically insignificant variation in percentage germination and number of seeds per pod at the M₁ generation and seedling height, plant height at maturity, number of pods per plant and number of seeds per pod at the M₂ generation of *P. lunatus* could also be attributed to repairs of some induced damages on the DNA by certain biochemical mechanism present in plants.

This corroborates with the works of Festus *et al.* (2016) who observed no significant difference in the percentage seed germination in all the treatment across the eight cowpea accessions. The enhancement in the yield trait such as pod length, pod diameter, pod weight and 100 seeds weight at 0.4% EMS treatment could be as a result of a favourable mutation that must have occurred in the genes controlling these traits thereby leading to an increase in yield. At this concentration also, days to first flowering and 50% flowering was found to increase. This may be the result of the increase in the rate of

deletions which was caused by increase in EMS concentration at the M₁ generation. This finding is in agreement with the reports of Khan and Goyal (2009) in mung bean.

The reduction in number of days to first flowering and 50% flowering at the M₂ generation with an increase in concentration of EMS could also be as a result of repairs of some induced damages in the DNA by certain biochemical mechanisms present in plants. This conforms with the findings of Aledare (2014) who observed a reduction in number of days to first flowering and 50% flowering in pigeon pea treated with 0.04% sodium azide. It also corroborates with the reports of Gopinath and Padavai (2015) in soy bean treated with 10mM EMS. The enhancement of agronomic traits such as number of pods per plant, pod length and 100 seeds weight at lower concentrations (0.1%) of EMS in the M₂ generation in heritable alterations in a segment of the DNA molecule. This corroborates to the reports of Gopinath and Padavai (2015) in soy bean and Aledare (2014) on pigeon pea treated with 0.01% sodium azide and was contrary to the findings of Monica and Seetharaman (2016) when they reported decrease in pod length, pod weight, 100 seeds weight in garden bean treated with 0.1% EMS.

The occurrence of high heritability values recorded in number of pods per plant and 100 seeds weight indicates that the variation observed was mostly due to the genotype and thus *P. lunatus* treated with EMS can be used for selection in further breeding for these traits (Tagyi *et al.*, 2000). In conclusion, Mutagenic effectiveness was concentration dependent; however mutagenic frequency, lethality and mutagenic efficiency induced by ethyl methane sulphonate were concentration independent. The variability shown in agronomic traits reflects the existence of genetic enhancement which can be exploited for further improvement of lima bean.

REFERENCES

- Adegbehingbe, K. T. (2013). Microbial and Nutrient Studies of Fermented Cooked Lima Bean (*Phaseolus lunatus* L.) seeds. *Global Journal of Biology, Agriculture and Health Sciences*, 2(2): 94-101.
- Akande, S. R. and Balogun, M. O. (2007). Evaluation and heritability studies of local bean (*Phaseolus lunatus* L.) cultivars from south-west Nigeria. *Revista UDO Agricola*, 7(1): 22-28.
- Aledare, B. M. (2014). Morphological and Cytogenetics studies on the effect of Sodium Azide and Gamma irradiation treatments on Pigeon pea (*Cajanus cajan* (L.) Millspaugh). (Unpublished MSc. Thesis), Ahmadu Bello University, Zaria, Nigeria, 78pp.
- Azeke, M. A., Elsanhoty, R. M., Egielewa, S. J. and Eigbogbo, M. U. (2011). The effect of germination on the phytase activity, phytate and total phosphorus contents of some Nigerian-grown grain legumes. *Journal of the Science of Food and Agriculture*. 91:75-79.
- Basu, S. K., Acharya, S. N. and Thomas, J. E. (2008). Genetic Improvement of Fenugreek (*Trigonella foenum-graecum* L.) Through EMS Induced Mutation Breeding For Higher Seed Yield Under Western Canada Prairie Conditions. *Euphytica*, 160: 249-258.
- Eckebil, J. P., Ross, W.M., Gardner, C. O. and Maranville, J.W. (1977). Heritability estimates, genetic correlations and predicted gain from S1 progeny tests in three grain sorghum random mating population. *Crop Science*, 17:363-377.
- Festus, O. O., Christopher, O. I. and Anna, A. M. (2016). Radio-sensitivity of cowpea to ultra-violet radiation by pollen treatment. *Journal of Plant Breeding and Crop Science*, 8(11): 228-239.
- Gaikwad, N. B. and Kothekar, V. S. (2004). Mutagenic effectiveness and efficiency of EMS and Sodium Azide in lentil (*Lens*

- culinaris* Medic.). *Indian Journal of Genetics*, 64(1):73-74.
- Gnanamurthy, S., Mariyammal, S., Dhanavel, D. and Bharathi, T. (2012). Effect of gamma rays on yield and yield components characters R₃ in cowpea (*Vigna unguiculata* (L.) Walp.). *International Journal of Plant Science Research*, 2:39-42.
- Gopinat, P. and Pavadai, P. (2015). Morphology and Yield parameters and Biochemical analysis of Soybean (*Glycine max* (L.) Mrr.) Using Gamma rays, EMS and DES treatment. *International Letters of Natural Sciences*, 35,50-58. doi,10.18052/www.scipress.com/ILNS.35.50
- Ikani, V. O., Adelanwa, M. A. and Aliyu, R. E. (2017). Effects of colchicine on some agro-morphological traits of *Phaseolus lunatus* (L.) at M₁ and M₂ generation. *International Journal of Applied Biological Research*, 8(1): 95 – 100.
- Ikechukwu, E. E. and Madu, D. I. (2010). Biochemical Composition and Nutritional Potential of Ukpa, A variety of Tropical Lima Bean (*Phaseolus lunatus*) from Nigeria-A Short Report. *Polish Journal of Food and Nutritional Science*, 60(2):231-235.
- Khan, M. H. and Tyagi, S. D, (2010). Studies on effectiveness and efficiency of gamma rays, EMS and their combination in soybean (*Glycine max* (L.) Merrill). *Journal of Plant Breeding and Crop Science*, 2: 55-58.
- Khan, S. and Goyal, S. (2009) Improvement of mungbean varieties through induced mutations. *African Journal of Plant Science*, 3 (8):174-180.
- Kharkwal, M. C. (2009). Induced mutations in chickpea (*Cicer arietinum* L.). I. Comparative mutagenic effectiveness and efficiency of physical and chemical mutagens. *Indian Journal of Genetics and Plant Breeding*, 58: 159-167.
- Konzak, C. P., Wagner, R. A., Nilan, J., and Foster, R. J. (1965). Efficient chemical mutagenesis. *Radiation Botany*, 12(5): 49-70.
- Kulthe, M, Mogle, U. P. and Kashid, N. G.(2013). Study of mutagenic efficiency of NMU in Winged beans (*Psophocarpus tetragonolobus* L.).DC. *Bioscience Discovery*, 4 (1): 121-123.
- Lyman, S. M.,Baudoin,J.P. and Hidalgo,R. (1985). Lima bean (*Phaseolus lunatus*) In, *Grain Legume Crops*. R. J. Summerfield and E. H. Roberts. (Eds.) Williams Collins Sons & Co. Ltd London United Kingdom. p. 477-519.
- Monica, S. and Seetharaman, N. (2016). Effect of Gamma irradiation and Ethyl Methane Sulphonate (EMS) Mutagenesis in early generation of Garden bean (*Lablab purpureus* (L.) Sweet var. *typicus*).*International Journal of Advanced Scientific and Technical Research*, 3 (6): 398-410.
- Robinson, H.F., Comstock, R. E. and Harvey, P. H. (1949). Estimate of heritability and degree of dominance in corn. *Agronomy Journal*, 41: 353-359.
- Sharma, R. P. and Chopra, V. L. (2000). In, Chopra, V. L. (Ed.) Plant Breeding Theory and Practice. Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi. pp. 321-342.
- Statistical analysis software (SAS) (2002) version 9.1. SAS Institute, North Carolina State University.
- Tyagi, P.C., Kumar, N. and Agarwal, M.C. (2000) Genetic variability and association of component characters for seed yield in cowpea (*Vigna unguiculata* [L.] Walp.).*Legume Resources*, 23(2): 92–96.
- Waghmare, V. N. and Mehra, R. B. (2001). Induced Chlorophyll Mutations, Mutagenic Effectiveness and Efficiency in *Lathyrus sativus* L. *Indian Journal of Genetics*, 61(1): 53-56

INFLUENCE OF THREE LOCAL LEAVES ON THE REPRODUCTIVE CHARACTERISTICS OF SNAILS, *Achatina fulica* AND *Archachatina marginata*

Amobi, M. I.

Department of Biological Sciences,
Federal University Kashere, Gombe State.
Corresponding email: decency75@gmail.com

ABSTRACT

This study evaluated the effects of three leaves [bitter leaf (*Vernonia amygdalina*), fluted pumpkin leaf (*Telfairia occidentalis*) and pawpaw leaf (*Carica papaya*)] on the reproductive performance of the two common species of edible snails; Garden snail (*Achatina fulica*) and Giant land snail (*Archachatina marginata*). The study was carried out in Ogidi, Idemili North Local Government Area of Anambra State, Nigeria. The snails were fed with the fresh leaves which served as the treatments over a period of 12 weeks. Eggs were collected from each of the feeding treatments once daily (7:00 am in the morning) for seven (7) weeks and were transferred to an empty house of same type and buried at a depth of 3cm in the soil in clutches of 10 eggs per clutch. Results obtained showed that there was no significant difference ($P > 0.05$) in Garden snail (*Achatina fulica*) and Giant land snail (*Archachatina marginata*) in terms of egg production. The highest number of eggs hatched as observed in *Achatina fulica* was recorded in treatment B (fluted pumpkin leaf). Similarly the highest number of eggs hatched as observed in *Archachatina marginata* was recorded in treatment B (fluted pumpkin leaf). In *Achatina fulica*, the eggs from treatment A (bitter leaf) hatched at 4th week, eggs from treatment B (fluted pumpkin leaf) hatched at 2nd week while eggs from treatment C (pawpaw leaf) hatched at 3rd week. In *Archachatina marginata*, eggs from treatment A (bitter leaf) hatched at 5th week, eggs from treatment B (fluted pumpkin leaf) hatched at 2nd week while eggs from treatment C (pawpaw leaf) hatched at 3rd week. Percentage egg hatchability is highest (56.4%) in *Achatina fulica* subjected to treatment A (bitter leaf) and treatment B (fluted pumpkin leaf) while in *Archachatina marginata* the highest hatchability (71.1%) is observed from the snails subjected to treatment A (bitter leaf). This study shows that egg production and hatchability is dependent on soil type and controlled environment.

KEYWORDS: *Achatina fulica*, *Archachatina marginata*, Snail, Egg, Hatchability.

INTRODUCTION

Snail rearing (achatiniculture) can be seen as a veritable self sufficiency activity in hard times as presently experienced in Nigeria (Adeola *et al.*, 2010). Snails as a species have an inherently high reproductive rate (Akintomide, 2004; Ejidike, 2002; Akinnusi, 1997). Okon and Ibom (2010) stated that the commercial production of snails can be seen as an honest approach towards realizing improved meat protein intake in Nigeria. The need for increased animal protein consumption of the rural and urban Nigeria populace in the face of rising inflation has resulted in the increase in the cost of conventional animal protein in comparison to plant sources because even the

prices of fish have soared above the reach of an average Nigerian hence the rearing of snails is a source of income to the peasant farmer in rural areas (Agbogidi *et al.*, 2008). Snails have been well known and highly appreciated by Africans and Nigerians in particular for the tasty and delicious nature of the meat (Agbelusi and Ejidike, 2002). Snail meat is recommended for patients with hypertension and heart attack. The shells can be used for ornamental purposes and also as a source of calcium and phosphorous in mixing rations for animals (Omole *et al.*, 2000; 2007). Snail meat contains anti-tuberculosis qualities (Awah, 2000).

Most species of land snails are hermaphrodites, possessing full set of

reproductive organs of both sexes. They are able to produce both spermatozoa and ova (Stivenart, 1992). The reproductive organs of giant African land snails are extremely complicated and each individual is monoecious (Ademola, 2008). Snails usually form an egg chamber in the soil and then proceed to fill the chamber with eggs. This can sometimes be completed throughout the course of a few nights, with one night dedicated to creating the chamber with the laying commencing the following night. The snail constructs a smooth walled chamber of oval outline that is usually no more than ½ inch deep from the wall of their enclosure and deposits its eggs in a group only the peripheral members of which are in contact with the soil. Studies have reported different clutch sizes for eggs in different species of snail; *Achatina fulica*, *Achatina achatina* and *Archachatina marginata* have clutch sizes of 10 – 400, 4 – 18 and 30 – 300 eggs respectively (Ugwu *et al.*, 2011).

With the recent increase in snail farming to provide food, income and employment opportunities, it is important to check for possible influence of feeding the snails and their reproductive potentials. This study therefore, was designed to determine the effects of three local leaves on reproductive characteristics of two species of land snails.

MATERIALS & METHODS

The study was carried out in a Commercial Snail Farm in Iyi Enu, Ogidi in Idemili North Local Government Area, Anambra State of Nigeria. Ogidi is a town located between latitude 6°N and 7°N and longitude 7°N and 8°N. It is located along the Enugu – Onitsha Old Road. Ecologically, it lies in the Tropical region experiencing an annual rainfall of 1500mm – 2000mm with two seasons – the dry and rainy season and average annual temperature of 26.8°C (Okafor, 2011).

The farm has an area of 100m² (50m x 50m) and each of the snail pens were placed in ceiling boards padded aluminum roofed

enclosures protecting them from direct rain and sunlight. There were plantain, banana and coconut trees around the farm to minimize wind effect and also to improve the microclimate of the snails as recommended by (Cobbinah *et al.*, 2008).

The Intensive system of snail farming was used and the snails were provided with food and water in a closed system throughout the study period. A total of 180 snails; 90 *Archachatina marginata* and 90 *Achatina fulica* species respectively were used for the study. The snails were obtained from Ministry of Agriculture Awka and were transported to the study site in baskets covered with banana leaves. Three different common leaves [bitter leaf (*Vernonia amygdalina*), fluted pumpkin leaf (*Telfairia occidentalis*) and pawpaw leaf (*Carica papaya*)] were used fresh as dietary treatments on the snails and their proximate composition was carried out in laboratory according to AOAC, 2005 (Table 1). Thirty (30) snails belonging to *Archachatina marginata* species of mean weight of 36.2g were subjected to each of the 3 dietary treatments in three replicates of 10 snails per replicate housed in a mini paddock pens with dimensions 120cm x 60cm x 30cm in 3x3 completely randomized design (CRD). Similarly, thirty (30) snails each belonging to *Achatina fulica* species of mean weight of 28.1g were also subjected to each of the 3 dietary treatments in three replicates of 10 snails per replicate housed in a mini paddock pens with dimensions 120cm x 60cm x 30cm in 3x3 completely randomized design (CRD). This was in line with the standard stocking density proposed by Cobbinah *et al* (2008). The snails in all the treatments were subjected to the same management conditions: they were fed daily, they were provided with humus soil to a depth of 20cm and were fed 50g of ground egg shell to ensure adequate calcium supply (Osemeobo, 1992) and same amount of water (0.75 liter) was sprinkled daily to increase humidity and prevent hibernation (Agbogidi *et al.*, 2008). Data were collected on the reproductive performance of the snails starting from 6th

week with mean weight of 45.43g and 7th week with mean weight of 72.83g of the experimental period for *Achatina fulica* and *Archachatina marginata* species respectively by investigating the following parameters – egg production and hatchability. Eggs were collected from each of the feeding treatments once daily (7:00 am in the morning) for seven (7) weeks and were transferred to an empty house of same type and buried at a depth of 3cm in the soil in clutches of 10 eggs per clutch (Ugwu *et al.*, 2011). A total of 100 eggs were introduced in each feeding treatment to observe hatchability. The total number of eggs laid by the snails per feeding treatment was observed, the time taken for the eggs to hatch was also observed and hatchability was determined thus:

$$\text{Hatchability (\%)} = \frac{\text{Number of eggs that hatched} \times 100}{\text{Total number of eggs laid}} \quad 1$$

The data generated were subjected to Analysis of Variance (ANOVA) and significant means were separated using the Least Significant Difference (LSD).

RESULTS AND DISCUSSIONS

The highest yield in egg production (Table 2) in *Achatina fulica* were observed in treatment C (pawpaw leaf) but there was no statistical significance ($P > 0.05$) when tested with ANOVA. Similarly, the highest yield in egg production in *Archachatina marginata* were observed in treatment B (fluted pumpkin leaf) but there was no statistical significance ($P > 0.05$) when tested with ANOVA. Also, numerically *Achatina fulica* laid more eggs than *Archachatina marginata* as in line with the findings of Ugwu *et al.*, (2011).

The highest number of eggs hatched (88.0) as observed in *Achatina fulica* was recorded in treatment B (fluted pumpkin leaf). Similarly the highest number of eggs hatched (80.0) as observed in *Archachatina marginata* was recorded in treatment B (fluted pumpkin leaf). In *Achatina fulica*, the eggs from treatment A (bitter leaf) hatched at 4th week, eggs from treatment B (fluted pumpkin leaf) hatched at 2nd week while eggs

from treatment C (pawpaw leaf) hatched at 3rd week. In *Archachatina marginata*, eggs from treatment A (bitter leaf) hatched at 5th week, eggs from treatment B (fluted pumpkin leaf) hatched at 2nd week while eggs from treatment C (pawpaw leaf) hatched at 3rd week. Percentage egg hatchability is highest (56.4%) in *Achatina fulica* subjected to treatment A (bitter leaf) and treatment B (fluted pumpkin leaf) while in *Archachatina marginata* the highest hatchability (71.1%) is observed from the snails subjected to treatment A (bitter leaf). Egg hatchability in snails however is dependent on a number of factors including soil depth and soil type (Ugwu *et al.*, 2011) and controlled environment (Ejidike, 2002).

This study has demonstrated that different common leaves (bitter leaf, fluted pumpkin leaf and pawpaw leaf) have no significant effect on the reproductive performance of the snails (*Achatina fulica* and *Archachatina marginata*). In terms of egg production and hatchability, feeding with any of the three leaves is recommended but hatchability of eggs is highly dependent on soil type, soil depth and controlled environment.

Table 1: Proximate composition of experimental diet (%)

Parameters	Bitter leaf	Fluted leaf	pumpkin	Pawpaw leaf
Dry matter	23.40	19.75		21.84
Crude protein	19.94	24.18		22.53
Crude fibre	12.26	6.39		13.98
Ash	9.38	8.94		9.76
Crude fat	0.08	0.12		1.24
Calcium	0.18	0.19		0.16
Phosphorus	1.15	1.20		1.21

Table 2: Summary of Reproductive Performance of the snails

Feeding treatments						
Parameters	AF			AM		
	BL	FPL	PL	BL	FPL	PL
No of eggs laid	140.0	156.0	162.0	104.0	123.0	110.0
No of eggs hatched	79.0	88.0	80.0	74.0	80.0	78.0
No of unhatched eggs	21.0	12.0	20.0	26.0	20.0	22.0
Hatchability (%)	56.4	56.4	49.3	71.1	65.0	70.9
Time of Hatching (weeks)	4	2	3	5	2	3

* AF = *Achatina fulica*; BL = Bitter leaf; FPL = Fluted pumpkin leaf; PL = Paw-paw leaf; AM = *Archachatina marginata*

REFERENCES

- Ademola, O. S (2008). *Tropical Zoology*. University Press, Ibadan. Pp 154.
- Ademolu, K. O., Idowu, A. B., Matiana, C. F and Osinowo, O. A (2004). Performance proximate and mineral analysis of African giant land snail (*Archachatina marginata*) fed different nitrogenous sources. *African Journal of Biotechnology* 3 (8): 412 – 417.
- Agbelusi, E.A and Ejidike, B.N (2002). Utilization of the African giant land snail *Archachatina marginata* in the humid area of Nigeria. *Journal of Tropical Agriculture*. 69: 88- 89
- Agbogidi, O. M, Okonta, B. C. and Ezeanya, E. L. (2008). Effects of two edible fruits on the growth performance of African giant land snail (*Archachatina marginata* Swainson). *Journal of Animal Protection Research* 9 (2): 546 - 577.
- Akinnusi, O. (1997). *Introduction to snail farming*. Omega Publishers, Lagos. Pp 56
- Akinnusi, O. (1998). *Introduction to snail and snail farming*. Omega science publishers, Lagos. Pp141.
- Akinnusi, O (2002). *Introduction to snail and snail farming*. Triolas Exquisite ventures. Abeokuta. Pp25.
- Akintomide, T. O. (2004). *Tropical snail farming*. Oak Ventures Publishers, Abeokuta. Pp63 .
- AOAC (2005). Association of official analytical chemists, official methods of analysis 15th edition Washington D.C. pp. 71-79.
- Awah, A. A. (2000). Introduction to Mini-livestock Development as Sustainable Agriculture Business. *Workshop paper presented at Anambra State Agricultural Development Programme during Monthly Technology Review*. Pp25.
- Cobbinah, J. R., Vink, A. and Onwuka, B. (2008). *Snail Farming, Processing and Marketing*. Agromisa Foundation, Wayeningen. Pp78.
- Ejidike, B.N. (2002). *Snail rearing practices in southern Nigeria*. Proceedings of the 27th Annual NSAP Conference, Akure. Pp307-310.
- Imevbore, E. and Ademosun, A. A. (1988). The nutritive value of African Giant land snail (*Archachatina marginata*). *Nigerian Journal of Animal production*. 15: 109 – 112.
- Okafor, F.O. (2011). The Geographical Location of Ogidi. *An annual Report of Idemili North Local Government Urban Development Bulletin*. Pp 65.
- Oloyede, S.Y (2005). *Prospects and problems associated with snail farming*. Heritage printers, Lagos. Pp 96
- Omole, A. J., Tewe, O. O., Adebowale, E. A., Oluokun, J. A., Ogundola, F. J. and Nworgu, F. C. (2000). Performance of different breeds of snails under the same management conditions. *Tropical journal of Animal Science*. 3 (1): 133 – 138.
- Omole, A. J., Oluokun, F. I., Ogundola, O. O., Tewa, A.M., Raji, A. J., Olopina, F. C. and Salako, R.A. (2007). *Perforance and carcass evaluation of the snail (Archachatina marginata) fed with ripe and unripe fruits*. A paper presented at the 26th Annual NSAP Conference, Ilorin, Nigeria. Pp 402 – 405.

- Osemeobo, A.U (1992). Effects of dietary calcium on the growth of the African snail (*Achatina achatina*). *Cahiers – Agricultures*. 4(6): 444 – 448.
- Stivenart, C. (1992). Snails as feed or food. *Proceedings of seminar on invertebrates (Minilivestock) farming*. 2: 180 – 182.
- Ugwu, S. O. C., Ogbu, C. C and Amaechi, C. C. (2011). Effects of soil type and soil depth on the reproductive performance of two species of giant African land snails in the humid Tropics. *International Journal of Science and Nature*. 2 (2): 176 – 182.

EFFECTS OF DIFFERENT PROCESSING METHODS OF RAW BAOBAB (*Adansonia digitata*) SEED MEAL ON GROWTH PERFORMANCE OF BROILER CHICKENS

¹Saulawa, L. A., ²Ukachukwu, S. N., and ²Ukoha, O.A.

¹Department of Animal Production and Health, Federal University Dutsinma, Katsina State,

²Dept of Animal Nutrition and Forage Science, Micheal Okpara Uni. of Agric., Umudike, Abia State

* Corresponding author's Email: labdusaulawa@fudutsinma.edu.ng

ABSTRACT

A 28-day feeding trial involving 360 four weeks old Anak broiler chicks was carried out to study the effects of different processing methods of raw baobab (*Adansonia digitata*) seed meal on productive performance of broiler chickens at finisher phase. The birds were grouped into six dietary treatments with 10% levels of inclusion of differently processed raw baobab seed meal (RBSM), in a completely randomized design. Feed and water were offered to birds *ad libitum*. Result of productive performance, carcass characteristics and organ weight shows significant differences ($p < 0.05$) between treatments for all the parameters considered. Feed intake, final body weight improves with birds fed boiled baobab seed meal. 10% level of inclusion of BBSM gave better productive performance among the processing methods. This indicate that boiling can be a better method of processing raw baobab seeds to used in broiler finisher diet without negative effect on productive performance.

Keywords: Growth performance, processing methods, raw baobab seed, broiler finisher

INTRODUCTION

In Nigeria the level of animal protein consumption is low. It was estimated to be about 8g per caput per day, about 27g less than the minimum requirement recommended by the National Research Council of the United State of America Abdu, (2012); Ojewola and Ewa, (2005) and Abdu, (2003). This low level of animal protein intake by Nigerians has been generally attributed to the short fall in its production due to closure of poultry farms. Madubuike and Ekenyem (2006) reported that the persistent decline in the poultry industry and its consequences on the sub-optimal animal protein consumption by Nigerians as a dangerous signal to imminent animal protein malnutrition. Earlier Esonu et al (2001), reported that 50% of the Nigerian poultry farms have closed down and another 30% were forced to reduce their production capacity because of shortage of feed. The feed shortage has been blamed on high cost of conventional sources of ingredients which

Abdu et al (2006) have rated at 70-80% of total cost of poultry production. Hence the need to source for alternative but promising feedstuffs. One of such alternative is baobab (*Adansonia digitata*) seed. Baobab (*Adansonia digitata*), locally called **kuka** (Hausa) and **luru** (Yoruba), which is another non-conventional feed stuff that is readily available in Nigeria and under-utilized but holds much agronomic potentials Saulawa et al (2012). They further reported that the seeds are not utilized by man and the industries. Baobab is a high yielding, draught resistant and all season plant. This gives it an advantage over other legumes that are seasonal, high rainfall and fertilizer demanding crops. There is therefore, the need to assess the potentials of such crop as a feedstuff for poultry production. The use of legumes as a component of poultry feed has been limited by the content of anti-nutritional factors (ANF). Saulawa et al (2012) reported that the inclusion of above 10% raw Baobab seed meal as plant proteins in diets of

growing broilers leads to a significant impairment of growth and other undesirable physiological and biochemical alterations. This they attributed to the presence of toxic factors and ANF in legume seeds. Many efforts have been made to detoxify ANF through the application of heat and other processes but only a few permanent breakthroughs have been made. Dietary quality is an important militating factor to adequate nutrition in poultry production. Several local processing and preparation methods can be used to enhance the bioavailability of protein in non- conventional legumes. These methods include thermal processing, mechanical processing, soaking, fermentation, dehulling, germination or combination of two or more methods Ologhobo *et al* (1993). It was against this back drop that, this study was embarked up on to study the effect of different processing methods of raw baobab (*adansonia digitata*) seeds as an alternative plant protein source in broilers.

MATERIALS AND METHODS

The experiment was conducted at the poultry unit of the Teaching and Research Farm of Abia State University, Umudike Campus. Raw baobab seeds (RBS) were collected from katsina market in Katsina state, Nigeria

Processing of baobab seeds: The seeds were divided into five parts and processed. Processing was carried-out according to the recommendation of Ukachukwu (2000) for *Mucuna cochinchinensis* as follows:

a) Boiling: Boiling lasted for 60 minutes with change of water at 20 minutes interval. In each case, water was brought to boil at 100°C and the seeds were poured into it. Boiling continued at 100-105°C during the interval (i.e. 20, 40 and 60 minutes) starting from the commencement of boiling. At the end of boiling, water was drained off using local basket. Thereafter, boiled seeds were dried in a forced-draught oven at 60°C.

b) Toasting: Toasting lasted for 60 minutes. Seeds were toasted in sand (placed inside a

frying pan) at temperatures that fluctuate between 105 and 110°C. The sand was sieved to remove organic matter. The mixture was turned for 3 minutes at short intervals of two minutes. Temperature was checked at intervals of five minutes. After toasting the sand was immediately sifted out by means of a sieve.

c) Soaking: Soaking lasted for 24 hours; Seeds were poured inside plastic buckets. Thereafter, water was added and allowed to stand for 24 hours without changes of water. Thereafter; water was drained off by means of local (oil palm bamboo) basket, and the seed were dried in a force-draught oven at 60°C.

d) Soaking and boiling: Soaking lasted for 24 hours and water drained off using local basket as in (c). These soaked seeds were boiled for 1 hour as in (a) though without changes of water. Decanting of water and drying of seeds also followed the same process as in (a) above.

e) Sprouting: Sprouting was conducted according to Obizoba and Amaechi (1983). They recommended 6 days of fermentation of raw baobab seeds. Seeds were poured inside a jute bag and placed inside water. Water was changed daily until germination starts. Decanting of water and drying of seeds also followed the same procedure as in (a) above.

All the processed seeds with the exception of raw and toasted seeds were oven dried at 60°C before being milled for chemical Analysis and feed compounding based on formulation.

Experimental procedure

Four hundred (400) day-old Anak broilers were housed and brood in a deep litter brooding room. Brooding lasted for four weeks and kerosene stoves served as heat source. Tarpaulin was used to cover the wire netting parts of the building to prevent cold at nights.

The birds had unrestricted access to feed and clean fresh drinking water. The birds were vaccinated against Newcastle disease with NDV (I/O) and NDV (lasota) at day old

and 4th week, respectively and Gumboro disease with Gumboro vaccine at 9th and 21st day. They were also given coccidiostat and antibiotics (KEPROCERYL WSP) through drinking water at 3rd and 6th weeks of age. Vitalyte was given at the end of every vaccination to reduce stress and combat dehydration.

At the end of the fourth week (brooding period) Three hundred and sixty (360) Birds were housed in 18 pens measuring 3x3m² and they were allotted to six (6) experimental diets and replicated three times in a completely randomized experimental design. Diet one was soybeans based (control) diet, while 10% processed raw Baobab seeds (Boiled, Soaked, Soaked and Boiled, Toasted and Sprouted) were used to quantitatively replace equivalent weight of soybeans meal in diets 2, 3, 4, 5, and 6 respectively. The birds were randomly assigned to these diets. Feed and water was given *ad-libitum* throughout the experimental period. This experiment lasted for 28 days (4th-8th weeks of age). Feed intake was determined daily and weight gain was determined weekly. Data on Growth performance, carcass characteristics and organ weight were obtained and values were subjected to statistical analysis (ANOVA)

Data collection

a) Growth performance: Productive performance parameters considered included initial Body weight, final Body weight, feed intake, weight gain; feed conversion ratio, protein efficiency ratio.

b) Gross Margin Analysis: This reveals the profitability of the test diets. Gross margin was calculated, using the method of Ukachukwu and Arugwa (1995).

i) Gross Margin = Revenue - Cost of total feed consumed.

ii) Revenue = Price/ kg meat X mean weight gain.

iii) Price / kg meat = $\frac{\text{total Cost of Production}}{\text{Weight gain}}$

Live weight

iv) Cost of total feed consumed / Bird = Total feed intake X Cost/ kg feed

v) Cost / kg feed = $\frac{\text{total Cost of feed production}}{100}$

vi) Cost / kg = $\frac{\text{Cost of feeding}}{\text{Weight gain}}$

OR

G.M = cost/Kg feed X FCR

c)Carcass characteristics: Evaluation of carcass characteristic was carried out as described by Amaefule *et al.*, (2003), this involved selection of six broilers per treatment i.e. two bird per replicate were randomly selected. The Selected birds were starved for 12hrs and weighed individually. Birds were slaughtered by cutting the neck close to the head with a sharp surgical blade and they were allowed to bleed completely. Scalding was done in hot water (below 100^oc) and the feathers plucked off manually and individually. The head, neck, shank, and viscera were removed to obtain the dressed weight and percentage dressed-weight calculated. The wings were removed by cutting interiorly, severing at the humero scapular joint. The cut was made close to the bodyline. Lateral cuts were made through the rib heads to the shoulder girdle and the breast was removed intact by pulling interiorly. The thigh, drumsticks, and back were also dissected from each carcass. All parts were weighed and expressed as percentage dressed weight. Also, organs like heart, Liver, kidney, spleen, and gizzard were weighed and expressed as percentages of dressed weight. All percentage values were transformed using Arcsine transformation. **Experimental diets:** Table 1 shows composition of the experimental diets containing same (10%) level of inclusion of differently processed test ingredients. 10% level of inclusion was chosen based on the recommendation of Saulawa et al (2012) who recommended 10% level of inclusion of RBSM on broiler diet without negative.

Table 1: Composition of experimental diets containing differently processed Baobab seed meal fed at finisher phase.

DIET						
*1kg of premix contains : Vitamins A (5,000,000 I.U), Vitamin D3 (1000000 I.U),Vitamin E						
Ingredients	Control (D1)	BBSM (D2)	SBSM (D3)	SBBSM (D4)	TBSM (D5)	SPBSM (D6)
Maize	54.00	54.00	54.00	54.00	54.00	54.00
Soyabeans	22.30	11.30	11.30	11.30	11.30	11.30
BSM	00.00	10.00	10.00	10.00	10.00	10.00
Bloodmeal	1.00	1.00	1.00	1.00	1.00	1.00
Palm Kernel Cake	14.00	14.00	14.00	14.00	14.00	14.00
Fishmeal	3.00	3.00	3.00	3.00	3.00	3.00
Bonemeal	3.00	3.00	3.00	3.00	3.00	3.00
Oystershell	2.00	2.00	2.00	2.00	2.00	2.00
Vit premix*	0.25	0.25	0.25	0.25	0.25	0.25
Salt	0.25	0.25	0.25	0.25	0.25	0.25
Methionine	0.10	0.10	0.10	0.10	0.10	0.10
Lysine	0.10	0.10	0.10	0.10	0.10	0.10
TOTAL	100.00	100.00	100.00	100.00	100.00	100.00
Determined composition (%)						
Crude protein	19.89	19.86	19.87	19.78	19.62	19.75
Ether Extract	4.89	1.43	1.48	1.49	1.63	1.21
Crude Fiber	4.01	6.58	6.67	6.69	6.45	6.93
Ash	12.41	8.60	8.64	8.41	8.00	8.87
NFE	56.28	50.54	51.34	52.21	53.30	51.46
Dry matter	90.40	87.01	88.00	88.17	89.00	88.22
Calculated composition (%)						
Crude protein	20.72	19.16	19.96	19.91	19.71	19.97
M.E(Kcal/Kg)	2910.60	2857.00	2808.18	2841.13	2881.00	2827.03

(16000mg), Vitamin K3 (800mg), Vitamin B1 (1200mg), Vitamin B2 (22000mg),Niacin(22000mg),Calcium pontothenate (4600mg),Vitamin B6 (200mg),Vitamin B12 (10mg), Folic acid (400mg), Biotin (32mg),Choline chloride (200000mg),Manganese(948000mg),Iron(40000mg),Zinc(32000mg),Copper(3400mg),Iodine(600mg),Cobalt(120mg), selenium(48mg),Anti-Oxidant(48000mg). RBSM: raw baobab seed meal, TBSM: toasted baobab seed meal, BBSM: boiled baobab seed meal, SBSM: Soaked baobab seed meal, SBBSM: Soaked and boiled baobab seed meal: SPBSM; Sprouted baobab seed meal, ME: Metabolisable energy,

RESULT AND DISCUSSION

The Growth performance of broiler birds fed both soybean based (control) diet and diets containing 10% of differently processed baobab seed meal at finisher phase is shown in Table 2. There were significant ($P<0.05$) differences in all the parameters considered with the exception of percentage mortality. In all the parameters considered there were no significant ($P>0.05$) differences between the control diet and boiled baobab seed based diet except in feed intake. Daily Feed intake was highest in birds fed boiled baobab (137.55g/bird) based diet (D₂) followed by D₆ (136.96g/b), D₄ (135.38g/b), and D₁ (134.46g/b) which were similar while D₅ was the lowest. The higher daily feed intake value of 137.55g/b for D₂ (Boiled) over the control diet and other treatments could be attributed to low availability of the energy of the diet, and hence uptake of more of the diet to balance for energy, as chickens are known to meet their energy requirements Emenalom and Udedibie (1998). The poor feed intake of birds fed diet 5 (Toasted) could be attributed to the inability of the processing method to detoxify the anti-nutrient present in the test ingredient to a tolerable level.

The weight-gain as shown in Table 2 indicated significant differences ($P<0.05$). Treatments D₁ (control) had similar weight gain with D₂ (Boiled), but, higher ($p<0.05$) than the values for D₃, D₄ and D₆, while D₅ had the lowest weight gain, Ukachukwu (2000) attributed this to the fact that body weight gain is a function of feed intake, management and other factors. The better performance of the birds placed on boiled baobab seeds over other treatments may be attributed to better detoxification of anti-nutrients and hence availability of proteins and their constituent amino acids, leading to better weight gain by birds placed on boiled seeds, This finding is in agreement with the findings of Amaefule and Obioha (1998), Ukachukwu and Obioha(2000a), and Amaefule *et al* (2003) who reported better weight gain on birds fed boiled pigeon pea and mucuna respectively.

Feed conversion ratio (FCR) ranged from 2.93 to 5.09. Feed conversion ratio of birds fed boiled baobab seed meal gave the best value among the treatments but higher than the

control diet. Usually, and all things being equal, higher feed intake usually results in higher FCR. It is probably that the lower FCR recorded by birds fed D₂ is due to better growth performance, which is in turn due to the lower level of anti-nutritional factors in the diet. Zero percentage mortality shows the effect of processing on the anti-nutritional factors reduction in the seed, as opposed to 33.33% mortality experienced in the case of raw seeds as reported by Saulawa *et al* (2012).

Significant differences ($P<0.05$) were observed in gross margin among treatment means, with birds fed boiled baobab seed meal diet having the highest value (N121.08), followed by that of D₁ (control), then those of D₄ and D₆ while that of D₅ was the lowest ($p<0.05$). This may be the product of favourable weight gain and moderate feed cost fed diet containing 10% boiled baobab seed meal. Based on final live weight, weight gain, feed conversion and gross margin values Diet 2 (boiled Baobab) compared favourably with the control diet in growth performance. This is in agreement with Abeke *et al* (2007) and Amaefule and Obioha (1998a) who reported better performance in broilers fed boiled lab lab purpureus beans and pigeon pea seed meal respectively. Kaankuka *et al* (2000) reported that cooking soybean seed for about 30 min improved the performance of weaner pigs better than cooking for less time periods. The authors also reported that moist cooking of soy beans gave better performance in broilers than other methods of processing, but over cooking legume seeds beyond 30 min might result in the destruction of the protein content.

The above results show that in evaluating the different processing techniques, boiling (D₂) compared favourably with the control diet hence, boiling is recommended as the best processing technique. Based on the result of body weight gain, FCR, PER, Feed intake and gross margin among the processing methods birds fed boiled baobab seed meal at 10% level of inclusion at the finisher phase gave the best result as it favourably compared with the control diet.

Table 2: Performance of broiler chickens fed differently processed baobab seed meal diet at finisher phase.

PARAMETER	DIETS						± SEM
	(D1)	(D2)	(D3)	(D4)	(D5)	(D6)	
	CONTROL	BBSM	SBSM	SBBSM	TBSM	SPBSM	
Initial body weight(g)	588.46	581.00	588.00	579.68	586.06	588.11	8.430
Final body weight (g)	1873.33 ^a	1738.66 ^{ab}	1638.36 ^b	1601.32 ^b	1381.17 ^c	1591.00 ^b	82.333
Daily weight Gain(g)	45.89 ^a	37.77 ^{ab}	37.51 ^b	36.48 ^b	28.40 ^c	35.82 ^b	2.4344
Daily feed Intake(g/b)	134.46 ^b	137.55 ^a	129.92 ^d	135.38 ^{bc}	126.44 ^e	136.96 ^b	16.035
FCR	2.93 ^c	3.64 ^b	3.46 ^b	3.71 ^b	4.45 ^a	3.82 ^b	1.12
PER	1.72 ^a	1.40 ^{ab}	1.32 ^{ab}	1.37 ^{ab}	1.00 ^b	1.38 ^{ab}	0.19
Mortality(%)	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Gross margine (N)	105.32 ^b	121.08 ^a	96.00 ^d	98.78 ^c	90.73 ^e	101.04 ^c	
	1.0638						

a,b,c,d,e Treatment means with different superscripts are significantly($p<0.05$)different from each other ; SEM : Standard error of the means . RBSM raw baobab seed meal, TBSM : toasted baobab seed meal, BBSM boiled baobab seed meal, SBSM: Soaked baobab seed meal, SBBSM: Soaked and boiled baobab seed meal: SPBSM; Sprouted baobab seed meal

Effects of different processing methods of raw baobab seeds on carcass characteristics of broiler chickens at finisher phase.

Table 3 shows the cut parts expressed as percent of the dressed weight. There were significant ($P < 0.05$) differences among the treatment means for all the parameter measured, with the exception of the thigh. The result showed that high live weight yield high dressed weights. This is in agreement with the work of Ologhobo et al (1993), who confirmed that heavier birds produced greater eviscerated yield. This is a further confirmation of the fact that plumpy appearance in broilers was associated with high percentage of edible meat. Birds fed D₁ (control) had the highest value (26.13%) for

breast while D₅ (Toasted) had the lowest value (18.00%). This shows the ability of the test diets to support tissue deposition to particular parts (Bamgbose *et al* 1998). The back parts of birds fed D₁ (control) and D₂ (BBSM) were significantly ($p < 0.05$) higher than other treatments. The poor values exhibited by birds fed D₅ (Toasted) could be attributed to poor ability of the test diets to inherently induce tissue lay down for the said cut-parts (Abiola and Sogunle, 1999).

Differences in Drumstick values may be attributed to similar reasons. Therefore considering the highest values of dressed percentage, breast, back, drumstick, thigh of D₂ (boiled) over other treatments; these were the basis for choosing boiled Baobab Seed meal for the next experiment.

Table 3 : cut-part of broiler chickens fed differently processed baobab seed meal Diet at finisher phase.

PARAMETER	DIETS						± SEM
	CONTROL	BBSM	SBSM	SBBSM	TBSM	SPBSM	
Live weight(g)	1873.33 ^a	1738.66 ^b	1638.36 ^c	1601.32 ^{bc}	1381.17 ^d	1591.00 ^{bc}	82.43
Dressed weight (g)	1311.31 ^a	1182.28 ^b	1081.31 ^d	1040.85 ^d	828.70 ^e	1050.46 ^c	50.39
Dressed(%)	70.00 ^c (53.73)	68.00 ^a (55.55)	66.00 ^b (54.13)	65.00 ^c (53.73)	60.00 ^d (50.77)	66.00 ^b (54.33)	0.67
Breast (%)	26.13 ^a (30.72)	24.05 ^b (29.33)	20.00 ^c (26.56)	24.00 ^b (29.33)	18.00 ^d (25.10)	26.13 ^a (30.72)	1.028
Back (%)	19.20 ^b (25.99)	20.00 ^a (26.56)	19.00 ^b (25.84)	20.00 ^a (26.56)	17.00 ^c (24.35)	20.00 ^a (26.56)	0.84
Thigh (%)	14.00 (22.38)	16.00 (23.58)	15.00 (22.79)	14.00 (21.97)	13.00 (21.13)	15.00 (22.79)	0.65
Wings (%)	12.00 ^b (20.27)	11.00 ^c (19.37)	10.00 ^d (18.44)	10.00 ^d (18.44)	10.00 ^d (18.44)	13.00 ^a (21.13)	0.91
Drumstick (%)	14.50 ^b (22.38)	15.00 ^a (22.79)	14.00 ^b (21.97)	15.00 ^a (22.79)	13.00 ^c (21.13)	15.00 ^a (22.79)	0.43

a,b,c,d,e :Treatment means with different superscripts are significantly($p < 0.05$)different from each other ; SEM : Standard error of the means.RBSM raw baobab seed meal,TBSM toasted baobab seed meal, BBSM boiled baobab seed meal, SBSM: Soaked baobab seed meal, SBBSM:Soaked and boiled baobab seed meal: SPBSM; Sprouted baobab seed meal
Figures in parentheses are the transformed figures using arcsine transformation method. Those before the parentheses are the untransformed figures

Effects of different processing methods of raw baobab seeds on organs weight of broiler chickens at finisher phase.

The result of organ weights expressed as percentage of dressed weight is as shown in Table 4. There were no significant ($p < 0.05$) difference among the treatment means for all the parameters considered. The high value (4.98) observed for gizzard of birds fed toasted diet is in agreement with Ologboho *et al* (1993) who reported same when lima beans was fed to chicks. This they attributed to the effect of high but less digestible fibre content of the test ingredients.

The above results show that in evaluating the different processing techniques, boiling (D₂) compared favourably with the control diet hence, boiling is recommended as the best processing technique. Based on the result of productive performance, carcass characteristics and organs weight among the processing methods birds fed boiled baobab seed meal at 10% level of inclusion at the finisher phase gave the best result as it favorably compared with the control diet.

Table 4: Organ weights of broiler chickens fed differently processed baobab seed meal diet at finisher phase.

ORGAN	CONTROL	LEVEL OF INCLUSION					SEM
		BBSM	SBSM	SBBSM	TBSM	SPBSM	
Liver	2.98 (9.81)	3.00 (9.98)	3.63 (10.94)	3.41 (10.63)	3.61 (10.94)	2.81 (9.68)	0.76
Heart	1.76 (7.49)	1.61 (7.27)	1.36 (6.80)	1.58 (7.27)	1.63 (7.27)	1.56 (7.27)	0.51
Kidney	1.18 (6.29)	1.19 (6.02)	1.33 (6.55)	1.47 (7.04)	1.53 (7.04)	1.29 (6.29)	0.75
Spleen	0.56 (4.29)	0.63 (4.55)	0.67 (4.69)	0.73 (4.90)	0.63 (4.55)	0.33 (3.29)	0.06
Gizzard	3.86 (11.39)	4.13 (11.68)	4.68 (12.52)	4.15 (11.68)	4.98 (12.79)	4.00 (11.54)	0.79

a,b,c,d,e Treatment means with different superscripts are significantly ($p < 0.05$) different from each other ; SEM : Standard error of the means. RBSM raw baobab seed meal, TBSM toasted baobab seed meal, BBSM boiled baobab seed meal, SBSM: Soaked baobab seed meal, SBBSM: Soaked and boiled baobab seed meal: SPBSM; Spouted baobab seed meal Figures in parentheses are the transformed figures using arcsine transformation method. Those before the parentheses are the untransformed figures

REFERENCES

- Abdu, L.S (2003) Evaluation of methionine and lysine Supplementation in Broiler finisher Ration: performance, organoleptic properties and Economic Efficiency. Msc thesis, Micheal Okpara University of Agriculture, Umudike. Pp1-3.
- Abdu, L.S., Anene, A., Ojewola, G.S., Eromaka, O.U and Okpara, E.C (2006). Substitution value of tiger nut (*Cyperus esculentus* L) for Maize in Broiler finisher Diet. Proc. ASAN. Ann. Conf. N.R.C.R.I Umudike pp504-507.
- Abdu, L.S (2012): chemical and nutritional evaluation of baobab (*Adansonia digitata*) seed meal as alternative protein source in broiler diet. Ph.D Dissertation. Micheal Okpara University of Agriculture, Umudike, Abia state.
- Abeke, F.O., Ogundipe, S.O., Oladele S.B., Sekan A.A., Dafwang I.I., Adeyinka I.A., Oni O.O. and Nwaorg, B.I (2003) Effects of cooking duration of Lablab (*Lablab urpureus*) Organ weight and blood parameters of pullet chicks. NSAP Proc. IAR and T, Ibadan, Pp.240-242.
- Abiola, S.S. and Sogunle, M.O. (1999). Effects of replacing soyabean meal with hatchery waste meal on performance and blood constituents of cockerels. NSAP Proceedings, Abeokuta. Pp.198-199.
- Amaefule, K.U; Odukwe C.N and Ndubuisi E.C (2003). Pigeon pea Seed meal as protein source for Broilers. *J. Sustain. Agric. Environ.* 5(1):1-10.
- Amaefule, K.U and Obioha F.C. (1998). The substitution of pigeon pea seed (*Cajanus cajan*) for groundnut cake in Broiler finisher rations. *Nig. J. Anim. Prod* 25(1):9-12.
- Bamgbose A.M., Oyewoye E.O., APata Olakulehin H.O., Mohammed A.S. and Musa A.M. (1998) Utilization of roasted full-fat soyabean in diets for broiler chickens. NSAP proceedings, Abokuta. Pp. 176-177.
- Emenalom, O.O. and Udedibie A.B.I (1998): Effect of Dietary Raw, Cooked and Toasted *Mucuna Pruriens* seeds (Velvet bean) on the performance of finisher broilers. *Nigeria Journal of Animal production.* 25:115-119.
- Esonu, B.O; O.O Emenalom, A.B.I Udedibie, U, Herbert, C.F Ekpor; I.C Okolie and F.C Iheukwumere (2001): Performance and blood chemistry of weaner pigs fed raw mucuna (velvet bean). *Tropical Animal production investigations.* 4:49-54.
- Kaankuka, F.G; Balogun T.F; and Yaakugh I.D.I (2000) : Effect of duration of cooking of full-fat soyabeans on dry matter digestibility and energy utilization by young pigs. *Proc. Anim. NSAP. Conf.* pp 191-193.
- Madubuike, F.N and B.U Ekenyem (2006): Haematology and serum Biochemistry characteristics of Broiler chicks fed varying Dietary levels of ipomoea asarifolia leaf meal. *Int. j. poult science* 5(1): 9-12, 2006
- Ojewole, G.S and Ewa U.E (2005). Response of Growing Broiler to varying Dietary plant protein. *Int. J. poult. Sci.* 4(10):765-771.
- Ologhobo, A.D., Apata, A. Oyejide A and Akinpelu, R.O. (1993): A comparison of protein fraction prepared from lima beans (*Phaseolus lunatus*) in starter diets. *Animal Resources* 4:13-30.
- Obizoba, T.C and Amaechi N.A (1983) the effect of processing methods on the chemical composition of baobab (*Adansonia digitata*) pulp and seed. *Ecol. food. nutr.* 29:199-205.
- Saulawa, L.A, S.N, Ukachukwu, O.C, Onwudike, M.G, Garba and Aruwayo, A (2012) Effect of Quantitative Replacement of Raw Baobab (*Adansonia digitata* L) seed meal for soyabean meal in Broiler finisher diet. *ASAN-NIAS* 17TH

- ANN CONF SEPT 2012, 525-528.
- Ukachukwu S.N; and Anugwa F.O.I (1995).BioEconomics of feeding Raw or Heat treated soybeans to broilers.
- Ukachukwu S.N (2000). Chemical and Nutritional evaluation of *mucuna cochinchinesis*(lyons beans) as an alternative protein ingredient in broiler diets(Ph.D) thesis, univ of Nigeria Nsukka.
- Ukachukwu S.N and Obioha F.C (1997).chemical evaluation of *mucuna cochinchinesis* alternative protein feedstuff . J. App.chemistry and Agric. Res. 4:33-38.

GROWTH RESPONSE AND ECONOMIC PRODUCTION OF BROILER CHICKENS FED MAIZE-CASSAVA BASED DIETS SUPPLEMENTED WITH DL-METHIONINE AND SODIUM SULPHITE

*Oguntoye, M.A., Akintunde, A.R., Ardo, B.A. and Azuaga, C.I. Jnr.

Department of Animal Science, Taraba State University, Jalingo.

*Corresponding author's email: ingenuityma@gmail.com

Phone: +234-8039550374

ABSTRACT

A total of two hundred and seventy (270) day-old broiler chicks were used in study to assess the growth performance and cost of production of broiler chickens fed maize-cassava based diets supplemented with DL-methionine and sodium sulphite. Nine experimental diets were used in a 3 × 3 factorial arrangement with three dietary inclusion levels of both DL-methionine and sodium sulphite (0, 125 and 250 mg/kg). The experiment lasted for 28 days (starter phase) and 28 days (finisher phase). The birds were divided into nine treatment groups of 30 birds each. Each group was replicated three times in a completely randomized design of 10 birds per replicate. Supplementation of DL-methionine and sodium sulphite in the diet of broiler chickens revealed that no significant differences ($P>0.05$) were recorded in terms of final weight, weight gain and feed intake at both phases. However, significant differences ($P<0.05$) were recorded for final weight, total weight gain and average daily gain (ADG) in the treatment group fed diet containing 250 mg/kg DL-methionine with 125 mg/kg sodium sulphite (D8) and diet containing 250mg /kg DL-methionine with 250 mg /kg sodium sulphite (D9) compared to other dietary treatment groups. At starter phase, birds fed diet containing 250 mg/kg DL-methionine with 125 mg/kg sodium sulphite (D8) recorded highest numeric values of 438.47g, 398.96g, and 40.34g/b/d for final weight, total weight gain and feed intake respectively. Finisher phase followed similar trend with birds on diet containing 250 mg/kg DL-methionine with 125 mg/kg sodium sulphite (D8) and 250 mg/kg DL-methionine with 250 mg/kg sodium sulphite (D9) showed higher statistical values. Birds on D8 obtained highest numeric values of 2011.58g, 1570.94g and 151.88g/b/d for final weight, total weight gain, and feed intake respectively. Birds on diet containing 250 mg/Kg DL-methionine with 125 mg/kg sodium sulphite (D8) recorded highest values of 1431.47 ₦/bird and 652.63 ₦/bird for total revenue and benefit respectively. It can be concluded that supplementation at level of 250 mg/kg DL-methionine and 125 mg/kg sodium sulphite reflected significant improvement for growth response without any allergic effect on broiler chickens. 250 mg/kg DL-methionine with 125 mg/kg sodium sulphite could be recommended for efficient tissue build up and optimum performance of broiler chickens.

Key words: Maize-cassava, DL-methionine, sodium sulphite, broiler chickens.

INTRODUCTION

Poultry diets are formulated using conventional feed ingredients such as maize, wheat, soya bean, groundnut cake to mention but a few to meet the nutrient requirement. The industry has not been able to address the protein demand and supply challenges due to high cost of poultry feed ingredients, especially energy sources such as maize, wheat, barley and oat. Ekenyem and Madubuike (2006) observed that poultry products (meat and egg) offer considerable potential for bridging the gap of animal

protein. In Nigeria, animal protein products have been in short supply due to the ever increasing cost of livestock feedstuffs. Broiler chicken rations are formulated to supply the macro and micro nutrients with relatively more emphasis on energy and crude protein due to their role in performance and health of birds. A perfect understanding combination among dietary components of broiler chicken is of main important in economical broiler production (Ferket and Gernat, 2006). Inadequate and unsteady production of maize and intense competition between human and

livestock has made poultry feed expensive hence, the need for alternative dietary energy sources become a matter of urgency in Nigeria. Obih (2009) suggested that greater emphasis should be placed on the use of unorthodox feed ingredients which are abundant cheap and not competitive for human consumption. Cassava (*Manihot spp.*) is a common tropical root and tuber crop (FAO, 1996) it is extensively grown in Nigeria where it serves as a major source of food for both man and animals. Nigeria is the world's leading producer of cassava production up to 33 million metric tonnes per year (Ikwelle, 1999) it therefore represents a great potentials in the country as an alternative source of energy for the feeding of both ruminant and monogastric animals.

There have been previous documentation on non-conventional feedstuff like cassava to replace maize partially (Dairo, 2011) or completely (Anaeto and Adighibe, 2011; Ngiki *et al.*, 2014). Utilization of whole unpeeled root is a total utilization concept; a strategy that is worth adopting in the cassava utilization (Tewe and Bokanga, 2005). However, one serious setback in the use of cassava root meal is linamarin which on hydrolysis produces hydrogen cyanide (HCN) which is highly toxic (Hill, 1977) with adverse effect on the growth and physiological performance (Tewe and Bokanga 2005). 25% inclusion with palm oil supplemented was reported by Ojewola *et al.* (1999) to produce improved growth response. Cassava based rations needed to be balanced for all nutrients and in particular sulphur containing amino acids, phosphorus, zinc, iodine and vitamin B₁₂ (Hutagalung, 1977). Therefore, amino acid such as methionine and chelated inorganic Sulphur sources are important in improving

bio-availability of nutrient such as protein through synergetic influence particularly in ingredient of low nitrogenous value like cassava.

This study was designed to evaluate the growth performance and cost benefit analysis of broiler chickens fed maize-cassava based diets supplemented with DL-methionine and sodium sulphite.

MATERIALS AND METHODS

Experimental birds design and management

A total of two hundred and seventy (270) day-old broiler chicks were purchase from commercial hatchery. The birds were randomly divided into nine treatment groups of 30 birds each in 3x3 factorial arrangement. Each group was replicated three times in a completely randomized design of 10 birds per replicate. The birds were raised in a deep litter system for 0-28 days (starter phase) and 28-56 days (finisher phase). Feed and water were provided *ad libitum*. Normal vaccination which involved administration of Newcastle Disease Vaccine (NDV) at day 3 and day 21 and Infectious Bursal Disease Vaccine (IBDV) at day 2 and day 10 was followed. Also, strictly adhered to routine medication schedule during the period of the research.

Experimental diets

Nine isocaloric and isonitrogenous experimental diets were formulated and arranged in a 3 × 3 factorial experimental layout with three dietary inclusion levels of DL-methionine (0, 125 and 250 mg/kg) and sodium sulphite (0, 125 and 250 mg/kg). The diets were formulated for starter phase (0-4 weeks) and finisher phase (5-8 weeks) respectively as presented in Table 1 and 2.

Data collection

Growth performance

Average daily feed intake was obtained by subtracting the quantity of feed left-over from quantity of feed supplied to the birds per day. Weekly body weight gain was measured by subtracting the body weight of

the bird of the preceding week from body weight of the following week. Feed conversion ratio (FCR) was obtained by dividing the average feed intake per bird per week by the weight gain per bird per week.

Production cost analysis

The following parameters were determined using the procedure of Medugu *et al.* (2010)

- $\text{Cost of feed per kg (₦)} = \frac{\text{summation of ingredients} \times \text{Cost per kg ingredien}}{100}$
 - Cost of feed consumed per bird (₦) = Cost per kg of feed × total feed intake per bird (kg)
 - $\text{Feed cost (\%)} = \frac{\text{Cost of feed consumed}}{\text{Cost of production}} \times \frac{100}{1}$
 - Cost of production = Operational cost + Cost of feed consumed
 - Revenue generated per bird = Weight of the bird × Price/kg live weight
- Profit = Revenue - Total cost.

Statistical Analysis

Data collected were subjected to analysis of variance using the SPSS software (2012). Where analysis of variance indicated significant treatment effects, means were compared using Duncan's New Multiple Range Test (DNMRT) (SPSS, 2012).

RESULTS

Main effects of varying levels of DL-methionine and sodium sulphite on the performance characteristics of broiler chickens are shown in Table 3. Final weight, total weight, weight gain/b/d and mortality were significantly ($P < 0.05$) influenced by DL-methionine supplementation.

Highest ($P < 0.05$) values of 433.35 g, 393.85 g and 14.06 g were recorded for final weight, total weight and weight gain/b/d respectively in the birds fed diet supplemented with 250 mg/kg DL-methionine. Birds on control diet recorded the least values of 420.04 g, 380.83 g and 13.60 g for final weight, total weight and weight gain/b/d respectively. Highest

($P < 0.05$) value of 5.56 was recorded for mortality in the birds fed control diet. Feed intake and feed conversion ratio were not significantly ($P < 0.05$) influenced by DL-methionine supplementation.

Sodium sulphite supplementation had significant ($P < 0.05$) effect on final weight, total weight and weight gain/b/d. Birds fed diet supplemented with 125 mg/kg and 250 mg/kg sodium sulphite recorded similar values for final weight, total weight and weight gain/b/d respectively. Feed intake, feed conversion ratio and mortality were not significantly ($P > 0.05$) influenced by sodium sulphite supplementation. At the finisher phase, with the exception of mortality all parameters measured were significantly ($P < 0.05$) influenced by DL-methionine and sodium sulphite supplementation. The final weight, total weight, weight gain/b/d and feed intake increased ($P < 0.05$) while the feed conversion ratio decreased ($P < 0.05$) with increasing level of DL-methionine. Diet supplemented with 250 mg/kg DL-methionine recorded higher ($P < 0.05$) values of 1987.62 g, 1546.69 g, 55.24 g and 150.92 g

for final weight, total weight, weight gain/b/d and feed intake respectively.

The final weight, total weight, weight gain/b/d and feed intake numerically increased ($P < 0.05$) while the feed conversion ratio decreased ($P < 0.05$) with increasing level of sodium sulphite supplementation. Birds fed diet supplemented with 125 mg/kg and 250 mg/kg sodium sulphite supplementation recorded statistical similar values across the parameters measured.

Interaction effect of varying levels of DL-methionine and sodium sulphite supplementation on growth performance of broiler chickens is presented in Table 4. Final weight, total weight gain, weight gain/b/d and feed intake were significantly ($P < 0.05$) influenced by dietary treatments. Statistically similar higher significant ($P < 0.05$) values were recorded for final weight, total weight gain and weight gain/b/d in the birds fed diet containing 250 mg/kg DL-methionine with 125 mg/kg sodium sulphite (D8) and diet containing 250 mg/kg DL-methionine with 250 mg/kg sodium sulphite (D9) compared to other dietary treatment groups. Birds fed diet containing 250 mg/kg DL-methionine with 125 mg/kg sodium sulphite (D8) recorded highest numeric values of 438.47g, 398.96g, 14.25 g/b/d and 40.34g/b/d for final weight, total weight gain weight gain/b/d and feed intake. Feed conversion ratio and mortality were not significantly ($P < 0.05$) affected by the dietary treatments.

The interaction effect of varying levels of DL-methionine and sodium sulphite on growth performance of finisher broiler chickens followed similar trend with the starter phase. Values recorded for birds on diet containing 250 mg/kg DL-methionine with 125 mg/kg sodium sulphite (D8) and 250 mg/kg DL-methionine with 250 mg/kg sodium sulphite (D9) were statistically similar with D8 recording highest numeric values of 2011.58g, 1570.94g 56.11g/b/d and 151.88g/b/d for final weight, total weight gain, weight gain/b/d and feed intake respectively.

Main effects of varying levels of DL-methionine and sodium sulphite on economic analysis of production are presented in Table 5. DL-methionine supplementation had significant ($P < 0.05$) influence on cost of diet, cost of feed consumed, cost of production, total cost, total revenue and benefit at starter phase. Birds fed 250 mg/kg DL-methionine showed higher statistical values across the parameters determined. Sodium sulphite supplementation reveal significant ($P < 0.05$) influence on cost of feed consumed, total cost and total revenue. Cost of feed consumed showed similar statistical values of 83.74 ₦/bird and 85.52 ₦/bird for birds fed 125 mg/kg and 250 mg/kg sodium sulphite. Similar trend was observed for total revenue.

At finisher phase, DL-methionine supplementation followed similar pattern with the starter phase. Significant ($P < 0.05$) influences were observed in cost of diet, cost feed consumed, cost of production, total revenue and benefit. Birds fed 250 mg/kg DL-methionine showed higher ($P < 0.05$) values across the parameters determined while least values were recorded for birds on the control diet. Sodium sulphite supplementation revealed significant ($P < 0.05$) influence on cost of feed consumed, total revenue and benefit. Birds on 250 mg/kg sodium sulphite recorded higher ($P < 0.05$) value of 331.42 ₦/bird compared to other dietary levels. Birds on 125 mg/kg sodium sulphite showed higher ($P < 0.05$) values of 1371.32 ₦/bird and 601.67 ₦/bird for total revenue and benefit respectively

The parameters considered to determine the interaction effect of DL-methionine and sodium sulphite on economic analysis of production are presented in Table 6. Cost of diet, cost of feed consumed, total revenue, benefit and cost benefit ratio were significantly ($P < 0.05$) influenced by the interaction effect of DL-methionine and sodium sulphite at starter phase. Highest significant ($P < 0.05$) statistically similar values were observed in the birds fed diet containing 250 mg/kg DL-methionine with 125 mg/kg sodium sulphite (D8) and 250

mg/kg DL-methionine with 250 mg/kg sodium sulphite (D9) across parameters measured. Least cost benefit ratio of 6.61 was recorded for birds on D9. The finisher phase followed similar trend with the starter phase. Cost of diet, cost of feed consumed, total cost, total revenue and benefit were significantly ($P < 0.05$) influenced by the interaction effect of DL-methionine and sodium sulphite. Higher statistical values; 76.65 ₦/kg Vs 80.32 ₦/kg, 336.49 ₦/bird Vs 339.66 ₦/bird and 778.84 ₦/bird Vs 782.01 ₦/bird were obtained for

cost of diet, cost of feed consumed and total cost respectively in the birds fed D8 and D9. Numerically, birds on diet containing 250 mg/Kg DL-methionine with 125 mg/kg sodium sulphite (D8) recorded highest values of 1431.47 ₦/bird and 652.63 ₦/bird for total revenue and benefit respectively. Least cost benefit ratio of 1.19 was recorded for birds fed with diet containing 250 mg/Kg DL-methionine with 125mg/kg sodium sulphite.

Table 1: Gross Composition of maize-cassava based diet supplemented with varying levels of DL-methionine and sodium sulphite for starter broiler chickens

DL-methionine levels (mg/kg)	0.00			125			250		
Sodium sulphite levels (mg/kg)	0	125	250	0	125	250	0	125	250
Ingredients:	D1	D2	D3	D4	D5	D6	D7	D8	D9
Maize	30.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00
PCRM	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00
Wheat offal	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00
Soy meal	12.80	12.80	12.80	12.80	12.80	12.80	12.80	12.80	12.80
GNC	24.00	24.00	24.00	24.00	24.00	24.00	24.00	24.00	24.00
Fish meal (72%CP)	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00
Oyster shell	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50
Bone meal	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
Lysine	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20
Premix*	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Salt (NaCl)	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Supplements:									
DL-Methionine	-	-	-	125	125	125	250	250	250
Na ₂ SO ₃	-	125	250	-	125	250	-	125	250
Determined analysis (%)									
Crude protein	23.01	23.01	23.01	23.01	23.01	23.01	23.01	23.01	23.01
Crude fibre	6.51	6.51	6.51	6.51	6.51	6.51	6.51	6.51	6.51
Ether extract	4.61	4.61	4.61	4.61	4.61	4.61	4.61	4.61	4.61
Methionine**	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32
Lysine**	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
S**	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13
Ca**	0.61	0.61	0.61	0.61	0.61	0.61	0.61	0.61	0.61
P**	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28
ME kcal/kg	2860.03	2860.03	2860.03	2860.03	2860.03	2860.03	2860.03	2860.03	2860.03

*Premix to supply per kg diet; 9,000,000IU of Vit A; 2,135,000IU of Vit D3; 20,000mg of Vit E; 1,340mg of Vit B1; 5,340mg of Vit B2; 1,670mg of Vit K3; 12,000mg of Pantothenate; 2,670mg of Vit B6; 13.4mg of Vit B12; 30,000mg of Niacin; 100mg of Biotin; 100mg of Folic acid; 63,340mg of Iron; 78,000 of Zinc; 1,17340mg of Manganese; 775mg of Iodine; 180mg of Selenium and 10,000mg of antioxi

Na₂SO₃ = sodium sulphite

** = Calculated Value

PCRM = Peeled Cassava Root Meal

Table 2: Gross Composition of maize-cassava based diet supplemented with varying levels of DL-methionine and sodium sulphite for finisher broiler chickens

DL-methionine levels (mg/kg)	0.00			125			250		
Sodium sulphite levels (mg/kg)	0	125	250	0	125	250	0	125	250
Ingredients:	D1	D2	D3	D4	D5	D6	D7	D8	D9
Maize	30.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00
PCRM	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00
Wheat offal	7.50	7.50	7.50	7.50	7.50	7.50	7.50	7.50	7.50
Soy meal	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00
Palm oil	3.30	3.30	3.30	3.30	3.30	3.30	3.30	3.30	3.30
GNC	21.00	21.00	21.00	21.00	21.00	21.00	21.00	21.00	21.00
Fish meal (72%CP)	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
Oyster shell	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50
Bone meal	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
Lysine	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20
Premix*	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Salt (NaCl)	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Supplements:									
DL-Methionine	-	-	-	125	125	125	250	250	250
Na ₂ SO ₃	-	125	250	-	125	250	-	125	250
Determined analysis (%)									
Crude protein	18.38	18.38	18.38	18.38	18.38	18.38	18.38	18.38	18.38
Crude fibre	7.63	7.63	7.63	7.63	7.63	7.63	7.63	7.63	7.63
Ether extract	4.82	4.82	4.82	4.82	4.82	4.82	4.82	4.82	4.82
Methionine*	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28
Lysine**	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87
S**	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12
Ca**	1.74	1.74	1.74	1.74	1.74	1.74	1.74	1.74	1.74
P**	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24
ME kcal/kg	2894.51	2894.51	2894.51	2894.51	2894.51	2894.51	2894.51	2894.51	2894.51

*Premix to supply per kg diet; 9,000,000IU of Vit A; 2,135,000IU of Vit D3; 20,000mg of Vit E; 1,340mg of Vit B1; 5,340mg of Vit B2; 1,670mg of Vit K3; 12,000mg of Pantothenate; 2,670mg of Vit B6; 13.4mg of Vit B12; 30,000mg of Niacin; 100mg of Biotin; 100mg of Folic acid; 63,340mg of Iron; 78,000 of Zinc; 1,17340mg of Manganese; 775mg of Iodine; 180mg of Selenium and 10,000mg of antioxidant

Na₂SO₃ = sodium sulphite ** = Calculated Value

PCRM = Peeled Cassava Root Meal

Table 3: Main effects of varying levels of DL-methionine and sodium sulphite on growth performance of broiler chickens.

Parameters	DL-methionine levels				Sodium sulphite levels			
	0	125	250	SEM	0	125	250	SEM
Starter (0-4 weeks)								
Initial weight (g)	39.21	39.47	39.51	0.19	39.35	39.34	39.49	0.17
Final weight (g)	420.04 ^b	420.26 ^b	433.35 ^a	0.95	421.55 ^b	426.11 ^a	426.00 ^a	0.52
Total weight gain (g)	380.83 ^b	380.76 ^b	393.85 ^a	0.99	382.19 ^b	386.74 ^a	386.51 ^a	0.96
Weight gain (g/b/d)	13.60 ^b	13.60 ^b	14.06 ^a	0.04	13.65 ^b	13.81 ^a	13.80 ^a	0.03
Feed intake (g/b/d)	39.01	39.20	39.95	0.35	39.04	39.31	39.81	0.24
Feed conversion ratio	2.87	2.90	2.87	0.02	2.87	2.87	2.87	0.02
Mortality	5.56 ^a	3.33 ^b	3.70 ^b	0.37	4.44	3.70	4.44	0.27
Finisher (5-8 weeks)								
Initial weight (g)	440.98	441.05	440.93	0.33	441.13	440.91	440.92	0.32
Final weight (g)	1866.51 ^c	1922.62 ^b	1987.62 ^a	5.53	1893.39 ^b	1934.48 ^a	1948.87 ^a	6.41
Total weight gain (g)	1425.53 ^c	1481.58 ^b	1546.69 ^a	6.11	1452.26 ^b	1493.57 ^a	1507.95 ^a	5.12
Weight gain (g/b/d)	50.91 ^c	52.91 ^b	55.24 ^a	0.24	51.87 ^b	53.34 ^a	53.86 ^a	0.22
Feed intake (g/b/d)	149.29 ^b	149.89 ^b	150.92 ^a	1.21	149.66 ^b	149.92 ^{ab}	150.53 ^a	1.27
Feed conversion ratio	2.93 ^a	2.83 ^b	2.73 ^c	0.02	2.89 ^a	2.81 ^b	2.79 ^b	0.01
Mortality (%)	3.33	2.22	2.22	0.64	2.22	2.22	3.33	0.54

^{abc}Mean values in the same row having different superscripts are significantly different (P<0.05)

Table 4: Interaction effect of varying levels of DL-methionine and sodium sulphite on growth performance of broiler chickens.

DL-methionine levels (mg/kg)	0.00			125			250			SEM
Sodium sulphite levels (mg/kg)	0	125	250	0	125	250	0	125	250	
Parameters	D1	D2	D3	D4	D5	D6	D7	D8	D9	
Starter (0-4 weeks)										
Initial weight (g)	39.01	39.22	39.40	39.63	39.30	39.46	39.41	39.51	39.60	0.32
Final weight (g)	419.33 ^b	420.35 ^b	420.45 ^b	420.66 ^b	419.51 ^b	420.59 ^b	424.64 ^b	438.47 ^a	436.95 ^a	1.64
Total weight gain (g)	380.32 ^b	381.13 ^b	381.05 ^b	381.03 ^b	380.12 ^b	381.13 ^b	385.23 ^b	398.96 ^a	397.35 ^a	1.72
Weight gain (g/b/d)	13.58 ^b	13.61 ^b	13.61 ^b	13.61 ^b	13.57 ^b	13.61 ^b	13.76 ^b	14.25 ^a	14.18 ^a	0.06
Feed intake (g/b/d)	38.86 ^b	38.67 ^b	39.50 ^{ab}	39.09 ^{ab}	38.95 ^b	39.58 ^{ab}	39.17 ^{ab}	40.34 ^a	40.32 ^a	0.61
Feed conversion ratio	2.87	2.87	2.88	2.86	2.91	2.87	2.89	2.85	2.86	0.04
Mortality (%)	3.33	4.44	5.56	3.33	3.33	3.33	3.33	3.33	4.44	0.64
Finisher (5-8 weeks)										
-Initial weight (g)	440.46	441.40	441.09	441.78	440.69	440.67	441.15	440.63	441.02	0.57
Final weight (g)	1834.75 ^f	1873.32 ^e	1891.46 ^d	1888.70 ^d	1918.55 ^d	1960.61 ^b	1956.73 ^c	2011.58 ^a	1994.55 ^a	11.69
Total weight gain (g)	1394.29 ^f	1431.92 ^e	1450.38 ^d	1446.93 ^d	1477.86 ^d	1519.94 ^b	1515.58 ^c	1570.94 ^a	1553.53 ^a	11.80
Weight gain (g/b/d)	49.80 ^f	51.14 ^{ef}	51.80 ^{de}	51.68 ^{de}	52.78 ^{cd}	54.28 ^{bc}	54.13 ^{bc}	56.11 ^a	55.48 ^{ab}	0.42
Feed intake (g/b/d)	149.19 ^{ab}	148.35 ^c	150.33 ^{ab}	148.92 ^{bc}	150.54 ^{ab}	150.22 ^{ab}	150.86 ^a	151.88 ^a	150.03 ^a	0.47
Feed conversion ratio	3.00	2.90	2.90	2.88	2.85	2.77	2.79	2.69	2.72	0.03
Mortality (%)	3.33	2.22	3.33	2.22	2.22	3.33	2.22	2.22	3.33	2.22

abcdef Mean values in the same row having different superscripts are significantly different (P<0.05)

Table 5: Main effects of varying levels of DL-methionine and sodium sulphite on cost benefit analysis of broiler chickens.

Parameters	DL –methionine levels				Sodium sulphite levels			
	0	125	250	SEM	0	125	250	SEM
Starter (0-4 weeks)								
Cost of diet (₦/kg)	74.36 ^c	76.05 ^b	77.74 ^a	0.32	75.38	76.05	76.72	0.21
Cost of feed consumed (₦/bird)	81.22 ^b	83.49 ^b	86.96 ^a	1.23	82.40 ^b	83.74 ^{ab}	85.52 ^a	1.14
Operational cost (₦/bird)	27.11	27.11	27.11	0.05	27.11	27.11	27.11	0.05
Cost of production (₦/bird)	108.33 ^b	110.60 ^{ab}	114.07 ^a	2.73	109.51	110.85	112.63	2.61
Feed cost (%)	74.90	75.48	76.23	1.20	75.24	75.46	75.92	1.02
Cost of DOC (₦/bird)	150.00	150.00	150.00	0.10	150.00	150.00	150.00	0.10
Total cost (₦/bird)	258.33 ^b	260.60 ^{ab}	264.07 ^a	1.15	259.51 ^b	260.85 ^b	262.63 ^a	1.13
Total revenue (₦/bird)	294.03 ^b	294.18 ^b	303.35 ^a	2.11	295.08 ^b	298.28 ^a	298.20 ^a	2.10
Benefit (₦/bird)	35.70 ^{ab}	33.58 ^b	39.29 ^a	1.13	35.57	37.43	35.57	1.02
Cost : Benefit ratio	7.24	7.76	6.75	0.10	7.29	7.02	7.44	0.10
Finisher (5-8 weeks)								
Cost of diet (₦/kg)	76.27 ^c	77.96 ^b	79.65 ^a	0.22	77.29	77.96	78.63	0.41
Cost of feed consumed (₦/bird)	318.83 ^c	327.21 ^b	336.59 ^a	2.59	323.91 ^c	327.30 ^b	331.42 ^a	2.25
Operational cost (₦/bird)	42.35	42.35	42.35	1.32	42.35	42.35	42.35	1.32
Cost of production (₦/bird)	361.17 ^c	369.56 ^b	378.94 ^a	2.03	366.25	369.65	373.77	3.72
Feed cost (%)	88.27	88.42	88.83	0.92	88.40	88.57	88.55	1.32
Cost of 28-days old (₦/bird)	400.00	400.00	400.00	0.01	400.00	400.00	400.00	0.01
Total cost (₦/bird)	761.17	769.56	778.94	1.76	766.26	769.65	773.77	1.15
Total revenue (₦/bird)	1311.51 ^c	1366.80 ^b	1396.12 ^a	3.66	1341.64 ^c	1371.32 ^a	1361.46 ^b	4.16
Benefit (₦/bird)	550.34 ^c	597.24 ^b	617.17 ^a	1.67	575.37 ^c	601.67 ^a	587.71 ^b	2.08
Cost : Benefit ratio	1.39	1.29	1.26	0.01	1.34	1.28	1.32	0.01

^{abc}Mean values in the same row having different superscripts are significantly (P<0.05) different

Table 6: Interaction effect of varying levels of DL-methionine and sodium sulphite on cost benefit analysis of broiler chickens.

DL-methionine (mg/kg)	0.00			125			250			
Sodium sulphite (mg/kg)	0	125	250	0	125	250	0	125	250	
Parameters	D1	D2	D3	D4	D5	D6	D7	D8	D9	SEM
Starter (0-4 weeks)										
Cost of diet (₦/kg)	73.69 ^d	74.36 ^d	75.03 ^c	75.38 ^c	76.05 ^{bc}	76.72 ^{ab}	77.07 ^{abc}	77.74 ^a	78.41 ^a	0.32
Cost of feed consumed (₦/bird)	80.17 ^c	80.51 ^c	82.98 ^{bc}	82.51 ^{bc}	82.93 ^{bc}	85.02 ^{ab}	84.53 ^{abc}	87.77 ^a	88.57 ^a	1.23
Operational cost (₦/bird)	27.11	27.11	27.11	27.11	27.11	27.11	27.11	27.11	27.11	0.05
Cost of production (₦/bird)	107.28	107.62	110.09	109.62	110.04	112.13	111.64	114.88	115.68	2.73
Feed cost (%)	74.72	74.81	75.37	75.27	75.36	75.82	75.72	76.40	76.56	1.20
Cost of DOC (₦/bird)	150.00	150.00	150.00	150.00	150.00	150.00	150.00	150.00	150.00	0.10
Total cost (₦/bird)	257.28	257.62	260.09	259.62	260.04	262.13	261.64	264.88	265.68	1.15
Total revenue (₦/bird)	293.53 ^b	294.24 ^b	294.32 ^b	294.46 ^b	293.66 ^b	294.42 ^b	297.25 ^b	306.93 ^a	305.87 ^a	2.11
Benefit (₦/bird)	36.25 ^b	36.62 ^b	34.23 ^{bc}	34.84 ^{bc}	33.62 ^{bc}	32.29 ^c	35.61 ^{bc}	42.06 ^a	40.19 ^a	0.02
Cost : Benefit ratio	7.09 ^b	7.03 ^{ab}	7.59 ^a	7.45 ^a	7.73 ^{ab}	8.11 ^{ab}	7.34 ^b	6.29 ^d	6.61 ^c	0.10
Finisher (5-8 weeks)										
Cost of diet (₦/kg)	75.60 ^d	76.27 ^c	76.94 ^c	77.29 ^{bc}	77.96 ^b	78.63 ^{ab}	78.98 ^{ab}	79.65 ^a	80.32 ^a	1.16
Cost of feed consumed (₦/bird)	315.81 ^e	316.81 ^e	323.85 ^d	322.28 ^d	328.60 ^c	330.74 ^{bc}	333.63 ^{ab}	336.49 ^a	339.66 ^a	2.25
Operational cost (₦/bird)	42.35	42.35	42.35	42.35	42.35	42.35	42.35	42.35	42.35	1.32
Cost of production (₦/bird)	358.16	359.16	366.20	364.63	370.95	373.09	375.98	378.84	382.01	3.72
Feed cost (%)	88.17	88.21	88.44	88.39	88.58	88.31	88.65	88.93	88.91	1.32
Cost of 28-days old (₦/bird)	400.00	400.00	400.00	400.00	400.00	400.00	400.00	400.00	400.00	0.01
Total cost (₦/bird)	758.16 ^e	759.16 ^e	766.20 ^d	764.63 ^d	770.95 ^c	773.09 ^{bc}	775.98 ^{ab}	778.84 ^a	782.01 ^a	1.15
Total revenue (₦/bird)	1281.49 ^d	1313.61 ^{cd}	1339.44 ^{bc}	1362.70 ^b	1368.87 ^b	1368.82 ^b	1380.74 ^b	1431.47 ^a	1376.16 ^b	4.16
Benefit (₦/bird)	523.33 ^c	554.45 ^{bc}	573.24 ^{bc}	598.07 ^b	597.92 ^b	595.73 ^b	604.72 ^{ab}	652.63 ^a	594.15 ^b	2.08
Cost : Benefit ratio	1.45	1.37	1.34	1.28	1.29	1.30	1.28	1.19	1.32	0.01

^{abcde}Mean values in the same row having different superscripts are significantly (P<0.05) different

DISCUSSION

The main effects of DL-methionine and sodium sulphite supplementation revealed improved final weight, total weight, weight gain/b/d and mortality at the starter phase of the birds. Significant improvement in growth performance was reported by Meirelles *et al.* (2003) when birds were fed supplemental DL-methionine.

This study corroborated the observation of Chattopadhyay *et al.* (2006) who reported improved growth performance, dressing percentage and breast yield in broilers with DL-methionine supplementation at rate of 15g/kg. Sodium sulphite supplementation revealed similar result with DL-methionine. The improved performance observed with sodium sulphite supplementation could be attributed to increased water consumption and efficient nutrient utilization due to extra Na and decrease in pH due to sulphite anion as reported by Ruiz-Feria *et al.* (2011). The finisher phase followed the same trend with the starter. The improved performances could be linked to influence of sodium (Na^+) as the principal cation of extracellular fluid involved in absorption of glucose and amino acid (Morgin, 1980; Leeson and Summer, 2001). Also, increased age at finisher phase could enhance nutrient digestion and absorption. Improvement in performance was observed with the interaction of DL-methionine and sodium sulphite supplementation. Sulphite induces oxidative reductive depolymerisation of starch polysaccharide (Paterson *et al.*, 1997). This potential of sulphite together with the ability of methionine in reducing long chain fatty acids could responsible for the improved synergetic interaction effect on the growth response.

The profit obtained from broilers depend on improved growth performance. This implies that supplementation of DL-methionine and sodium sulphite did not has

adverse effect on the economics of production of broiler chickens. The significant differences observed for the weight gain as growth response translated to significant effects of parameters for the cost benefit analysis. Profit margin from broiler chickens depend on the carcass yield and feed conversion ratio as a lower feed efficiency ratio being an indication of appreciable economic gain in term of turning feed to flesh. This is the bases for all the parameters considered to determine the economic viability using DL-methionine and sodium sulphite. The result of feed cost as percentage of total cost of production varied between 74.72% – 76.56% for starter and 88.17% - 88.93% for finisher. This observation did not agreed with the study of Singh *et al.*, 2010 who reported 56.23% - 70% as the range for feed cost in broiler production.

CONCLUSION AND RECOMMENDATIONS

Dietary supplementation of DL-methionine and sodium sulphite in diet of broiler chickens from this study revealed an improved final weight, weight gain and feed intake at both starter and finisher phases. Statistically higher significant ($P < 0.05$) values were recorded for final weight, total weight gain and weight gain/b/d in the birds fed diet containing 250 mg/kg DL-methionine with 125 mg/kg sodium sulphite (D8) and diet containing 250mg /kg DL-methionine with 250 mg /kg sodium sulphite (D9) compared to other dietary treatment groups. Birds fed diet containing 250 mg/kg DL-methionine with 125 mg/kg sodium sulphite (D8) recorded highest numeric values for growth response. 250 mg/kg DL-methionine with 125 mg/kg sodium sulphite could be a veritable additives for efficient tissue build up and optimum performance of broiler chickens. Further researches are required to investigate other chelated Sulphur sources for efficient utilization of cassava in poultry diets.

REFERENCES

- Aduku, A.O. (2004). Animal production in the Tropics. Feed and Feeding, Pasture Management, Monogastric and Ruminant Nutrition. Davcon Computer and Business Bureau Zaria, Nigeria.
- Anaeto, M. and Adighibe, L.C. (2011). Cassava root meal as a substitute for maize in layers ration. *Revista Baseileira de Ciencia Avicola*, (13): 2.<http://dx.doi.org/10.1590/s1516-635x2011000200010>.
- Chattopadhyay, K., Mondel, M.K. and Roy, B. (2006). Comparative Efficacy of DL-methionine and Herbal methionine on performance of broiler chicken. *International Journal of Poultry Science* 5(11): 1034 – 1039.
- Dairo, A. (2011). Utilization of ensiled metabolizable mixture of cassava peel and caged layers manure as energy source in broiler diet. *African Journal of Food, Agriculture, Nutrition and Development*. 11 (5): 5110-5124.
- Ekenyem, B. U. and Madubuike, F. N. (2006). An assessment of *Impomoea asarifolia* leaf meal as feed ingredient in broiler chick production. *Pakistan Journal of Nutrition*. Vol. 5(1): 46 – 50.
- FAO. (1996). Food and Agriculture Organization. Food outlook. Pp. 19-30.
- Ferket, P.R. and Gernat, A.G. (2006). Factors that affect feed intake of meat birds: A review. *International Journal of poultry Science*. 5: 905-911.
- Hill, D.C. (1977). Physiological and biochemical response of Rat given potassium cyanides or Linamarin. Poc. Workshop on cassava feed by B. Nestle and M. Graham. (Eds) pp. 21-25.
- Hutagalung, R. I. (1977). Additives other than methionine. In Mestel, B. and Graham, M. eds., *Cassava as Animal Feed*. Proceedings of a workshop held at the University of Guelph, 18 – 20 April, 1977. Ottawa, International Development Research Centre, IDRC-095e, 18 – 32.
- Ikwelle, M. (1999). Director Keynotes. Annual review and planning workshop of the national root crop research institute, Umudike, Abia State, Nigeria. February 1999.
- Leeson, S. and Summers, J.D. (2001). Scott's Nutrition of the Chicken, (4th Edn.), Academic press. Guelph, Ontario, Canada, pp: 466-468.
- McDonald, P., Edward, R.A., Greenhalgh, J.F.D. and Morgan, C.A. (1995). Animal Nutrition 5th edition Longman Group Limited United Kingdom.
- Medugu, C., IKwari, I.D., Igwebuke, J., Nkana, I., Muhammed, I.D. and Hamaker, B. (2010). Performance and economic of production of broiler chicken fed sorghum or millet as replacement for maize in the semi-arid zone of Nigeria. *Agric Biol. J. N.Am* 1(3): 321-325.
- Meirelles, H.T., Albuquerque, R., Borgatti, L.M.O., Souza, L.W.O., Meister, N.C. and Lima, F.R. (2003). Performance of broilers fed with different levels of methionine hydroxy analogue and DL-methionine. *Journal Poultry Science*. 5: 69-74.
- Morgin, P. (1980). Recent advantages in dietary anion cations balance: Applications in poultry. *Proc. Nutrition. Society*. Vol. 40. P. 285–294.

- Ngiki, Y.U., Igwebuke, J.U. and Moruppa, S.M. (2014). Effect of replacing maize with cassava root-leaf meal mixture on the performance of broiler chickens. *International Journal of Science and Technology* 3 (6).
- Obih, T.K. (2009). Replacement value of Bambara seed (*Vignasubteranea* (L) Verdc) Offal for soya bean meal on the performance of growing pigs and broilers. Ph.D thesis, Imo state University, Owerri, Nigeria.
- Ojewola, G.S., Okpara, O.E. and Ndupu, O. (1999). The substitution value of cassava meals supplemented and unsupplemented with palm oil for maize in broiler diet. *Journal Animal Veterinarv Adv.* 5 (6): 478-482.
- Paterson, L.A., Hill, S.E., Mitchell, J.R. and Blanshard, J.M.V. (1997). Sulphite and oxidative-reductive depolymerization reactions. *Food Chememistry.* 60: 143–147.
- Ruiz-Feria, C.A., Larrison, E., Davis, M., Fernell, M., Carey, J., Grimes, J.L and Pitts, J. (2011). Supplementation of feed grade sodium bisulphite in broiler diets improved feed efficacy. *International Journal of Poultry Science* 10(9): 670 – 676.
- Singh, V.P., Sharma, V.K., Sidhu, M.S. and Kingra, H.S. (2010). Broiler production in Punjab. *An Economic Analysis. Agricultural Economic Research Review* 23: 315- 324
- SPSS (2012). Statistical package for social sciences, version 21. USA IBM Corporation.
- Tewe, O.O. and Bokanga, M. (2005). Cost effectiveness of cassava plant based rations in poultry and pigs. *Proceeding of the ISTRC, Africa Branch (IITA)* 10-11 November 2001. Ibadan, Nigeria.

EFFECTS OF PROCESSING TEMPERATURE AND HOLDING TIME ON NUTRITIONAL PROPERTIES OF CHICKEN TABLE EGGS POWDER

Umar, M. M., Muhammad, B. F. and Abubakar, M.

Department of Animal Science, Federal University of Kashere, Gombe State, Nigeria

E-Mail: mmumar83@gmail.com Mobile: 08060936902

ABSTRACT

Effect of processing temperature (40, 50 and 60°C) and holding time (4, 5 and 6 hours) on nutritional and functional properties of chicken eggs powder were determined in a completely randomized design with 3x3 factorial arrangements in 4 replicates. The results showed that temperature and holding time of 40°C:4 hours and 40°C:6 hours had the highest moisture (8.16%) and crude protein (19.83%) contents while temperature and holding time of 60°C:6 hours and 40°C:6 hours recorded the highest ash (1.33%) and fat (10.92%) contents, respectively. The linear regression coefficient indicated that temperature had strong negative effect on moisture ($R^2=-1.326$), crude protein ($R^2=-2.621$) and fat ($R^2=-0.963$). From the result, it could be concluded that the nutrients compositions of chicken eggs powder were not adversely affected by processing temperature and holding time of the study. Hence, it could be incorporated as nutritive ingredient in the production of food products.

Key words: processing, temperature, holding time, egg powder

INTRODUCTION

Nigeria is a country with heavy human population and this population is continuously on the rise. This increase had led to the high demand for the available animal and poultry products in all parts of the country. Among the cheapest and highly affordable animal protein source for this teeming population is an egg. The poultry industry is an important segment of Nigeria's food industry, providing egg to a large populace. Egg is one of the most versatile and near perfect food in nature. It is rich in protein, vitamins and most mineral substances, the white and yolk components are all of high biological value and are readily digested. They are known to supply one of the best protein (Vaclavik and Christian, 2008; Kumaravel *et al.*, 2012).

Egg is a complete protein with excellent quality; one egg will give 6g of protein and egg-white protein has a biological value of 100, the highest biological value of any single protein (FAO, 2005). The nutritional status of many Nigerians is characterized by low protein intakes (FAO 2005). The average daily animal protein intake is still far less than the 35 g per adult per day recommended by FAO (2007).

Adepoju (2008) and Nmadu *et al.* (2014) reported the average *per capita* protein intake in Nigeria as 51.7 g of which only 6.8 g came from animal sources. However, in developed countries, the average *per capita* protein intake was 90 g with more than 65 g of animal protein. However, fresh eggs are difficult to transport because of their bulkiness, fragility and high perishability nature (Jay, 2000; Kumaravel *et al.*, 2012).

The current technological procedures of egg powder production are to wash, break, filter and pasteurize the egg liquid produced, dry them whole or into their various components of egg white and yolk. Several processing and preservation methods like spray drying, tray drying and freeze drying techniques have been adopted with repercussion on qualities of the products (Potter and Hotchkiss, 2006)

This study is therefore aimed at determining the effect of processing temperature and holding time on nutritional properties of chicken egg powder.

MATERIALS AND METHODS

Experimental Eggs

A total of one hundred and eighty (180) fresh eggs (laid less than 24 hours) were used for the experiment. The eggs were purchased from poultry unit of the Department of Animal Science Bayero University Kano.

Experimental Design

The experiment was laid in a 3x3 factorial arrangement of a completely randomized design, which include 3 oven temperatures (40, 50 and 60 °C) and 3 holding times (4, 5 and 6hrs) in 4 replicates.

Preparation and drying of experimental eggs

Fresh eggs (laid less than 24 hours) were used for this trial. The eggs were candled to confirm their freshness. Eggs were deshelled. These were later homogenized with a metal whisk during which 0.5 ml of hydrogen peroxide solution was added to free the products from microorganism and to prevent browning of products as reported by (Desrosier, 1977). The samples were later oven dried at temperature of 40, 50 and 60°C respectively with holding times of 4, 5 and 6hrs for each temperature and allowed to cool. The egg flakes were scooped, milled and sieved. The egg powders were packed into different plastic films for determination of Nutritional properties.

Determination of Nutritional Properties

The crude protein was determined using Kjeldahl method. The fat content was determined using reflux soxhlet method. The ash content was determined by igniting 2 g of sample at 550°C in a furnace. The moisture content of the sample was determined by drying 2 g of sample to a constant weight at 100°C. AOAC (1999) was used to determined Nutritional properties.

Data Analysis

Data generated was subjected to Analysis of variance using SPSS Version 20.0. Differences among means were separated using Least Significant Different (LSD) at 5% level of probability. Correlation and regression analysis were carried out to predict and establish the nature and strength of the relationship between the factors and the variables.

RESULTS AND DISCUSSION

The Fat, Moisture and Ash values (Table 1-3) compared favorably with the findings of Ndife *et al.* (2010) who reported Fat, Moisture and Ash values of 8.94%, 6.74% and 1.02% respectively for whole eggs oven dried at 44°C for 4 hours, this is also in line with the findings of Kumaravel *et al.* (2012). However, the crude protein obtained was lower than 45.2% reported by Ndife *et al.* (2010). The moisture contents were low enough to extend the shelf life of powdered chicken eggs in environment of low humidity (Jay, 2000; Kumaravel *et al.*, 2012).

Table. 1: Effects of temperature on nutritional properties of chicken eggs powder

Nutritional Properties (%)	Temperature (°C)			SE
	40	50	60	
Moisture	8.07 ^a	7.11 ^b	5.41 ^c	0.114
Crude protein	17.66 ^a	18.08 ^a	11.92 ^b	0.526
Ash	1.16	1.01	1.14	0.087
Fat	10.50 ^a	9.50 ^b	8.57 ^c	0.193

^{abc} means in the same row with different superscripts differ significantly (p<0.05), SE= standard error and ns= not significant

Table. 2: Effects of holding time on Nutritional Properties of chicken eggs powder.

Nutritional Properties (%)	Holding time (hours)			SE
	4	5	6	
Moisture	6.82	6.91	6.84	0.114
Crude protein	15.31	15.71	16.14	0.526
Ash	1.19 ^a	0.84 ^b	1.27 ^a	0.087
Fat	9.96 ^a	9.17 ^b	9.41 ^{ab}	0.193

^{abc} means in the same row with different superscripts differ significantly ($p < 0.05$), SE= standard error and ns= not significant

Table.3: Interaction effects of temperature and holding time on nutritional properties of chicken eggs powder.

Temperature(°C)/HoldingTime(hours)	Nutritional properties (%)			
	Moisture	Crude protein	Ash	Fat
40x4	8.16 ^a	15.60 ^b	1.19 ^{ab}	9.94 ^{ab}
40x5	8.01 ^a	16.06 ^b	0.87 ^b	10.63 ^{ab}
40x6	8.04 ^a	19.83 ^a	1.42 ^a	10.92 ^a
50x4	7.08 ^b	17.74 ^{ab}	1.23 ^{ab}	10.10 ^{ab}
50x5	7.17 ^b	18.83 ^a	0.73 ^b	8.86 ^b
50x6	7.07 ^b	17.65 ^{ab}	1.07 ^{ab}	9.42 ^b
60x4	5.23 ^c	12.60 ^c	1.17 ^{ab}	9.83 ^b
60x5	5.56 ^c	12.24 ^c	0.91 ^b	8.01 ^c
60x6	5.45 ^c	10.93 ^c	1.33 ^{ab}	7.89 ^c
SE	0.197	0.911	0.151	0.334

^{abc} means in the same column with different superscripts differ significantly ($p < 0.05$), SE= standard error and ns= not significant

Table 4: Pearson correlation among nutritional properties of chicken eggs powder

Parameters	Moisture	Crude protein	Ash	Fat
Moisture	1	0.313 ^{ns}	0.155 ^{ns}	-0.200 ^{ns}
Crude protein	–	1	-0.202 ^{ns}	0.440 ^{ns}
Ash	–	–	1	0.159 ^{ns}
Fat	–	–	–	1

ns= not significant

Table 5: Linear regression among nutritional properties of chicken eggs powder

Variables	Coefficient (R ²)		
	Temperature (°C)	Holding time (hours)	Constant
Moisture	-1.326 ^{***}	0.013 ^{ns}	9.487 ^{***}
Crude protein	-2.621 ^{***}	0.414 ^{ns}	20.131 ^{***}
Ash	-0.011 ^{ns}	0.039 ^{ns}	1.046 ^{***}
Fat	-0.963 ^{***}	-0.272 ^{ns}	11.981 ^{***}

*** $p < 0.001$, ns= not significant and R²= Regression coefficient

The Pearson correlation among the nutritional properties showed no significant relationship, this in line with the findings of Ndife *et al.* (2010). The linear regression among nutritional properties indicated that temperature had strong negative effect on moisture, crude protein and fat, this statement agreed with the findings of Kumaravel *et al.* (2012). However, no significant effect was recorded on Ash due to temperature. In addition, there were no significant effects on nutritional properties of powdered chicken eggs due to holding time.

CONCLUSION AND RECOMMENDATION

It was concluded that chicken eggs could be powdered at 60°C temperature and 6 hours holding time without adversely affecting the nutritional properties for shelf-life extension. Therefore, it is recommended that powdered eggs could be incorporated as nutritive ingredient in the production of other food products.

REFERENCES

- Adepoju, A. A. (2008). Technical Efficiency of egg production in Osun State *International Journal of Agricultural Economics and Rural Development* **1**(1): 7-14
- AOAC (1999). **Official Method of Analysis** of the Association of Analytical chemists 14th Edn. Washington D.C., Pp. 1094
- Desrosier, N. W. (1977). *Element of Food Technology*. AVI Publishing company, India.
- FAO (2005) Food and Agricultural Organisation of United Nations. Recommended Nutrient Intake for Malaysia Pp. 52-65, FAO, Rome.
- FAO (2007). Composition analysis methods in: Food and Agricultural organization of the United Nations (Ed.) *Manual of food quality control, food analysis. General techniques, additives, contaminants and composition*. Rome Food and Agricultural Organisation, Pp. 203-232
- Jay M. J. (2000). *Modern Food Microbiology*. 6th ed. Aspen Publishers Inc., Gaithersburg, Maryland
- Kumaravel, S., Hema, R. and Kamaleshwari, A. (2012). Effect of Oven drying on Nutritional Properties of Whole egg and its components. *International Journal of Food and Nutrition Science* **1**(1): 4-12.
- Ndife, J. , Udobi, Chinweizu, E. and Nuria, A. (2010). Effect of Oven drying on the Functional and Nutritional properties of Whole egg and its Components. *African Journal of Food Science* **4**(5): 254-257
- Nmadu, J. N., Ogidan, I.O. and Omolehin, R.A. (2014). Profitability and Resource use efficiency of poultry egg production in Abuja, Nigeria. *Kasetsart Journal of Social Science* **35**: 134-146.
- Potter, N. and Hotchkiss J. (2006). *Food science* 5th ed. CBS Publishers and Distributors, Delhi, India.
- Vaclavik , A. V. and Christian, W. E. (2008). **Essential of Food Science**. Springer Science Business Media, LLC New York Pp. 205-230.

GROWTH PERFORMANCE, HAEMATOLOGICAL AND SERUM BIOCHEMICAL INDICES OF STARTER BROILER CHICKENS FED SORGHUM BASED DIETS WITH PHYTASE ENZYME INCLUSION

*Oguntoye, M.A., Akintunde, A.R., Ardo, B.A., Mafindi, U.M., Daudu, D.B. and Marcel, G.

Department of Animal Science,
Taraba State University, Jalingo.

Corresponding author's email: ingenuityma@gmail.com

Mobile Phone: +234-8039550374

ABSTRACT

A study was conducted to investigate the effect of graded levels of sorghum as a replacement for maize on growth performance, haematological and serum biochemical indices of starter broiler chickens. One hundred and five day-old broiler chicks of mixed sexes were used for investigation which lasted for 28 days. Five diets were formulated to contain 0% (Control), 25%, 50%, 75% and 100% replacement levels of sorghum in a completely randomized design. Statistically, higher similar values of 921.32g, 921.29g and 921.20g were obtained for final weight in the birds fed diets containing; 0%, 25% and 50% sorghum (D1, D2 and D3) respectively at comparative level to other dietary groups. Values recorded for FCR were not significantly ($p > 0.05$) affected. White blood cell (WBC), mean corpuscular haemoglobin concentration (MCHC) and mean corpuscular haemoglobin (MCH) were the haematological parameters significantly ($p < 0.05$) influenced by dietary treatments. Numerically, birds on diet containing 50% sorghum (D3) revealed least ($p < 0.05$) value of $2.90 \times 10^9/L$ for WBC among dietary groups compared to $4.55 \times 10^9/L$ recorded for birds fed 100% sorghum (D5). Higher ($p < 0.05$) values of 30.70 g/dl, 30.50 g/dl and 30.70 g/dl were recorded for MCHC in birds fed diets containing 50%, 75% and 100% levels of sorghum respectively. MCH showed numerical similar values though statistically different. Higher value of 27.70 pg and least value of 26.15 pg were recorded for birds fed diet containing 100% sorghum (D5) and 25% sorghum (D2) respectively. Higher value of 43.00g/l was obtained for total protein in birds fed 25% sorghum with enzymes inclusion. The total protein did not follow any definite pattern with birds in D3 and D5 had similar values (34.40g/l for D3 and 33.70g/l for D5). It was concluded that sorghum with enzyme inclusion as a replacement for maize could be efficiently utilized and tolerated by starter broiler chicks at 25% and 50% inclusion levels for improved performance without negative effect.

Key words: Sorghum, phytase, haematology, serum biochemistry, broiler.

INTRODUCTION

The challenge of inadequate supply of animal protein with emphasis on poultry protein has been blamed on high cost of conventional feedstuff. High feed cost is the major constraint for further progress of the poultry industry (Esonu *et al.*, 2006; Sharif *et al.*, 2012). Cereal grains account for about 50-60% of a typical broiler diet where this feed ingredients serve as a principal energy source for poultry. Maize has remained the chief energy source in compounded diets and constitutes about 50% of poultry diet (Ajaja *et al.*, 2002). In poultry nutrition, energy is used for the provision of body heat, maintenance, growth and production (Inaku *et al.*, 2011). However, dependence on corn grain becomes a problem in feed formulations

due to its unavailability, expensive or poor quality and competition between human beings and poultry. This has compelled the nutritionists to explore new and non-conventional feedstuff.

In regard to the nutritive value, cost and availability, sorghum can compete favourably as the next alternative to maize in poultry feed (Hancock, 2000). However, presence of high level of tannins, variable amounts of phytate and possibly polyphenols in the sorghum grain may act as anti-nutritional factors (Doka *et al.*, 2004; Selle *et al.*, 2010). These factors can negatively influence the nutritive properties of sorghum and therefore cause negative effects on feed intake, palatability, digestibility of nutrients and growth performance (Hassan *et al.*, 2003;

Kim and Miller, 2005). Researchers used sorghum in chicken diets (Robertson and Perez-Maldonado, 2006; Campos *et al.*, 2007; Medugu *et al.*, 2010) but revealed contradictory results. One of the methods of tackling problem of anti-nutritional factor is the use of enzymes as feed additives to improve the growth, nutrient digestibility, improvement of feed efficiency and as a result increase economic indicators (Selle *et al.*, 2010; Ibrahim *et al.*, 2012).

Phytase enzymes improve the digestibility and availability of proteins, optimizing diet costs by allowing lower quality protein feed ingredients to be used in the diet. This helps reduction in feed costs, as grain prices continue to fluctuate. Researchers have also been digging into the additional benefits of the protease enzyme and its link to gut health and bacteria balance in poultry. Phytase enzymes are important factor in protein digestion as they hydrolyse the less digestible proteins in animal feeds and break them down into more usable peptides (Cadogan *et al.*, 2005).

Table 1: Percentage composition of experimental diet for broiler chicks (0 – 4 weeks)

Ingredients	0%	25%	50%	75%	100%
Maize	52.00	39.00	26.00	13.00	0.00
Sorghum	0.00	13.00	26.00	39.00	53.00
Soya bean meal	19.00	19.00	21.30	19.50	23.40
Groundnut cake	16.70	17.70	14.00	15.40	11.00
Fish meal	3.00	3.00	3.00	3.00	3.00
Rice offal	4.95	4.95	5.35	5.75	6.25
Bone meal	2.00	2.00	2.00	2.00	2.00
Limestone	1.50	1.50	1.50	1.50	1.50
Lysine	0.10	0.10	0.10	0.10	0.10
Methionine	0.20	0.20	0.20	0.20	0.20
Salt	0.25	0.25	0.25	0.25	0.25
Premix	0.25	0.25	0.25	0.25	0.25
Phytase enzyme	0.00	0.05	0.05	0.05	0.05
Total	100	100	100	100	100
Calculated analysis					
Metabolizable Energy (kcal/kg)	2862.70	2835.40	2801.63	2769.90	2734.00
Crude protein (%)	23.54	23.78	23.85	23.96	23.97
Fibre (%)	3.03	3.02	3.01	3.01	2.99
Fat (%)	4.11	4.10	3.90	3.82	3.57
Calcium (%)	1.19	1.19	1.20	1.30	1.21
Phosphorus (%)	0.47	0.49	0.53	0.56	0.59
Lysine (%)	1.30	1.26	1.30	1.28	1.33
Methionine (%)	0.55	0.54	0.53	0.51	0.50

Data Collection

Growth Performance

MATERIALS AND METHODS

Design and management of the birds

A total of one hundred and five unsexed day old broiler chicks after one week of acclimatization were randomly allotted to five dietary treatments of twenty one birds each. The birds were replicated three times with 7 birds per replicate in a complete randomized designed (CRD). Birds were raised on deep litter system for the period of the experiment. Feed and water were provided *ad libitum* and routine medication and management were duly followed.

Experimental diets

Five isonitrogenous diets were formulated for broiler chicks during the period of the study. Diet 1 which serves as control contain 0% of sorghum (*Sorghum bicolor*). In the other remaining four diets, 25%, 50%, 75% and 100% of maize in the control diet was replaced with sorghum as diet 2, 3, 4 and 5 respectively. Diet 2, 3, 4 and 5 were supplemented with 0.05kg phytase enzyme as presented in Table 1.

The chicks were weighed at the commencement of the study and subsequently on weekly basis for four weeks. The feed intake was calculated on daily basis as feed offered minus feed leftover.

$$\text{Feed intake/bird (g)} = \frac{\text{Quantity of feed fed} - \text{Quantity of feed left over}}{\text{Number of birds} \times 28 \text{ days}}$$

$$\text{Daily weight gain (g)} = \frac{\text{Final live weight} - \text{Initial weight}}{\text{Number of birds} \times 28 \text{ days}}$$

$$\text{Feed conversion ratio} = \frac{\text{Quantity of feed consumed}}{\text{Weight gain}}$$

Collection of blood sample

At the end of the feeding trial, 4ml of blood was collected from two birds per replicate that is, six from each treatment. The blood was collected through the wing vein with a syringe. 2ml of blood sample was transferred into a bottle containing Ethylene Diamine Tetra Acetic Acid (EDTA) for haematological analyses. The parameters determined include Packed Cell Volume (PCV), White Blood Cell (WBC), Haemoglobin (Hb), Red Blood Cell (RBC), Mean Corpuscular Haemoglobin Concentration (MCHC), Mean Cell Haemoglobin (MCH) and Mean Cell Volume (MCV)

Another two mills of blood sample collected was transferred into a plain bottle for serum analysis. The serum metabolite such as Serum Total Protein, Albumin, Globulin, Cholesterol, Creatinine, and Uric Acid were determined.

Statistical Analysis

Data collected were subjected to analysis of variance using the SPSS software (2012). Where analysis of variance indicated significant treatment effects, means were compared using Duncan's New Multiple Range Test (DNMRT) (SPSS, 2012).

RESULTS

The results of growth performance characteristics of starter broiler chickens fed

maize-sorghum based diet supplemented with phytase enzyme were presented in Table 2. Result revealed that varying levels of sorghum as a replacement for maize significantly ($p < 0.05$) influenced parameters investigated except daily weight gain and feed conversion ratio. Statistically, higher similar values of 921.32g, 921.29g and 921.20g were obtained for final weight in the birds fed diets containing; 0%, 25% and 50% sorghum (D1, D2 and D3) respectively at comparative level to other dietary groups. Birds fed 100% replacement level of sorghum recorded least significant ($p < 0.05$) value of 917.90g. Similar trend was observed for weight gain. Birds fed diet containing 0%, 25% and 50% levels of sorghum revealed higher ($p < 0.05$) similar values of 776.25g, 776.99g and 776.38g respectively for weight gain. Values recorded for daily weight gain were not significantly ($p > 0.05$) affected by dietary treatments. Least ($p < 0.05$) statistical values of 59.70 g/bird, 59.96 g/bird and 59.91 g/bird were recorded for daily feed intake in the birds fed diet containing 0%, 25% and 50% levels of sorghum respectively. Birds fed diet containing 75% and 100% levels of sorghum recorded higher ($p < 0.05$) statistical values of 61.77g/bird and 62.16 g/bird respectively at comparative level. Values recorded for FCR were not significantly ($p > 0.05$) affected and were numerically similar.

Table 2: Growth response of starter broiler chickens fed maize-sorghum based diets with enzyme inclusion

	0% Sorghum D1	25% Sorghum D2	50% Sorghum D3	75% Sorghum D4	100% Sorghum D5	
Parameter						SEM
Initial weight (g)	145.07	144.31	144.81	145.46	144.85	0.15
Final weight (g)	921.32 ^a	921.29 ^a	921.20 ^a	919.72 ^{ab}	917.90 ^b	0.47
Weight gain (g/bird)	776.25 ^a	776.99 ^a	776.38 ^a	774.26 ^{ab}	773.05 ^b	0.51
Daily weight gain (g/bird)	36.96	37.00	36.97	36.87	36.81	0.02
Daily feed intake (g/bird)	59.70 ^b	59.96 ^b	59.91 ^b	61.77 ^a	62.16 ^a	0.33
FCR	1.61	1.62	1.62	1.67	1.69	0.10

^{ab}Mean values in the same row having different superscripts are significantly different (P<0.05)

The result of haematological and serum biochemical parameters of starter broiler chickens fed maize-sorghum based diet supplemented with phytase enzyme were presented in Table 3. White blood cell (WBC), mean corpuscular haemoglobin concentration (MCHC) and mean corpuscular haemoglobin (MCH) were the parameters significantly ($p < 0.05$) influenced by dietary treatments. Varying levels of sorghum supplemented with phytase enzyme had no significant ($p > 0.05$) influence on PCV, Hb, RBC and MCV. PCV, though not significantly ($p > 0.05$) influenced showed higher ($p > 0.05$) numerical value of 23.00 % in the birds fed 0% sorghum (control) and 100% sorghum (D5) compared to other dietary groups. Values range of 6.50 – 7.05g/dl and $2.40 - 2.67 \times 10^{14}/L$ recorded for haemoglobin and RBC were numerically close for the respective parameters. Numerically, birds on diet containing 50% sorghum (D3) revealed least ($p < 0.05$) value of $2.90 \times 10^9/L$ for WBC among dietary groups compared to $4.55 \times 10^9/L$ recorded for birds fed 100% sorghum (D5). Although values recorded for MCHC were numerically similar, statistical higher ($p < 0.05$) values of 30.70 g/dl, 30.50 g/dl and 30.70 g/dl were recorded for birds fed diets containing 50%, 75% and 100% levels of sorghum respectively. MCH showed numerical similar values though statistically different. Higher statistical value of 27.70 pg

and least value of 26.15 pg were recorded for birds fed diet containing 100% sorghum (D5) and 25% sorghum (D2) respectively. MCV though not significantly affected showed higher ($p > 0.05$) numeric value of 90.25fl and 90.30fl for birds on control diet (D1) and 100% sorghum (D5) respectively at comparative level.

The result of serum biochemistry indices revealed significant ($P < 0.05$) influence on glucose, total protein, albumin, globulin, uric acid and cholesterol. Birds fed diet containing 75% sorghum with enzymes inclusion (D4) showed high significant ($P < 0.05$) value of 12.40mmol/l for glucose and birds on control diet had least ($P < 0.05$) value of 9.00mmol/l. Higher statistical value of 43.00g/l was obtained for total protein in birds fed 25% sorghum with enzymes inclusion. The total protein did not follow any definite pattern with birds in D3 and D5 had similar statistical values (34.40 Vs 33.70). Birds fed diet containing 75% sorghum with enzymes inclusion (D4) and control diet (D1) recorded statistical similar values 36.60g/l and 39.80g/l respectively.

Result on albumin revealed that birds in control diet had higher ($P < 0.05$) value of 16.05 and birds fed 100% sorghum with enzyme inclusion (D5) being the least. Birds on other three dietary groups (D2, D3, and D4) revealed statistical similar values of 13.65g/l, 13.86g/l, and 13.20g/l respectively.

Globulin showed similar pattern with total protein with birds on diet containing 25% sorghum with enzymes inclusion (D2) shown high ($P < 0.05$) value of 29.35g/l for globulin compared to other dietary groups. Birds fed control diet recorded high significant ($p < 0.05$) value of 223.10 μ mol/l for uric acid and least statistical value of 86.24 μ mol/l was recorded for the birds on 100% sorghum

with enzyme at comparative level. Statistical similar values were recorded for uric acid in the birds fed diet containing 25% and 50% levels of sorghum with enzyme inclusion. Cholesterol values were statistically similar for birds on D4 and control diet D1, while birds on D2, D4 and D5 revealed similar high significant values of 3.90mmol/l, 3.80mmol/l and 3.86mmol/l respectively.

Table 3: Haematological and serum biochemical parameter of starter broiler chickens fed sorghum based diets supplemented with enzyme

Parameter	0% Sorghum D1	25% Sorghum D2	50% Sorghum D3	75% Sorghum D4	100% Sorghum D5	SEM
PCV (%)	23.00	22.00	21.50	21.50	23.00	0.34
HB (g/dl)	6.80	6.50	6.60	6.55	7.05	0.09
RBC ($\times 10^{14}$ /L)	2.55	2.66	2.40	2.44	2.55	0.05
WBC ($\times 10^9$ /L)	3.13 ^b	3.60 ^b	2.90 ^b	3.60 ^b	4.55 ^a	0.19
MCHC (g/dl)	29.6 ^b	29.60 ^b	30.70 ^a	30.50 ^a	30.70 ^a	0.15
MCH (pg)	26.70 ^{ab}	26.15 ^b	27.50 ^{ab}	26.7 ^{ab}	27.7 ^a	0.28
MCV (fl)	90.25	89.96	89.60	87.75	90.30	0.54
Glucose(mmol/l)	9.00 ^c	10.55 ^b	9.65 ^{bc}	12.40 ^a	10.00 ^{bc}	1.52
T. Protein(g/l)	39.80 ^{ab}	43.00 ^a	34.40 ^b	36.10 ^{ab}	33.70 ^b	1.27
Albumin(g/l)	16.05 ^a	13.65 ^{ab}	13.86 ^{ab}	13.20 ^{ab}	12.40 ^b	0.50
Globulin(g/l)	23.75 ^b	29.35 ^a	20.53 ^b	22.90 ^b	21.30 ^b	0.99
Uric acid(μ mol/l)	223.10 ^a	145.80 ^{ab}	150.25 ^{ab}	172.55 ^b	86.24 ^b	18.06
Creatinine(μ mol/l)	45.60	39.60	43.20	49.29	39.60	1.52
Cholesterol(mmol/l)	3.00 ^b	3.90 ^a	2.90 ^b	3.80 ^a	3.86 ^a	0.13

^{abc}Mean values in the same row having different superscripts are significantly different ($P < 0.05$)

Hb = Haemoglobin, PCV = Packed Cell Volume, RBC = Red Blood Cell, WBC = White Blood Cell, MCV = Mean Cell Volume, MCHC = Mean Corpuscular Haemoglobin Concentration, MCH = Mean Corpuscular Haemoglobin.

DISCUSSION

Growth performance as observed in this study revealed an improvement with varying level of sorghum with enzyme inclusion. Ranged ($p < 0.05$) value of 917.90g – 921.32g recorded for final weight in this study was close to value of 948.00g reported by Oladipo *et al.* (2015) when broiler chickens were fed maize-sorghum based diet supplemented with phytase enzyme. Similarly values obtain for final weight and daily feed intake in this study fell within the normal range of 845g – 924g and 56.30g –

61.80g respectively as reported for broiler chicken fed diets supplemented with antibiotic growth promoter (Onimisi *et al.*, 2017). Improved final weight with enzyme inclusion as observed in this study could be attributed to ability of exogenous enzyme to hydrolyse non – starch polysaccharides and consequently reduced the negative effect of polysaccharide by making the nutrients available for birds.

The improved value for weight gain as observed in this study could be associated with efficient feed utilization. Enzyme

improved the overall feed utilization by causing degradation of fibre and non – starch polysaccharide (NSP) component of sorghum based diet into soluble metabolizable energy (Choct, 2006). This improvement in feed intake could be attributed to the ability of enzyme to reduce the viscosity of gut contents thereby reduced transit period and consequently improve feed intake (Ani and Nnamani, 2011).

Haematological parameters investigated revealed ranged values of 21.50% - 23.00% for PCV. This value obtained for PCV was close to the range value of 24.00% - 28.00% reported for broiler chickens (Onimisi *et al.*, 2017). Ranged value of 6.50g/dl – 7.05g/dl recorded for haemoglobin as reported in this study were closer to 7g/dl – 11.00g/dl reported for broiler chicken fed diets containing garlic granule. (Ekine *et al.*, 2017). Improved values record for PCV and haemoglobin as obtained in this study could be an indication that the bone marrow of the birds were functioning properly and revealing the absence of microcytic and hypochronic anaemia. PCV and haemoglobin are descriptors of the function and concentration of red blood cell (Kenedy, 2011). Significant ($p < 0.05$) value of $2.90 \times 10^9/L$ – $4.55 \times 10^9/L$ recorded for WBC corroborated the ranged value of $3.10 \times 10^9/L$ – $5.67 \times 10^9/L$ reported by Oladipo *et al.* (2015) when maize-sorghum based diets supplemented with phytase enzyme was fed to broiler chickens. Ranged value of 29.60g/dl – 30.70g/dl and 87.75fl – 90.30fl recorded for MCHC and MCV in this study were closer to the value of 33.20g/dl and 93.22fl reported for broiler chicken fed corn bran supplemented with enzyme (Owosibo *et al.*, 2017). The improved values recorded for MCHC and MCV may suggest that there was no negative interaction of energy and protein levels in the dietary treatments. Thus the diets were nutritionally balanced with inclusion of test ingredients.

Significant improved total protein and globulin as observed in this study suggested adequacy of the diet in supplying of protein

needed by the birds. Total protein and serum creatinine had been reported to depend on quality and quantity of protein supplied in the diet (Awosanya *et al.*, 1999). Elevated uric acid is an indication of imbalance of amino acid in the diet and consequently energy wastage (Nworgu *et al.*, 2007). Amino acids are required for biosynthesis of protein. The specific number of amino acids required must be present for synthesis of protein. However, observation in this study could be attributed to inefficient digestion and absorption of nutrient in the birds fed control diet.

CONCLUSION AND RECOMMENDATIONS

From the results obtained in this study, it revealed that replacement of maize by sorghum with enzyme supplementation improved growth performance haematological and serum biochemical indices of broiler chickens. Sorghum can compete favourably with maize in broiler starter ration at 25%, 50% and up to 75% replacement levels without any negative effect on growth performance and blood parameters. Researcher efforts should be geared toward complete replacement of maize by sorghum using every available method of treating sorghum to enhance bioavailability of nutrient for birds.

REFERENCES

- Ajaja, K., Agbede, J. O. and Aletor, V. A. (2002). Replacement value of sorghum dust for maize in diets for broiler chicks. *Proceeding 27th Annual Conference Nigeria Society for Animal Production*. March 17 – 21, Federal University of Technology, Akure, pp. 109 – 112.
- Ani, A. O. and Nnamani, M. E. (2011). Performance of growing cockerels fed diet containing raw Bambara nut (*Vigna subterranean (L) Verdo*) offal and supplementary enzyme. *Nigerian Poultry Science Journal*. 8: 58 – 69.
- Awosanya, B. J., Joseph, K., Akpata, D. F. and Ayoola, M. A. (1999). Performance, blood chemistry and carcass quality

- attributes of rabbit fed raw and processed pueraria seed meal. *Tropical Journal of Animal Science*. 2: 89 – 96.
- Cadogan, D. J., Selle, P. H., Creswell, D. and Partridge, G. (2005). Phytate limits broiler performance and nutrient digestibility in sorghum-based diets. *Australian Poultry Science Symposium*, 17: 39-43.
- Campos, D. M. B., FariaFilho, D. E. Torres, K. A. A. Furlan, R. L. and Macari, M. (2007). Desenvolvimento da mucosa intestinal e substituição do milho por sorgo na dieta de pintainhos de corte. *Ensaios Cienc*, 5: 44-48.
- Choct, M. 2006. Enzymes for the feed industry, past, present and future. *World poultry science journal*. 6:5-15.
- Doka, O., Bicanic, D. D., Dicko, M. H. and Slingerland, M. A. (2004). Photoacoustic approach to direct determination of the total phenolic content in red sorghum flours. *Journal Agricultural Food Chemistry*, 52: 2133-2136.
- Ekine, O. A., Akinola, L. A. F. and Idakwo, E. (2017). Effect of various management strategies and garlic granules on haematological status of broilers in the tropics. *Nigerian Journal of Animal Science*. 19(1) 166 – 172.
- Esonu, B. O., Ogbonna, U. D., Anyanwu, G. A., Emenalom, O. O., Uchegbu, M. C., Etuk, E. B. and Udedibie, A. B. I. (2006). Evaluation of performance, organ characteristics and economic analysis of broiler finisher fed dried rumen digestibility. *International Journal Poultry Science*, 5: 1116-1118.
- Hassan, I. A. G., Elzubeir, E. A. and El-Tinay, A.H. (2003). Growth and apparent absorption of minerals in broiler chicks fed diets with low or high tannin contents. *Tropical Animal Health Production*, 35: 189-196.
- Ibrahim, B., Abass, K. and Mudawi, H. (2012). The effect of β -glucanase inclusion in sorghum based diet on performance of broiler chicks. *Proceedings of the Conference on International Research on Food Security, Natural Resource Management and Rural Development*, September 19-21, 2012, Georg-August Universität Göttingen and University of Kassel-Witzenhausen, Göttingen, Germany, pp: 1-4.
- Inaku, E. N., Bawa, G. S., Olugbemi, T. S. and Buba, W. (2011). Nutritive value of yam peel meal in broiler diet. In: Adeniji, A.A., Olatunji, E.A. and Gana, E.S. (Eds) Value Re-orientation in Animal Production: A Key to National Food Security and sustainable Economy. Pp 481-483. *Proceedings of 36th Annual Conference of Nigerian Society of Animal Production*. 13th-16th March, 2011.
- Isikwenu, J. O., Akpodiete, O. J., Omeje, S. I. and Okagbare, G. O. (2010). Effect of replacing groundnut cake with urea treated and fermented brewers dried grain on nutrient digestibility, retention and carcass characteristics of broilers. *Nigeria Journal of Animal Production* 37 (1& 2): 1 – 12.
- Kenedy, R. (2011). CBC (Complete Blood Count) Interpretation. The medical doctors' library. http://www.medical-library.net/cbc_red_blood_cells.html.
- Kim, H. S. and Miller, D. D. (2005). Proline-rich proteins moderate the inhibitory effect of tea on iron absorption in rats. *Journal Nutrition*, 135: 532-537.
- Medugu, C. I., Kwari, I. D., Igwebuike, J., Nkama, I., Mohammed, I. D. and Hamaker, B. (2010). Performance and economics of production of broiler chickens fed sorghum or millet as replacement for maize in the semi-arid zone of Nigeria. *Agricultural Biology Journal Northern America*, 1: 321-325.

- Mojtaba, K., Farshid, K. and Mostafa, F. (2014). The effect of dried potato powder with enzyme supplementation on performance of Japanese quail (*Coturnix coturnic Japonica*). *Journal of Zoology*. 3(3): 124 – 130.
- Nworgu, F. C., Ogungbenro, S. A. and Solesi, K. S. (2007). Performance and some blood chemistry indices of broiler chicken served fluted pumpkin (*Telfaria occidentalis*) leaves extract supplement. *American-Eurasian Journal of Agriculture and Environment Science*. 2(1): 90 – 98.
- Oladipo, M. F., Onimisi, P. A. and Bawa, G. S. (2015). Response of broiler chicken fed kaura variety of sorghum (*Sorghum bicolor*) based diets supplemented with enzyme. *Nigerian Journal of Animal Science*. 15(1): 75-82.
- Onimisi, P. A., Moses, O. and Jegede, J. O. (2017). Evaluation of optimum inclusion level of Biostrong® 510 as replacement for antibiotic growth promoters in broiler chickens production under field condition in Nigeria. *Nigerian Journal of Animal Science*. 19(1) 203 – 214.
- Owosibo, A. O., Odetola, O. M., Okere, I. A. and Odejide, J. O. (2017). Growth performance, blood parameters and carcass characteristics of broiler fed corn bran based diets with or without enzymes (Maxigrain®) supplementation. *Nigerian Journal of Animal Science*. 19(1) 135 – 143.
- Robertson, S. K. and Perez-Maldonado, R. A. (2006). Nutritional characteristics of sorghums from Qld and NSW. *Australian Poultry Science Symposium*, 18: 49-52.
- Sekoni, A. A., Omaye, J. J., Bawa, G. S. and Esuga, D. M. (2008). Evaluation of enzyme (Maxigrain) treatment of graded level of palm kernel meal (PKM) on nutrient retention. *Pakistan Journal of nutrition*. 7(4): 614 – 619.
- Selle, P. H., Cadogan, D. J., Li, X. and Bryden, W. L. (2010). Implications of sorghum in broiler chicken nutrition. *Animal Feed Science Technology*, 156: 57-74.
- Sharif, M., Shahzad, M. A., Rehman, S., Khan, S., Ali, R., Khan, M. L. and Khan, K. (2012). Nutritional evaluation of distillery sludge and its effect as a substitute of canola meal on performance of broiler chickens. *Asian Australasian Journal of Animal Science*, 25: 401-409.
- SPSS 2012. Statistical package for social sciences, version 21. USA IBM Corporation.
- Taylor, J. R. N. and Emmambux, M. N. (1989). Products containing other specialty grains: sorghum, the millets and pseudo cereals. Hamaker, B.R. (ed.) *Technology of Functional Cereal Products*. Cambridge: Woodhead Publishing. Pp 281-335.
- Tornekar, A. P., Munde, V. K. and Kokane, S. S. (2009). Effect of replacing maize with Bajra (Pearl millet) on the performance of broilers. *Veterinary World*, 2(8): 310 – 312.
- Ugwuene, M. C. (2011). Replacement value of palm kernel meal for maize on carcass characteristics of turkeys. *Nigerian Journal of Animal Science*. 13: 86 – 95.

EFFICACY OF YOUNG AND MATURED COCONUT WATER AS AN ALTERNATIVE SEMEN EXTENDER FOR AMOR BREED OF COCKEREL

Tijjani, H.U*, Sadiq M.S, Ma'aruf, B.S, Idi A.A, Ibrahim Y and Sir MS

Department of Animal Science,

Faculty of Agriculture,

Federal University of Kashere, Gombe State, Nigeria

*Correspondent Author; thusman4real@gmail.com Tel: +2348069524254

ABSTRACT

The aims of the study were to evaluate the efficacy of coconut water for short term preservation. A total number of nine Amor breed of cockerels were used, and the semen was collected using abdominal massage method and subjected to macroscopic and microscopic criteria. Semen evaluation was assessed hourly over a period of three hours. The semen was mixed with Ringer's solution, matured and young coconut water stored at room temperature. The pooled fresh semen results were within acceptable range for AI. However, preserved semen result showed a statistical significant difference at ($P \leq 0.05$) in the percentages of sperm progressive motility, live/dead and normal sperm, abnormal sperm head/neck/tail and total abnormalities in all the treatments over four hours storage. The present study suggests that mature coconut water can be recommended as a suitable extender for the short term semen preservation of Amor breed of cockerels for improved semen quality characteristics at room temperature

Key words: Cockerel, Semen and coconut water.

INTRODUCTION

Poultry" are domestic fowls, including chickens, turkeys, geese and ducks, raised for the production of meat or eggs and the word is also used for the flesh of these birds used as food. *Gao et al.*, (2014). Coconut water extender with ringer's solution was used successfully in cryoprotectant of caprine semen and is often used in goat breeding (Toniolli 1998). Coconut water as extender has been used in chill semen of other species such as cattle and poultry (Cardoso *et al.*, (2000).

MATERIALS AND METHODS

Experimental Area

The experiment was conducted at the Faculty of Agriculture Teaching and Research Farm, Federal University, Kashere. Kashere is located in Akko Local Government Area of Gombe State. It is located at an elevation of 431 meters above sea level and its human population is 77,015 (NPC, 2006). Its coordinates are 9°46'0" N and 10°57'0" E or 9.76667 and 10.95 (in decimal degrees). (NPC, 2006).

Experimental Birds and Management

A total of nine (9) cockerels of Amor breed of one year old were purchased from a reputable farm in Sharada, Kano State. Each cockerel was fed daily with growers mash feed on *ad libitum* basis. The cockerels were rested for a period of four weeks, which served as an adaptation period in order to make the cocks familiar with the semen collector and to improve the effectiveness of collection; likewise they were trained to respond to the abdominal massage technique prior to the onset of semen collection.

Semen collection

The semen from the commercial cockerels was collected three times in a week by means of abdominal massage method as described by Burrow and Quinn (1937). Two operators were involved in the collection, one hold the bird and concentrates on stimulating the flow of semen while the other one is collecting the semen in a test tube. The birds were held in a horizontal position at a height convenient to the operator who in turn secured the semen.

Semen evaluation

Semen samples collected were analyzed as per the procedures of..... These were as follows; The ejaculated volume from cockerel was measured with the use of 2ml syringe. The semen colour was visualized and evaluated immediately after the collection and graded on a scale of 1– 4 (where, 1 = watery, 2 = slightly creamy, 3 = creamy, 4= milky) (Peters *et al.*, 2008).The pH was measured using pH test strip.

A drop of undiluted semen from the pooled was placed on a microscope slide, and covered with a glass cover slip to spread the semen in order to have a uniform thickness and to prevent drying, which is placed on a 100x magnified microscope for examination and scored from 0– 9 according to Blesboiset *al.* (2008) scale of Mass Motility.The individual cell motility was estimated by placing a drop of the diluted semen on the glass slide and covered with cover slip and was observed under the x10 objective of microscope. 15 microscopic fields was examined and 150 sperm was counted for each sample.

The semen concentration was measured using haemocytometer with the direct cell count method. Haemocytometer is a specially designed slide that contains two counting chambers and two dilution pipettes. The counting chambers are 0.1mm in depth and have a ruled area on the bottom of the chambers that is 1.0mm² of width. The square is subdivided into 25 smaller squares. In this study, 10 µl of semen was mixed with 990µl of distilled water at the dilution rate of 1:100. One drop of the diluted semen was then dropped on one end of the haemocytometer and also on the other end and this was done to allow the diluted semen to settle. The loaded haemocytometer was then placed on the microscope at 400x magnification. The sperm's head that falls within the sub-divided smaller squares at the four edges and center of the haemocytometer was counted and the average per cockerel was found based on the judgment of the individuals making the determination. The concentration of sperm/semen was calculated using the formula as below:

$$\text{Concentration} = \frac{\text{Sperm Counted} \times \text{Dilution Rate} \times \text{Depth of Haemocytometer}}{\text{Number of Squares Counted}}$$

The slides of live and dead staining (eosin and nigrosin) were used under 1000x magnified microscope, to identify the number of abnormal sperm head (pear head, double head, elongated head, detached head), midpiece (swollen midpiece, coiled midpiece), tail (coiled tail, double tail, bent tail) and normal sperm were counted.

Preparation of Ringer's Solution

The modified Ringer's solution was prepared using sodium chloride: 9.0 g, potassium chloride: 0.4 g, calcium chloride: 0.3 g, dextrose: 1.3 g, sodium bicarbonate: 0.2 g and mixed with 1000 ml of distilled water was added in 100 mL of Ringer's solution.

Preparation of Coconut Water

The coconut water extender (mature and young coconut water) was filtered two times using filter paper. However, a solution of 1 molar of sodium bicarbonate was made and a dropped into the fresh coconut water extender to adjust the pH level

Storage Protocol

After semen collection, pooled semen from three cockerels (0.36ml) was diluted 1:2 with modified ringers solution and then divided into three equal parts and placed into three extended tubes containing three different extenders (ringers solution, mature and young coconut water).

RESULTS AND DISCUSSION

Table 1 shows the mean ($\pm$ SD) of pooled seminal characteristics of Amor breed of cockrels. The semen volume in this study was in line with Tunceret *et al.*, (2008) who reported a semen volume between 0.37 ± 0.02 and 0.01 ml also consistent with recent finding on Malaysian indigenous semen (Tijjani, *et al.*, 2015). This can be as a result of weather condition, management, strain, age and frequency of semen collection.

The semen colour obtained in the present study was similar with (Peters *et al.*, 2008) who reported the semen reading of 3 on the scale was creamy. The semen colour depends on the species of bird used, but generally should be creamy which indicates high sperm concentration as revealed (Bearden *et al.*, 2004). The sperm concentration in the present research was close to the findings by (Tunceret *et al.*, 2006; Peters *et al.*, 2008; Tunceret *et al.*, 2008). Who's reported a sperm concentration of 3.32×10^9 sperm/ml, and 3.347×10^9 sperm/ml. These differ with both (Bearden *et al.*, 2004) Tunceret *et al.*, (2008) who recorded cockerel sperm concentrations of $2.42 \pm 0.02 \times 10^9$ sperm/ml. These may be attributed as a result of breed differences, frequency of semen collection and fertilizing capacity of individual's cockerels.

The mass motility in this study was compared with the mass motility scale which ranges between 0-9 according to Blesbois *et al.*, (2008). This indicates that up to 80% of the cells having forward Movement and starting to form waves with 10-20% agglutination. As reported by (Chalahet *et al.*, 1999; Tunceret *et al.*, 2008). A similar sperm mass motility between two strain breed of cockerel such as White Leghorn and New Hampshire.

The live sperm in this study was different with Mosenene (2009) who reported but in agreement according to Hafiz & Hafiz (2000), also tally with Tijjani *et al.*, (2015) who reported the average live sperm of 94.8 ± 1.3 these variations might be as a result of difference strains age, frequency of semen collection, poor handling and extreme weather condition. The average dead sperm in

this study was consistent to Tijjani *et al.*, (2015) who reported the average dead sperm of 6.0 ± 1.32 , but differ with Mosenene, (2009) who reported the average dead sperm of 19.2 ± 27.9 . These variations might be attributed to season and frequency of semen collection. The average normal sperm in this study was in line with Tijjani *et al.*, (2015) who reported the average normal sperm of 91.1 ± 0.4 on Malaysian indigenous cockerel se but in contrast the findings of (Tijjani *et al.*, 2015). This difference may be attributed to the breed of chicken used, live-weight, age, season, environmental temperature and humidity, and semen collection techniques.

Table: 1. The Mean ($\pm$ SD) Pooled Seminal Viability Characteristics

Parameters	Mean ($\pm$) SD
Ejaculate volume (mL)	0.4 ± 0.1
Colour (1-4)	3.3 ± 1.1
Sperm concentration (n= $4.1 \pm 0.5 \times 10^9$ /ml)	
Mass motility (0-9)	4.6 ± 0.5
Progressive motility (%)	67.7 ± 4.4
Live sperm (%)	96.3 ± 1
Dead sperm (%)	3.6 ± 1.1
Normal sperm (%)	95.33 ± 0.5

The sperm morphology in table 2 indicates the head, neck, tail defect and total abnormalities of the present study were in agreement with Tunceret *et al.*, (2008). They reported that if the sperm has high defects the sperm cells will not be able to fertilize the ova so it is not good for insemination. The total abnormalities in this present study was low this could be as a result of temperature, breed, and short preservation the agreed with Mosenene (2009) who recorded the abnormalities of 17.5 ± 13.4 this indicates that the abnormalities is low the sperm is good for insemination compared to other previous findings Moure *et al.*, (1999) who reported 25.4 total abnormalities.

Table 2: The means ($\pm$ SD) pooled fresh seminal morphological defects characteristics

Sperm Morphology	Mean $\pm$ SE (%)
Head defect	2.3 $\pm$ 0.2
Neck defect	6.6 $\pm$ 0.5
Tail defect	8.5 $\pm$ 0.5
Total abnormalities	17.5 $\pm$ 0.8

The percentages of cockerel sperm progressive motility in this study were higher in young coconut water and mature coconut water compared Ringer's solution throughout the preservation time at room temperature for 3 hours shown in Figure 1. This is in line with previous research conducted by Rita *et al.*, (2002) who recorded 90% sperm motility. Also the result is in contrast with Moura *et al.*, (1999) who obtained 75.4 percent motility this could be as a result of strain, temperature, age and poor management. The percentages of live sperm in the present study were higher in mature coconut water and young coconut water than in Ringer's solution throughout the preservation time at room temperature for three hours shown in Figure 2. This is in agreement with Alfaro *et al.*, (2013) who recorded 90 percent live sperm prior to preservation and 50 percent post preservation. This result was in contrast with Mouret *et al.*, (1999) who recorded 75.4 percent. This could be as a result of long preservation or temperature. It is suggested that, the sperm is viable for insemination.

The percentages of dead sperm preserved cockerel sperm from mature coconut water and young coconut water are low compared to Ringer's solution (Figure 3). The outcome of this present study was in contrast to the previous finding reported by Rita *et al.*, (2002) this could be as a result of poor management and storage. Figure 4 showed that the percentages of normal sperm in the present study were higher in mature coconut water and young coconut water than Ringer's solution throughout the preservation period at room temperature for 3 hours. The outcome of this study was in line with Rita *et*

al., (2002) who recorded 90 percent normal sperm. Tijjaniet *al.*, (2015) recorded 90 percent normal sperm. The present result is in contrasts with Moura *et al.*, (1999) who recorded 75.4 percent of normal sperm. This might be as a result of difference in strain of the birds used and temperature. The percentages of abnormal head in this present study were high in Ringer's solution compared to mature coconut water and young coconut water as presented in figure 5. This was differ from previous finding by Rita *et al.*, (2002) who recorded 20.9 percent head defect. Also was tally with Alforoet *al.*, (2013) who recorded 10 percent head abnormalities. These variations might be attributed as a results of long preservation.

The percentages of neck defect in the present study were higher in Ringer's solution compared to mature coconut water and young coconut water (Figure 6). The result differ with Rita *et al.*, (2002) who recorded 1.2 percent, on the other hand, was in line with Alfaro *et al.*, (2013) who recorded 10 percent head abnormalities. The variations may be as a result breed differences and the quality of ejaculate. In figure 7, the percentages of tail defects in the present study were higher in Ringer's solution compared to mature coconut water and young coconut water during the preservation time this result was in contrast with Rita *et al.*, (2002) who recorded 12.7 percent tail abnormalities. This could be as a result of poor handling and temperature. Figure 8 presents the overall morphological abnormalities of preserved sperm were higher in Ringer's solution compared to other treatment groups throughout the storage time at room. The morphological abnormalities were more pronounced in tail than in neck and head defects. This present study was agreed with Rita *et al.*, (2002) who recorded 39.5 percent total abnormalities. The high number of spermatozoa with defect could be caused by an error in smear manufacture and high level of sperm abnormalities could be the effect of the Ringer's solution as reported by Fahy (1986) and Hammerstedt (1992).

CONCLUSION

The findings of this study revealed that, the percentage of viability between Mature and Young coconut water were higher than Ringer's solution throughout the storage time. At the beginning of storage (0 hour) no difference was observed on the semen viability characteristics stored at room temperature. However, during preservation (mature and young coconut water) were contributed in protecting and maintaining the semen viability most especially the mature coconut water.

REFERENCES

- Alfaro-Camboa, R. Ake enturion- Castro, M. M. Bottini-Luzardo, F. R. ake-1 (2013). Effects of addition of coconut water (Cocos nucifera) to the freezing media on post-thaw Viability of boar sperm. *Tropical Animal Health and Production*, **45**: 100-106.
- Bearden, H.J., Fuquay, J.W. and Willard, S.T., (2004). *Applied Animal Reproduction*. Pearson Education, Inc. New Jersey. 6th edition.
- Blesbois, E., Seigneurin, F., Grasseau, I., Limouzin, C., Besnard, J., Gourichon, D., Coquerelle, G., Rault, P. & Tixier-Boichard, M., (2007). Semen cryopreservation for ex-situ management of genetic diversity in chicken: creation of the French avian cryobanks. *Poultry Science*. **86**: 555-564.
- Burrows W, H. and Quinn, J.P., (1937). The collection of spermatozoa from the domestic fowl and turkey. *Poultry Science*. **24**: 19-24.
- Cardoso, R. C. S., Silver, A. R., Uchoa, D. C. and Silver, L. D. M. (2000). Canine semen freezing using an egg Yolk-glycerol-coconut water extender 10:29-36.
- Chalah, T., Seigneurin, F., Blesbois, E. & Brillard, J.P., (1999). In vitro comparison of fowl sperm viability in ejaculates frozen by three different techniques and relationship with subsequent fertility in vivo. *Cryobiology*. **39**: 185-191.
- Fahy GM., (1986) and Hammerstedt RH. (1992). effect of Ringer' solution on spermatozoa.
- Gao. J.; Yu, B.; Zhou, H.; Cai, D.; Zhang, Y. & Zhao, X. (2014). "Early Holocene chicken domestication in northern China". *Proceedings of the National Academy of Sciences*. 111 (49): 17564-17569.
- Hafez, B. & Hafez, E.S.E., (2000). *Reproduction in Farm Animals*. 7th edition. New York. Lippincott Williams & Wilkins, USA.
- Moura, C. S., Cavalcanti, M. O., Guerra, M. P. P. and Tavares, P. T. S. (1999). Cryopreservation of canine semen using different method. *Rev. Bras. Reprod. Anim.* 23:304-5.
- Mosenene, T. M. B. (2009). Characterization and cryopreservation of semen of four south African chicken breeds. Master's Thesis University of the Free State Bloemfontein, pp: 132.
- Peters, S.O., Shoyebo, O.D., Ilori, B.M., Ozoje, M.O., Ikeobi, C.O. N. and Adebambo, O. A. (2008). Semen quality traits of seven strain of chickens raised in humid tropics. *International Journal of Poultry Science*. **7**: 949-953.
- Rita de Casia Soares Cardoso (2002) Cryoprotectant of can. Sem. Using con. Wat. Ext. with. Egg yolk and three diff. gly. Con.
- Tijjani, H.U, Faisal A. and Asmad, K. (2015) Faculty of Bio resources and Food Industry, University Sultan Zainal Abidin (UniSZA), Kampus Tembila Besut Terengganu, Malaysia
- Tuncer, P.B., Kinet, H. & Ozdogan, N., (2008). Evaluation of some spermatological characteristics in Gerze cocks. *Ankara Univ. Vet. Fak. Derg.* 55, 99-102.

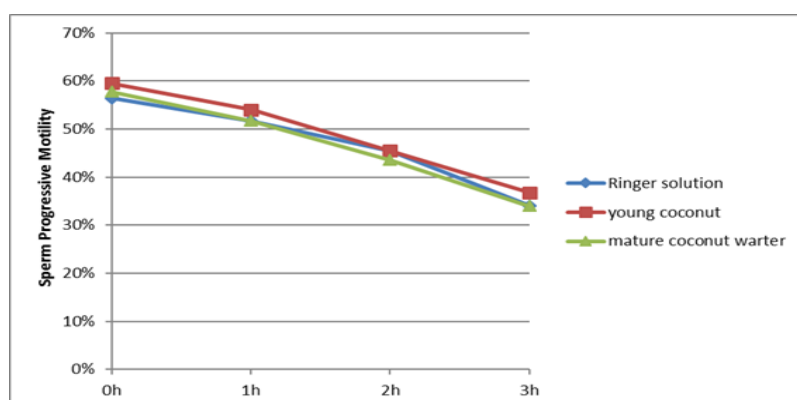
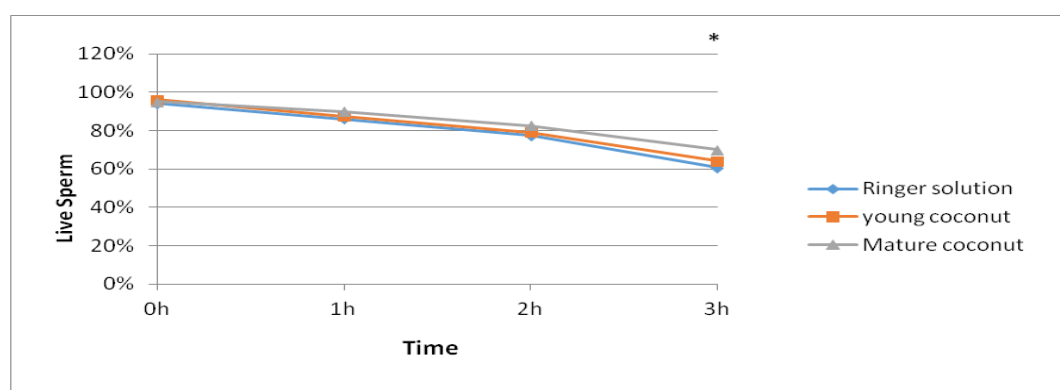
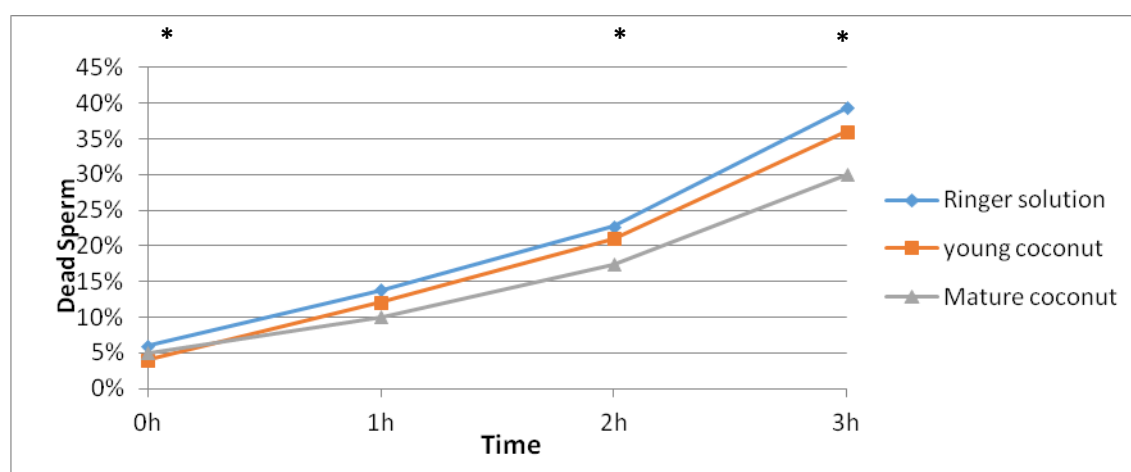


Figure 1: Percentage sperm progressive motility treated with Young coconut water, Matured coconut water and Ringer's solution as semen extender



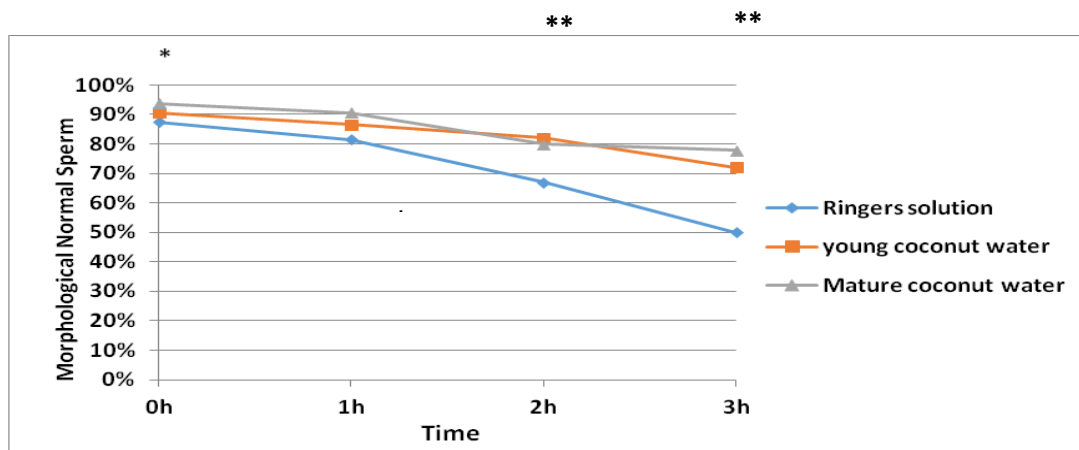
*indicates a significant difference at ($P \leq 0.05$)

Figure 2: Percentage live sperm treated with Young coconut water, Matured coconut water and Ringer's solution as semen extender



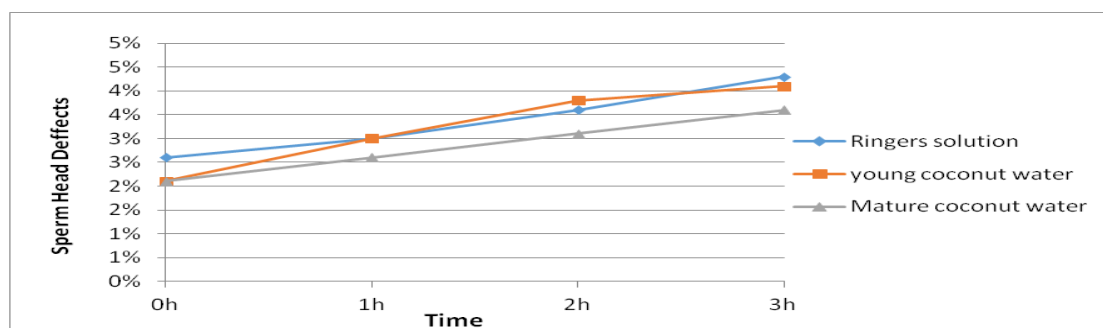
*Indicates a significant different at ($P \leq 0.05$).

Figure 3: Percentage dead sperm treated with Young coconut water, Matured coconut water and Ringer's solution as semen extender



* Indicates a significant different at ($P \leq 0.05$)

Figure 4: Percentage normal sperm treated with Young coconut water, Matured coconut water and Ringer's solution as semen extender



*Indicates a significant different at ($P \leq 0.05$)

Figure 5: Percentage abnormal head sperm treated with Young coconut water, Matured coconut water and Ringer's solution as semen extender

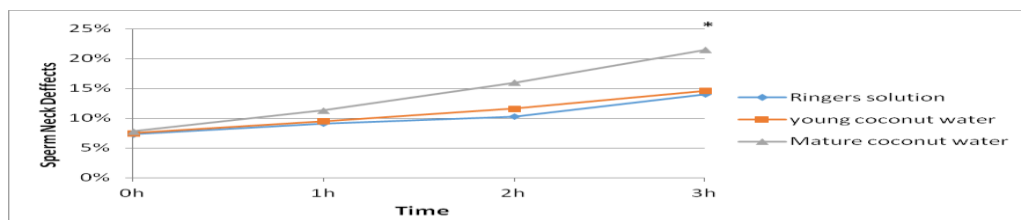
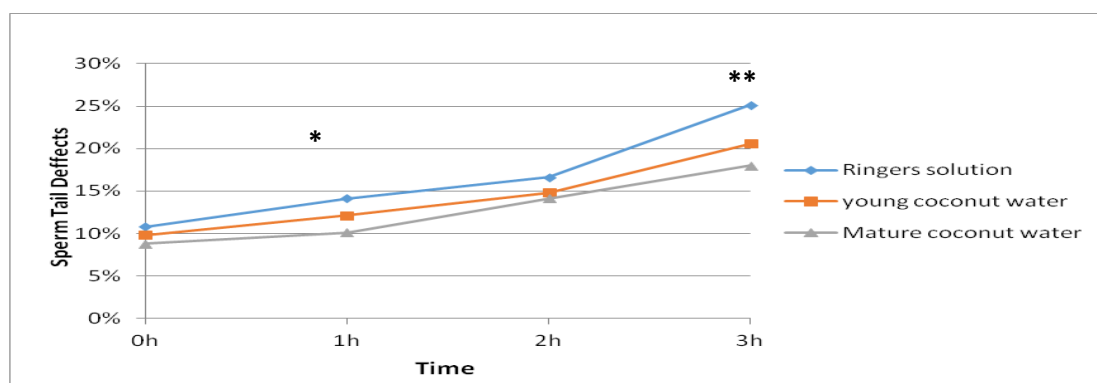
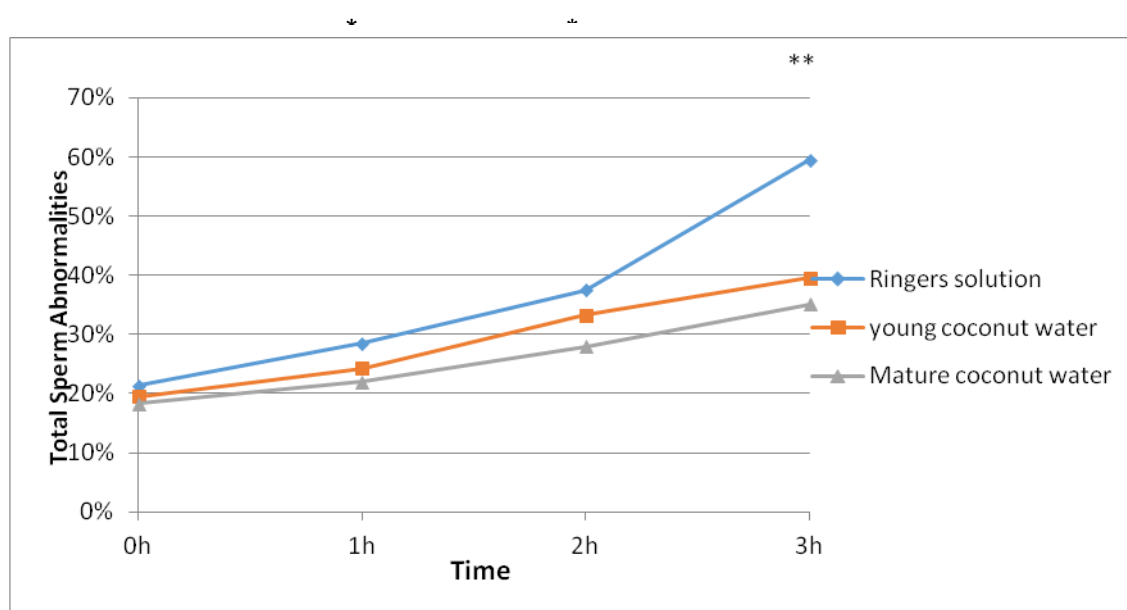


Figure 6: Percentage neck defect treated with Young coconut water, Matured coconut water and Ringer's solution as semen extender



*indicates a significant different at ($P \leq 0.05$).

Figure 7: Percentage sperm tail defect treated with Young coconut water, Matured coconut water and Ringer's solution as semen extender



*Indicates a significant different at ($P \leq 0.05$)

Figure 8: Percentage total sperm abnormalities treated with Young coconut water, Matured coconut water and Ringer's solution as semen extender

PERFORMANCE OF RED SOKOTO BUCKS FED TWO FORMS OF THREE BROWSE PLANT LEAVES IN SHIKA, NIGERIA

Ibrahim, U. B.,^{1*} Sadiq M. S.,¹ Abdu, S. B.,² Adamu, H. Y.,² Bello, S. S.,² Bala, A. G.,² Amodu, J. T.,³ Tanko, R. J.,³ and Ahmad A. T.,⁴

¹ Department of Animal Science, Faculty of Agriculture, Federal University Kashere, Gombe State, Nigeria

² Department of Animal Science, Faculty of Agriculture, Ahmadu Bello University, Zaria, Nigeria

³ National Animal Production Research Institute, Shika, Zaria.

⁴ Department of Biological Sciences, Faculty of Science, Federal University Kashere, Gombe State, Nigeria.

*Correspondent Author: ibrahimumar7700@gmail.com Tel: +2347039378263

ABSTRACT

A study was carried out to evaluate the performance of Red Sokoto bucks fed unwilted and wilted leaves of three browse plant species, namely: *Adenodolichos paniculatus*, *Ficus thoningii* and *Gmelina arborea*. A total of eighteen (18) Red Sokoto bucks of age nine to fifteen months weighing twenty one to twenty four kg were randomly allotted to six treatments with three bucks per group and fed the leaves of the three browse plants leaves for 56 days in a 3 x 2 factorial design. The performance parameters measured were; Initial body weight (kg), final body weight (Kg), daily feed intake (kg), total feed intake (Kg), daily weight gain (g), total weight gain (kg) and Feed conversion ratio. The experiment was conducted at National Animal Production Research Institute, (NAPRI) Shika, Zaria in the rainy season. Data collected at the end of the experiment were analyzed using the General Linear Model (GLM) Procedure of Statistical Analysis System. Treatment means were compared and separated using Duncan Multiple Range Test. Wilting was found not to increase weight gain in *Gmelina arborea*, but resulted in a weight loss ($P<0.05$) in *Ficus thoningii*, when compared with other treatments. The same result of weight losses were observed in both unwilted and wilted *Adenodolichos paniculatus*. Wilting was found to significantly ($P<0.05$) affect feed intake, weight gain/loss and feed conversion ratio. Feeding *Adenodolichos paniculatus* leaves resulted in a lower feed intake (45.51 Kg) and higher loss in weight (5.03 kg) when compared to other treatments. Higher feed intake was observed in *F. thoningii* and *G. arborea* (60.75 Kg) and a lowest weight loss was observed in *Gmelina arborea* (0.07 Kg). It is therefore concluded that the *G. arborea* was better consumed and gave the better performance than the rest of the treatments.

KEY WORDS; Browse, Wilted, Unwilted, Bucks

INTRODUCTION

Livestock production transcends other sectors as key food and economic activity for many communities of Nigeria. Nevertheless, livestock production has been faced with major challenges of feed deficits, especially in the dry periods. One of the recommended practices to overcome challenges of feed deficits is the use of browse plants, especially during the dry season. Browse plants are available all year round because of their drought resistance, persistence, vigorous growth, re-growth and palatability (Crowder and Chheda, 1982). Browse plants are also found all year round in contrast to grasses which rapidly deteriorate with maturity increasing fiber and decreasing protein. Browse plants have higher nutritive value than grasses (Agishi, 1984). They provide vitamins and, frequently, mineral elements, which are mostly lacking in

grassland pastures. Their year round evergreen presence and nutritional abundance provide for year round provision of fodder (Opara, 1996; Oji and Isilebo, 2000). It also enables standing feed reserves to be built so that herds can survive critical periods of shortfall, or even prolonged periods of dry spell without remarkable losses (Odoh and Adamu-Noma, 2000).

Deforestation, urbanization and bush burning are some of the major factors responsible for shortage of browse feed resources for ruminant livestock. Conservatory methods however, would ensure that locally adapted and well established species do not become extinct. *Gmelina arborea* Roxb. is of the family *Verbenaceae*. It is a fast growing deciduous tree reaching up to 40 m in height and 140 cm in diameter, but some could be smaller (Jensen, 1995). Previous records have shown

that the leaves contained as much as 10.01-38.4% crude protein and 3.10-30.46% crude fiber (Adu *et al.*, 1996; Ahamefule *et al.*, 2006; Osakwe and Udeogu, 2007). *Gmelina arborea* has become one of the most widely planted species (second only to the *Eucalyptus* species) in the tropics. FAO (1989) recorded that by 1983, the Sahelian countries of West Africa had established about 5,850 ha of *Gmelina arborea* in their anti-desertification plantation schemes. By 1990, Nigeria had established over 60,000 ha *Gmelina arborea* (Umeh, 1990).

Ficus thonningii is an evergreen tree of about 6-21 m, with a rounded to spreading dense crown. *Ficus thonningii*, also known as fig tree is a multipurpose tree that can be found almost everywhere in the northern part of Nigeria. Mecha and Adegbola (1980) identified fig tree as a palatable fodder plant with a wide distribution in the savannah zone of the humid tropics, while Agishi (1985) attested to the high nutritive value of its leaves to ruminant livestock.

Adenodolichos paniculatus Hutch. is a perennial woody multi-purpose shrub or sub shrub legume. It reaches a height of 1.5 to 4.5 m (CJB, 2010; Burkill, 1985). *Adenodolichos paniculatus* leaves are used as fodder for ruminants and for edible caterpillars. The stems are used to make utensils. Roots and leaves have been reported to have medicinal uses (Burkill, 1985).

MATERIALS AND METHODS

Experimental Site and Climate

The study was carried out in the Experimental Unit of the Small Ruminant Research Programme of the National Animal Production Research Institute (NAPRI), Shika, Zaria, Nigeria. Shika lies between latitudes 11 and 12 °N and between longitudes 7 and 33°E, at an altitude of 640 m above sea level. Shika is located about 20 km along the Zaria – Sokoto road in Northern Guinea Savannah zone of Nigeria. It has three distinct climatic seasons. The seasonal distribution of Shika's annual rainfall is approximately 617 to 1365 mm with a long time (50 years) average of

1041 mm. Most of the rains fall between May and June (Oni *et al.*, 1991). The mean maximum temperature and relative humidity range from 27-35°C and 13.82%, respectively depending on the season of the year

Source of Leaves of the Browse Plants and Animals

Leaves of the three browse plants were sourced around the National Animal Production Research Institute (NAPRI), Shika, Zaria. Every morning between 8-9 am, the leaves were collected from the *Adenodolichos paniculatus*, *Ficus thonningii* and *Gmelina arborea*. The leaves were wilted for 24 hours before feeding to the animals the next morning. The unwilted leaves were provided to the animal directly from the tree and fed as unwilted every morning for the period of eight (8) weeks.

Animal Management

A total of eighteen (18) Red Sokoto bucks of age nine to fifteen months weighing twenty one to twenty four kg were obtained from the Small Ruminant Research Unit of the National Animal Production Research Institute (NAPRI), Shika. They were dewormed using Albendazole bolus and injected with Ivermectin to control ecto-parasite. They were also injected with oxytetracyclin so as to take care of all unwanted bacteria. The animals were housed in individual pens and weighed every fortnight. The pens were cleaned every day. Water was provided *ad libitum*.

Feeding Trial

Eighteen (18) Red Sokoto bucks were used for the experiment for a short time study. The animals were fed a known weight of unwilted and wilted browse leaves *ad libitum* each for the period of fifty six (56) days in a short time trial. The bucks were allotted to six dietary treatments in a 3×2 factorial arrangement in a completely randomized design, to compare the effect of unwilted and wilted forms of *Adenodolichos paniculatus* tree leaves, *Ficus thonningii* tree

leaves and *Gmelina arborea* tree leaves on the performance of red Sokoto bucks. Three animals were assigned to each treatment. Two hundred and fifty grams of *Digitaria* grass was given to each animal daily to provide variety of feed. Salt lick and water were also provided *ad libitum*. The leftover was measured every morning.

Chemical Analysis

Analysis of individual leaves and faecal samples were carried out by AOAC (2000) procedure, Acid detergent fibre (ADF) and Neutral Detergent fibre (NDF) were determined in all the feed ingredients according to Van Soest *et al* (1991). Metabolisable energy (ME) was determined by equation of (Alderman 1985).

$$\text{ME (MJ/Kg)} = 11.78 + 0.0064 \text{ CP} + (0.000665\text{EE})^2 - \text{CF} (0.00414\text{EE}) - 0.0118\text{A}$$

Data Analysis

All data collected at the end of the experiment were analyzed using the General Linear Model (GLM) Procedure of Statistical Analysis (SAS, 2002). Significant treatment means were separated using Duncan Multiple

Range Test (Duncan, 1995). The Model used for the trial is provided below.

$$Y_{ijk} = \mu + F_i + D_j + (FD)_{ij} + e_{ijk}$$

Where;

Y_{ijk} = Observation measured,

μ = Overall mean,

F_i = effect of form

D_j = effect of species

$(FD)_{ij}$ = interaction between forms and species

e_{ijk} = random error.

RESULTS

Browse Effect on the Performance of Red Sokoto bucks fed *A. paniculatus*, *F. thonningii* and *G. arborea* leaves. Table 1. Show the effect of browse on the performance of Red Sokoto bucks fed *Adenodolichos paniculatus*, *Ficus thonningii* and *Gmelina arborea* leaves. There were significant ($P < 0.05$) differences in all the parameters measured across the treatments. The final body weight and the total feed intake of *Ficus thonningii* and *Gmelina arborea* were statistically similar ($P > 0.05$). Losses were recorded across the treatments. The highest loss was observed in *A. paniculatus* (5.03) and the lowest was *G. arborea* (0.07)

Table 1. Browse effect on the Performance of Red Sokoto bucks fed *A. paniculatus*, *F. thonningii* and *G. arborea* leaves

Parameters	<i>A. Paniculatus</i>	<i>F. thonningii</i>	<i>G. arborea</i>	SEM	LOS
Initial body weight(kg)	23.10	22.17	22.52	0.65	NS
Final body weight(kg)	18.07 ^b	21.80 ^a	22.45 ^a	0.60	*
Total feed intake(kg)	45.51 ^b	60.44 ^a	60.75 ^a	0.48	*
Weight gain/loss(kg)	-5.03 ^c	-0.37 ^b	-0.07 ^a	0.30	*
Daily weight gain loss(g)	-89.88 ^c	-6.55 ^b	1.19 ^a	1.07	*
Daily feed intake (g)	810 ^b	1080 ^a	1080 ^a	0.18	*
Feed conversion ratio	-12.15 ^c	66.89 ^b	127 ^a	2.36	*

^{abc} = Means with different superscript along rows show significant difference ($P < 0.05$). NS= No Significant Difference

Table 2. Shows form effect on the performance of Red Sokoto bucks fed wilted and unwilted *Adenodolichos paniculatus*, *Ficus thonningii* and *Gmelina arborea* leaves. There were significant ($P < 0.05$) differences in total

feed intake, weight gain and feed conversion ratio. Un wilted *G. arborea* had the highest intake (57.80 kg) and had lower feed conversion ratio (52.07 kg)

Table 2. Form effect on the Performance of Red Sokoto bucks fed wilted and unwilted browse plant leaves

Parameters	Wilted browse	Unwilted Browse	SEM	LOS
Initial body weight(kg)	22.84	22.34	0.65	NS
Final body weight(kg)	20.27	21.28	0.60	NS
Total feed intake (kg)	53.33 ^b	57.80 ^a	0.48	*
Weight gain/loss(kg)	-2.58 ^b	-1.07 ^a	0.30	*
Daily weight gain/loss(g)	-46.03 ^b	-19.05 ^a	1.28	*
Daily feed intake(g)	950 ^b	1030	0.07	NS
Feed conversion ratio	69.25 ^b	52.07 ^a	2.36	*

^{ab} = Means with different superscript along rows show significant difference ($P < 0.05$). NS= No Significant Difference

Table 3, Show weight changes, feed Intake and interaction between unwilted and wilted *Adenodolichos paniculatus*, *Ficus thonningii* and *Gmelina arborea* leave on the performance of red Sokoto bucks. There were significant ($P < 0.05$) differences in body weight gain/loss across the treatments. Only unwilted *Gmelina arborea* recorded weight gain of (0.63 kg), wilted *Ficus thonningii* recorded a loss in weight of (0.27kg), the

trend was observed to be similar across the treatments. The highest weight loss was observed in wilted *Adenodolichus paniculatus* with (6.70 kg) and unwilted *Adenodolichus paniculatus* had (3.37kg) weight loss. The feed conversion ratio was highest in unwilted *Gmelina arborea*. The lease feed conversion ratio was seen in unwilted *Adenodolichos paniculatus*.

Table 3 Show Weight Changes, Feed Intake and Interaction between unwilted and wilted *A. paniculatus*, *F. thonningii* and *G. arborea* leaves on the performance of Red Sokoto bucks

Parameters	<i>A. paniculatus</i>		<i>F. thonningii</i>		<i>G. arborea</i>		SEM	LOS
	Wilted	unwilt ed	Wilted	unwilted	Wilted	Unwilted		
Initial body weight(kg)	24.30	21.90	21.83	22.50	22.40	22.63	0.65	NS
Final body weight (kg)	17.60 ^c	18.53 ^c	21.57 ^b	22.03 ^b	21.63 ^b	23.27 ^a	0.60	*
Total feed intake (kg)	39.87 ^d	51.16 ^c	59.54 ^b	61.33 ^a	60.59 ^a	60.91 ^a	0.48	*
Weight gain/loss(kg)	-6.70 ^d	-3.37 ^c	-0.27 ^b	-0.47 ^b	-0.77 ^b	0.65 ^a	0.30	*
Daily weight gain/loss(g)	-119.64 ^f	-60.12 ^e	-4.76 ^b	-8.33 ^c	-13.69 ^d	11.31 ^a	1.28	*
Daily feed intake(g)	710 ^b	910 ^{ab}	1060 ^a	1090 ^a	1080 ^a	1090 ^a	0.07	*
Feed conversion ratio	-6.58 ^e	-17.72 ^d	149.31 ^b	-15.60 ^d	64.93 ^c	189.52 ^a	2.36	*

^{abcd} = Means with different superscript along rows show significant difference ($P < 0.05$). NS= No Significant Difference

DISCUSSION

There were significant ($P < 0.05$) differences in all the parameters measured across the treatments in the species of the browse leaves. *Ficus thonningii* and *Gmelina arborea* had statistically the same values in terms of final body weight and total feed intake; losses were recorded across the treatments in all the three species. However, the highest loss was observed in *A. paniculatus* (5.03 kg), the least loss was recorded in the *G. arborea* (0.07 kg).

The lower weight loss as a result of consuming (*Gmelina arborea* Leaves) may be as a result of the relatively high content of crude protein of the leaf which was able to meet the requirement of the bucks. Other scientist who worked on *Gmelina arborea* reported different weight gains. Sevilla and Mariales (1999) reported daily weight gain of 36 g/d for sheep fed *Gmelina arborea* leaves. In another work, Adamu, (2011) reported a daily weight gain of 33.33 g/d on Yankasa rams fed 60% *Gmelina arborea*. Anugwa and Okore (1987) reported a gain in weight of 71 g/day over a period of 14 day period when they fed a sole diet of *Ficus elasticoides* foliage.

For the form effect, there were significant ($P < 0.05$) differences in total feed intake, weight gain and feed conversion ratio. The unwilted browse had significantly ($p < 0.05$) higher intake, higher weight gain (even though, losses were observed across the treatments). The unwilted browse had lower feed conversion ratio. The gain in weight in the unwilted species may be as a result of the relatively high content of crude protein and palatability of the leaf which was able to meet the requirement of the bucks. However, some scientist who worked with browses as sole diets reported weight losses.

Wilting had effect on the weight changes and performance of Red Sokoto bucks fed *Gmelina arborea* leaves. The bucks on the unwilted leaves showed a gain in weigh. Wilting had effect on the weight changes and performance of the bucks fed

Ficus thonningii leaves. The bucks on wilted *Ficus thonningii* had a lower weight loss when compared with their counterparts on the unwilted treatment. With *Adenodolichos paniculatus*, feeding wilted and unwilted leaves resulted in the same result of weight loss, showing that feeding wilted and unwilted *Adenodolichos paniculatus* leaves had no difference. The loss in weight could be as a result of the low palatability of *A. paniculatus*, leading to lower intake and the inability of the leaves to meet the nutritional requirement of the bucks.

The gain in weight as a result of consuming unwilted *Gmelina arborea* Leaves is in agreement with the work of Devendra (1995) who highlighted that wider use has been made of the leguminous forages, especially the browse species, as dietary supplements to promote live weight gain in sheep and goats.

Feeding trials involving the use of *Gliricidia sepium* (Ifut, 1992; Onwuka, 1994) and *Tephrosia bracteolata* (Adeloye, 1994) as sole diets for goats showed average daily weight gain ranging from 20 g to 51 g. Onwuka (1994) reported loss of body weight when cassava or *Spondias mombin* leaves were fed as sole diets to West African Dwarf goats. However, in some studies with leaves of *Ficus religiosa*, *Acacia arabica* and *Melia azadirachta* fed as sole diets showed positive response in sheep (Rao *et al.*, 1983). Sevilla and Mariales (1999) reported daily weight gain of 36 g/d for sheep fed *Gmelina* leaves. In another work, Adamu, (2011) reported a daily weight gain of 33.33 g/d on Yankasa rams fed 60% *Gmelina arborea*. Adeleye and Fasae (2008) reported higher live weight gain for bucks on 100% GL when they fed *Gmelina* leaves, banana leaves and mixture to West African dwarf bucks.

The loss in weight experienced in this trial may be as a result of a lot of factors. Some of the reasons may include; the dry matter content of most fodder legumes is considerably low and tends to vary with leaf maturity. This has a detrimental effect on the

use of fodder trees and shrubs as a source of Metabolisable energy for animals especially when compared to grass species. The low Metabolisable energy content of fodder legumes is also associated with the high fiber content of these materials which also tend to reduce protein digestibility in these materials (D'mello, 1992). Low palatability of some of the browses may be another factor. The bucks on unwilted *Adenodolichos paniculatus* had higher dry matter intake as compared to the wilted *Adenodolichos paniculatus*. Generally, low intake was observed in *Adenodolichos paniculatus* leaves in both the wilted and unwilted. However, it was characterized by a very low short term intake rate (6 g DM/h per kg). In another trial, intake was further reduced by sun drying (10 vs 2 g DM/h per kg for the fresh and sun dried forage) Dung *et al.* (2000). Wilting was observed not to have any effect on the dry matter intake of both *Ficus thonningii* and *Gmelina arborea* (i.e unwilted and wilted had the same dry matter intake). The higher intake noticed in *Gmelina arborea* and *Ficus thonningii* could be as a result of the higher palatability and the higher crude protein content of the plants. Studies have shown that the higher the quality of the roughage, the higher the intake and performance with sheep or goats on all roughage diets. Leng (1992) reported *Gmelina arborea* as one of the leaves with high protein content of even up to 34% and that the protein does not seem to change with leaf maturity and even when they dry and fall off on the ground. According to Smith (1993), the minimum level of crude protein in forages that enhance voluntary intake, digestibility and utilization is about 7%.

Gmelina arborea is particularly notable for its fast growth, large green leaves and very high dry matter yield. Goats relish the leaves of *Gmelina arborea* (Adu *et al.*, 1996). Several studies have been done using *Gmelina arborea* as sole feed, as a supplement in combination with other forages, fresh, wilted, air or sun dried. Supplement of *Pennisetum purpureum* with increasing levels of *Gmelina arborea* leaves brought about

increased total dry matter intake and weight gain in weaner goats (Osakwe and Udeogbo, 2007). The high daily dry matter intake observed was in agreement with the report of Hague *et al.* (1997).

The reason for low dry matter intake in *Adenodolichos paniculatus* leaves may be attributed to the unpalatability and accumulated effect of anti nutritional factors of the plant. Anti-nutritional factors diminish animal productivity but may also cause toxicity during periods of scarcity or confinement when the feed rich in these substances is consumed by animals in large quantities (Kumar, 1992).

Tannins decreased feed consumption in animals, bind dietary protein and digestive enzymes to form complexes that are not readily digestible, cause decreased palatability and hence reduced growth rate (Aletor and Omodara, 1993). Saponins cause hypocholesterolaemia by binding cholesterol, making it unavailable for absorption. They also cause haemolysis of red blood cells and are toxic to rats (Johnson *et al.*, 1986).

CONCLUSION AND RECOMMENDATION

It is therefore concluded that the *G. arborea* was better consumed and gave the better performance than the rest of the treatments. More research should be conducted on *G. arborea*. *G. arborea* should be planted so as to provide feeds to livestock in addition to its other functions.

REFERENCES

- Adamu, H.Y., (2011) Growth performance of Yankasa sheep fed varying proportions of *Gmelina arborea* leaves and maize stover. M.Sc. Thesis Animal Science department. Ahmadu Bello University, Zaria, Nigeria.
- Agishi, E.C. (1984). Nigerian indigenous legumes and their forage value. A paper presented at the 9th Annual Conference of Nigerian Society for Animal Production held March, 1984 at the university of Nigeria Nsukka.

- Agishi, E. C. (1985). Forage resources of Nigeria rangelands. In Adu, I.F., Osinowo, O.A., Taiwo, B.B.A. and Alhassan, W.S. (Eds). *Small ruminant production in Nigeria. Proceedings of National conference on Small Ruminant production* held at National Animal Production Research Institute (NAPRI) Shika - Zaria, Nigeria. Pp 115 – 140.
- Ahamefule, F. O., Ibewuchi, J. A. and Agu, C.I. (2006). Comparative evaluation of some forages offered to goats in Umudike Southeastern Nigeria. *Journal of Sustainability and Agricultural Resources*. 5(2):84-86.
- Adeleye, O. O and Fasae, O. A. (2008). Evaluation of *Gmelina arborea* and Banana (*Musa sapientum*) leaves as feed for household goat production. In: Adeyemi, O.A., Ogungbesan, A.M., Dada, A.O., Eniolorunda, O.O., Awojobi, H.A., Oke, D.B. and Agunibide, J.A. (Eds). *Proceedings of Nigeria Society for Animal Production 23rd Annual conference held in Ayetoro, Ogun State*. 4-8 March, Pp 590 – 592.
- Adu, I. F., Udebibie, A. B. I and Okeleye, K. A., (1996). On-farm establishment and productivity of *Gmelina* and *Gliricidia* as browse for goats. *Nigeria Journal of Animal Production* 23 (1 and 2): 47 – 52. AOAC, (2000). Official Methods of Analysis, 17th ed. Association of Analytical Chemists. Washington, DC.
- Alderman, G. (1985). Prediction of the energy value of compound feeds. In: W. Haresign and D.J.A. Cole (Editors). *Recent advances in animal nutrition*. Butterworths, London, U.K.
- Aletor, V. A. and Omodara, O. A. (1993). Allechemicals in plant foods and feeding stuffs part 1, Nutritional, biochemical and Physio-pathological aspects in animal production. *Veterinary Human Toxicology*. 35(1):57-67.
- Burkill, H. M. (1985). Entry for *Adenodolichus paniculatus* (Hua) Hutch, and Dalz. (Family Leguminosae-papilionoideae). In; *The useful plant of west tropical Africa*, vol 3, Royal Botanic Gardens, Kew, U.K.
- CJB, (2010). Base des données des plantes d'Afrique (version 3.3). Conservatoire et jardin botaniques de la ville de Genève and South African National Biodiversity Institute Pretoria.
- Crowder, L.V. and Chheda, H.R. (1982). *Tropical Grassland Husbandry*, Longman Inc, New York. Pp. 294 and 295
- D'Mello, J. F. (1992). Chemical constraints to the use of tropical legumes in animal nutrition.
- Dung, D. D., Omokanye, A. T. and Lamidi, O. S. (2000). Short-term intake and in sacco degradability of mixtures of two tropical legumes. *Tropicultura*, 18 (4): 164-166.
- Animal Feed Science and Technology* 38: 237-261.
- Duncan, B. D. (1995) Multiple Range Test and Multiple Test Biometrics 1:1-42
- FAO (1989) *Le Gmelina arborea; Essence de reboisement dans les savannes*. Bureau Régional de la FAO pour l'Afrique, Accra-Ghana. 118pp.
- Hague, N., Khan, M. and Murarilal, L. (1997). Effect of level of *L. leucocephala* in the diets of Samaru-pari goats on carbon, nitrogen and energy balance. *Asian Australasian Journal of Animal Science*, 10:455-459.
- Jensen, M. (1995). Trees commonly cultivated in Southeast Asia; Illustrated field guide. RAP Publication: 1995/38, FAO, Bangkok, Thailand. p.93.
- Johnson, I. T., Gee, J. M., Price, K., Curl, C. and Fenwick, G. R. (1986). Influence of saponin on gut permeability and active nutrient transport *in vitro*. *Journal of Nutrition*, 116: 2270-2277.
- Kumar, R. (1992). Antinutritional factors, the potential risks of toxicity and methods to alleviate them. *Proceedings of the FAO Expert Consultation held at the Malaysian Agricultural Research and*

- Development Institute (MARDI) in Kuala Lumpur, Malaysia, 14-18.
- Leng, R. A. (1992). "Feeding fodder trees". In drought feeding strategies and practice, FAO Publication Number 107 pp 149 – 151.
- Mecha, I. and Adegbola. T. A. (1980) Chemical composition of some Southern Nigeria forage eaten by goats. *In: Le Houerou, H.N. (Ed.). Browse in Africa. The current state of knowledge. ILCA, Addis Ababa, Ethiopia. Pp 303 – 306*
- Odo, B. I., Omeje, F. U., Okwor, J. N. (2001) Forage species availability, food preferences and grazing behaviour of goats in Southern Nigeria. *Small Ruminant Research 42: 163-168.*
- Oji, U. I. and Isilebo, J. O. (2000). Nutrient characteristics of selected browse plants of humid tropics. Proceedings of the 25th annual conference of Nigerian Society for Animal Production. 19-23 March, 2000, Umudike, Nigeria, pp: 54-56
- Oni, O. O., Abubakar, B. Y. and Ogundipe, S. O. (1991). Genetic and phenotypic association of juvenile body weights and egg production traits in 2 strains of Rhode Island Chickens. *Nigerian Journal of Animal Production. 18:66-69.*
- Opara, C. C., (1996). The use of *Alchornea cordifolia* leaf meal as feed ingredient in poultry diet. M.Sc Thesis, Federal University of Technology, Owerri. Unpublished.
- SAS (2002) Institute inc.SAS/STAT user 's guide.6.03 Edition, Cary NC, USA.
- Sevilla, C. C. and Meriales, S. M. (1999). Utilization of *Gmelina arborea* Roxb leaves and fruits as feed for sheep. *Proceedings of PSAP 36th Annual Convention, Acorda, J. A. College, Lagna (Philippines). P395.*
- Smith, O. B. (1993). Small ruminant feeding systems for small scale farmers in humid West Africa. In: stare, J.E.S., Said, A.N. and Kategile, J.A. (Eds). The Complementary of feed Resources for Animal Production in Africa. *Proceedings of the joint feed Resources Network. ILCA. Gaborone, Botswana 4 – 8 March, 1991. African feeds research Network. ILCA (International Livestock Centre for Africa), Addis Ababa Ethiopia. Pp 363 – 376.*
- Osakwe, I. I and Udeogu, R. N. (2007). Feed Intake and Nutrient Digestibility of West African Dwarf (WAD) Goat Fed *Pennisatum purpureum* Supplemented with *Gmelina arborea*. *Animal Research International. 4(3):724-727.*
- Umeh, L. I. (1990). The establishment and management of large scale *Gmelina* plantations. In IUFRO Symposium on Productivity and utilization of *Gmelina arborea* in West Africa. University of Ibadan, Nigeria, 21pp.
- Van Soest, P. J. Robertson, J. B. and Lewsi, B. A. (1991). Methods for dietary Fiber, NDR and Starch Polysaccharides in relation to animal nutrition. *Journal of Dairy Science. 74: 3583 – 3542.*

PERFORMANCE AND COST BENEFITS OF BROILER CHICKENS FED SORGHUM SK-5912 (*Sorghum bicolor* L. Moench) VARIETY WITH DIFFERENT PLANT PROTEIN SOURCES

^aLakurbe, O. A., ^bDoma, U.D., ^bBello, K.M. and ^bAbubakar, M.

^aDepartment of Animal Science, Federal University Kashere, Gombe State, Nigeria*.

^bDepartment of Animal Production, Abubakar Tafawa Balewa University, Bauchi, Nigeria.

Corresponding Author e-mail: auduobedtb@gmail.com; GSM- 07030453905

ABSTRACT

An experiment was conducted to evaluate the performance and cost benefits of broiler chickens fed sorghum SK-5912 variety with different plant protein sources. Five diets were formulated in which maize with boiled soya bean (MBSB) was used as the control and sorghum SK-5912 variety was combined with boiled soya bean (SBSB), soya bean meal (SSBM), industrial ground nuts cake (SIGNC) and local ground nuts cake (LGNC) tagged as diets 1, 2, 3, 4 and 5 respectively. Three hundred broilers chicks 'marshal strain' were randomly allotted in to the dietary treatments with four replications in a completely randomized design. Feed and water were supplied ad libitum and experiment lasted for a period of eight weeks. Results at the starter phase revealed that diet 2 (SBSB) had a significantly ($P < 0.01$) higher daily feed intake (51.17g), and a highly significant (0.001) daily weight gain (24.73g), while values obtained for feed conversion ratio showed a significantly ($P < 0.05$) difference among the treatment means with diet 1 having the best value of 1.90. At the finisher as well as the overall phases all the performance measured were not influenced except daily feed intake where diet 2 also had a significantly ($P < 0.01$) higher value (83.30g) at the overall phase. The financial benefit indicated that the lowest feed cost per kilogram body weight gain value of ₦318.24 on diet 5 (SLGNC) and diet 1(MBSB) had the highest value of ₦385.92. It can be concluded that sorghum SK-5912 variety is a suitable source of dietary energy can be combined with different plant protein sources without compromising broiler chickens performance in addition to reduction in feed cost.

Keywords: Broilers, feed cost, plant protein sources, performance, sorghum SK-5912.

INTRODUCTION

The main limitation to expansion of poultry industry in Nigeria is the high cost of feeds due to unavailability of required feed ingredients at reasonable prices (Babatunde and Hamzat, 2005). This is consequent upon the fact that there exist a stiff competition between human, industries and livestock for the available cereal and legume grains which are major sources of feed ingredients i.e. as dietary energy and plant protein sources (Olomu, 2011). Maize forms the major source of dietary energy while soya beans the main source of plant proteins for poultry, but their relative high cost and scarcity presently being experienced in the country as a result of the existing competition on them remain an issue that require urgent attention. Several attempts at reducing this high cost of feed continue with the search for useful alternatives of comparatively lower prices to conventional ones with lower human demand and little or no industrial use (Akinmutimi, *et al.*, 2001).

Some improved varieties of sorghum have been developed by the International Crop Research Institute for the Semi Arid

tropics (ICRISAT), Kano centre and the Institute for Agricultural Research (IAR), Ahmadu Bello University (ABU), Zaria, Nigeria. These are the yellow coloured SAMSORG 17 (i.e. sorghum SK-5912 variety) and the cream coloured ICSV 400 varieties. The industrial success in the use of this sorghum and sorghum malt for brewing larger has contributed in raising their commercial production, (ICRISAT, 2003). Sorghum SK-5912 variety together with ICSV 400 was used in a trial, and the result showed that it can conveniently replace maize and other conventional energy sources in turkey diets thereby improving the feed supply system at affordable cost, (Etuk, *et al.*, 2015).

Sorghum SK-5912 variety has low tannin content, this coupled with low cost due to availability and low human demand more especially in Northern part of the country where its being cultivated has shown that the sorghum variety could be a suitable energy feedstuff for poultry. However, there is paucity of information on the utilization of sorghum SK-5912 variety with different plant protein sources (Etuk *et al.*, 2012). Information is required on the type of plant

protein sources that may be cost effective when combined with sorghum SK-5912 in poultry diets.

This study therefore was designed to investigate the growth performance and financial benefit of broiler chickens fed sorghum (SK-5912) variety with different plant sources.

MATERIALS AND METHODS

A total of three hundred experimental birds were randomly allotted to five experimental diets that were replicated four times in a completely randomized design of fifteen birds per replicate. Feed and water were supplied to them *ad libitum* during the experiment which lasted for eight weeks. Five experimental diets for both starter (23%CP) and finisher (20%CP) phases were formulated in which maize with boiled soya bean (MBSB) was used as the control and sorghum SK-5912

variety combined with boiled soya bean (SBSB), soya bean meal (SSBM), industrial ground nuts cake (SIGNC) and local groundnuts cake (SLGNC) were tagged as diets 1, 2, 3, 4 and 5 respectively (Tables 1 and 2). Samples of feed were analyzed to determine their proximate composition according to AOAC, (2006). Daily records of feed intake were taken while body weights were recorded weekly. Records of mortality were also taken. Routine vaccinations and medications were carried out accordingly.

Data on daily feed intake, weight gain, initial weights, final weights, feed conversion ratio and mortality were subjected to Analysis of Variance (ANOVA) technique as described by (Steel and Torrie, 1980), using Minitab software statistical package (Minitab, 2014). Differences between treatment means were separated using Duncan's Multiple Range Test (Duncan, 1955).

Table 1: Ingredients and composition (%) of sorghum SK-5912 with different plant protein sources fed to broilers chickens at the starter phase (1-4 weeks)

Ingredients	1(MBSB)	2(SBSB)	Diets 3(SSBM)	4(SIGNC)	5(SLGNC)
Maize	49.68	0.00	0.00	0.00	0.00
Sorghum (SK-5912)	0.00	49.68	49.68	49.68	49.68
Plant protein sources	32.52	32.52	32.52	32.52	32.52
Wheat offal	10.00	10.00	10.00	10.00	10.00
Fish meal	4.00	4.00	4.00	4.00	4.00
Bone meal	3.00	3.00	3.00	3.00	3.00
+ Premix	0.25	0.25	0.25	0.25	0.25
Salt	0.25	0.25	0.25	0.25	0.25
Methionine	0.20	0.20	0.20	0.20	0.20
Lysine	0.10	0.10	0.10	0.10	0.10
Total	100.00	100.00	100.00	100.00	100.00
Calculated analysis					
Crude protein (%)	23.00	23.00	23.00	23.00	23.00
ME (kcal/kg)	2950.00	2900.00	2850.00	2800.00	2800.00
Crude fibre (%)	4.10	4.02	3.95	3.88	3.80
Ether Extracts (%)	4.99	4.98	4.57	4.62	4.477
Calcium (%)	1.44	1.45	1.45	1.46	1.46
Phosphorus (%)	0.74	0.77	0.80	0.82	0.86
Methionine (%)	0.37	0.36	0.35	0.34	0.33
Lysine (%)	1.20	1.21	1.23	1.24	1.25

+Premix: A bio-organics nutrient supplement containing Vit. A 12,500,000 I.U; Vit.D3 2,500,000 I.U; Vit. E 40,000mg; Biotin 80mg; Vit. B1 3,000mg; Vit.B2 5,500mg; Niacin 55,000mg; Vit.K3 2,000mg; Calcium Pantothenate 11,500mg; Vit. B6 5,000mg; Vit. B12 25mg; Folic acid 1,000mg; Cholin Chloride 500,000mg; Cobalt 300mg; Copper 8,500mg; Iodine 1,500mg; Iron 100,000mg; Manganese 120,000mg; Selenium 120mg; Zinc 80,000mg; Anti-oxidant 120,000mg. MBSB = Maize + Boiled Soya Bean, SBSB = Sorghum SK-5912 + Boiled Soya Bean, SSBM = Sorghum SK-5912 + Soya Bean Meal, SIGNC = Sorghum SK-5912 + Industrial Groundnuts Cake, SLGNC = Sorghum SK-5912 + Local Groundnuts Cake.

Table 2: Ingredients and composition (%) of sorghum SK-5912 variety with different plant protein sources fed to broiler chickens at the finisher phase (5-8 weeks)

Ingredients	Diets				
	1 (MBSB)	2 (SBSB)	3 (SSBM)	4 (SIGNC)	5 (SLGNC)
Maize	53.91	0.00	0.00	0.00	0.00
Sorghum(SK-5912)	0.00	53.91	53.91	53.91	53.91
Plant protein sources	25.29	25.29	25.29	25.29	25.29
Wheat offal	15.00	15.00	15.00	15.00	15.00
Fish meal	2.00	2.00	2.00	2.00	2.00
Bone meal	3.00	3.00	3.00	3.00	3.00
+ Premix	0.25	0.25	0.25	0.25	0.25
Salt	0.25	0.25	0.25	0.25	0.25
Methionine	0.20	0.20	0.20	0.20	0.20
Lysine	0.10	0.10	0.10	0.10	0.10
Total	100.00	100.00	100.00	100.00	100.00
Calculated analysis					
Crude protein (%)	20.00	20.00	20.00	20.00	20.00
ME (kcal./kg)	2950.00	2950.00	2900.00	2850.00	2850.00
Crude fibre (%)	4.08	4.01	3.93	3.85	3.77
Ether Extracts (%)	4.01	3.98	3.25	3.16	3.08
Calcium (%)	1.71	1.71	1.71	1.72	1.72
Phosphorus (%)	0.73	0.76	0.79	0.82	0.85
Methionine (%)	0.43	0.42	0.40	0.39	0.38
Lysine (%)	1.10	1.12	1.13	1.14	1.16

+Premix: A bio-organics nutrient supplement containing Vit. A 12,500,000 I.U; Vit.D3 2,500,000 I.U; Vit. E 40,000mg; Biotin 80mg; Vit. B1 3,000mg; Vit.B2 5,500mg; Niacin 55,000mg; Vit.K3 2,000mg; Calcium Pantothenate 11,500mg; Vit. B6 5,000mg; Vit. B 12 25mg; Folic acid 1,000mg; Cholin Chloride 500,000mg; Cobalt 300mg; Copper 8,500mg; Iodine 1,500mg; Iron 100,000mg; Manganese 120,000mg; Selenium 120mg; Zinc 80,000mg; Anti-oxidant 120,000mg. MBSB = Maize + Boiled Soya Bean, SBSB = Sorghum SK-5912 + Boiled Soya Bean, SSBM = Sorghum SK-5912 + Soya Bean Meal, SIGNC = Sorghum SK-5912 + Industrial Groundnuts Cake, SLGNC = Sorghum SK-5912 + Local Groundnuts Cake.

RESULTS

The growth performances of broiler chickens fed sorghum SK-5912 variety with different plant protein sources are presented in Table 3. The initial weight of the broiler chicks varied between 51.23 to 53.87g on diets 4 and 2 respectively. Although, the initial weight values varied between 51.23 and 53.87g on diets 4 and 2 respectively but were statistically similar. The total body weight gain varied from 1371.20 to 1487.20g on broiler chickens fed diets 3 and 1 respectively. The daily feed intake at the starter phase varied from 43.49 to 51.17g in broiler birds fed diets 5 and 2 respectively and values obtained were significantly ($P<0.01$) affected by the dietary levels of the treatment groups. The daily weight gain was also highly significantly ($P<0.001$) affected by the dietary treatments, values observed varied between 20.48 to 24.78g in broiler diets fed diets 4 and 1 respectively. The feed conversion ratio varied from 1.90 to 2.23 on diets 4 and 1 respectively and were significantly ($P<0.05$) influenced by the dietary means. The mortality values ranges between 1 to 2 birds on diets 1, 3 and 2, 4, 5 respectively.

At the finisher phase, the daily feed intake ranged from 112.96 to 124.43g for

broiler chickens fed on diets 1 and 5 respectively. The result showed that there was no significant difference at the finisher phase. The daily weight gain varied from 31.94 to 39.88g for birds on diets 3 and 4 respectively. All the daily weight gain values obtained in broiler birds fed the dietary treatment did not differ significantly at the finisher phase. The feed conversion ratio ranged between 3.13 and 4.18 for birds on diets 4 and 3 respectively. The feed conversion ratios observed on all the dietary treatments were similar. The mortality rate of the chicks during the finisher phase ranged from 0 to 1 for birds on diets 3 and those on 1, 2, 4, 5 respectively.

The overall daily feed intake ranged from 78.70 to 83.30g for broiler chickens fed on diets 4 and 1 respectively. The result showed that daily feed intake significantly ($P<0.01$) was affected by the dietary treatments at the overall phase. The daily weight gain varied from 27.43 to 29.75g for birds on diets 3 and 1 respectively. All the daily weight gain values obtained in broiler birds fed the dietary treatments did not differ significantly at the overall phase. The feed conversion ratio ranged between 2.70 and 3.03 for birds on diets 1 and 3 respectively

and values observed on all the dietary groups were similar. The mortality rate of the chicks during the overall phase ranged from 1 to 3 for birds on diets 3 and those on 2, 4, 5 respectively. There was no evidence of any disease regarding the death of the broiler chickens.

The financial benefit analysis of broiler chickens production fed Sorghum SK-5912 variety using different plant protein sources is shown in Table 4. The total feed intake at the starter phase varied between 1.41 and 1.51kg on diets 3 and 1 respectively. All the values observed on the dietary treatments were lower than the value on the control diet. The feed cost (₦/kg) ranged from ₦120.18 on diet 5 to ₦161.23 on diet 1. The total feed cost (₦) ranged from ₦170.66 diet 5 and ₦243.46 on diet 1. The total weight gain (kg) ranged from 0.57kg to 0.69kg on diets 1 and 2 respectively during the starter phase. The value on the control diet and diet 2 (0.69kg) were higher compared to other treatment groups. The feed cost in ₦ per kg gain varied between ₦276.97 to ₦352.84 on diets 2 and 1 respectively and were cheaper on other treatment diets than on the control diet ₦352.84. At the finisher phase, the total feed intake values varied between 2.59 to 2.70kg for diets 4 and 2 respectively. The values of feed cost (₦/kg) ranged from ₦100.38 to ₦114.03 on diets 5 and 1. The values were higher on maize based diets than

the treatment diets. Similarly, the values of total feed cost varied from ₦263.00 to ₦301.04 on diets 5 and 1 respectively. The total weight gain in kg ranged from 0.70 to 0.88kg on diets 3 and 4 respectively. The value on diet 4 (0.88kg) was higher than all other values among the treatment groups. Feed cost ₦/kg gain values varied between ₦320.22 and ₦425.76 on diets 5 and 3 respectively. Except the values on diet 2 (₦425.76), all other values are lower compared to the value on the control diet (₦381.06). The overall total feed intake varied between 4.03 and 4.17kg on diets 4 and 2 respectively. The values observed on diets 2 was higher then followed by the control diet (4.15kg). The feed cost in ₦ per kg gain ranged from ₦110.28 to ₦137.63 on diets 5 and 1 respectively. The total feed cost varied between ₦445.53 and ₦529.66 on diets 5 and 1 respectively. The total weight gain had the highest value observed on the control diet (1.48kg) and the lowest was diet 2 (1.37kg). The highest value observed for feed cost ₦ per kg weight gain was on diet 1 (₦385.92) and the lowest on diet 4 (₦318.24). The feed cost in ₦ per kg gain of all the treatment groups were lower compared to the value on the control diet and there is a cost saving on all the treatment diets. The percentage cost saving varied between 2.33% on diet 3 and 17.54% on diet 5.

Table 3: Performance of broiler chickens fed sorghum SK-5912 with different plant protein sources

Parameters	Diets					SEM
	1 MBSB	2 SBSB	3 SSBM	4 SIGNC	5 SLGNC	
Starter phase(1-4 wks)						
Initial weight (g)	52.18	53.87	51.37	51.23	51.99	1.97 ^{NS}
Daily Feed Intake (g)	47.54 ^{bc}	51.17 ^a	49.83 ^{ab}	45.56 ^{cd}	43.49 ^d	3.09 ^{**}
Daily Weight Gain (g)	24.78 ^a	24.73 ^a	23.88 ^b	20.48 ^c	21.29 ^{bc}	2.79 ^{***}
FCR	1.90 ^a	2.07 ^{ab}	2.09 ^b	2.23 ^c	2.05 ^{ab}	0.13 [*]
Mortality (Number)	1	2	1	2	2	-
Finisher phase (5-8 wks)						
Final weight (g)	1539.4	1500.60	1422.6	1501.80	1500.40	56.91 ^{NS}
Daily feed intake (g)	121.96	124.20	123.86	123.48	124.43	1.69 ^{NS}
Daily weight gain (g)	36.06	34.29	31.94	39.88	36.57	2.99 ^{NS}
Feed conversion ratio	3.43	3.76	4.18	3.13	3.55	0.35 ^{NS}
Mortality (Number)	1	1	0	1	1	-
Overall phase (1-8wks)						
Daily feed intake (g)	80.01 ^{ab}	83.30 ^a	82.41 ^{ab}	79.70 ^b	78.95 ^b	3.14 ^{**}
Daily weight gain (g)	29.75	28.94	27.43	29.01	28.97	1.15 ^{NS}
Feed conversion ratio	2.70	2.91	3.03	2.76	2.75	0.13 ^{NS}
Mortality (Number)	2	3	1	3	3	-

^{abc}Means bearing different superscripts within the same row differ (***=P<0.001), (**=P<0.01), (*=P<0.005),NS= Not significant; SEM= Standard error of means

Table 4: Financial Benefit of broiler chickens production fed sorghum SK-5912 variety with different plant protein sources

Parameters	1	2	Diets 3	4	5
Starter phase:					
Total feed intake (kg)	1.51	1.47	1.41	1.44	1.42
Feed cost (₦/kg)	161.23	130.01	141.70	136.16	120.18
Total feed cost (₦)	243.46	191.11	199.80	196.07	170.66
Total weight gain (kg)	0.69	0.69	0.67	0.57	0.60
Feed cost ₦/kg gain	352.84	276.97	298.21	343.98	284.43
Finisher phase:					
Total feed intake (kg)	2.64	2.70	2.66	2.59	2.62
Feed cost (₦/kg)	114.03	104.11	112.04	108.08	100.38
Total feed cost (₦)	301.04	281.10	298.03	281.79	263.00
Total weight gain (kg)	0.79	0.75	0.70	0.88	0.80
Feed cost ₦/kg gain	381.06	374.80	425.76	320.22	328.75
Overall performance					
Total feed intake (kg)	4.15	4.17	4.07	4.03	4.04
Feed cost (₦/kg)	137.63	117.06	126.87	122.48	110.28
Total feed cost (₦)	571.16	488.14	516.36	493.59	445.53
Total weight gain (kg)	1.48	1.44	1.37	1.45	1.40
Feed cost ₦/kg gain	385.92	338.99	376.91	340.41	318.24
Cost saving (₦)	0.00	46.93	9.01	45.51	67.68
% cost saving	0.00	12.16	2.33	11.79	17.54

DISCUSSION

The daily feed intake of broiler chickens fed Sorghum SK-5912 with different plant protein sources in Table 3, showed a significant ($P < 0.01$) difference among the treatment means during the starter and overall phases. The values obtained ranged from 43.49 to 51.17g on diet 5 and control diet for the starter and 78.95 to 83.30g on the diets 5 and 2 at the overall phase respectively. This result is in contrast with the findings of Medugu *et al.* (2010) and Pour-Reza and Edriss (1997) who stated that all the dietary maize portion of broiler diets can be replaced with low-tannin sorghum without adverse effects on the live weight gain, feed intake and feed conversion ratio. Since birds have been known to eat in order to satisfy energy requirement (Oluyemi and Roberts, 2013; NRC, 1994), this differences could be attributed to the effect of different plant protein sources used in this study. The daily weight gain also showed a highly significant ($P < 0.001$) effect on the treatment means at the starter phase. The highest value was observed on the control (24.78g) while diet 4 was the lowest (20.48g). Feed conversion ratio which is a direct indication of how best the feed given to birds was turned to meat also showed a significant ($P < 0.05$) difference among the treatment groups, with diet 4 (Sorghum + industrial groundnuts cake) having the best FCR and the worst was the control diet. This observation do not agreed with the report of Ibitoye *et al.* (2012) who observed that replacing maize with sorghum or millet had no

effect on feed intake, weight gain and feed conversion ratio. This difference could also be attributed to effect of each different plant protein included in the diets, since it also have influence on performance.

This observation is in agreement with the findings of Aguihe *et al.* (2013) who reported that at higher level of inclusion of local groundnuts cake performance was impaired with less nutrient digestibility, and in contrast with the findings of Mysaa *et al.* (2016) who observed that feeding peanut meal at a high level (100% peanut meal as a protein source) in the birds rations improved final body weight and feed intake, while did not affect feed conversion ratio and average daily gain. The feed cost in ₦ per kg in both starter and finisher phases was higher in the control diet than other dietary treatments. Similarly, the feed cost per kilogram gain was lower on the Sorghum SK-5912 based diets (i.e. diets 2, 3, 4 and 5) compared to diet 1 (control) in both the starter and finisher phases. This indicates that Sorghum SK-5912 with low price due to low human demand if combined with any plant protein source available in this case soya bean, soya bean meal or groundnuts cake in broiler diets is capable of bringing down the cost of production. This observation was similar to that of Medugu *et al.* (2010) who reported that the highest cost per kg feed was in maize based diet compared to millet, low-tannin sorghum and high-tannin sorghum based

diets. The lowest feed cost per kg gain was on diet 5 (SorghumSK-5912 + LGNC).

CONCLUSION

The study revealed that growth performance of broiler chickens were not adversely affected by the inclusion of Sorghum SK-5912 with different plant sources. It can be concluded that Sorghum SK-5912 can effectively replace up to 100% of conventional maize in the diets of broiler chickens with a concomitant reduction in feed cost associated with raising the birds. The low tannin content and availability makes it a sustainable alternative energy source for feeding broiler chickens.

REFERENCES

- Aghuihe, P.C., Fatokun, B.O., Samuel, A.S., Aguihe, E.D. and Osaguora, P.O. (2013). Growth performance and nutrient digestibility of broiler chickens fed diets with graded levels of local processed groundnut cake meal as replacement for soya bean meal. *International Journal of Agriculture and Biosciences*, 2(5):256-259.
- Akinmutimi, H.A. and Opiah, G.O. (2001). Effects of potash-cooked lima bean (*Phaseolus lunatus*) on broiler starter diets. *Niger Agric.* 32, Pp 109-118.
- AOAC(2006). Association of official Analytical Chemists. Official methods of Analysis. 20th Edition. Washington, U.S.A.
- Babatunde, B.B. and Hamzat, R.A. (2005). Effect of feeding graded levels of Kolanut husk meal on the performance of cockerels. *Nigerian Journal of Animal Production*, 32(1):61-66.
- Duncan, D.B. (1955). Multiple Range and Multiple F. Test. *Biometrics*. 11:1-42.
- Etuk E.B., Opara M.N., Okeudo N. J., Esonu B.O. and Udedibie A.B.I. (2012). Haematological and serum biochemical parameters of local turkey poult fed diets containing two varieties of sorghum. *Journal of World's Poultry Research* 2(4): 81-89. Journal homepage: <http://jwpr.science-line.com/>
- Etuk, E.B., Ugwu, C.C., Okeudo, N.J., Esonu, B.O. and Udedibie, A.B.I. (2015). Haematology and serum chemistry of local grower Turkeys fed diets containing Samsorg 17 and ICSV 400 varieties of sorghum. *Journal of World's Poultry Research* 5(1):01-09.
- Ibitoye, E.B., Olorede, B.R., Jimoh, A.A. and Abubakar, H. (2012). Comparative performance and organ relative weight of broiler chickens fed three sources of energy diet. *Journal of Animal Production Advances*, 2(5):233-238.
- ICRISAT (2003) www.icrisat.org.
- Medugu, C.I., Kwari, I.D., Igwebuike, J., Nkama, I., Mohammed, I.D. and Hamakar, B. (2010). Carcass and blood components of broiler chicken fed sorghum or millet as replacement for maize in the semi arid zone of Nigeria. *Agriculture and Biology Journal of North America*, 1(31):326-329.
- Minitab (2014). Statistical Software.V.17.3.1. Minitab Inc., State College, P.A.
- Mysaa, A. (2016). The impact of partial or total replacement of soya bean with pea nut meal on broiler performance. *Journal of Natural Sciences Research*, 6(4).pp 77-81. <https://www.researchgate.net/publication/314262116>.
- NRC (1994). Nutrient Requirement of Poultry. National Academic of Science. Washington, D.C.
- Olomu, J.M., (2011). Monogastric Animal Nutrition. Principles and practices. St. Jackson Publishing, Benin City. Page 217-218.
- Oluyemi, J.A. and Roberts, F.A. (2007). Poultry Production in Warm wet Climates. Spectrum Books Limited, Ibadan. Pp 153-155.
- Pour-Reza, J. and Edriss, M.A. (1997). Effects of dietary sorghum of different tannin concentration and tallow supplementation on the performance of broiler chicks. *British Poultry Science*. 38:512.
- Steel, R.G.C., and Torrie, J.H. (1980) Principles and Procedures of Statistics. Mcgraw-Hill book company Inc. London.

PERFORMANCE AND CARCASS CHARACTERISTICS OF BROILER CHICKENS FED DIETS CONTAINING GROUNDNUT CAKE AND FULL FAT SOYA BEAN

^a*Babawuro, Y. and ^bMuhammad, B. A.

^a School of Vocational Education, Department of Agricultural Education F. C. E (T) Gombe

^bMinistry of Animal Production and Nomadic Affairs Gombe State Poultry Production Unit, (PPU)

Corresponding Author's E-Mail: sarkinshanu2005@yahoo.com; Mobile Phone No: +2347068214403

ABSTRACT

An experiment was carried out to determine the performance and carcass characteristics of broilers fed diets containing groundnut cake (GNC) and full fat soya bean (FFSB) using one hundred and eighty day-old Anak 2000 broiler chickens between August and November 2017. The birds were randomly distributed to four dietary treatments of plant protein sources processed in different form namely; local groundnut cake (LGNC), industrial groundnut cake (IGNC), cooked soya bean (CSB), and roasted soya bean (RSB). The birds were housed and fed in a deep litter system; each treatment was replicated three times with fifteen birds per replicate. Parameters measured at starter and finisher phases include daily feed intake (DFI), daily weight gain (DWG), feed conversion ratio (FCR) and carcass characteristics. At the starter phase, average DWG was lowest on CSB (17.70g) and highest on LGNC (23.65g) at $P < 0.001$, while LGNC and IGNC were the highest and lowest at the finisher phase (31.83) and (29.88g) respectively. DWG and FCR were significantly influenced by the dietary treatments at both starter and overall phases, except for DFI and mortality. In the overall weight gain performance on LGNC and IGNC were higher 1677 and 1647g in GNC class, while FFSB showed the lowest weight gain of 1303 and 1447g, respectively. Slaughter characteristics measured were higher in the GNC mainly in live weight, plucked and eviscerated weight, dressing percentage, gizzard, small intestine, spleen and heart, other organs weight were not significantly influenced by the dietary treatments. It can be concluded that birds fed on LGNC-based diet gained more weight than those fed with FFSB based diet. In order to reduced production cost and affordable energy source, the used of GNC-based diet should be encouraged among poultry farmers.

Key Word: Broiler, Performance, Carcass, Groundnut cake, Soya bean

INTRODUCTION

Over the years, the supply of protein concentrates to monogastric especially the conventional ones such as oil seed meals like groundnut seed cake, and soya beans meals which have emerged to be of high quality protein content is of great concern as well as the most common breeds of poultry existing within our livestock industry is of great concern. Poultry industry in Nigeria has witnessed series of development especially in the field of nutrition. The advancement from primitive mode of feed to modern ways has given way to in-situ feeding, without the birds roaming around searching for food. Ayoola *et al.*, (1991) observed that there are definite prospect for appreciable increase in livestock productivity but these will not occur spontaneously they can be achieved only by the adoption of progressive policies and lot of hard work on the part of the people, and such must be geared to ecological, sociological, and economic condition and will be achieved only by improved method of feeding management and breeding of population groups. Mustafa *et al.*, (2012) observed that livestock production performance in Nigeria is far below the actual potential vis-a-vis the output from the

resource available. In terms of the productivity of resource soya beans meal and groundnut cake are the major oil seed crop in the world that provide approximately 60% of vegetable protein and 30% oil (Oluyemi and Robberts, 1988).

According to (Ojewola *et al.*, 2012), the requirement of feed for growing poultry industry in Nigeria is about 6.5 million tones per annum where vegetable protein source constitutes around 30% of the total compounded poultry diet. Other commonly used plant protein sources includes seed meals of groundnut, soya beans, sesame, sunflower, mustard, etc, (Patneck and Schaible, 1980). The amino-acid composition of majority of the oil seed meals is deficient in one or more critical amino acids like methionine, lysine etc, (Steenfeldt *et al.*, 2012). Another limiting factor for free use of oil seed meals is the presence of anti-nutritional factors. Nevertheless, several attempts have been made to detoxify the oil seed meals for effective usage of the same in practical ration, (Shaib *et al.*, 1997). Groundnut (*Arachis hypogea*) meal has been a major source of vegetable protein in poultry diet in our country. However it contains

trypsin inhibitor that limit the use of raw groundnut meal. This trypsin inhibitor can be destroyed by mild heating. So, solvent extracted groundnut meal is mostly used and it contains 43 to 48% crude protein. It is an excellent source of arginine but deficient in lysine cystine, and methionine, supplementation of synthetic lysine to groundnut meal can make it ideal protein source in poultry feeds. However, it has been seen that groundnut meal is susceptible to toxin like mycotoxins, mowarin, etc. Groundnut seed coat contains tannins, a polyphenolic substance that lowers the quality of protein content of groundnut. Ojewola *et al.*, (2012) stated that Soya bean (*Glycin max*) meal is a good source of protein for poultry; it contains 45-52% crude protein. The amino acid profile of soya beans meal is well balanced and is an excellent source of lysine to the poultry in combination with sesame meal which contain higher levels of methionine but deficient in lysine, soya bean seeds have certain anti nutritional factors like trypsin inhibitors, phytohemagglutinin, saponins, goitrogen and estrogenic factors that can affect the production performance of chickens. But they are all thermo-labile and can be destroyed by roasting, heating, or autoclaving. An adequate balance of amino acid by substituting methionine to soya beans meal based diet can successfully replace even fishmeal from poultry feed.

A major constraint in the development of poultry industry in most tropical countries Nigeria inclusive is the scarcity of animal protein source being supplemented and or in cooperated along with plant protein source to make up the needed amino acid profile (Dafwang *et al.*, 1999). However, the use of fishmeal, meat meal, blood meal is restricted due to problems like development of fish off flavor incidence of gizzard and intestinal eruption, which make it somewhat unpalatable, (Steenfeldt *et al.*, 2012; Olomu, 2013). A major problem facing poultry production in Nigeria is high cost of feeds. Thus has necessitated the feed manufacturers to frequently vary their formula and the ingredient being used. The major protein concentrates used in animal feed formulation are the oil seed meals such as the soya bean meal (SBM) and groundnut cake (GNC). They

usually have their crude protein content above 40%. SBM is an excellent source of plant protein, except for it deficiency in methionine. Soya bean contain trypsin inhibitors which cause enlargement of pancreas in chicks as observed by (Ojewola *et al.*, 2012), therefore it is usually subjected to heat treatment prior to use as animal feed in order to destroy the anti-nutritional factors. However the use of SBM in Nigeria had been limited due to almost nonexistence of local processing of the little quantity of soya bean seed produced in the country and the consequent increase in price of the ingredient (Ojewola *et al.*, 2012),

Proteins are large complex class of nutrient composed of smaller units known as amino acids. Oluyemi and Roberts, (1988) stated that the location of proteins in the body is quite broad; they are found in structural tissues, blood enzymes, and hormones. Their study also revealed that on a dry weight basis, the body of a mature broiler is more than 65% protein and that the content of an egg are about 50% proteins whereas digestions of feed proteins result in the liberation of individual amino acid. Protein is useful mainly for the synthesis of body tissues and hence for growth, for body repairs and also for egg formation. Retardation in growth poor feathering and vice habit can be traced to protein deficiency rather than the protein itself in its component parts, the amino acids are of greatest nutritional importance (Oluyemi and Roberts, 1988)

Groundnut may be used as a grinded cake after the oil is extracted to make up 8 to 24 percent of poultry ration. Mouldy groundnut may contain toxic substances, the most dangerous of which is aflatoxin. Njike (1997) investigated the optimum substitution level of cotton seed (CSM) for groundnut meal (GNM) protein at 0, 10, 20, 30, 40 and 50% in broiler starter, the author indicated that up to 40% GNM could be replaced with CSM without any adverse effect on rate of gain, final body weight and feed efficiency. Tewe and Ologhobo (1987) fed graded level of raw and cooked soya bean based diets to broilers and observed daily weight gain of (17.31-28.21g), daily feed intake of (40.55-55.84g), feed conversion ratio of (1.81-2.33) and dressing percentage of (52.13-66.67%).

Adeniji (2008) investigated the effects of replacing soya bean meal (SBM) with groundnut cake (GNC) with or without fishmeal on the performance characteristic of the fed pullet chicks in which groundnut cake (GNC) replaced 0, 25, 50, 75 and 100% of soya bean meal (SBM), chicks fed 50% GNC replacement for SBM diet had the highest feed intake of (29.86g) which was comparable with (28.10g), intake by those feed on 0% GNC. The chicks fed diet in which 75% of SBM is replaced by GNC had the lowest feed intake value of (27.24g), there was no significant effect of the fishmeal supplementation on feed intake. There was also no significant effect of the treatment on the weight gain and feed-to-gain ratio of the birds. The pullet chicks on 50% replacement of GNC for SBM had the highest value of crude fibre retention (42.07%), while those on 100% replacement of GNC for SBM had the lowest crude fibre retention of (26.07%).

Whole soya bean contains 18 - 22 percent oil which is usually removed by solvent extraction during preparation of the meal (Church, 1991). Soya bean seed (full fat) has 38% crude proteins, 18% fat, 5% fibre, 0.25% calcium, 0.59 phosphorous, 4.6% ashes, 2.4% lysine, 0.54% methionine, 0.54% cystine, 2.8% arginine, and 0.52% tryptophan. While soya bean meal contain about 44.0% crude protein, 35% fat, 65% fibre, 0.20% calcium, 0.60% ash, 2.7% lysine, methionine 0.6% cystine, 0.62% arginine 3.2% and tryptophan 0.52% (Aduku, 1993). Today most soya beans are fed in oil meal form. But, as result of increased in processing cost, the use of heat processed whole soya beans may play an increasing role in livestock nutrition: Olomu (2013) and Odiba (2014) reported that full fat soya bean meal is rich in energy and protein source, its approximate composition was given as 93% dry matter 44% crude protein 6.0% of ether extract 8.0% crude fibre, 0.30% calcium, 3.88% lysine, 0.66% methionine, and 223 kcal/kg of M.E.

Groundnut meal is available in substantial amount in many countries because groundnuts (*Arachis hypogea*) are produce for human food in many warmer areas, groundnut meals is a by-product of groundnut oil (Tyokpat 1999). The cake is produced after oil extraction. The processing

may take the form of hydraulic processing or containing horizontal screw pressing or solvent extraction. Groundnut forms the main source of protein of chickens. Protein of groundnut meal has sub-optimal amount of cystine and methionine, also the first limiting amino acid is lysine. When the meal is used, high cereals diets adequate supplementation with animal protein is necessary. This is to ensure that the deficiencies of vitamin B12 and calcium are reduced.

The Objectives of the Study therefore is to find locally available protein source that could be used in broiler diets without adversely affecting performance and to compare the performance of birds on the protein sources namely Ground nut cake and Full-fat soya bean so as to eliminate fishmeal at the finisher phase and finally to determine carcass yield, gut characteristic and the cost benefits in using the two protein sources

MATERIAL AND METHODS

Experimental site

The experiment was conducted at Gombe State Ministry of Agriculture in the Poultry Production Unit (PPU) between March 2016 and May 2016, Gombe state is located between latitude 9 30 and 12 30N and longitude 8 45 and 11 45 E (Anonymous, 2007). It is on altitude of 540m above sea level. Gombe covers an estimated land mass of 20,265km² and has a population of 1,820,415 inhabitant (Anonymous, 2007). The state has the mean maximum monthly temperature of 37c, minimum of 120c, and relative humidity of 94% in august and 10% in December. The climatic and adaphic factors favor crop and livestock agriculture.

Materials for the Experiment

Two protein sources namely groundnut seed cake and full fat soya beans were obtained/purchased at Gombe central market, maize, fishmeal, wheat offal were obtained from local markets in Gombe town. Methionine, lysine, and vitamin/mineral premixes, a Pfizer supplement were obtained from Lidanis poultry feed sell unit, while one hundred and eighty (180) day old Anak breed were obtained from Pyradox Nig. Limited Jos. Feed formulation and mixing were done at the feed mill of Poultry Production Unit (PPU)

Gombe. The IGNC was obtained from Kano at oil processing company.

Experimental Diets and Design

Four diets for both starter (23% CP) and broiler finisher (20% CP) phases were formulated. The experimental design used was balanced design (one way factorial) where the starter phase lasted from 1st week to 4th week (4 weeks) while the finisher phase lasted from 5th week to 8th week (4 weeks). The birds were subjected to four dietary treatments namely; Local Groundnut Cake (LGNC) as diet 1, Industrial Groundnut Cake (IGNC) diet 2, Cooked Soya Beans (CSB) diet 3 and Roasted Soya Beans (RSB) as diet 4. The soya bean was toasted and cooked before incorporation in to the treatment diets while GNC was milled before incorporation.

Management of the Birds

Commercial feed obtained from ECWA feed mill Jos Plateau state was used at brooding stage, for a period of one week. Heat for brooding was supplied by electric bulbs, kerosene stoves and lanterns. The open sided portions of the pens were covered with empty sacks at the early stages of growth to conserve heat. Birds were initially weighed after brooding and then randomly allocated to the treatments. Drinkers were washed daily and feeders were cleared of poultry droppings daily. Both starter and finisher phases lasted for a period of 28 days each. The experimental diets and water were supplied ad-libitum. Birds were weighed in groups after the brooding stage and weekly thereafter till the end of the experiment. The birds were vaccinated with Newcastle intra-ocular (IO) at the hatchery. NDVK Lasota was administered on the second week through drinking water D-glucose, vitalityte, an anti stress medication was administered on the day of arrival of the birds and after each and every vaccination exercise to enhance performance. Routine management was carried out to reduce the incidence of diseases.

Carcass Characteristics and Organ Weight

At the end of the experiment two birds from each replicates were randomly selected starved overnight and slaughtered for carcass characteristics and organ weight analysis.

Bird were slaughtered and eviscerated. Parameters examined include live, plucked, eviscerated, and carcass weights express in kilogram. The legs, head, kidney, lungs, spleen, gastro-intestinal tract, intestinal fat, caeca, and pancreas weights, were expressed in percentage of carcass weight, where dressing percentages were calculated. Finally the length of the intestine and caeca were expressed in centimeter (cm).

Statistical Analysis

Data collected were subjected to analysis of variance technique (ANOVA) as described by Steel and Torrie (1980). Difference between treatment means were separated using standard error of the means and least significant difference (LSD). The economics of using ground nut seed cake and full fat soya bean was determined using the current market price of the feed stuff.

RESULTS AND DISCUSSION

The performance of broilers fed diet containing groundnut cake and full fat soya bean at the starter phase (1 -4 weeks) and finisher phase (5 -8 weeks) are shown in table 1 and 2 respectively. However the Overall Performance of the birds and the Carcass Characteristics, Organ Weights (% body weight) are shown in tables 3 and 4. Data on the Economic analysis of broiler production using groundnut cake and full fat soya bean are shown in Table 5.

Performance

Groundnut cake (GNC) and full fat soya bean (FFSB) are good source of proteins but poor source of lysine and methionine although the use of these two conventional protein sources is limited due to the presence of anti-nutritional factors which affect the digestion and absorption of proteins. These two protein sources revealed that Local and Industrial GNC were the best in all the parameters measured both at the starter and finisher phases of the experiment as indicated in Tables 1 and 2. The result shows that birds fed GNC based diets during the experimental period consumed significantly ($P < 0.001$) more feed (47.96 and 47.28g) than those fed FFSB based diets.

Table 1: Performance of Broiler fed GNC and Full Fat Soya Bean Based Diets at Starter phase (1- 4 wks)

Parameter	Types of dietary plant proteins				SEM	LSD
	LGNC ^β	IGNC	CSB	RSB		
Initial weight (g)	74.33	66.67	73.33	70.67	2.26	NS
Final weight Gain (g)	736.7 ^a	725.3 ^a	570.0 ^b	602 ^b	17.05	3.0***
Daily feed intake (g)	47.96	47.28	44.28	46.24	1.23	NS
Daily weight gain	23.65 ^a	23.52 ^a	17.74 ^b	18.97 ^b	0.61	1.90***
FCR	2.03 ^a	2.01 ^a	2.50 ^b	2.45 ^b	0.07	0.23***

Means in the same row with different superscript differ significantly (***) = $P < 0.001$; NS = not significant. LGNC=Local Groundnut Cake, IGNC= Industrial Groundnut Cake, CSB=Cooked Soy Bean, RSB=Roasted Soy Bean, SEM=Standard Error of the mean, LSD=Least Significant Difference

The better performance of birds at finisher phase on GNC particularly LGNC based diets observed in this work could be due to better nutrient digestibility coupled with a more correctly balanced amino acid

profile of in GNC meal. The dietary plant proteins levels in diets significantly influence feed consumption in birds throughout the feeding trial had effects on the pooled performance of the birds in table 3.

Table 2: Performance of Broiler fed GNC and Full Fat Soya Bean Based Diets at Finisher phase (5-8 weeks)

Parameter	Types of dietary plant proteins				SEM	LSD
	LGNC ^β	IGNC	CSB	RSB		
Initial weight (g)	736.67	725.33	570	602	52.98	NS
Final weight Gain (g)	1677 ^a	1647 ^a	1303 ^b	1447 ^b	49.13	2.9**
Daily feed intake (g)	100.71	101.89	95.61	97.84	2.62	NS
Daily weight gain	31.83	29.88	27.1	27.19	1.37	NS
FCR	3.17	3.45	3.53	3.6	0.15	NS
Mortality	0	1	1	0	0	

Means in the same row with different superscript differ significantly at $P = 0.01$; NS = not significant). ^β LGNC: Local Groundnut Cake, IGNC: Industrial Groundnut Cake, Cooked Soybean, Roasted Soybean, SEM: Standard Error of the mean, Least significant difference

Table 3: Overall Performance of BroilerFeed Diets Containing GNC and Full Fat Soya Bean based Diets (1-8 weeks)

Parameter	Types of dietary plant proteins				SEM	LSD
	LGNC ^β	IGNC	CSB	RSB		
Initial weight (g)	74.33	66.67	73.33	70.67	2.26	NS
Final weight Gain (g)	1677.1	1677.1	1303.4	1447	91.95	NS
Daily feed Intake (g)	74.34	74.59	69.94	72.76	1.59	NS
Daily weight gain (g)	27.75 ^a	26.71 ^a	22.42 ^b	23.08 ^b	0.87	2.70**
FCR	2.68 ^a	2.81 ^a	3.12 ^b	3.13 ^b	3.13	0.26**

Means in the same row with different superscript differ significantly (** = $p < 0.01$; NS = not significant). ^β LGNC: Local Groundnut Cake, IGNC: Industrial Groundnut Cake, Cooked Soybean, Roasted Soybean, SEM: Standard Error of the mean, Least significant difference.

Studies have shown that groundnut meal of high protein value (54%) does not

need di-methionine supplementation to improve the performance of broilers

(Dafwang *et al.*, 1999). Carpenter *et al.*, (2004) and Arenas *et al.*, (2010) reported that roasted soya bean have shown to be a suitable source of protein for broilers, however this study is in contrast to their findings but agree with the work of (Lalshaw and Clayton, 2015), where roasted or extruded soya bean or soya bean meal plus raw soya bean were fed to broilers, and all treatments gave similar weight gain lower than groundnut cake although soya bean meal with added fat gave additional body weight.

At the starter phase daily weight gain was significantly affected by the dietary treatment with groundnut seed cake and IGNC having the highest daily weight gain while cooked and roasted soya bean meals showed the lowest weight gain. The result obtained at the finisher phase signifies no significant dietary effect in feeding groundnut seed cake and full fat SB which can be seen in the feeds intake of the bird at starter phase and finisher phases of the birds.

Feed conversion ratio (FCR) is an index of the efficiency of converting feed in to gain. The values obtained of this research were only significant at starter phase and overall data but not significant in the finisher phase this variation may not be connected with the processing method of the GNC and full fat soya beans as suggested by (Dafwang *et al.*, 1999). Mortality rate indicated no discernable treatment trend. The mortality observed could there for not be attributed to the effect of the GNC nor Soya Beans. Though it was only noticed at the finisher phase; therefore good management practice is the key to successful business operation.

Carcass Characteristics and Organ Weights

Table 4 presents the main effect of protein sources relative to organs weight (expressed in percentage body weight) and carcass characteristics of broilers. The addition of groundnut cake and soya bean in the broiler diets improved live weight gain (particularly in the GNC group), and subsequently, plucked weight, eviscerated weight, gizzard and small intestine weight of the birds, across treatments. This also agrees with the work of (Dafwang *et al.*, 1999) where they noticed that increase in feed intake leads

to improved guts and carcass characteristics, however the same study revealed that most consumers of poultry products do not like product with accumulated fat which may decreases the shelf life of the product. The result showed that except in diet 4 consisting of Roasted Soya Beans, there is no significant dietary effects to the liver, which is the organ of detoxification of feed materials in the body. Doma (1994) had earlier reported a slight increase in kidney weight in rabbits and concluded that the weight of various regions of the gut increased due to increase difficulty in digestion of fibrous feed stuff. This study also showed that there is no significant difference in kidney and liver weight across the diets.

There were significant ($P < 0.001$) effects of the protein sources on live weight, eviscerated weight, plucked weight, carcass weight and dressing percentage of broilers. The protein sources also had a very highly significant ($P < 0.001$) effect on the heart, and abdominal fat but had no significant effect on the liver, gut and caeca indicating that the diets were devoid of any toxic materials.

Economy of Broiler Production Using GNC and FFSB

Table 5 shows the economic analysis of broiler production using groundnut cake and full fat soya bean. GNC is cheaper than soya bean and fish meal, however, the competition by humans for GNC is low than soya bean. This may be attributed to the fact that groundnut is most cherished for it higher oil content while soya beans is presently processed in to different food sources e.g. Awara, Soya milk, Soya Sauce, Soya Curd, Candies, Biscuits, Ice Creams, etc. Therefore GNC is a cheaper source of plant protein if not for aflatoxin as indicated by (Olumo and Offiong, 2011). However, the present study indicated that GNC is superior to both roasted and cooked soya bean, however the differences in the soya bean class performance was probably due to the different processing method of the soya bean that lead to trypsin inhibitors deactivation as suggested by (Olomo and Offiong, 2011).

Table 4: Carcass Characteristics and Organ Weights (% body weight) of Broilers Fed Diets Containing Groundnut Cake and Full Fat Soya Bean Based Diets at the end of the Feeding trial

Parameter	Types of dietary plant proteins				SEM	LSD
	LGNC	IGNC	CSB	RSB		
Live weight (g)	1850.0 ^a	1763.3 ^a	1493.3 ^b	1541.7 ^b	116.3	340.42**
Plucked weight (g)	1688.3 ^a	1633.3 ^a	1346.7 ^b	1413.3 ^b	103	301.51**
Eviscerated weight (g)	1438.3 ^a	1425.0 ^a	1121.7 ^b	1213.3 ^b	94.1	275.32**
Carcass weight (g)	1316.7 ^a	1288.3 ^b	1031.7 ^c	1073.3 ^c	80.5	235.79**
Dressing %	71.17	72.5	68.50	71.00	1.74	-
Leg weight (%)	3.03	2.58	2.78	2.86	0.36	-
Lungs weight (%)	0.48	0.37	0.33	0.35	0.35	-
Head weight (%)	2.03	1.97	1.92	1.98	0.19	-
Kidney weight (g)	0.17	0.15	0.22	0.22	0.04	-
Spleen weight (%)	0.07	0.09	0.07	0.09	0.03	-
Heart weight (%)	0.23	0.24	0.24	0.21	0.02	-
Gizzard weight (%)	1.92 ^a	2.07 ^a	2.39 ^b	2.38 ^b	0.16	0.47**
Small intestine (%)	1.17 ^a	1.21 ^a	1.94 ^b	1.64 ^b	0.17	0.51***
Intestinal length (cm)	129.33	132.67	147.33	141	10.13	-
Large intestine (g)	0.06	0.08	0.12	0.7	0.03	-
Length (cm)	4.33	6.67	5.83	6.67	1.77	-
Caecal weight (%)	0.42	0.47	0.6	0.57	0.04	NS
Caecal length (cm)	0.43	0.42	0.47	0.6	0.57	NS
Abdominal fat (%)	0.13	0.12	0.87	1.133	0.22	-
Pancreas weight (%)	0.13	0.12	0.17	0.18	0.03	-
Liver weigh (%)	1.067	1.13	1.07	1.03	0.1	-

Means in the same row with different superscripts differ significantly (* = $p < 0.05$; ** = $p < 0.01$, *** = $p < 0.001$; NS = not significant).

Table 5: Economic Analysis of Broiler Production Using Groundnut Cake and Full Fat Soya Bean

Parameter	Types of dietary plant proteins			
	LGNC ^β	IGNC	CSB	RSB
Total feed intake (N/kg)	3.90	4.08	4.16	4.18
Feed cost (N/kg)	65.00	68.00	97.59	93.59
Total feed cost (N/kg)	365.00	397.20	497.20	412.80
Total weight gain	1554.00	1495.76	1255.52	1292.48
Feed cost #/kg (1-8 wks)	200.75	209.39	233.77	236.18

^β LGNC: Local Groundnut Cake, IGNC: Industrial Groundnut Cake, Cooked Soybean, Roasted Soy Bean.

Summary, Conclusion and Recommendation

The study evaluated the performance and carcass characteristics of broilers fed diets containing GNC and FFSB. The performance of birds fed Local GNC and IGNC indicated better final weight gain. The mean DWG shows that LGNC and IGNC were significantly ($P < 0.01$) higher in terms of body weight gain and carcass

characteristics. The significant lower body weight gain from FFSB in diet 3 and 4 when compared to Local GNC and Industrial GNC may be attributed to their lower feed intake. The study indicated that cost of one kilogram of GNC is much lower than that FFSB as per the period of research work. It is concluded that birds on either LGNC or IGNC performed better than

those on FFSB meal. It was therefore, recommended that Local GNC can be used in the formulation of broiler diet without adverse effect on performance. However, for the use of FFSB meal, further studies are required before recommending it to the small holder farmers, because there is need to establish optimal roasting time and temperature and inclusion rate for optimum performance by poultry.

REFERENCES

- Adeniji, A. A. (2008). Replacement Value of soyabeans meal with groundnut cake with or without fish meal supplementation in diet of pullet chicks. *Journal of Applied Science Research*. 4 (10) 1249-1252.
- Aduku, A. O. (1993). Tropical Feedstuff Analysis Table Ahmadu Bello University Press, Zaria Pp 1 – 4
- Arenas L.G., Brewer C.E. and Gehle M.H. 2010. Evaluation of heat processed soybeans for caged layers. *Poultry Science*, 50:1546
- Ayoola, G.B., Ayooode, J.A. and Goshit, D.T. (1991). The synthesis of the Nigerian livestock policy: The case of Plateau State in : Agricultural Policy in Sub-Saharan Africa (Eds. Longham, M.R. and Kamojou, F.) Proceedings of an International Symposium, Novemer 4-6, 1s991. Pp 401-410.
- Carpenter K.J., Duckworth J. And Ellinger E.M. (2004). Economics in the use of Animal by products in poultry rations. 2. Vitamins and amino acid provision for laying hens. *Journal of Agricultural Science*, 44:340
- Church, D.C. (1991). Livestock feed and feeding. Prentice-Hall International, United Kingdom, Pp. 133-150.
- Dafwang, I.I., Olomu, J.M. and Offiong C.A (1999). Uptimum utilization of fishmeal and NPK supplement value of locally processed blood meal for fish meal in practical broiler ratio. Proceedings of Annual Conference of Nigerian Society of Animal Production Pp 51-57.
- Doma, U.D. (1994). Utilization of cowpea shell and maize cob as source of dietary fibre for rabbits. M.Sc Thesis Department of Animal Production ATBU Bauchi.
- Lalshaw J.D. and Clayton P.C. (2015). Raw and heated full fat soyabeans in laying diets. *Poultry Science*, 55:1268.
- Mustafa R A, Hakim AS, Azizullah M, Rab NS, Hidayatullah SN, Ahmed U (2012). Effect of various protein source feed ingredients on the growth performance of broiler. *Int. J. Med. Plant Res*. 1(4):038-044.
- Njike, M.C. (1997) the effect of cotton seed meal (CSM) groundnut meal (GNM) Mixture and protein levels in practical broiler diets. *Nigerian Journal of Animal Production* 42:81-94.
- Odiba, J.Y (2014): *Poultry feed ingredient and feed formulation*: invited paper, livestock and poultry management course NAPRI/ABU Zaria,
- Ojewola GS, Okoye FC, Ukoha OA (2012). Comparative Utilization of Three Animal Protein Sources by Broiler Chickens. *Int. J. Poult. Sci*. 4(7):462-467.
- Olomu, J.M. (2013). Determination Optimum protein and energy requirement for finishing broilers chickens in the tropical environment *Nigerian Journal of Animal Production* 41: 239-252.
- Olomu, J.M, and Offiong, S.A. (2011): The effect of different protein and energy level and time of change from starter to finisher ration on the performance of broiler chicks in the tropics. *Poultry Science*, 24:41
- Oluyemi J. A and Roberts. F. A. (1988). *Feeds and feeding poultry production in warm wet climates* (low-cost edition). Macmillan Publishers Ltd. London. Pp125-140
- Patnek, H and Schaible, P.J. (1980): Poultry feeds and nutrition AVI Publishing Company, West Point, U.S.A. pp 67-80
- Shaib B, Adedipe NO, Aliyu A, Jir MA (1997). Integrated Agricultural Production in Nigeria. In: Strategies and Mechanisms for Food Security. Proceedings of the National Workshop on Nigeria's Position at the World Food Summit, Abuja, July 31st - August 2nd, 1996. pp. 11-74
- Steel, A.G.D and Torrie, J.H. (1980). Principles and procedures of statistics, 2nd edition McGrawhill, new York.
- Steenfeldt S, Kjaer J. B, Engberg R. M (2012). Effect of feeding silages or carrots as supplements to laying hens on production performance, nutrient digestibility, gut structure, gut microflora and feather pecking behaviour. *Br. Poult. Sci*. 48(4):454-468.
- Tewe. O.O. and Ologbobo, A.D. (1987). Evaluation of raw and cooked soybean for broilers *Nigerian Journal of Animal Production*, 13 (1-2): 109-113
- Tyokpat, Y.B. (1999). Evaluation of nutritional value of crushed spentsorghum and its effects in broiler chickens B. tech. Thesis Abubakar Tafawa Balewa University Nigeria (unpublished).

CONSTRAINTS OF ADOPTION OF IMPROVED RICE PRODUCTION PRACTICES BY RICE FARMERS IN JIGAWA STATE

¹Muhammad, M.B., ²Beli, S.A and ²Musa, J.

¹Samaru College of Agriculture, Ahmadu Bello University, Zaria, Nigeria

²Department of Agricultural Economics, Federal University, Dutsinma, Katsina State, Nigeria.

Corresponding email: musabakomuhhammad@gmail.com.

ABSTRACT

In Jigawa State, an increasing number of improved rice production practices has been introduced to rice farmers. In spite of this introduction of the rice production practices, rice productivity still remains very low. This study therefore, analyzed factors associated with adoption of improved rice production practices by rice farmers in Jigawa State, Nigeria. Specifically, the study identified the selected socio-economic characteristics of the farmers, ascertained recommended rice production practices adopted and identified the factors influencing adoption of improved rice production practices. Multistage sampling technique was used to select 171 respondents. Data were collected using a structured questionnaire. The study revealed that the mean age and household size of the respondents were 37.7 years and 11, respectively. The mean of formal education was 7.50 years and that of years spent in rice farming enterprises was 19.76 years. Average farm size was 2.44 ha. The results also showed that 76.14% of the respondents not have access to credit and over 66% perceived credit as important in rice farming. Over half (51.83%) of the respondents produced rice under rain fed lowland ecology. The study further found that planting techniques (95.32%) was the most adopted practice by the respondents. Farmers' socioeconomic factors such as age, years of formal education, years of rice farming and information sources used were the main factors affecting adoption of recommended rice production practices. The study recommended that farmers should be supported with credit facilities by financing institutions and agricultural organizations and facilitation of formation of groups. The study recommended that farmers should be supported with efficient extension mechanism.

Keywords: Assessment, adoption, recommended practices, awareness, Jigawa State

INTRODUCTION

The development and promotion of the adoption of yield increasing crop varieties in a sustainable manner helps improve livelihood of farmers (Asfaw *et al*, 2012). Rice is the second largest crop produced in the world with special significance and economic importance in agricultural development and poverty reduction (FAO, 2012). Thus, increasing rice production is essential to ensure national food security and poverty reduction.

Rice (*Oryza sativa*) is produced from over 160 million hectares annually. Rice has twice the value of production in the developing world as any other food crop, with an annual value of more than US\$150 billion. Africa has become a major player in international rice markets, accounting for one-third of global rice imports. Africa's emergence as a big rice importer is explained

by the fact that rice has become the most rapidly growing food source in sub-Saharan Africa where its consumption has been growing at a minimum of 6% per annum over the years. This is due to the 4% average population growth, rising incomes and a shift in consumer preferences in favor of rice, especially in rural areas (FAO, 2012; Conteh, 2014). Nigeria's rice demand has been expanding with consumption levels growing significantly at a minimum annual average of about 10.5% per annum since 2008 when the estimated rice demand is about 5.3 million tonnes and estimated annual production of 2.3 million metric tonnes (Ayanwale *et al*, 2011), making Nigeria the second biggest global importer of rice in 2015.

According to a survey by Abubakar *et al* (2012), the land mass under rice cultivation in Nigeria has increased from about 150,000 hectares in the 1960's to about

2.685 million hectares in 2013 (FAO, 2013). However, since area expansion and irrigation has already become a minimal source of rice output, growth will depend more on yield increasing technology and intensification of production.

Jigawa State which is the fourth largest rice producer in Nigeria is blessed with vast arable land and human resources for rice production. However, it seems that rice farmers in the state have not been able to explore all these potentials for rice production. Some factors have been attributed to the slow bridging of this demand and supply gap. They include the lack of sufficient high yielding rice varieties, competition with imported rice, land degradation, uneven rainfall distribution, problems of weeds, insect, pests, diseases, birds, and lack of training for institutional and key stakeholders (Abubakar *et al.*, 2012).

Productivity of farmers can be increased by adoption of improved production practices. The rate of adoption of recommended practices in Nigeria, according to Saka and Lawal (2009) is low and this is capable of truncating the achievement of complete self-sufficiency in rice production. Therefore, as Nigeria is aiming for self-sufficiency in rice production and food security by elimination of the rice imports, it is important to study the constraints associated with rice production among farmers in Jigawa State. This study, therefore, evaluated the problems associated with adoption of recommended rice production practices by rice farmers in Jigawa State, Nigeria. The specific objectives of the study were to describe socio-economic characteristics of the rice farmers, identify recommended rice production practices adopted, find out the extent of adoption of the improved rice production technologies by the

rice farmers. and, examine constraints to adoption of improved rice production practices in the study area.

MATERIALS AND METHOD

The study was conducted in Jigawa State between 2014 and 2015. Jigawa State is located in the Northwest geo-political zone of Nigeria. The state has projected population of about 6 million (NPC, 2015) with a land size of 23,509.6 square kilometers. Majority of the people live in rural areas where over 80% of the inhabitants are engaged in subsistence farming and animal husbandry. The state has borders with Kano and Katsina States to the West, Bauchi and Yobe States to the East and Northeast respectively while to the North, it shares an international border with Niger Republic.

A population frame of 4291 rice farmers was obtained from Jigawa Agricultural and Rural Development Authority from where 4 Local Government Areas were selected. The Local Government Areas purposively selected were Gwaram, Kazaure, Kafin-hausa and Miga. This was on the basis of high level of rice production activities. Three villages were then selected from each Local Government Area to give a sum of 12 villages from where 4% of the rice farmers were randomly selected for enumeration to obtain a sum of 171 farmers who formed the sample size for this study. Primary data were collected through face-to-face interviews with the rice farmers using a structured interview schedule that was filled up by recruited and trained enumerators under the close supervision of the researcher. Descriptive statistics such as range, ranking, means, percentage and frequency distributions were used to achieve the objectives of the study.

Table 1: Study Population and Sample Size

LGA	Village	Estimated Population	Sample Size (4%)
Gwaram	Zandam	340	14
	Maruta	333	13
	Jikas	377	15
Kazaure	Gada	299	12
	Jekarabe	352	14
	Daba	326	13
Kafin Hausa	Kafinhaus	462	18
	Mezan	403	16
	Sabon-gida	298	12
Miga	Miga	469	19
	Kwaki	333	13
	Tanni	299	12
4 LGAs	12 VILLAGES	4291	171

RESULTS AND DISCUSSION

Age distribution of the respondents indicates that the mean age of the respondents was 37.7 years while the maximum and minimum ages were 77 and 17 years respectively. The study showed that more than half (57%) of the respondents were not more than 45 years of age. The implication is that rice farmers in this age category may be more likely to handle risks involved in adopting improved technologies in rice production. This age category is in line with what Bekele (2005) referred to as economically active groups. Yahaya (2007) deduced that farmers in the age range of 20-55 comprise the most active group in agricultural activities in Nigeria. Also, 96% of the respondents were males. Hassan and Nhemachena (2008) concluded that a male farmer is more likely to adopt an improved technology because males have more access to production resources. Over one-third (37%) of the respondents had a mean household size of 10 persons implying availability of family labour. This is consistent with the findings of Dontsop Nguetzet *et al.*, (2011) who found the average household size of rice farmers in main rice cultivation areas in Nigeria to be 10.

The study revealed that 49.17% of the respondents had formal education while 28% had informal education. Also, 23% of the respondents have non-formal education. The mean years of formal education was 7.50 years. This indicates moderate literacy level in the study area and attesting to the findings of Sani and Bagana (2007) who reported that the

potential for increased awareness and adoption of recommended practices by rural farmers is largely influenced by years of formal education. The study also shows that over 65% of the respondents were not members of any associations probably due to reported non-adherence to laid down rules and regulations of such associations. The study also showed that over a third (38%) of the respondents had farm size of less than 1 ha with another 32% cultivating farm size of 1-3 hectares implying that rice farming is mainly done on a small-scale by farmers who had a mean farm size is 2.44. Findings from the study also revealed that 38.43% of the respondents had 11- 20 years of farming experience while only 4.69% had over 40 years' experience. The minimum and maximum years of rice farming experience was 1 and 58 respectively. The mean farming experience was 19.76 years. Analysis of the respondents' access to credit facility revealed that about 76.14% did not have access to any form of credit (Table 2). In fact, over 66% of the farmers had perceived the role of credit facility in rice farming as important. About half (52%) of the farmers practiced rain-fed lowland rice farming. Also, 34% produced rice under rain fed upland ecology while 14% of the respondents produce rice through irrigation. This seems to agree with the findings of Ezedinma (2008) whose study showed similar distribution of the rice farming system in Nigeria.

Table 2. Socioeconomic characteristics of the respondents. (n=171)

Variable	Frequency	Percentage	Average
Age(years)			
Less than or 25	22	12.87	
26-35	33	19.30	
36-45	42	24.56	37.77
46-55	52	30.40	
56-65	9	5.26	
>65	113	7.60	
Sex			
Male	165	96.49	
Female	6	3.51	
Household size			
1-5	30	17.36	
6-10	68	39.67	
11-15	49	28.51	
16-20	15	8.68	11.00
>21	10	5.79	
Educational status			
Informal education	47	27.69	
Formal education	84	49.17	
Non-formal education	40	23.14	
Years of formal education			
6-10	27	32.14	
11-15	35	41.67	
16-20	22	26.19	
Farm size			
<1	64	37.60	
1-3	54	31.82	
4-6	21		12.39
7-9	7	2.42	2.44
>9	64	37.60	
Years of rice farming experience			
1-10	54	31.82	
11-20	66	38.43	
21-30	27	15.70	19.76
31-40	16	9.09	
>40	8	4.96	
Credit access			
No response	17	9.94	
Yes	125	73.10	
No	29	16.96	
Credit perception			
No response	13	8.90	
least important	11	7.53	
less important	14	9.59	
Important	32	21.91	
Very important	76	52.05	
Membership of association			
No	60	35.09	
Yes	111	64.91	
*Rice Farming System			
Rain fed lowland	156	51.83	
Rain fed upland	103	34.22	
Irrigated	42	13.95	
Reasons for Rice Farming			
Cash	11	6.43	
Consumption	5	2.92	
Cash and Consumption	155	90.64	

*Total greater than N due to multiple response

Recommended rice production practices Adopted by the Respondents

Table 3 shows the practices the farmers had adopted. The practices include recommended planting practices (95.32%), use of seed of improved seed varieties (90.08%) and storage methods (67.16%). The least practices which farmers adopted were water management (42%), harvesting techniques (52%) and fertilizer application (40%). The very low adoption rate of fertilizer application (40%) might be because the farmers used varying fertilizer doses which are in most cases less than the recommended rates probably due to the high cost or non-availability of fertilizer to the respondents. This might be in agreement with Ramayah and Mohammed (2004) position that decision to accept or reject an innovation is based on trade-offs of sorts between perceived benefits of the system to the user and the complexity of learning ways of using the system. The practices with low adoption values may imply that the rice farmers have not known their relevance to their production or have no access to these practices. However, low adoption of some of the technology could just be a matter of choice.

Extent of adoption of the improved rice production practices by the rice farmers.

Adoption level of rice farming refers to the extent a practice of rice farming adopted is by the rice farmer when the farmer has complete information on how to use the technology and its merits. For this study, the level of adoption was measured as a ratio of each technology adopted by the farmer against the recommended adoption ratio of that technology. The low adoption ratio indicates slight uptake of recommended technology slated between 1-33% compliance (Table 4). The medium adoption level means an average degree of farmer's compliance with the recommended practices slated between 34-66% adoptions. The high

adoption level means complete adoption of between 67-100% recommendations adoptions by the farmers.

Table 4 also showed that 30.41% of the respondents are in the medium adopter category, 28.07% are in the non-adopter category while 22.81% were low adopters. Only 18.71% were high adopters. Some practices as fertilizer application, water management and harvesting techniques were not put into practice by all farmers. The reason for non-adoption might be due to the costs involved in these practices thus, the recommended practice is not fully

practicable. Umar *et al.* (2009) observed that diffusion of high improved practices depends on availability of farm inputs such as fertilizer which is sometimes constrained by the inability of the extension personal to reach the farmers. Other factors negating adoption of new practices which seems to concur with some of the findings of studies by Chinaka *et al* (2007) may be high cost of agricultural innovations, unavailability of the technology, risk element involved, ignorance of the existence of new innovations and the conservative attitudes of most farmers.

Table 3 *Distribution of Farmers Based on Adoption Status of Improved Rice Production Practices (n=171)

Variables	Adopters	Non Adopters
Planting techniques	163(95.32%)	8(4.69%)
Water management	71(41.52%)	135(55.65%)
Seed of improved varieties	154(90.08%)	17(8.68%)
Fertilizer application	68(39.67%)	98(56.98%)
Pest and disease control	105(60.95%)	61(35.78%)
Harvesting techniques	90(52.34%)	76(44.39%)
Storage methods	115(67.16%)	56(32.46%)

*Total greater than n due to multiple response

Source: Field survey, 2015

Table 4: Distribution of Farmers Based on Adoption of Improved Rice Practices

Adoption Category	Adoption Index Score	Frequency	Percentage
Non Adopters	0.0	48	28.07
Low Adopters	0.01-0.33	39	22.81
Medium Adopters	0.34-0.66	52	30.41
High Adopters	0.67-1.0	32	18.71
TOTAL		171	100

Source: Field Survey, 2015

Problems associated with use of improved practices by farmers

Table 5 revealed the constraints or difficulty the rice farmers may have endured in the use of the practices. The study showed that over half (56.59%) of the rice farmers had no issue with the use or adoption of any

of the rice production practices. The farmers in this case might have over time come to terms with the learning and correct application of the practices in question while about 43.41% had some reservations or challenges with the use or adoption of the practices used.

Table 5: Distribution of rice farmers' constraints in usage of improved practices by the rice farmers

Any constraints	Frequency	Percent
No	97	56.73
Yes	74	43.27
	171	100.00

Source: Field survey, 2015

3.4.4: Constraints in the adoption of improved rice production practices by farmers

The adoption and continuous use of improved practices is the ultimate goal of any agricultural entity. Some practices have some constraints which limit their complete use. It is thus imperative that practices developed should not be complex to a point where its further usage is jeopardized. Table 5 above had revealed 56.73% of the respondents had constraints in the use of improved rice production practices while Table 6 showed

practices respondents had issues in coming to terms with. These practices include fertilizer application technique (43.28%), use of seed of improved varieties (16.92%) and improved storage techniques (11.93%). From the study, the practices with least problems in using it are weed, pest and disease control (4.98% and harvesting techniques (5.87%). This finding seems to be in agreement with that of (Mapiye , 2006) which showed adoption of some practices is impeded by high cost and low availability of farm inputs.

Table 6: Distribution of constraints in the use of improved rice production practices

Technology	Frequency	Percent	Ranking
Seed of improved varieties	29	16.96	2 nd
Planting technologies	11	6.43	5 th
Water management	18	10.53	4 th
Fertilizer application technique	74	43.27	1 st
Weed, pest and disease control	9	5.26	7 th
Harvesting techniques	10	5.85	6 th
Storage methods	20	11.70	3 rd
Total	171	100.00	

Source: Field survey, 2015

CONCLUSION AND RECOMMENDATIONS

Based on the findings of the study, the most adopted rice production practices were planting techniques, use of improved seed varieties and harvesting techniques in that order. It was concluded that fertilizer application techniques was the major constraints respondents face in rice farming in study area. From the findings of this study, it was recommended that training programs should be designed to improve efficient use of the practices rice farmers. This could be done through effective communication in the study

area. The study also recommended that farmers should be supported by credit.

REFERENCES

- Abubakar, B., Aliyu, A., and Bukar, G.(2012). Problem analysis of rice production in Wurno irrigation scheme using participatory approaches. *Scientific Journal of Agriculture*. 1(15), 112-116
- Anne, G.T., R.M. Mulwa, J. Okello, and M. Kamau (2012) The Role of Varietal Attributes on Adoption of Improved Seed Varieties. The Case of Sorghum

- in Kenya. *Paper Presented at the Agricultural and Applied Economics Association's Annual Meeting, Seattle, Washington, August 12 - 14, 201*
- Asfaw S., Shiferaw B., Simtowe F., and Lipper, L. (2012). Impact of modern agricultural technologies on smallholder welfare: Evidence from Tanzania and Ethiopia. *Food Policy*, 37(3): 283– 295.
- Awotide, B.A., Diagne, A., Awoyemi, T.T., Ebiohomon, V. and Titilayo Ojehomon (2010). Farm level constraints and adoption of improved varieties in Nigeria. *Learning Publics*. 1(2), 12-29.
- Ayanwale, A.O.S., Akinyosoye, V.O., Yusuf, S.A. and Oni, A.O. (2011) rice supply response in Nigeria; whither changing policies and climate. *World Rural Observations*, 3(4), 78 – 84
- Bekele I.W. (2005). Analysis of Farmers' Preferences for Development Intervention Programme: A Case of Subsistence Farmers from Eastern Ethiopian Highland. Proceeding of International Conference on shared Growth in Africa, ISSER/Cornell University/ World Bank/DFID/USAID.
- Chinaka, C.C., Ogbokiri, L.C. and Chinaka E.C. (2007). Adoption of improved agricultural technologies by farmers in Aba agricultural zone of Abia State. Proceedings of the 41st conference of the Agricultural Society of Nigeria, IAR/ABU Zaria, Nigeria. pp. 531-534.
- Conteh, A.M.H., Yan, X., and Sankoh, F.P. (2012). The influence of price on rice production in Sierra Leone. *Agricultural Sciences* 3(4), 462-469.
- Dontsop-Nguezet P.M., Diagne A, Okoruwa V.O, Ojehomon V (2011). Impact of Improved Rice Technology on Income and Poverty among Rice Farming Household in Nigeria: A Local Average Treatment Effect (LATE) Approach. Contributed paper prepared for the 25th conference of the Centre for the Studies of African Economies (CSAE). St. Catherine College, University of Oxford, UK. 20-22, March 2011.
- Ersado, L., Amacher, G.S. and Alwang, J. (2004), "Productivity and land enhancing technologies in Northern Ethiopia: Health, public investments, and sequential adoption," *American Journal of Agricultural Economics*, 86(2)321-331.
- Ezedinma, C. (2008). Impact of trade on domestic rice production and the challenge of self- sufficiency in Nigeria. International Institute of Tropical Agriculture. Available from: Chuma Ezedinma. DOI: 10.13140/2.1.3601.1204. Accessed on August 3, 2015
- FAO. (2012). *Rice Market Monitor*. Rome: FAO.
- Gregor, T. and Sewando, P. (2013). Determinants of the probability of adopting of quality protein maize (QPM) technology in Tanzania: A logistic regression analysis. *International Journal of Development and Sustainability*, 2(2), 729-746
- Hassan, R. and Nhemachena, C. (2008). Determinants of African farmers' Strategies for Adapting to Climate Change: Multinomial Choice Analysis. *Afr. J. Agric. Res.* 2(1):83- 104.
- Idiong, L.C. (2007). Estimation of farm-level technical efficiency in small scale swamp rice production in Cross-River State, Nigeria: A stochastic frontier approach. *World Journal of Agricultural Science*. 3(5):653-658.
- Kafle B. and Shah, P. (2011). Adoption of improved potato varieties in Nepal: A case of Bara District. *Journal of Agricultural Science*. 7(1):14-22.
- Mapiye C, M. J. (2006). A review of forage legumes research for rangeland improvement in Zimbabwe. *Tropical Grasslands*, 40, Tropical Grasslands, 40: 145-149.
- Odoemenem, I.U. and Obinne C.P.O. (2010). Assessing the Factors Influencing the Utilization and Adoption of Improved Cereal Crop Production Technologies

- by Small-Scale Farmers in Nigeria. *Indian Journal of Science and Technology*, 3(1).
- Ramayah, T. and J. Muhammad (2004). Technology Acceptance: An Individual Perspective. Current and Future Research in Malaysia. *Review of Business Research*, 2(1), 103-119.
- Saka, J.O., Lawal, B.O. (2009). Determinants of adoption and productivity of improved rice varieties in South western Nigeria. *African Journal of Biotechnology*. 8(19), 4923 – 4932.
- Sani, R.M. and A. Bagana (2007). Adoption of improved seeds of millet and cowpea by farmers in Madarounfa District, Niger Republic. *Continental Journal of Agricultural Economics*, 1, 1-6.
- Umar, S. N., Ndanisa, M.A. and Olaleye, S.R. (2009). Adoption of improved rice production technologies youth farmers in Gbako Local Government Area Niger State, Nigeria. *Journal of Agricultural Extension*, 13(1), 1-8.
- Yahaya, J.O.A. (2007). Coomercialisation of public sector irrigation as it affects River Basic development. A paper presented at National seminar on sustainable irrigation development in Nigeria in the 21st Century held on 2-6 July, at Giginya Hotel, Sokoto.

TRADITIONAL BREEDING PRACTICES AND OBJECTIVES OF SHEEP BREEDERS IN KANO STATE

¹Aminu, S.U.,¹Abdussamad, M.,¹Dankoli, Z.A.,²Maaruf B.S. and ³Ibrahim, T.

¹Department of Animal Science, Faculty of Agriculture, Bayero University, Kano.

²Department of Animal Science, Faculty of Agriculture, Federal University of Kashere

³Department of Animal Science, Abubakar Tafawabelewa University, Bauchi.

*Corresponding Author's Email: yalwa4usman@hotmail.com.

Phones: 08065826111; 07083344006

ABSTRACT

The study was conducted in five selected Local Government Areas of Kano State, namely Shanono, Dawakin kudu, Dambatta, Wudil and Bebeji, to assess the traditional breeding practices for indigenous sheep breeds and identify aspects of sheep breeding to be improved based on farmers' trait preferences. Purposive sampling technique was employed to select 350 farmers (71.43% of which were males) from the locations. A structured questionnaire and focused group discussions were used to generate the required data. Sheep were kept for a variety of reasons including income generation, economic security (savings) and social/religious functions. The relative importance given by respondents to the different functions varied across locations. However, irrespective of location, sheep were primarily kept as source of income. The fact that used rams for breeding either born in their flocks or from neighboring flocks may result in reduction of genetic diversity and probably increased rate of inbreeding and its related consequences. Although certain beliefs regarding raising and/or eating meat of animals of certain coat color are widespread across many West African societies and elsewhere in Africa, they were given little emphasis among respondents in all the locations and could be explained by cultural differences across Nigeria and Africa in general. Although considerable proportions (68.28%) of the respondents were aware of inbreeding, mating was predominantly uncontrolled (61.14%). Uncontrolled mating and absence of breeding rams in many of the flocks are challenges which have to be tackled in order to improve the productivity of sheep in the study areas. Awareness should be created among farmers on the need to retain superior rams for breeding rather than sell them indiscriminately during festivities. A community based traditional breeding program with farmers' involvement considering the existing breeding practices, selection criteria and trait preferences is therefore recommended.

Keywords: Breeding practices, breeding ram, trait, inbreeding, Kano.

INTRODUCTION

Nigeria possesses vast resources in livestock comprising cattle, sheep, goats, poultry horses, donkeys, camels, rabbits and fish. (Yemi, 2010). Small ruminants are widespread in the tropics and contribute to the subsistence, economic and social livelihood of a large human population. They are a source of tangible benefits (i.e., cash income from animal sales, meat for home consumption, manure, fiber and skins) and intangible benefits (e.g., savings, insurance, culture and ceremonial purposes) Kosgey, (2004).

Sheep contribute enormously towards promotion of livelihoods security and as an insurance cover to crop with crop failures particularly for rural landless, small and marginal farmers (Adeloye, 1998). Sheep are favored because of low investments, easy to raise and manage, low feed requirement compared to cattle, ability to thrive different flora, high disease resistance, and superior market potential (Oni, 2002).

The productivity of sheep as in case of most of the ruminants is markedly low due to several genetic and environmental factors besides the institutional, environmental and infrastructure constraints (Markos, Ayalew, Awgichew, Ermias, and Rege, 2004; Kosgey, and Okeyo, 2007). Detailed and up-to-date information on production system, indigenous knowledge of managing the breed, identification of important traits for selection with full participation of farmers are prerequisites (Sölkner, Nakimbige and Valle-Zarate, 1998; Kosgey, Baker, Udo, and van Arendonk, 2006). The current study investigate the traditional breeding practices and objectives of sheep owners.

MATERIALS AND METHODS

The study was conducted in some selected Local Government Areas of Kano State: Shanono, Dawakin Kudu, Dambatta, Wudil and Bebeji. A multistage sampling was adopted where five local were purposively selected. Two villages were also selected from each local

government area. Thirty Five households that owned significant number of Sheep and willing to participate in the program were also selected. The selection of the study area was based on their suitability for sheep production, market and road access and willingness of people to participate in the program

A reconnaissance tour was conducted and structured questionnaire was pre-tested on a small number of selected farmers from each site. Information from the pre-tested was used to improve the final questionnaires used. Data collected were analyzed using Statistical Package for Social Sciences (SPSS, 16); Cross tabulation procedure was used to calculate the percentages of discrete variables,

RESULTS

The breeding practices of Sheep Owners in the Locations are shown in Table 1. The ratio of farmers that had no breeding ram at all, were greater in all the locations with the exception of Dawakin kudu. The overall ratio of those famers that had no breeding ram to those that owned one and those with more than one was found to be 5:3:2. The ratio was 5:2:3 in Shanono, 3:4:3 in Dawakin Kudu, 6:2:2 in Danbatta, 6:3:1 in Wudil and 7:2:1 in Bebeji.

The greater proportions of respondents that had their breeding ram from their own flock were found in Dawakin Kudu (72.86%) and Wudil (55.71%) while they had lower proportions in Shanono (38.57%), Dambatta (37.14%) and Bebeji (31.43%). Famers that had their breeding ram from their neighbor flock had higher proportions in Bebeji (68.57%), Dambatta (42.86%) Shanono (42.86%) and Wudil (40.00%), while the lowest proportion was recorded in Dawakin Kudu (20.00%). While the number of respondents that had their breeding ram (source) from market were lower in all the locations, yet the proportion was considerable in Dambatta (20.00%), and totally absent in Bebeji. Respondents that had their breeding ram from all the sources were only found in Shanono and Dawakin Kudu with proportion of 15.71% and 1.43% respectively. Irrespective of locations, the proportion of respondents that had their breeding ram from their own flock was the highest (47.1%) , followed by those that had it

from neighbor flock (42.9%), from the market (6.6%) ,while those that obtained the rams from all the sources had the lowest proportion (3.4%).

Breeding and fattening purpose for keeping ram was given higher priority in all the locations except in Wudil where the proportion was the lowest. The highest proportion was recorded to be 90% in Dawakin Kudu, followed by Bebeji with 82.86%, Shanono (77.14), Dambatta (52.86%) and Wudil (35.71%) while famers that were keeping ram for the purpose of breeding and socio-cultural reason were only found in Shanono, Dawakin Kudu and Dambatta with little proportion of 7.14%, 2.86% and 5.71%, respectively. The reason for keeping ram for the purpose of all the reason stated above (breeding, fattening and socio-cultural) was greater by the respondents of wudil with proportion of 64.28% but lower in all the locations. The proportion was recorded to be 41.43%, 17.14%, 7.14%, and 3.1% in Dambatta, Bebeji, Dawakin kudu and Shanono, respectively. Similarly, across the locations, respondent that kept ram for breeding and fattening were greater in proportion (67.7%), followed by those that kept it for breeding, fattening and socio-cultural reason (29.1%) and those that kept it for breeding and socio-cultural reason where the lowest (3.1%).

The purposes of keeping sheep by farmers in the study area are presented in Table 2. Majority (38.0%) of the respondents across the locations kept sheep as a means of savings with greater proportions in Bebeji (92.86%) and Dambatta (42.86%), while lower proportions were recorded in Wudil (24.28%) and Shanono (21.43%). However, an exceptionally lower proportion (8.57%) was observed in Dawakin Kudu. The second highest objective of rearing sheep across locations was to gain all the advantages (savings, socio-cultural reasons, manure, meat and commercial) with an overall proportion of 30.0% .Location wise, the highest proportion was found in Shanono (48.57%), and Wudil (48.57%), while Dambatta, Dawakin Kudu and Bebeji had lower proportions of 37.14%, 14.28% and 2.86%, respectively. The next purpose in ranking is the overall percentage of farmers that kept sheep solely as business

(27.1%) with the largest proportion of respondents in Dawakin Kudu (75.71%) followed by Shanono (27.14%) while lower proportions were observed in Wudil (17.14%), Dambatta (11.43%) and Bebeji (4.28%). The overall proportion of those respondents that kept sheep for socio-cultural reasons was only 4.0% with Wudil recording the highest proportion (10.0%) followed by Dambatta, Shanono and Dawakin Kudu with proportion of 5.71% , 2.86% and 1.43% respectively, while Bebeji had none. Farmers that kept sheep as a source of manure only and those that kept them as source of meat for home consumption only, were found in Dambatta only with proportion of 1.43% each within the location, and overall percentages of 0.3 each.

Table 3 presents the breeding practices of sheep owners in the selected locations. Most of the farmers in Shanono and Dambatta practiced controlled breeding with proportions of 61.43% and 68.57%, respectively, while the least proportions were found in Dawakin Kudu (37.14%), Wudil (20.00%) and Bebeji (7.14%). Those respondents that practiced uncontrolled breeding were greater in Bebeji (92.86%), followed by Wudil (80.00%), Dawakin Kudu (62.86%) and lower proportion as recorded in Shanono (38.57%) and Dambatta (31.43%). Irrespective of location, the percentage of respondents that were not controlling the breeding activities in their flocks was higher (61.14%) compared to those that

practiced controlled breeding (38.86%).

For those farmers who practiced controlled breeding methods differed across locations with Dambatta having the proportion 66.66% that practiced tethering as a method of control, Shanono (67.44%), Dawakin Kudu (65.38%), Wudil (100%) and Bebeji (100%) as shown in Table 7. Those that practiced castration as a method of control were found to proportion in Dawakin Kudu (23.08%), followed by Dambatta (10.42%) and Shanono (2.32%) while Wudil and Bebeji respondents did not practice castration at all. Similarly only farmers of Dambatta, Shanono and Dawakin Kudu practiced culling in controlling breeding with proportions of 22.92%, 23.25% and 11.54% respectively. Considering the whole locations, those respondents that practiced tethering were the highest in proportion (71.32%), followed by those that practiced culling (17.65%), castration (8.82%) whereas those that practiced other methods of control had the lowest proportion (2.21%).

Farmers awareness of inbreeding and its effects in the locations is also presented in Table 3, with Shanono, Dawakin Kudu, Dambatta and wudil having the proportions of those that were aware being 92.86%, 62.86%, 55.71% and 91.43%, respectively. In contrast, the proportion of those that were aware about inbreeding in Bebeji was less than those that were not aware, being 38.57% and 61.43%, respectively.

Table 1: Purpose of Keeping Sheep in the Locations

Location						
Purpose	SNN (n= 70)	DKD (n= 70)	DBT (n= 70)	WDL (n= 70)	BBJ (n= 70)	TOTAL (n= 70)
Commercial	19(27.14)		53(75.71)	08(11.43)	12(17.14)	03(4.28)
Meat	0 (0.0)		0 (0.0)	01(1.4.3)	0 (0.0)	0 (0.0)
Manure	0 (0.0)		0 (0.0)	01(1.43)	0 (0.0)	0 (0.0)
SC	02(2.86)		01(1.43)	04(5.71)	07(10.00)	0 (0.0)
Savings	15(21.43)		06(8.57)	30(42.86)	17(24.28)	65(92.86)
All	34(48.57)		10(14.28)	26(37.14)	34(48.57)	02(2.86)

SNN = Shanono, DKD = Dawakin kudu, DBT = Danbatta, WDL = Wudil, BBJ = Bebeji, SC = socio-cultu

Table 2: Breeding Practices of Sheep Owners in the Locations

Breeding Practice.	Variable	Locations					TOTAL (n=350)
		SNN (n= 70)	DKD (n= 70)	DBT (n= 70)	WDL (n= 70)	BBJ (n= 70)	
Ram possession	NONE	35(50.00)	23(32.86)	40(57.14)	39(55.71)	52(74.28)	189(54.2)
	1	16(22.86)	27(38.57)	13(18.57)	23(32.86)	13(18.57)	92(26.28)
	> 1	19(27.14)	20(28.57)	17(24.28)	08(11.43)	05(7.14)	68(19.8)
	RATIO	5: 2 : 3	3 : 4 : 3	6 : 2 : 2	6 : 3 : 1	7 : 2 : 1	5 : 3 : 2
Source of Breeding ram	OF	27(38.57)	51(72.86)	26(37.14)	39(55.71)	22(31.43)	165(47.1)
	NF	30(42.86)	14(20.00)	30(42.86)	28(40.00)	48(68.57)	150(42.9)
	MKT	02(2.86)	04(5.71)	14(20.00)	03(4.28)	0 (00)	23(6.6)
	All	11(15.71)	01(1.43)	0 (00)	0 (00)	0 (00)	12(3.4)
	RATIO	4 : 4 : 0 : 2	7 : 2 : 1 : 0	4 : 4 : 2 : 0	6 : 4 : 0 : 0	3 : 7 : 0 : 0	5 : 4 : 1 : 0
Purpose of keeping ram	BF	54(77.14)	63(90.00)	37(52.86)	25(35.71)	58(82.86)	237(67.7)
	BS	05(7.14)	02(2.86)	04(5.71)	0 (00)	0 (00)	11(3.1)
	All	11(3.1)	05(7.14)	29(41.43)	45(64.28)	12(17.14)	102(29.1)
	RATIO	8 : 1 : 1	9 : 0 : 1	5 : 1 : 4	4 : 0 : 6	8 : 0 : 2	7 : 0 : 3

SNN = Shanono, DKD = Dawakin kudu, DBT = Danbatta, WDL = Wudil, BBJ = Bebeji, OF = own flock, NF = neighbor flock, MKT = market, BF = breeding and fattening, BS = breeding and socio-cultural, all ratios are in ascending order.

Table 3: Breeding Practice of Sheep Owners in the locations

Location						
Variable	SNN	DKD	DBT	WDL	BBJ	TOTAL
	(n= 70)	(n= 70)	(n= 70)	(n=70)	(n= 70)	(n= 350)
Breeding practice						
Controlled	43(61.43)	26(37.14)	48(68.57)	14(20.00)	05(7.14)	136(38.86)
Uncontrolled	27(38.57)	44(62.86)	22(31.43)	56(80.00)	65(92.86)	214(61.14)
Control method						
Tethering	(n=43) 29(67.44)	(n=26) 17(65.38)	(n=48) 34(66.66)	(n=14) 14(100)	(n=05) 05(100)	(n=136) 97(71.32)
Castration	01(2.32)	06(23.08)	05(10.42)	0 (00)	0 (00)	12(8.82)
Culling	10(23.25)	03(11.54)	11(22.92)	0 (00)	0 (00)	24(17.65)
Inbreeding awareness	(n=70)	(n=70)	(n=70)	(n=70)	(n=70)	(n=350)
Aware	65(92.86)	44(62.86)	39(55.71)	64(91.43)	27(38.57)	239(68.28)
Not aware	05(7.14)	26(37.14)	31(44.28)	06(8.57)	43(61.43)	111(31.71)
SNN = Shanono, DKD = Dawakin kudu, DBT = Danbatta, WDL = Wudil, BBJ = Bebeji						

DISCUSSIONS

Most of the farmers were keeping ram for the purpose of breeding and fattening in all the locations, indicating their primary objective which was for sales and savings this is consistent with the finding of Judith (2006) who discovered that rural sheep owners kept sheep for the purpose of breeding and fattening because it can be immediately sold for quick cash at the local markets and had short generation interval and require low initial capital. This finding is consistent with what was stated in other studies by Touré and Ouattara (2001), Ajala, Lamidi and Otaru (2008) and Baah, Tuah, Addah and Tait (2012) in selected urban communities in Côte d'Ivoire, Nigeria and Ghana, respectively. Similar findings was made by Gizaw (2008), who observed that cash income source and insurance were the principal objectives why barley farmers also keep the animals in a sheep-barley system. However reports by Thys and Ekembe (1992) and Lawal-Adebawale (2012) indicated that urban small ruminants were mainly raised for home consumption. The results of this research revealed the multi-functionality of sheep among rural dwellers in the five locations, whereby their financial functions were ranked as of paramount importance and also shows the improvement of rural sheep owners from subsistence to commercial sheep farming which will in turn increase their commercial status and improve their standard of living.

Those farmers who did not own breeding rams indicated that they use neighboring rams or their ewe mate with breeding rams from other flock during grazing. Some of the respondents attributed the absence of breeding rams in their flocks to the fact that the rams were sold during the Eid el-Kabir festival as Kano State is a predominantly Muslim state. Similarly, this

reason, as well as because keeping more of breeding ewes will increase their flock size after the festival. This observation was also made by Fсахatsion, Melesse and Banerjee (2013) in Gamogofa Zone, Southern Ethiopia, which they attributed to the prevalent practice of keeping growing ewes as replacements for breeding purpose while rams were sold when money is needed, during festivals or slaughtered during ceremonies. A similar flock structure was observed in Menz sheep by Getachew *et al.* (2010) where breeding ewes were dominant. By doing so however, they were unintentionally selecting against fast-growing desirable genotypes with remarkable features and large body sizes. Since there were no controlled breeding practices by most of the respondents, rams which were not sold because of poor growth and conformation had the best chances to mate with females in the flocks thus increasing their gene frequencies.

The fact that used rams for breeding either born in their flocks or from neighboring flocks may result in reduction of genetic diversity and probably increased rate of inbreeding and its related consequences. Although certain beliefs regarding raising and/or eating meat of animals of certain coat color are widespread across many West African societies (Brisebarre and Kuczynski 2009) and elsewhere in Africa (Gwaze *et al.* 2009), they were given little emphasis among respondents in all the locations and could be explained by cultural differences across Nigeria and Africa in general. Some of the respondents were selecting their breeding rams on the basis of their desirable traits such as consideration of the testicles where they preferred rams with compact testicles and avoiding those with pendulous testicles due to their reason that the former had greater mating ability.

REFERENCES

- Adeloye, A. (1998). *The Nigerian Small Ruminants Species*. 1st Edn., Ilorin, Nigeria: Corporate Office Maximum Press.
- Ajala, M.K., Lamidi, O.S. and Otaru, S.M. (2008). Peri-Urban Small Ruminant Production in Northern Guinea Savanna, Nigeria. *Asian Journal of Animal and Veterinary Advances*, 3: 138-146.
- Baah, J., Tuah, A.K., Addah, W and Tait, R.M. (2012). Small Ruminant Production Characteristics in Urban Households in Ghana. *Livestock Research for Rural Development*, 24(86). Retrieved July 21, 2012, from <http://www.lrrd.org/lrrd24/5/baah24086.htm>.
- Brisebarre A.M. and Kuczynski L. (2009). *La Tabaski au Sénégal. Une fête musulmane en milieu urbain. Collection Hommes et Sociétés, Karthala*
- Fsahatsion, H., Melesse, A. and Banerjee, S. (2013). Traditional Sheep Production and Breeding Practice in Gamogofa Zone, Southern Ethiopia. *International Journal of Livestock Production Research*, 1(3): 26 – 43.
- Gizaw, S. (2008). *Sheep Resources of Ethiopia: Genetic Diversity and Breeding Strategy*. (Unpublished doctoral thesis). Wageningen University, Netherlands.
- Gizaw, S., Getachew, T., Edea, Z., Mirkena, T., Duguma, G., Tibbo, M., Rischkowsky, B., Mwai, O., Dessie, T., Wurzinger, M., Solkner, J. and Haile, A. (2013). *Characterization of Indigenous Breeding Strategies of the Sheep Farming Communities of Ethiopia*. Aleppo, Syria: International Center for Agricultural Research in the Dry Areas.
- Gwaze, R.F.G., Chimonyo, M. and Dzama, K. (2009). Communal Goat Production in Southern Africa: A Review. *Tropical Animal Health Production*, 41:1157–1168.
- Judith, M. (2006). *Goat and Sheep Production and Marketing in the Amhara Region of Ethiopia, A Preliminary Survey Report for Designing Project on Small Ruminants Bahr Dar, Ethiopia*. Retrieved on 27th June, 2015 from jmoses@pacer.org
- Kosgey, I. S. (2004). *Breeding Objectives and Breeding Strategies For Small Ruminants in the Tropics* (Unpublished doctoral thesis). Wageningen University, Netherlands.
- Kosgey, I.S., Baker, R.L., Udo, H.M.J. and van Arendonk, J.A.M. (2006). Successes and Failures of Small Ruminant Breeding Programs in the Tropics: A Review. *Small Ruminant Research*, 61:13–28.
- Kosgey, I.S and Okeyo, A.M. (2007). Genetic Improvement of Small Ruminants in Low-Input, Smallholder Production Systems: Technical and Infrastructural Issues. *Small Ruminant Research*, 70: 76-88.
- Lawal-Adebawale, O.A. (2012). Factors Influencing Small Ruminant Production in Selected Urban Communities of Abeokuta, Ogun State. *Niger Journal of Animal Production*, 39(1): 218–228.
- Markos, T., Ayalew, W., Awgichew, K., Ermias, E. and Rege, J. E. O. (2004). On-Station Characterization of Indigenous Menz and Horro Sheep Breeds in the Central Highlands of Ethiopia. *Agriculture*, 35:61-74.
- Oni, O.O. (2002). Breeds and Genetic Improvement of Small Ruminants. In C.A.M. Lakpini, A.M. Adamu, O.W. Ehoche and J.O. Gefu (eds.) *Small Ruminant Production Training Workshop Manual*. Zaria, Nigeria: National Animal Production Research Institute. Pp. 10-12.
- Sölkner, J., Nakimbigwe, H. and Valle-Zarate, A. (1998, January). Analysis of

- Determinants for Success and Failure of Village Breeding Programs. In: Proceedings of the Sixth World Congress on Genetics Applied to Livestock Production Held in Armidale, New South Wales, Australia.
- Thys, E. and Ekembe, T. (1992). Elevage Citadin Des Petits Ruminants à Maroua (Province De L'extrême Nord Du Cameroun). *Cahiers Agriculture*, 1:249–255.
- Toure, G. and Ouattara, Z. (2001). Elevage Urbain Des Ovins Par Les Femmes à Bouaké, Côte d'Ivoire. *Cahiers Agriculture*, 10:45–49.
- Yemi, K. (2010). *The Review of the Nigerian Economy*. 2010 Edn., Abuja: Federal Ministry of Agriculture, .National Bureau of Statistics. Retrieved on 22nd April, 2016 from <http://www.nigerianstat.gov.ng>

ECONOMIC EVALUATION AND HAEMATOLOGICAL CHARACTERISTICS OF BROILER CHICKEN FED GRADED LEVELS OF BAوبا (*Adansonia digitata* L.) LEAF MEAL

¹ Adeosun, S.L., ² Adeosun, J.O. and ¹ Yahaya, M.A.

¹ Department of Animal Science, Federal University Dutsinma, Katsina State

² National Agricultural Extension Research Liaison Services, ABU, Zaria

Corresponding Author's email: astella@fudutsinma.edu.ng

ABSTRACT

A study was conducted to assess economic value and haematological characteristics of broiler chickens fed dietary levels of *Adansonia digitata* (L) Leaf Meal (ADLM). One hundred and eighty day old Oba Marshall broiler chicks were used in this research. The birds were randomly distributed in groups of 15 to four experimental diets in three replicates. Group T₀ is the control and had no ADLM while T₁, T₂ and T₃ were supplemented with ADLM at the rate of 5, 10 and 15% respectively. Initial weight, final weight, weight gain, feed intake, feed conversion ratio was measured and mortality recorded when it occurred. Blood samples were collected from six birds per treatment for haematological study. Results showed that birds on control diets performed better in all the parameters measured. However feed cost/kg (A) and, feed cost/bird and percent mortality were lower in birds on dietary treatments. Significant ($P < 0.05$) differences were obtained for the treatments in WBC, RBC, Hb, MCHC, PLT and PCV but no significant ($P < 0.05$) effects were obtained in MCV and MCHC. In general up to 5% inclusion of ADLM seems to be better in haematological study and also the values obtained fell within the recommended range for avian species. The findings of this research indicated that there's no economic justification for the inclusion of ADLM in broiler diet. However, it had no detrimental effects on the haematological characteristics birds fed with ADLM.

Keywords: *Adansonia digitata* L, broilers, economic value, haematology

INTRODUCTION

To maximize production performance of broiler chickens under intensive management, feed materials need to be sourced locally. Poultry production in Nigeria has witnessed tremendous use of feed additives, synthetic, plants and that of animal origins with the aim of reducing production cost (Iyayi, 2001; Sultan et al 2007; Nwogu, et al., 2015, Adeosun et al 2015). Adeosun et al., (2016) reported that while nutritionist source for alternative feedstuff to replace expensive conventional ones, emphasis should be on those non-conventional feedstuffs in the producer's environment, the economic value and the safety of such feedstuff for animal consumption. Leakey (1999) had earlier found out when citing the work of ICRAF (1997) on potential for novel food products that agro-forestry trees are important in alleviation poverty and promotion of environmental rehabilitation in developing countries through integration of indigenous trees which products have traditionally been used as natural products from tropical farming system. This International Centre for Research in

Agroforestry (ICRAF) in collaboration with farmers for ecoregion of tropics (the humid and dry zones of West Africa, Amazonia and southern Africa) had identified indigenous trees for domestication so as to provide people's need for food and nutritional security. *Adansonia digitata* (L), baobab, was among the identified indigenous trees.

These plants are found in different ecological zones of Nigeria particularly in the northern Sudan Savanna of Nigeria. The plant is known as Africa tree. It is a valuable source of energy, protein and a non conventional feedstuff. It grows in the arid and semi-arid regions of the world. The trees are tolerant to high ambient temperatures and long span of drought. The leaves, bark and fruits in several regions of Africa as foodstuff and for medicinal purposes. For this reason, baobab is named "the small pharmacy" or chemist tree (Kerharo and Adam 1974, Etkin and Ross, 1982). The young tender leaves of *Adansonia digitata* are used as green or dried vegetables, rich in vitamin A and calcium. It is an excellent source of iron, potassium, magnesium, molybdenum, phosphorus and zinc and it also has a

favourable amino acid profile. Dry leaves are rich in carotene with significant amount of mucilage. These leaves are generally used for making soup in the northern part of Nigeria (Both and Wicken 1988, Yazzie, *et al* 1994 and Nordeide *et al* 1996).

This study was carried out to determine the economic value of *Adansonia digitata* leaf meal inclusion in chicken diets and the effect on haematological characteristics of broiler chickens.

MATERIALS AND METHODS

Experimental Site

The research was carried out at Teaching and Research Farm, Department of Animal Science, Federal University Dutsinma, Katsina State, Nigeria. Dutsinma is located in Northern Sudan Savannah zone with latitude 12°27'18"N, longitude 07°29'29"E and an altitude of 542m above sea level(www.maplandia.com/nigera/katsina/dutsin-ma). The area is distinctly characterized by a tropical wet and dry season with predominantly hot humid environment. The average annual rainfall is 700mm with annual temperature range of 29°-30C.

Experimental Design, Diets and Management of Birds

One hundred and eighty Oba Marshal broiler chicks were used in a completely randomized design. There were four dietary treatments replicated three times, with each replicate consisting of 15 birds. The birds were weighed and allocated into the four dietary treatments T₀, T₁ T₂ and T₃ accordingly.

Treatment (T₀) served as control and had no ADLM, while T₁ T₂ and T₃ had ADLM at the rate of 5, 10 and 15%, respectively. The experimental diets were formulated to meet the body requirement of birds according to NRC (1994) for both starter and finisher phases as shown on Tables 1 and 2 respectively. Feed and water were provided *ad libitum* throughout the period of 8 weeks duration. Routine management practices such as vaccination,

drug administration and hygienic environment were regularly maintained.

Data Collection and Analysis

At the onset of the feeding trial, average group initial weight of birds were taken and thereafter on weekly basis, from which the body weight gain were taken. Feed intake, feed conversion ratio, feed cost per kilogram (feed/kg) and cost of feed per kilogram weight gain (feed/kg gain) were measured. Income above feed expensis (IAFE) was calculated from the data collected. Mortality was also recorded as it occurred. At the end of the feeding trial, six birds per treatment were selected and blood samples collected from their wing veins into test tubes containing EDTA as anticoagulant. These blood samples were used to determine the haematological indices which included white blood cells (WBC), red blood cell (RBC), haemoglobin content (Hb), mean corpuscular volume (MCV), means corpuscular haemoglobin (MCH), mean corpuscular haemoglobin content (MCHC), platelets (PLT) and packed cell volume (PCV) according to Cheesbrough(2006) methods.

The summarized data were subjected to analysis of variance. Where significant differences occurred, Duncan Multiple Range Test (Steel and Torrie 1980) was used to separate the means.

RESULTS

The results of the economic evaluation and the haematological characteristics of broiler chickens fed graded levels of *Adonsonia digitata* leaf meal (ADLM) are indicated on Tables 3 and 4. Table 3 shows significant ($P<0.05$) differences among treatment means for final weight(g/bird), weight gain(g/bird), feed intake(g/bird), feed conversion ratio, feed cost per bird (feed cost/bird), feed cost per kilogram weight gain(feed cost/kg gain), income above feed expenses (IAFE) and mortality rate but no significant($p>0.05$) difference for feed

cost kilogram(feedcost/kg). It was observed that as the inclusion levels of ADLM in the diets of treated broilers increased final weight, weight gain, feed conversion ratio and feed cost/gain decreased. The birds on control diet indicated improved performance than those on treated diets, but highest mortality rate, followed by the treatment group T₁, while treatments T₂ and T₃ had no mortality. Although it cost more to produce one bird in control diet, cost per gain and the income above feed expenses paid in control compared to treated diets. The result of the haematological indices showed significant($p < 0.05$) differences for red blood

cells(RBC), means corpuscular haemoglobin(MCH), means corpuscular haemoglobin content(MCHC) and packed cell volume(PCV) but non-significant($p > 0.05$) differences for white blood cells(WBC), haemoglobin content(Hb), mean corpuscular volume(MCV) and platelets. Although there were non significant($p > 0.05$) differences for WBC, Hb, MCV and PLT in this study, a gradual decrease in these parameters were noticed as the inclusion levels of ADLM in the diets of treated broilers increased. It was also noticed that RBC decreased as the ADLM increased. MHC and MCHC increased with the increment of ADLM inclusion levels.

Table 1: Composition of Experimental Diets with Gradded Levels of *Adansonia digitata* (L) Leaf Meal for Broiler Starter

Ingredient	T ₀	T ₁	T ₂	T ₃
Maize	54.31	51.34	48.36	45.26
Groundnut cake	26.31	23.91	21.52	19.21
Soya bean cake	10.00	10.00	10.00	10.00
Fish meal	3.50	3.50	3.50	3.50
Limestone	0.15	0.15	0.15	0.15
Salt	0.35	0.35	0.35	0.35
Bone meal	3.50	3.50	3.50	3.50
Vitamin pre.	0.25	0.25	0.25	0.25
Lysine	0.25	0.25	0.25	0.25
Methionine	0.18	0.18	0.18	0.18
Oil	1.20	1.57	1.94	2.35
ADLM	0.00	5.00	10.00	15.00
Total	100.00	100.00	100.00	100.00
Metabolizable energy (Kcal/kg)	2970.66	2970.39	2970.42	2970.14
Crude protein (%)	23.00	23.00	23.00	23.00
Crude fiber (%)	3.17	3.41	3.66	3.89
Ether extract (%)	5.20	4.90	4.60	4.19
Lysine (%)	1.27	1.21	1.17	1.12
Methionine (%)	0.93	0.87	0.84	0.80
Avail phosp. (%)	0.77	0.70	0.70	0.69
Calcium (%)	1.42	1.44	1.43	1.39

Table 2: Composition of Experimental Diets with Graded Levels of *Adansonia digitata* (L) Leaf Meal for Broiler Finisher

Ingredient	T ₀	T ₁	T ₂	T ₃
Maize	60.32	57.42	54.48	51.61
Groundnut cake	21.30	18.89	16.49	14.11
Soya bean cake	10.00	10.00	10.00	10.00
Fish meal	3.00	3.00	3.00	3.00
Limestone	0.15	0.15	0.15	0.15
Salt	0.35	0.35	0.35	0.35
Bone meal	3.00	3.00	3.00	3.00
Vitamin pre.	0.25	0.25	0.25	0.25
Lysine	0.25	0.25	0.25	0.25
Methionine	0.18	0.18	0.18	0.18
Oil	1.20	1.51	1.85	2.16
ADLM	0.00	5.00	10.00	15.00
Total	100.00	100.00	100.00	100.00

	T ₀	T ₁	T ₂	T ₃
Metabolizable energy (Kcal/kg)	3045.53	3045.05	3045.91	3045.34
Crude protein (%)	21.00	21.00	21.00	21.00
Crude fiber (%)	3.13	3.37	3.62	3.86
Ether extract (%)	4.93	4.85	4.35	4.05
Lysine (%)	1.18	1.35	1.52	1.87
Methionine (%)	0.90	0.84	0.80	0.75
Avail phosp.(%)	0.62	0.62	0.61	0.65
Calcium (%)	1.32	1.32	1.31	1.30

Table 3: Economic Evaluation of Broiler Chickens fed Graded Levels of *Adansonia Digitata* (L) Leaf Meal

Parameter	Dietary Treatment Levels				SEM
	T ₀	T ₁	T ₂	T ₃	
Initial weight (g/bird)	46.67	46.67	46.67	46.67	0.11
Final weight(g/bird)	2008.16 ^a	1737.91 ^b	1467.33 ^c	1190.21 ^d	11.61
Weight gain(g/bird)	1961.49 ^a	1691.24 ^b	1420.66 ^c	1143.54 ^d	12.33
Feed intake(g/bird)	4203.98	4225.16	3987.23	3961.62	21.02
Feed conversion ratio	2.14 ^a	2.11 ^a	2.81 ^c	3.41 ^c	0.27
Feed cost/kg(₦)	107.00	104.33	105.97	105.44	2.02
Feed cost/bird(₦)	449.83 ^b	440.81 ^b	410.39 ^a	411.39 ^a	8.31
Feed cost/kg gain(₦)	228.98 ^a	260.83 ^b	297.78 ^c	359.55 ^d	7.14
IAFE(₦)	571.02 ^a	539.17 ^b	502.22 ^c	440.45 ^d	4.73
Mortality (%)	24.44 ^c	2.22 ^b	0.00 ^a	0.00 ^a	2.27

a,b,c,d: Means with different superscript in the same row are significantly (P<0.05) different.

SEM: Standard Error of Means.

IAFE: Income Above Feed Expenses at ₦800 per kg live weight.m

Table 4: Hematological characteristic of broiler chickens fed graded levels of *Adansonia digitata* (L) leaf meal

Parameter	Dietary treatment levels				SEM
	T ₀	T ₁	T ₂	T ₃	
WBC (X 10 ⁶ /mm ³)	8.67	7.11	6.45	4.89	1.97
RBC (X 10 ⁶ /mm ³)	5.18 ^a	4.72 ^{ab}	3.71 ^{bc}	3.34 ^c	6.37
Hb (g/dL)	14.50	13.50	12.70	11.75	0.87
MCV (μ)	77.33	73.67	58.00	55.33	0.87
MCH (pg)	26.17 ^b	26.50 ^b	30.83 ^a	35.50 ^a	2.82
MCH (%)	35.4 ^b	48.23 ^{ab}	55.77 ^a	50.40 ^{ab}	4.26
PLT (X 10 ⁹ /L)	228.00	217.33	199.33	181.00	35.04
PCV (%)	36.13 ^a	35.23 ^{ab}	35.23 ^{ab}	32.47 ^b	1.80

A,b,c,d: mean with different super scripts in the same row are significantly (p<0.050 different)

SEM: Standard Error of Means

WBC: White blood cells

RBC: Red blood cells

Hb: Haemoglobin content

MCV: Means corpuscular volume

MCH: Means corpuscular haemoglobin

MCHV: Means corpuscular haemoglobin volume

PLT: Platelets

PCV: Packed cell volume

DISCUSSION

Broiler chickens fed graded levels of *Adansonia digitata* leaf meal (ADLM) showed low final weight, body weight gain and feed conversion ratio as a result of low feed intake. The results in this study did not agree with the findings of Madubuike and Ekenyem (2006) who recommended 10% inclusion level of *Ipomoea asarifolia* leaf meal in the diet of broilers chickens. The low feed intake observed might be an indication of acceptability of ADLM by the broiler chickens. The feed cost per kilogram decrease with increment of ADLM levels in the diets of treated broilers, since the birds did not grow well it is unjustifiable to include ADLM in the diet of broiler chickens. The low to non-mortality rate in birds fed dietary treatments agreed with the report of (Kerharo and Adam 1974, Etkin and Ross 1982) who reported that all baobab plant parts have medicinal values, which suggests some that intrinsic factors might be present in *Adansonia digitata* leaf that could boost the immune system of the broiler chickens therefore preventing the treated birds from infectious diseases. This equally shows that ADLM is safe and that it has no detrimental effect when fed to animals. Researchers have established that feed affects haematological characteristics

of livestock (Ezeagu, 2005, Madubuike and Ekenyem, 2006, Sadeghi and Paurrea, 2007). The decrease in the haematological values for WBC, RBC, Hb, MCV, MCHC, PCV, and PLT as the inclusion levels of ADLM could be connected to insufficient nutrient values of the test materials. This could also explain why the weights of birds on treated diets were low. However, the values obtained in these results fell within the documented values for avian species (CCAC 1999).

CONCLUSION

The findings obtained in this study shows that including ADLM at the levels indicated is not economical as the cost of feed per kilogram weight gain and income above feed expensis did not justify the inclusion. However 5% inclusion level is the best for the hematological indices.

REFERENCES

- Adeosun, S.L., Ogundipe, S.O. and Sekoni, A.A. (2015). Effects of Ascorbic acid supplementation in the diets of heat-stressed laying hens. *Journal of Animal Production* 27:90-98.
- Adeosun, S.L., Adeosun, J.O. and Yahaya, M.A. (2016). Response of broiler chickens fed dietary levels of

- roasted Baobab (*Adansonia digitata*) seed meal. *Journal of Agriculture and Environment* Vol. 12, No. 1, 53-59.
- Both, F.E.M and Wicken, G.E (1988). Non-timber use of selected arid zone trees and shrubs in Africa, FAO, Rome, Italy; 176pp
- Canadian Council of Animal Care (1993). Breeding, Physiological and Nutritional parameters by species. In Guide to the Care and Use of Experimental Animals. 2nd Edition. <http://www.unmc.edu/iacuc/index.cfm>
- Cheesbrough, M. (2006). Haematological Test in District Practice in Tropical countries. Second edition Part 2 Pg 269-347.
- Ektin, N.L. and Ross, P.J (1982). Food as medicine and medicine as food. *Social Science Medicine* 16:1559-1573
- Ezeagu, I.E (2005). Baobab (*Adansonia digitata* L) Seed Protein Utilization in young Albino Rats 1: A biochemical ingredients and performance characteristics'. *Animal Research International* 2(1):240-245
- ICRAF (1997). International Centre for Research in Agroforestry. Medium-Term plan 1998-2000. ICRAF, Nairobi, Kenya. 73pp. In Potential for novel Food Production from Agroforestry trees. *A Review Food Chemistry* 66:1-14
- Iyayi, E.A. (2001). Cassava Leaf as supplement for feeding weaner swine. *Tropical Animal Production Investment* 4:141-150.
- Kerharo, J and Adam, J.G. (1974). "La Pharmacopée Sénégalaise traditionnelle des plantes médicinales. Toxiques Edition Vigot Freres Paris.
- Leakey, R.B. (1999). Potential for novel Food Production from Agroforestry trees. *A Review Food Chemistry* 66:1-14
- Madubuike, F.N. and Ekenyem, B.U. (2006). Haematology and Serum Biochemistry Characteristics of Broiler Chickens fed varying levels of *Ipomea asarifolia* leaf meal. *International journal of Poultry Science* 5(1):09-12.
- Nordeide, M.B; Hatlpy, A., Fpling, M., Lied, E and Oshaug, A (1996). Nutrient Composition and nutritional importance of green leaves and wild food resources In an Agricultural district, Kutiala, in Southern Mali, *In Journal of food Science Nutrition*; 47:455-468
- Nworgu, F.C., Alikwe, P.C.N., Egbunike, G.N and Obinamain, E.I. (2015). Economic importance and Growth rate of broiler fed with water leaf (*Talinum triangulare*) Meal supplements. *A Sian Journal of Agricultural Extension, Economic Sociology*. 4 (1): 49-57.
- NRC (1994); Nutritional Requirement of poultry 9th Revised Edition. National Academy Press Washington DC.
- Sadeghi, GH and Pourreza, I. (2007). Serum Protein and Some Biochemical Parameters in Broiler Chickens fed with Raw and Treated Bitter Vetch (*Vicia ervilla*). *Pakistan Journal of Biological Sciences*. 10(6):977-981.
- Steck, R.G.D. and Torrie J.A. (1980). Principles and Practice of Statistics. A Biometric Approach, 2nd Edition McGraw Book Co. Inc New York.
- Sultan, K.H., Faithi, A. and Abdul-Rahman, S.Y. (2007). Effects of Thyme leaf on blood glucose, reproductive and productive parameters in male and female local rabbits, *Mesopotamia Journal of Agriculture* 35:38-45.
- Yazzie, D., Vander Jaget, D.J. Pastuszen, A. Okolo, A. and Glwu, R.A. (1994). The amino acid and mineral content of Baobab (*Adansonia digitata* L) leave. *Journal of Food Comp Anal* 7:189-193.

AN EVALUATION OF PLANTAIN MARKETING IN ADAVI LOCAL GOVERNMENT AREA OF KOGI STATE NIGERIA

Mohammed, A. B.

Department of Agricultural Economics
Ahmadu Bello University, Zaria, Nigeria

Corresponding authors e-mail: bashraixp25@gmail.com

ABSTRACT

An evaluation of plantain marketing was carried out in Adavi Local Government Area of Kogi state. Plantain is a seasonal crop with relative short shelf life hence; it is available for a limited period. The study was therefore carried out within three months during the 2017 peak marketing season (September, October and November). A total of 94 plantain marketers were randomly selected from ten markets in the Local government area. Descriptive statistics, marketing margin, gross margin analysis and regression analysis were used to analyze the data collected. The results indicated that majority (83.0%) of the marketers were female. Most (87.2%) of the marketers were married. More than half (51.1%) of the marketers were between 21-40 years of age with an average age of 40 years. Majority (84.0%) of the marketers were literate with marketing experience of 10 years and has on the average household size of 7 persons. The results of gross margin analysis revealed that purchase cost constituted the highest percentage of the total variable cost (90.34%). The marketing margin of ₦190 (19.57%) was obtained for marketing plantain in the study area. Furthermore, the findings show that even though plantain marketing was profitable with gross returns of ₦12,390.61 per three month from the sales of 256 plantain bunches, sales losses amounting to ₦18,449 was incurred. Results from regression analysis showed that there was significant relationship between purchase cost, selling price, quantity sold and profitability of plantain in the study area. Low capital investment and high cost of transportation were the major problems associated with plantain marketing in the study area. It is therefore recommended that plantain marketers should device proper handling, packaging and storage techniques in order to reduce loss in the quantity of plantain purchased and sold.

Key words: Plantain marketing, gross margin, marketing efficiency Adavi LGA

INTRODUCTION

Plantain (*Musa paradisiaca* L.) is a perennial crop that takes the form of a tree as it matures. It is believed to have originated in Southeast Asia but its introduction into Africa is unclear. Throughout history it has provided humans with food, medicine, clothing, tools, shelter, furniture, paper and handicrafts (Adewole and Duruji, 2010). It could be termed the “first fruit crop” as its cultivation originated during a time when hunting and gathering was still the principal means of acquiring food (IITA, 2009). Plantain is an important staple food for nearly 400 million people in many developing countries, especially in Africa (Daniells et al, 2010). In the East African Highlands, consumption may be as high as 1 kilogram per person per day. In Africa, plantain and banana provide more than 25% of food energy requirement for around 70 million people (Adopo, 2010). The role of plantain is becoming more important with the increasing emphasis today on diets that are low in sodium but

high in potassium and vitamins (Rosales et al, 2010). High intake of sodium has always been associated with hypertension. Plantain is a good source of potassium and it is low in sodium. It is very rich in vitamin A, highly digestible and contains fiber, blood pressure stabilizers, calcium and phosphates for healthy skin, teeth and bones. It is also one of the few fruit sources of chromium, a nutrient vital for combating diabetes because it stimulates the metabolism of glucose (Adetunji and Adesiyani, 2008).

The marketing channel of food crops such as banana and plantain is an important part of its cost, and its location to the market may shorten the path of distribution from producers to consumers and makes the marketing process simple and efficient (Egbuna, 2009). Plantain marketing involves the role of middlemen in passing plantain from the farms to the markets. Therefore, the roles of markets cannot be over emphasized because production centres are fragmented and mostly in small

scale. Plantain is usually eaten cooked unless they are very ripe. It can also be roasted to make bole, a common snack eaten by many especially in the Southern parts of Nigeria. Plantain is also dried and fried to make chips. It can also be baked and fermented to make beer and vinegar. Plantain can also be dried and made into plantain flour, which can be baked and used for eating with soup. Ripe plantain is also fried to make dodo which is loved by many especially children. Plantain provides food security and income for small-scale farmers who represent the majority of producers. Medicinally plantain can be used to cure some ailments; like sore throats, tonsillitis, diarrhoea and vomiting. Due to its high nutrients, plantain is used in the production of Soymusa, which can be used in the treatment of kwashiorkor (Rony, 2010).

The plantain business is faced with a lot of marketing problems which determine whether production can be expanded or not (Adetunji and Adesiyani, 2008). The relative attention given to plantain is focused on the technical and productive viability of plantain in Nigeria, while little is done on its marketing. Agricultural production problems can be overcome through introducing new technology and efficient marketing systems (Adetunji and Adesiyani, 2008). The area under production of plantain has been increasing over the years however, low farm-gate pricing with traders determining prices has been a major hindrance to production and marketing. It is however obvious that increased production without corresponding well-developed and efficient marketing system may amount to wastage of resources (Adetunji and Adesiyani, 2008). The study therefore described socio-economic characteristics of the plantain marketers, analyses gross margin, marketing margin, marketing efficiency, factors affecting the profitability of plantain marketers as well as identify the factors that constraint the marketing of plantain in the study area.

Study Area

The study was carried out in Adavi Local Government Area of Kogi State. It is an agrarian community within the guinea savannah ecological zone of Nigeria. The study area is located in the central part of

the state on longitude 7°40' N and latitude 6°27' E of the Greenwich meridian. There are two (2) distinct seasons, the dry season (November – March) and the rainy season (April – October). Agriculture is the mainstay of the economy. There are many farm produce from the state notably coffee, cocoa, palm oil, cashews, groundnut, maize, plantain, banana, cassava, yam, rice and melon and they rear livestock such as goat, sheep, cow, poultry, etc. Majority of the people are farmers and civil service workers, while some are involved in trading and other economic activities.

Sampling Techniques

A purposive sampling technique was used to select two farm settlements which are Irrepeni and Osara out of the four farm settlement in the local government area based on their level of plantain marketing activities. Random sampling technique was employed to select one hundred (100) plantain marketers from the study area. However only data collected from 94 plantain marketers' were found useful for analysis.

Method of Data Analysis

Data collected were analyzed using descriptive statistics, gross margin and regression analysis. Specifically, Descriptive statistics was used to describe the socio-economic characteristics of the respondents, the marketing activities of the plantain marketers and identify the factors that constrained the marketing of plantain in the study area.

Gross margin analyses was used to analyze the cost and returns in plantain marketers' activities.

Mathematically: Gross margin (GM) = Total Revenue – Total variable cost = TR – VC

Marketing margin (Mm) = selling price (Sp) – purchase price (pp)/selling price × 100

$$MM = \frac{SP - PP}{SP} \times 100$$

Regression analysis was used to determine the factors affecting the profitability of plantain marketing in the study area. The regression model is represented as follows:

$$Y = b_0 + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + b_5X_5 + b_6X_6 + e$$

Y = Gross margin or Profitability
 X_1 = Labour cost
 X_2 = Trading material cost
 X_3 = Quantity sold
 X_4 = Selling price
 X_5 = Purchase cost
 X_6 = Transportation cost
 e = Error term
 b_0 = Constant term
 $b_1 - b_6$ = Coefficient of independent variables

RESULT AND DISCUSSION

Table 1 presents the socioeconomic characteristics of plantain marketers in the study area. Results revealed that 83.0% of the marketers were female while 17.0% were Male. This means that females dominated marketing of plantain in the study area. This finding agrees with Akalumbe (1998) as cited in Oladejo and Sanusi (2008) that postharvest handling of plantain is still in the domain of women while men are more in to farming or production, he reported that men have negative attitudes towards marketing activities compare to women.

More than half (51.1%) of the respondents are between 21-40 years while 48.9% are above 40 years with mean age of 40 years .Implying that the respondents are still in their active age . Majority 87.2%

of the marketers were married, while 12.8% were single or otherwise. Results revealed that 94.6% of the markers sampled had education levels ranging from secondary to tertiary education while only 5.4% of them had primary education. It was also discovered that majority of the marketers had household size of 1-10 persons with mean household size of 7 persons. This finding is in contrast with the findings of Adaigho and Okpeke (2016) in the evaluation of small scale plantain marketing in Delta State who reported a household size of between 1-4 persons.

Further result on marketing experience show that averagely the marketers have been involved in marketing plantain for 10 years. Findings from the study area revealed that, 76.6% of the marketers used bus to transport plantain while just 23.4% use other means such as try cycle Car and lorry etc, the general use of vehicles for transportation especially bus maybe attributed to the bulky nature of the plantain involved in transits. The marketers use family labour (86.2%) as their major sources of labour this helps to reduce cost of labour as a token will be used to upset the cost incurred compared to the cost incurred for hired labour .

Table 1: Socio-economic characteristics of plantain marketers

Variables	Frequency	Percentage	Mean
SEX			
Male	16	17.0	
Female	78	83.0	
MARITAL STATUS			
Single	6	6.4	
Married	82	87.2	
Divorce	3	3.2	
Widow/widower	3	3.2	
AGE			40
21-40	48	51.1	
41-60	46	48.9	
EDUCATIONAL LEVEL			
Primary education	5	5.4	
Secondary education	79	84.0	
Tertiary education	10	10.6	
FAMILY SIZE			7
1-4	35	37.2	
5-8	51	54.3	
9-12	8	8.5	
EXPERIENCE			10
1-10	60	63.8	
11-20	32	34.0	
21-30	1	1.1	
31 and above	1	1.1	
MEANS OF TRANSPORTATION			
Bus	49	52.1	
Lorry	19	20.2	
Car	25	26.6	
Tyr cycling	1	1.1	
PURCHASE SOURCE			
Neighboring villages	50	53.2	
Market	20	21.3	
Wholesaler	15	16.0	
Farm	9	9.6	
LABOUR TYPE			
Family	81	86.2	
Hired	7	7.4	
Both	6	6.4	

Source: Filed survey 2017

Table 2 presents the marketing activities in the study area. Results revealed that on the average a bunch of plantain is purchased for ₦780. On the average a marketer purchased per 3 month period 283 bunches of plantain. The study revealed that an average of 265 bunches was sold within the three month the study was carried out at ₦ 971 per bunch. A total of ₦11, 222.32k was incurred on transporting plantain for sale during the period under consideration. The sales losses

incurred during the marketing activities amounted to ₦18, 449. Labour cost for plantain marketing includes cost of loading, off-loading and de-bunching. A typical marketer on the average incurred ₦3, 886.17, ₦2, 889.89 and ₦ 4,615.43 for loading, off loading and de-bunching of plantain respectively. Cost of trading material amounted to ₦ 1,062.46 k for the period under consideration.

Table 2. Input and Output Characteristics of Plantain Marketers in the Study Area

	N	Minimum	Maximum	Sum	Mean
Purchase price/Bunches	94	300	2000	73400	780.85
Number of bunches purchase in 3month.	94	44	1280	26661	284
Quantity sold in 3 month.	94	40	1250	24936	265.28
Sales losses in 3 month	94	18.35	1725	1674705	18,449.00
Cost of loading	94	100	15000	365300	3886.17
Cost of off-loading	94	100	12000	271650	2889.89
Cost of de-bunching	94	0	9000	433850	4615.43
Trading Materials	94	450	1820	99871	1062.46
Selling Price/ bunch	94	395	2941	91265	970.9043
Transport cost	94	450	26,000	1054898	11222.32

Source: Field survey 2017

Result on table 3 shows the summary of the gross margin and marketing margin of marketers in the study area. Results from analysis shows that plantain marketing has a gross margin of ₦12,390 during the study period. The level of profit made with respect to the total cost incurred in marketing of plantain was low this can be attributed to losses from sale. This is in contrast with the findings of Oladejo and Sanusi (2008) and Aina et.al., (2012). Who

observed a gross margin of ₦2,707.9k per dozen of plantain marketing in their research on socio-economic analysis of plantain marketing in Odigbo LGA of Ondo State Nigeria. Marketing margin of 19.57 on the average shows the relationship between the selling price of ₦971 and purchase price of ₦780 of plantain marketing per 3 month. Further analysis shows that Purchase cost constituted the highest cost of plantain marketing compared to all other cost.

Table 3. Gross Margin Analysis of Plantain Marketing Per 3 Month in the Study Area

Variables	Cost (₦)	Percentage (%)
Loading	3,886.17	1.58
Off-loading	2,889.89	1.17
De-bunching	4,615.43	1.88
Transport cost	11,222.32	4.58
Cost of trading material	1,062.46	0.43
Purchase cost of plantain	221,520	90.34
Total variable cost	245,196.27	
Total revenue from sales	257,265.88	
Gross margin (Gm)	12,390.61	
Marketing margin(Mm)	19.57	

Source: Field survey, 2017

Table 4 presents the result of the factors affecting profitability of plantain marketing in the study area. The R^2 value of (0.770) indicates that the independent variables can explain 77.0% of the variation in the dependent variable. The result of regression analysis shows that two of the variables included in the model were significant at 0.05 levels while three variables were significant at 1% level. Findings further revealed that trading material, quantity sold and selling price has positive coefficient while labour cost and cost of purchase has negative coefficient. The positive coefficient of trading material implies that an increase in this variable will increase profitability of plantain marketing. This finding is contrary to apriori expectation, probably due to the low cost incurred on trading material in the study area. The positive coefficient of selling price implies that an increase in the selling price will result to an increase in the profitability of plantain. This collaborates the finding of Nwaru and Iwuji (2005), on factors affecting the productivity and profitability of vegetables production in Swaziland. Also the positive coefficient of quantity sold implies that an increase in quantity sold will increase the profitability of plantain marketing, this is in contrast to the finding of Nse-Nelson, et al (2016) who work on analysis of plantain marketing in Ikwuano

LGA of Abia State, Nigeria and observed that quantity sold is negatively related to profit.

On the other hand the negative coefficient of labour cost implies that an increase in labour cost will result to a decrease in profitability of plantain marketing, this is in line with the apriori expectation and contrary with the findings of Adetunji and Adesiyani,(2008) Who observed that labour cost was positively related to profit in his research on economic analysis of plantain marketing in Akinyele Local Government Area of Oyo State Nigeria. Also the negative coefficient of cost of purchase indicates that an increase in cost of purchase will result to a decrease in profitability. This result is in line with Nwaiwu et al., (2012) who reported that purchasing cost was negatively related to profit in his work on marketing margin and their determinants in plantain marketing in Owerri Agricultural zone of Imo State in Nigeria.

The result from table 5 shows that low capital/initial investment and high cost of transportation constitutes a major constraint which hinders the expansion of plantain business, Rapid deterioration in the quality of plantain, pest and disease attack, inadequate information, breakage, and Heavy imposition of tax/levies constitute the other serious problems faced by plantain marketer in the study area.

Table 4. Factors Affecting Profitability of Plantain Marketing

Independent Variable	Coefficients			
	B	Std. Error	T	Sig.
(constant)	.430	.121	3.561	.001
Labour cost(x ₁)	-.062	.029	-2.157	.034**
Trading materials(x ₂)	.055	.025	2.151	.034**
Quantity sold(x ₃)	.845	.096	8.795	.000***
Selling price(x ₄)	.791	.097	8.136	.000***
Cost of purchase(x ₅)	-.615	.092	-6.694	.000***
Cost of transportation(x ₆)	-.005	.021	-.283	.813 ^{NS}
R ²	0.77			

Source: Field survey, 2017 *** = Sig at 0.01, ** = Sig at 0.05, * = Sig @ 0.1

Table 5 : Factors that Constraint the Marketing of Plantain in the Study Area.

Constraint	Frequency *	Percentage %
low capital/initial investment	51	54.26
High cost of transportation	47	50.00
Rapid deterioration in quality	28	29.78
Pest and disease attack	27	28.72
Inadequate information	24	25.53
breakage	24	25.53
heavy imposition of tax/levies	22	23.40

Source: field survey, 2017

*Multiple responses recorded.

CONCLUSION AND RECOMMENDATION

It was established from the findings of this study that plantain marketers made profit however losses recorded in the process of marketing (6.7%) of the total bunches of plantain purchased reduced the quantity of plantain sold thus affecting the level of profit made. The quantity of plantain sold, and the selling price per bunch positively increase the profitability of plantain marketing while cost of plantain per bunch negatively affect the profitability of plantain in the study area. Low initial investment, high cost of transportation and rapid deterioration of the quality of plantain among others constrained the marketing of plantain in the study area.

It is therefore recommended that efforts should be made to reduce losses in plantain marketing by devising proper handling packaging and storage techniques this would not only increase the profitability of plantain marketing but also encourage others to join the business

Purchase price of plantain also needs to be regulated as it constitutes the highest marketing cost in the study area.

All the factors constraining the marketing of plantain in the area need to be adequately addressed by the government and all stakeholders involved in the marketing of plantain. This can be achieved through collective effort by establishing plantain marketer's cooperative groups from which members could obtain loans at very low interest rates to finance and expand their business additionally, micro-finance banks and other related lending houses should be insured and encouraged to provide start-up capital for the marketers. All tiers of government local, state and federal should as a matter of concern renovate bad roads and construct new ones especially those that link the producers with the marketers. This will help in getting the produce to the market places at a cheaper rate thus reducing marketing cost.

REFERENCES

- Adaigho, D. and Okpeke M.Y. (2016). Evaluation of small scale plantain marketing in Delta State :A case study of Isoko North Local Government Area, Delta State. *International Journal Of Science & Technoledge* (ISSN 2321 – 919X).
- Adetunji, M.O and Adesiyun, I.O (2008): Economic Analysis of Plantain marketing in Akinyele local Government Area in Oyo State, Nigeria. *International Journal of Agricultural Economics & Rural Development* -1 (1).
- Adewole, M. B. and Duruji, R. W. (2010). Quality assessment of plantain (*Musa paradisiaca* L.) as affected by different ripening methods: *African Journal of Biotechnology* Vol. 9 (38). Retrieved on 11/10/2010 from <http://www.academicjournal.org>
- Adopo, Achille N'Da (2010) Plantain case study post harvest operation. Retrieved from INPhO homepage: <http://www.foa.orglinphol.on> 13/11/2010.
- Aina, O. S., Ajilola, S., Bappah, M. T., Ibrahim, I. and Musa, I. A. 2012. Economic analysis of plantain marketing in Odigbo Local Government Area of Ondo State Nigeria. *Global Advanced Research Journal of Agricultural Science*, 1(5):104 -109. *Institute of Economics, University of Copenhagen, Copenhagen*, 25 – 26th May
- Akalumbe, O. (1998). "Economics of Marketing and Post-Harvest Losses in South-Eastern Nigeria". Unpublished M. Sc Thesis Department of Agricultural Economic University of Ibadan, Ibadan.
- Daniells, J., Englberger, L. and Lovens, A. (2010). Farm and forestry production and marketing profile for banana and plantain: In Eleovich, C.R. (ed). Specialty crops for Pacific Island. Resources (PAK) Holualoa, Hawaii, Retrieved on March 18, 2011 from <http://www.agroforestry.net/scps>.
- Egbuna, N.E (2009) *Urban Agriculture: Strategy for poverty reduction in Nigeria*. CBN.
- IITA (2009) plantain cultivation under west African condition. A reference manual Ibadan pp 117.
- Nse-Nelson F. A., Oke, U. R. and Adindu, J. U. (2016) Analysis of plantain marketing in Ikwuano Local Government Area in Oyo State, Nigeria. *International journal of Agricultural Food and Environment* 12(1):85-89
- Nwaru, J. C. and Iwuji, O. 2005. Marketing margin and their determinants in plantain marketing in Owerri Agricultural Zone of Imo State in Nigeria. *Agricultural Research for Improved Agriculture In Nigeria* (Eds).
- Nwaiwu, I. U., Eze, C., Amaechi, E. C. and Osuagwu, C. O. 2012. Problems and prospects of large scale plantain and banana (*Musa spp.*) production in Abia State. *Nigeria. International Journal of Basic and Applied Sciences*, 1(4): 322-327
- Oladejo, J. A. and Sanusi, W. A. 2008. Marketing analysis of plantain in Owo and Ose Local Government Area Of Ondo State, Nigeria. *International Journal of Agricultural Economics and Rural Development*, 7(2):60 - 67.
- Rony, S. (2010) Plantain cultivation under West African condition: A reference manual. Retrieved on 23/2/2011 from <http://www.banana-plant.com>
- Rosales, F.E., Alvarez, J.M. and Vargasm A. (2010) Practical guide for plantain production using high-density plantain. Experience from Latin America and the Caribbean. Biodiversity International Montpellier, France.

GROWTH PERFORMANCE OF BROILER CHICKENS FED DIETS CONTAINING VARYING LEVELS OF SOYA BEAN MEAL RESIDUE (AWARA)

¹Dikko, I. M. Dikko, ¹Yakubu, A. H., ³Doma, U. D., ²Yakubu. B., ⁴Dilala, M. A., and ²Bah, U. J.

¹Department of Animal Science, Federal University of Kashere, P.M.B 0182, Gombe State, Nigeria.

²Department of Animal Science and Range Management, Modibbo Adama University of Technology, Yola, Nigeria,

³Department of Animal Production, Abubakar Tafawa Balewa University, Bauchi, Nigeria.

⁴College of Agriculture Gujiba, P.M.B 1104, Damaturu, Yobe State, Nigeria.

Corresponding Author: E-mail: dikko005@yahoo.co.uk. GSM: 0803-4516-951

ABSTRACT

A feeding trial was conducted to investigate the effects of graded levels of soya bean meal residue (awara) included at 0, 5, 10, 15, and 20% on the growth performance of broiler chickens. A total of 220 unsexed day old Marshall Broiler chickens were randomly assigned to five dietary treatments each replicated four times in a completely randomised design (CRD). The Birds were provided with feed and water ad libitum and the experiment lasted for seven weeks. Data collected were daily feed intake and weekly weight gain which were subjected to one way analysis of variance (ANOVA). Result obtained showed that at the starter phase, there was significant ($P<0.05$) difference in both feed intake and weight gain as well as final weight gain. At the finisher phase, daily feed intake, total weight gain and final weight gain showed significant ($P<0.05$) difference, however weight gain and feed conversion ratio recorded were similar ($P>0.05$). It can be concluded therefore inclusion of soya bean meal residue up to 20% proved performance of broiler chickens at both starter and finisher phases and without any adverse effect. It is therefore recommended that poultry farmers and feed mill industries to effectively use soya bean residue meal (awara) in their feed formulations at 20% inclusion levels.

Keywords: Awara Residue Meals, soya- beans. Broilers- Performance.

INTRODUCTION

Feeding has been recognised as an important aspect as it account for 56 percent of the total cost of poultry production. Poultry convert feed into food products quickly and efficiently. Their high rate of productivity results in relatively high nutrient needs. Today's system of animal agricultural production put humans and animals in competition for protein. Therefore any positive effort targeted at reducing the cost of feeds will be one of the possible remedy to the shortage of animal protein for human consumption. Residues generated by the food industries represent a potential resource to reduce this problem if properly utilized. The possibility of separation, collection and utilization of food residue as feedstuff for animals has been studied in many places in the world (Farhat *et al.*, 2001). The use of local, cheap and readily available material, particularly those that are not directly utilized by man has received particular attention as the only viable alternatives to the use of conventional feed stuffs (Akpodiete *et al.*, 1997; Akande *et al.*, 2007). Soya bean meal serves as the world standard in regard to protein meals for livestock production (Leeson and Summers, 1997). It is palatable, nutrient dense and highly digestible. Similarly, full fat soya bean (ffSB) was said to possess the same features, but in addition, it is an excellent source of energy and fatty acids.

Awara residue (AR) or Okara is a by-product of soymilk or awara processing which contains shells, husk of ground soybean. It is beige in colour and has a light crumbly, fine grained texture which makes it look like moist sawdust or grated coconut and taste similar to almond.(Singha SK *et al.*, 2013). Although AR is mostly treated as an industrial wastes with little market value, but it is potentially nutritious product that is high in protein, carbohydrate, vitamins, minerals fibre and fat, Aquado (2010). Ma *et al.* (1997) reported that AR has high quality protein for feeding livestock. Consequently, (Abd-Elsamee *et al.*, 2005) observed that the use of AR as a replacer for soybean meal in broiler diet up to 60% did not adversely affect feed conversion and improve economical efficiency.

Finally, the use of AR as a plant by-product protein source for feeding broiler chickens to determine their general performance will go a long way in alleviating the existing protein competition between man and his animals.

MATERIALS AND METHOD

This study was conducted at Gombe state poultry production unit of state ministry of Agriculture. Gombe State which lies between latitude 90° to 120° North and longitude 80° to 110°East with an altitude of 407 meters above sea level. It has mean maximum and mean minimum temperature of

32.8°C and 18.3°C respectively. The coldest months are from November to January while March to May is the hottest period. Gombe metropolis has a rainfall distribution which ranges from 970.7 mm to 1,142 mm annually, with a mean of 1,009.4 mm. The rain falls from the month of April to October. The vegetation of the area is savannah grassland (Gombe State Government, 2009).

Soya bean by-product (Awara residue) was purchased from locals who prepare and sale fried soya bean cake (awara) in Gombe metropolis, Gombe state and Yola, Adamawa state, Nigeria. The residue was boiled for 30 minutes in a large metallic pot and then sun dried to destroy the anti-nutritional factors in it, such as trypsin inhibitors, chymo inhibitors. The processed samples were then analyzed for nutritive value according to AOAC technique (AOAC, 1990).

A total of two hundred and twenty (220) unsexed day old Marshall Broiler chicks were used for this experiment. The chicks were obtained at day-old from Sovet

International Nig LTD, Kano State Nigeria. Before arrival of the chicks, the room was thoroughly swept, washed with detergent and then disinfected with disinfectant (IZAL). Flat feeding trays were spread on the litter materials (wood shaving) and plastic drinkers for the young chicks in the brooder room. On arrival, chicks were fed commercial broiler starter mash and water containing anti-stress to relieve them of transit stress, charcoal was used to supply warmth to the chicks. The birds were then randomly weigh and allotted to five (5) treatment groups of 44 birds each. Each treatment was replicated four times with 11 birds per replicate in a completely randomized design (CRD). Five starter and five finisher experimental diets were formulated with graded levels of toasted awara residue meal at 0%, 5%, 10%, 15%, and 20%. Water and Feeding were provided *ad libitum* throughout the 7 weeks period of the experiment. The gross composition of broiler starter and finisher formulated experimental diets are as shown in (Table 1 and 2 respectively).

TABLE 1: GROSS COMPOSITION OF EXPERIMENTAL STARTER DIETS

Ingredients	Treatment/Diets				
	T1 (0%)	T2 (5%)	T3 (10%)	T4 (15%)	T5 (20%)
Maize	46.97	42.63	38.30	43.97	42.97
Soybean	33.63	32.97	27.30	21.63	17.63
Wheat Offal	10.0	10.0	10.0	10.0	10.0
Awara Residue Meal	0.0	5.0	10.0	15.0	20
Fish Meal	5.0	5.0	5.0	5.0	5.0
Bone Meal	2.0	2.0	2.0	2.0	2.0
Limestone	1.50	1.50	1.50	1.50	1.50
Salt	0.25	0.25	0.25	0.25	0.25
Min-vit-Premix*	0.25	0.25	0.25	0.25	0.25
Lysine	0.20	0.20	0.20	0.20	0.20
Methionine	0.20	0.20	0.20	0.20	0.20
Total	100%	100%	100%	100%	100%
Calculated analysis					
Crude Protein (%)	23	23	23	23	23
Energy (Kcal/kg ME)	2890.61	2891.26	2919.87	2935.89	2950.93
Crude Fibre (%)	4.02	4.99	4.93	5.56	5.91
Ca (%)	1.31	1.31	1.31	1.31	1.31
P (%)	0.68	0.68	0.68	0.68	0.68
Lysine (%)	1.23	1.38	1.30	1.24	1.21
Methionine (%)	1.34	1.34	1.34	1.34	1.34

Key: P = phosphorus, Ca = calcium,

TABLE 2: GROSS COMPOSITION OF EXPERIMENTAL FINISHER DIETS

Ingredients	Treatment/Diets				
	T1 (0%)	T2 (5%)	T3 (1)0%	T4 (15%)	T5 (20%)
Maize	50.47	49.47	50.77	47.47	46.47
Soybean	28.13	24.13	19.33	16.13	12.13
Wheat Offal	15.0	15.0	15.0	15.0	15.0
Awara Residue Meal	0.0	5.0	10.0	15.0	20.0
Fish Meal	2.0	2.0	2.0	2.0	2.0
Bone Meal	2.0	2.0	2.0	2.0	2.0
Limestone	1.50	1.50	1.50	1.50	1.50
Salt	0.25	0.25	0.25	0.25	0.25
Min-vit-Premix*	0.25	0.25	0.25	0.25	0.25
Lysine	0.20	0.20	0.20	0.20	0.20
Methionine	0.20	0.20	0.20	0.20	0.20
Total	100%	100%	100%	100%	100%
Calculated analysis					
Crude Protein(%)	20.0	20.0	20.0	20.0	20.0
Energy (Kcal/kg ME)	2822.07	2837.15	2907.17	2867.31	2882.39
Crude Fibre (%)	4.72	5.05	5.47	5.77	6.11
Ca (%)	1.31	1.31	1.31	1.31	1.31
P (%)	0.68	0.68	0.68	0.68	0.68
Lysine (%)	1.10	1.07	1.02	1.01	0.99
Methionine (%)	1.33	1.34	1.33	1.31	1.34

Key: P = phosphorus, Ca = calcium,

RESULTS AND DISCUSSION

The result of the proximate analysis of processed awara residue meal obtained in this research is presented in Table 3. It showed that the test diet is highly nutritious and had crude protein content of 30.44%, which is in line with 30.90% crude protein reported by (Herman *et al.*, 2004), although (Surel *et al.*, 2005) reported a varied CP of 37.5%, while Vishwanathan (2011) obtained 34.7% CP. This variation may be probably due to difference in varieties and region of production of the soya beans. The crude fibre reported in this research of 11.40% was almost similar to 12.7% reported by (Farhat *et al.*, 1998), however, higher value of 31.1% crude fibre was reported by (Surel *et al.*, 2005). Furthermore, the metabolizable energy of 3267.51 ME (Kcal/Kg) recorded in this experiment was in agreement with the work of (Herman *et al.*, 2004) who reported 3388 ME (Kcal/Kg).

TABLE 3: PROXIMATE ANALYSIS OF PROCESSED AWARA RESIDUE MEAL

NUTRIENT	%
Dry matter	94.67
Crude Protein	30.44
Crude fibre	11.40
Ether extract	8.60
Nitrogen Free extract	40.50
Ash	3.73
Acid detergent fibre	26.33
ME(Kcal/Kg)	3267.51

The results of growth Performance of broilers fed graded levels of awara residue meals are presented in Tables 4, 5 and 6 for starter, finisher and pooled phases of production respectively. Feed intake was significantly ($P < 0.001$) influenced by the dietary levels of awara residue meal both at the starter, finisher, and pooled phases of performance across the treatments. There was progressive increase in feed consumption across the treatment groups with corresponding increase in the inclusion level of the test diets. This can be explained by the fact that birds eat to meet their energy requirement (Church, 1991). Highest

level of feed intake was recorded in diet 2 (127.51g/bird/day) at the pooled phase and this may be attributed to the fact that the bulkiness, palatability and balance of amino acid in the test diets since T2 has 5% level of inclusion of the tested ingredient. This is in line with the report of (Aletor *et al.*, 2000) who reported that diet with balanced amino acid are palatable and consumed in large amount with attendant improvement in the performance of broiler chickens. Furthermore, the inclusion level of awara residue meal in this study falls within the recommended range of 25-40% of soya bean inclusion levels in broilers (Willis, 2003).

Daily weight gain showed high significant difference ($P < 0.001$) at the pooled phase among the treatment groups. The highest value of weight gain was obtained at treatment 2 (39.29g/bird/day) while the control treatment recorded the lowest weight gain of (31.64g/bird/day). Furthermore, the daily weight gain obtained in treatment 3 (35.73g/bird/day) in this research is in agreement with the work of (Doma *et al.*, 2013) who reported a similar weight gain of (35.73g/bird/day) when they studied the growth performance, carcass characteristics and economy of production of broilers fed two sources of protein (soya bean meal and groundnut cake). Meanwhile, as the inclusion level increases so also the weight gain and this development may be explain by the fact that the nutrient quality of the test diets was sufficient which is also in line with the results recorded by (Nassiri-fard *et al.*, 2013) who reported that weight gain in broiler during grower period and also the whole period in the experimental groups fed different levels of full-fat soya bean meal were increased than the control group which was not significant.

Finally, there was significant different ($P < 0.01$) with respect to both the total weight gain and final weight gained recorded in this research. The highest total weight gain of (2370.29g/bird) was obtained in treatment 2, and this is probably due to the moderate inclusion level of 5% awara residue meal in the experimental diet of that particular diet. The lowest final

weight gain was obtained in the control treatment group 1 (1517g/bird) while the highest was recorded in treatment 2 (2370.29g/bird/day). This result agreed with the work of (Ifeoma *et al.*, 2012) who reported a similar final weight gain of (1520.00g/bird/day) when they conducted research on performance of broilers fed full fat soya bean based diet. No significant difference ($P>0.05$) was observed for the feed conversion ratio (FCR) among the treatment groups and this is probably due to the uniformity of nutrients in the feed, feed wastages avoided during the trial and less antinutritional factors in the diets. The values of FCR ranges from (2.26) in treatment 2 to (2.71) in treatment 3 and this conforms to the value of FCR of 2.94 obtained by (Doma *et al.*, 2013). Furthermore, the highest value of FCR (4.05) obtained at the finisher level in this research may be attributed to the effect of heat stress experienced by the birds towards the end of the experiment and this

was in line with the study conducted by (Lucas *et al.*, 2013) who reported that broilers subjected to chronic heat stress had significantly ($P<0.05$) reduced feed intake and higher feed conversion ratio (+25.6%) at 42 days of age.

CONCLUSION

This research showed that soya bean residue meal, 'Awara' residue meal, despite the fact that is regarded as industrial waste with little market value can still be useful as good plant by-product protein source for monogastric animals. Therefore from the result obtained in this study, conclusion can be drawn that the nutrients and amino acid composition of awara residue meal are high and can replace soya bean meal successfully. Inclusion level up to 20% of awara residue meal in broiler diets supplied the protein requirements of the birds, thereby facilitating better performance without any adverse effects.

TABLE 4: EFFECTS OF DIETARY LEVELS OF AWARA RESIDUE MEALS ON THE GROWTH PERFORMANCE OF BROILER CHICKENS. (%)

Starter Phase (1-4 weeks)		Diets/Treatments				
Parameters	T1(0%)	T2(5%)	T3(10%)	T4(15%)	T5(20%)	SEM
Initial wgt (g)	259.09	245.45	245.45	254.55	250.0	4.55 ^{NS}
Final wgt (g)	1015.68 ^b	1209.1 ^a	1048.29 ^b	1103.41 ^b	1176.82 ^a	38.11 [*]
DFI (g)	69.24 ^b	77.68 ^a	76.95 ^a	76.78 ^a	80.21 ^a	2.20 [*]
DWG (g)	26.94 ^c	34.42 ^a	28.68 ^{bc}	30.32 ^{abc}	33.10 ^{ab}	1.41 [*]
FCR	2.59	2.2	2.71	2.56	2.45	1.10 ^{NS}

abc means on the same row with different superscript are significantly different ($P<0.05$)^{*}

KEY: DFI = Daily Feed Intake in gram per bird, DWG = Daily weight gain in gram per bird, FCR = Feed Conversion Ratio, Wgt= weight, g = gram, SEM= Standard Error of Means

TABLE 5: EFFECTS OF DIETARY LEVELS OF AWARA RESIDUE MEALS ON THE GROWTH PERFORMANCE OF BROILER CHICKENS. (%)

Finisher Phase (4-7 weeks)						
Parameters	T1(0%)	T2(5%)	T3(10%)	T4(15%)	T5(20%)	SEM
Initial wgt (g)	1015.68 ^b	1209.1 ^a	1048.29 ^b	1103.41 ^b	1176.82 ^a	38.11 [*]
Final wgt (g)	1517.27 ^c	2124.84 ^a	1801.13 ^b	53.03 ^a	155.54 ^a	8.26 [*]
DFI (g)	120.61 ^c	177.32 ^a	137.21 ^a	53.03 ^a	155.54 ^a	8.26 [*]
DWG (g)	36.34	44.15	42.77	43.98	44.85	2.36 ^{NS}
FCR	3.36	4.05	3.26	3.59	3.49	3.01 ^{NS}
Total wgt gain (g)	1776.36 ^c	2370.29 ^a	2046.59 ^{bc}	2135.97 ^{ab}	2348.88 ^a	92.36 [*]
FCR	2.91	3.16	2.99	3.08	2.97	1.37 ^{NS}

Total wgt gain (g)	1776.36 ^c	2370.29 ^a	2046.59 ^{bc}	2135.97 ^{ab}	2348.88 ^a	92.36 [*]
--------------------	----------------------	----------------------	-----------------------	-----------------------	----------------------	--------------------

abc means on the same row with different superscript are significantly different (P<0.05)*

KEY: DFI = Daily Feed Intake in gram per bird ,DWG = Daily weight gain in gram per bird, FCR = Feed Conversion Ratio, Wgt= weight ,g = gram, SEM= Standard Error of Means

TABLE 6: EFFECTS OF DIETARY LEVELS OF AWARA RESIDUE MEALS ON THE GROWTH PERFORMANCE OF BROILER CHICKENS. (%)

Pooled Phase (1-7 weeks)						
Parameters	T1(0%)	T2(5%)	T3(10%)	T4(15%)	T5(20%)	SEM
Initial wgt (g)	259.09	245.45	245.45	254.55	250.0	4.55 ^{NS}
Final wgt (g)	1517.27 ^c	2124.84 ^a	1801.13 ^b	1881.43 ^b	2098.89 ^a	91.45 [*]
DFI (g)	94.93 ^c	127.51 ^a	107.09 ^{bc}	114.89 ^{ab}	117.88 ^{ab}	4.62 [*]
DWG (g)	31.64 ^c	39.29 ^a	35.73 ^b	37.15 ^{ab}	38.96 ^{ab}	1.09 [*]

abc means on the same row with different superscript are significantly different (P<0.05)*

KEY: DFI = Daily Feed Intake in gram per bird ,DWG = Daily weight gain in gram per bird, FCR = Feed Conversion Ratio, Wgt= weight ,g = gram, SEM= Standard Error of Means

REFERENCE

- Abd-Elsamee, M.O. Ibrahim, M.R.M. and Abd-Elkrim, F. M. (2005). Use of some plant Protein sources in broiler diets. *Journal of Agricultural Science. Mansoura Univ.*, 20 (12): 7495–7506.
- Ana, C. A, (2010).Development of okara powder as a gluten free alternative to All purpose flour for value added use in baked goods, Msc Thesis submitted to the Faculty of the Graduate School of the University of Maryland, College Park, in partial fulfilment of the requirements for the degree of Master of Science in Food Science.
- Aletor, V.A, Hamid,H., Neiss, E. and Peffe, P. (2000). Low protein amino acid supplemented diets in Broiler Chicken. *Journal of the Science of Food and Agriculture* 84:263–270.
- Akande T.O., Adeyeri, M.k., Longe O.G., Odunsi A.A. (2007). Response of laying chickens to graded levels of Tephrosia bracteolata leaf meal fed with soya bean meal or full fat soya bean meal. *Livestock research for rural development*, 19, 8: 2007
- AOAC (1990). Official Methods of Analyses of the Association of Official Analytical Chemists International. 15th edition, Association of Official Analytical Chemists, Arlington, VA, USA.
- Akpodiete O.J. Okagbare G.O. Opara, M.O. (2004). Performance of broilers fed diet containing differently processed soya beans. In: proceedings of the 9th Annual conference of Animal Science Association of Nigeria, Abakaliki, 13th–16th Sept. 2004. Ogunyi J.O., Osakwe I.I., EWA V.U., Alaku S.O., Otuma M.O., B.O. (eds.).
- Church, D.C. (1991). *Livestock Feed and Feeding*. Prentice – Hall Inc.
- Doma, U. D, Dieumou F. E. and Adegbola T. A. (2013). Growth performance, carcass characteristics and economics of production of broilers fed diets with two sources of protein and two levels of wheat offal
- Duncan.D.B. (1955). Multiple Range and Multiple F Test Biometrics, 11:1-42.
- Farhat, A., Normand, L., Chavez, E. R. and Touchburn, S. P, (2001). Comparison of growth performance, carcass yield and composition, and fatty acid profiles of Pekin and Muscovy

- ducklings fed diets based on food wastes. *Canadian Journal of Animal Science*. 81: 107–114
- Gombe State Government Website, “Jewel in the Savannah Diary Book”, (2009). www.gombestate.com, accessed in 2013.
- Herman, J.R. Honeyman, M.S, (2004). Okara: A possible high protein feedstuff for organic pig diet. Iowa State University, Animal industry Report.
- Hassan Nassiri-fard¹, Habib Aghdam Shahryar¹, Ali Hossein Khani. (2013). Effects of Replacement of Soybean Meal with Extruded Full-fat Soybean on Performance and Lipid Serum in Broiler.
- Ifeoma, J .O. Jjosiah chidiebere okonkwo , Orienru job akpodiete 1.(2012). Growth response of broiler chickens fed graded levels of yeast treated raw soya bean and full fat soya bean. Cobiss: 1.01 Agris category code: L02
- Leeson, S. Summers, J.d., Akande T.O. Adeyeri M.k., Longe O.G. and Odunsi A.A. (1997). response of laying chickens to graded levels of Tephrosia bracteolata leaf meal fed with soya beans meal or full fat soya bean meal. *Livestock research for rural development*, 19, 8: 2007.
- Lucas, J, Lara and Marcosh, R.(2013).Impact of heat stress on poultry production www.mdpi.com/Journal/Animal.
- Ma C.Y, Liu W.S, Kwok K.C and Kwok, F. (1997) Isolation and characterization of proteins from soymilk residue (okara). *Food Research International*, 29, 799-805.
- Subodh, K. Singh, Ajit Kimar Sinha,Deepak Kimar Mahto and Reev Ranjan .(2013). Study on growth performance of the broiler after feeding awara (okara meal) containing with or without non-starch polysaccharides degrading enzyme.
- Steel, R.G.D. and Torrie, J.H. (1980). *Principles and procedures of statistics. A biometrical approach*, 2nd Edition. McGraw Hill Books Co. New York.U.S.A
- [Subuh, A.M. Motl, M.A. Fritts, C.A. and Waldroup, P. W. \(2002\). Use of various ratios of extruded full fat soybean meal and dehulled solvent extracted soybean meal in broiler diets. *International of Journal Poultry Science*, 1:09-12.](#)
- Vishwanathan, K.H, Singh, V and Subramanian R (2011) Influence of particle size on protein extractability from soybean and okara. *Journal of Food Engineering*, 102, 240-246.
- Wills, S. (2003). The use of soybean meal and full-fat soybean meal by the animal feed Industry.12th Australian soybean conference.

PERCEPTION OF CONSUMERS' ACCEPTANCE OF YOGHURT AS INFLUENCED BY YOGHURT COLOUR AND IT'S CONTAINER COLOUR

¹Sanusi A.Z., ²Suleiman B.T. and ²Jibir, M.

¹Department of Animal Science Federal University Dutsinma Katsina State Nigeria

²Department of Animal Science Usmanu Danfodiyo University Sokoto State Nigeria

*Corresponding Author's email: ahmadsanusi727@gmail.com; Phone: +2348034770879

ABSTRACT

Study was carried out to investigate the influence of yoghurt color and its packaging container colors on consumer's perception of sweetness. Plain, pink and yellow yoghurt in three different packaging container color (red, blue and yellow) were evaluated by forty trained panels for their perception of sweetness. The experiment was done by preparing yoghurt of the same sugar concentration and consumer panelists were asked to taste and tell which of the samples is sweeter in a ranking order of 3 to 1. The obtained data was analyzed using General Linear Model (GLM) and means were separated using Turkey HSD. The results of yoghurt color was significant were the plain yoghurt had higher rating for sweetness ($p < 0.05$) than yellow and pink, while the yellow and pink are statistically similar ($p > 0.05$). On the packaging color no significant difference among the plain, pink and yellow packaging colors on their perception of sweetness ($p > 0.05$). Hence a reduction of sugar in yoghurt base on color is achievable and will be of great benefit to both producer and consumers while packaging colors may be of other attribute but not reduction of sugar in yoghurt

Key Words:

MATERIAL AND METHODS:

The study was conducted in the Agriculture Physical Laboratory of Faculty of Agriculture, Usmanu Danfodiyo University Sokoto. The school is in the ancient city of Sokoto, Sokoto state. The state is located in the extreme north west of Nigeria, near to the confluence of River Sokoto and Rima. It is in the semi-arid ecological zone, surrounded by sandy savannah and isolated hills. The mean annual temperatures is 28.3°C (82.9°F), the warmest months are February to April, where the day time temperature can exceed 45°C (113.0°F). The highest recorded temperature is 47.2°C (117.0°F) which is also the hottest temperature in Nigeria (Tsoho, 2007).

The study was carried out in two phases: In phase I, plain, yellow and pink yoghurt samples of same sugar concentration were evaluated for intensity of sweetness. The second phase involved evaluation of plain yoghurt of the same sugar concentration in three different packaging colors (red, blue and yellow) for intensity of sweetness.

Phase I

Yoghurt was prepared according to the procedure of (Tamime et al., 1980). 1500g of powdered skimmed milk was reconstituted into fluid milk by adding 1800ml of cold water and thoroughly mixed. 1200ml of hot water was added to the reconstituted milk. The reconstituted milk was then allowed to cool to a temperature of 35°C, after which it was inoculated with 45ml of yoghurt per 100g of powdered milk and mixed thoroughly, the mixture was incubated for 10 hours. This was followed by the addition of sugar, color, milk flavor and sodium benzoate. Sugar was added at 12.5%, milk flavor at 3% and sodium benzoate at 2%. The yoghurt was equally divided into three containers. To one container, seven drops of tango mango yellow was added to make it yellow, and to the second container, seven drops of quinoline pink was added to make it pink.

To make plain yoghurt, the third container was left without adding of any color. The three samples were refrigerated at 4°C. A consumer panel selected from the students population of Usmanu Danfodiyo University Sokoto was used for the sensory analysis. The selected participants were non

smokers of age range between 20-35 years and consist of 20 males and 20 females. The participants were trained as consumer panelists. The participants were asked to rank the samples (plain, pink and yellow) yoghurt for the intensity of sweetness (Kemp *et al.*, 2009). The samples were blind coded using a three digit random numbers. The order of presentation of the yoghurt samples was balanced. The ranks were converted to scores, where samples that were ranked first were given a score of 3, those ranked second were given a score of 2 and the least sweet was scored 1.

Phase II

Plain yoghurt was prepared as in phase I of the study. Each participant was presented with three samples of the same yoghurt served in three cups differing in color. The samples were blind coded and order of presentation was balanced. The participants were asked to rank the three samples for intensity of sweetness. Sensory analysis in this phase of the study was in every respect similar to that in phase I, the only difference being that it was only the color of the cups that differ. In similar fashion as phase I, the sample perceived to be the sweetest was ranked first, the next in sweetness intensity ranked second and the least sweet was ranked third. The scores were converted to scores in the same way as in phase I.

In the first experiment, the three yoghurt colors' (plain, pink and yellow) were compared for perceived sweetness intensity. Using intensity score as the dependent variable. Similar score was used as dependent variable comparing the package colors' for intensity of sweetness. The General Linear Model (GLM) was used for the comparison and significant means were separated using Tuckey test. The model used was;

$$Y = \mu + P_{pi} + E$$

$Y(\text{intensity of sweetness})$ = Estimated parameter

μ = Population mean

P_{pi} = Fixed effect of yoghurt color or packaging colors' (as the case may be)

E = Random error.

RESULT AND DISCUSSION

There was a significant effect of color on perception of sweetness in yoghurt. The plain yoghurt had higher rating for sweetness ($p < 0.05$) than yellow and pink between which there was no significant difference.

Table 1. Effects of yoghurt color on perception of sweetness

Yoghurt color	Sweetness intensity
Plain	2.80 ^a
Yellow	1.53 ^b
Pink	1.63 ^b
SEM	0.09
P Value	0.01

a and b = Means bearing different superscripts along the same column differ ($p < 0.05$).

SEM = Standard Error of Mean

The result in Table 1 indicate that Plain yoghurt was perceived to be sweeter than the pink and yellow samples. This may be as a result of the color added during the preparation of the sample which reacted with sucrose a form of a chemical reaction and this might have somehow reduced the sweetness and perhaps the perception of sweetness. This is contrary to the findings of Lavin and Lawless (1998) who reported that dark red solutions of strawberry flavored drinks is sweeter than purple, blue and yellow strawberry flavored drinks color. It is quite possible for plain to have greater perception of sweetness, for the reason being that the relative non-familiarity with pink and yellow yoghurt might have caused a greater preference for more familiar sample. This is in agreement with findings of Clydesdale (1993) stated that familiarity with beverages made from powders or concentrates, do increase in the sensations as color increases. Also in line with the findings of DuBose *et al.*, (1980) who reported that a cherry-flavored drink in orange or green color is thought to taste like an orange or lemon-lime drink. Also according to Francis (1999) who reported that nearly every food product has an

acceptable color range which depends on a wide range of factors including variability among consumers, their age and ethnic origin and physical nature of the surroundings at time of judgment.

There was no significant effect of packaging container color on intensity of sweetness in plain yoghurt samples. Yoghurt in blue, yellow and red containers had similar ratings for sweetness ($p>0.05$).

Table 2. Effect of package color on perception of sweetness

Container colour	Sweetness intensity
Blue	1.83
Yellow	2.03
Red	2.18
SEM	0.18
P Value	0.01

SE = Standard Error of Mean

The result in the table 2 shows that participants did not perceive any of the container colors' to be sweeter than each other which may be due to the reasons that nowadays consumers do not really care about the packaging color of the products they consume, but rather the content inside the container, and this is contrary to the report of Rahunathan *et al.*, (2006) who stated that food in red package is perceived sweeter than food in other package colors'. In another view, it is possible that participants have developed an attachment to brand's physical identity hence the color of the container do influence the perception of sweetness. This is in agreement with the findings of Labrecque and Milline (2011) who reported that brand loyalty may become unhinged if dramatic changes are effected on the color scheme or packaging.

CONCLUSION AND RECOMENDATION:

Plain yoghurt was perceived to have higher sweetness intensity than yellow and pink. Hence, the sugar content in plain yoghurt can be alter in further research in other to ascertain a maximum reduction level of sugar for plain yogurt and also packaging color of yoghurt can be further restudy to ascertain reduction possibilities using the same or other attributes.

REFERENCE

- Cheema A., Adeloje D., Sidhu S., Sridhar D., and Chan KY.(2014). Urbanization and prevalence of type 2 diabetes in southern Asia; A systematic analysis. J Glob Heal internet.(cited2015feb6;4(1).Available from;<http://www.ncbi.nlm.nih.gov/pmc/articles/PMC4073245/>.
- Chriqui JF, Pickel M, and Story M (2014). Influence of School Competitive Food and Beverage Policies on Obesity, Consumption, and Availability: A Systematic Review. JAMA Pediatr;168(3):279.
- Clydesdale FM(1993). Color as a factor in food choice. Crit Rev Food Sci Nutrit.
- DuBose, C. N., Cardello, A. V., and Maller, O. (1980). Effects Of Colorants And Flavorants On Identification, Perceived Flavor Intensity, And Hedonic Quality Of Fruit-Flavored Beverages And Cake.*Journal of Food Science*, 45(5), 1393-1399. doi: 10.1111/j.1365-2621.1980.tb06562.x
- Fracis, F. J. (1999) Colorants. Eagen Press, St Paul, Minnesota. Howard BV., Wylie-Rosett J (2002). Sugar and Cardiovascular Disease Circulation 106;523-527.
- Kemp S.E, Hollowood T and Hort J (2009). Sensory Evaluation.A Practical HandBook, WILEY BLACK WELL ,Publication, United Kingdom.ISBN: 9781-4051-6210-4.
- Koning L de., Malik VS., Rimm EB., Willett WC., and HU-FB. (2011) Sugar-sweetened beverages consumption and risk of type 2 diabetes in men. AMJ Clin Nutr., 1;93(6);1321-7.
- Lavin, J. G., and Lawless, H. T. (1998). Effects of color and odor on judgments of sweetness among children and adults. *Food Quality and Preference*, 9(4), 283-289.
- Tamime, A.Y. and H.C. Deeth. 1980. Yogurt: technology and biochemistry1. *Journal of Food Protection* 43(12):939-977.
- Tamine A.Y. and Robinson RK (1999). Yoghurt; science and technology (2nd ed.). Cambridge, UK; Woodhead.

Raghunathan, R., Naylor, R. W., and Hoyer, W. D. (2006). The unhealthy = tasty intuition and its effects on taste inferences, enjoyment, and choice of food products. *Journal of Marketing*, 70(4), 170-184. doi: 10.2307/30162121/.

Weeratunga P., Jayasinghe S., Perera Y, Jayasena G., and Jayasinghe S.(2014). Per Capital Consumption and prevalence of diabetes mellitus-global

and regional association. *BMC Public Health*;14[1];186.

World Health Organization (WHO,2015). Policy brief; producing and promoting more food product consistent world health diet (internet). Available from ;http://www.who.int/nmh/ncd-coordinate-mechanism/policy_brief_32.pdf.

ANALYSIS OF FACTORS INFLUENCING TOTAL EXPENDITURE AMONG FARM HOUSEHOLDS IN ADAMAWA STATE, NORTHEAST NIGERIA

*Habu, S., Nandi, J. A. and Mohammed, S. Y.

Department of Agricultural Economics and Extension
Federal University of Kashere, Gombe State, Nigeria

* Corresponding Author's Email: sulehabu69@yahoo.com Mobile: 07082779210

ABSTRACT

The study analyzed the factors influencing total expenditure among farm households. Multistage sampling technique was used in selecting respondents for the purpose of data collection. The basic analytical tools used in this study were Simple Descriptive Statistics and Multiple Regression Models. The simple descriptive statistics were used to describe socio-economic characteristics of the respondents while the multiple regression models were used in analyzing the factors influencing household total expenditure in the study area. The results revealed that 29 respondents representing 25.4% were within the age range of 41-50 years with the mean age of 48 years. Annual estimated income and household expenditure on farming activities were associated with positive signs and both significant at 1% level while farm size was associated with negative sign and significant at 10%. Age of respondents, education and farming experience have direct but insignificant relationship with farm household total expenditure while gender and household size have inverse and insignificant relationship with the dependent variable. It was recommended that governments should come up with laws that will enable real farmers' access to required hectares of land and, Natural and States poverty alleviation programmes should properly target rural dwellers with supervisory staff to raise their income levels. The study contributes to the understanding of farm households in rural communities of Adamawa State, Northeast Nigeria.

Keywords: Factors, Farm Household, Total Expenditure, Multiple Regression, Adamawa State

INTRODUCTION

According to Pradhan *et al.*, (1998) farm household standard of living is measured in terms of its food consumption expenditure. In fact, several household expenditure surveys reveal food consumption expenditure as the main item that influences poor household total expenditure (Umeh and Asogwa, 2012; Oladimeji *et al.*, 2015; Babalola and Isitor, 2014; Iorlamen *et al.* 2014; Thirumarpan, 2013). The day-to-day purchases on food, farm inputs, clothing, and payment for services such as farming activities, transport, health, education and, so on comprise farm household total expenditure.

In most developing countries of the world (Nigeria inclusive), total expenditure of farm households are low due to low levels of incomes. Most of them have very limited resources, a factor that retards their production income and expenditure. Expenditure patterns have been found to change across various income spectrum of a society even among the

poor farm households. They tend to spend a larger portion of their incomes on food items, while richer farm households earning relatively higher income spend greater shares of their income on manufactured goods and preferred foods such as dairy products, meat and fruits (Delgado *et al.*, 1998).

Within every country of the world, there are various socio-economic and demographic factors affecting farm households' income and patterns of their expenditure. Among these factors are human population, number of households and associated data, value of their Gross Domestic Product, annual inflation, and employment indicators (Euromonitor International, 2012). Household's income, households size, age of household heads, employment status of household heads and the educational attainment of the household heads positively and significantly influence households' food expenditure among low income households in low income township in South Africa (Tshediso, 2012). It was also

reported in Oshodi-Isolo Local Government Area of Lagos State, Nigeria that, of the household heads, educational level and size of monthly income only among other variables were the significant factors influencing the household monthly expenditure on food (Aminu *et al.*, 2016).

Since the influencing factors are varied from place to place, it is necessary to explore the economic and non economic variables that seem to have bearing on farm household total expenditure. As a result, this study was set out to describe the socioeconomic characteristics of farm households, and to analyse the factors that influence farm household total expenditure in the study area.

METHODOLOGY

The Study Area

Adamawa State is located at the northeastern part of Nigeria. It lies between Latitude 7° and 11° N of the Equator and between Longitude 11° and 14° E of the Greenwich Meridian. It shares boundary with Taraba State in the south and west, Gombe State in its northwest and Borno to the north and, it has an international boundary with the Cameroun Republic along its eastern border (Adebayo and Tukur, 1999). The state has a land area of about 38,741 km² with a population of 3,168,101 people (NPC, 2006). Adamawa State is 4, 385, 392 people. This is projected using 3.0% population growth rate of 2006 (NPC, 2006). The state is made up of twenty-one (21) Local Government Areas, which is divided into four (4) Agricultural Development Programme (ADP) zones.

The State has a mean monthly sunshine hour of 220 during January to April and increases to 225 for the period between October and December, and rainfall varies; the mean annual rainfall is less than 1000mm in the

central and northern parts of the state while the northeastern strip and the southern parts record over 1000mm rainfall annually (Adebayo, 1999). The major occupation of the people of the State is farming (crop and animal production). Major food crops grown are cereals (sorghum, maize, rice and millet) and, cash crops are cotton, groundnuts, sugarcane, beans, fruits and vegetables. In addition to crops, Adamawa state has a high concentration of wide variety of livestock managed either intensively or extensively.

Sampling Technique and Sample Size

Multistage sampling technique was used in selecting respondents (farm household heads) for the purpose of data collection. In this technique, the respondents were selected in a manner which provided equal and independent chance of being selected. First stage sampling involved the purposive selection of one LGA in each of the four Agricultural Development Programme (ADP) Zones in Adamawa State. These selected LGAs include; Mubi South (Mubi Zone), Song (Gombi Zone), Mayo-Belwa (Yola Zone), and Numan (Guyuk Zone). From each of the selected LGAs, three rural communities were randomly selected giving a total of twelve (12) sampled rural communities. Lastly, ten (10) farm household heads in each of the twelve (12) selected rural communities were randomly selected, giving a total of One Hundred and Twenty (120) farm household heads. Out of the 120 randomly selected farm household heads, only 114 respondents were successfully interviewed. Questionnaires were carefully prepared for collection of data for this study during the year 2017.

Model Specification

The basic analytical tools used in this study were simple descriptive statistics (Frequency, Percentage and Mean) and Multiple Regression

Models. The simple descriptive statistics were used to describe socio-economic characteristics of the farm households while regression model (best fit) was used in analyzing the factors influencing household total expenditure in the study area. The explicit form of the model is presented as:

$$Y = \alpha_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + \beta_8 X_8 + U$$

Where;

Y = Farm Household Total Expenditure in Naira

X_1 = Gender of Farm Household Heads (Male = 1; Female = 0)

X_2 = Age of Farm Household Heads in Years

X_3 = Educational Level of Farm Household Heads in Years

X_4 = Farm Household Size (no of person)

X_5 = Farm Size in Hectares

X_6 = Farming Experience of Farm Household Heads in Years

X_7 = Annual Estimated Income in Naira

X_8 = Household Expenditure on Farming activities in Naira

α_0 = Constant

$\beta_1 - \beta_8$ = Coefficients of Independent

Variables

U = Error Term

Four functional forms (Linear, Exponential, Semi-Logarithm and Double Logarithm functions) were fitted. Based on statistical criteria, linear functional form having the highest R^2 , F-ratio significant at 1% and having the highest number of variables that are significant at various levels of significance gave the best fit equation. Thus, it was chosen to analyse the factors influencing farm household total expenditure in the study area.

RESULTS AND DISCUSSION

Description of Socio-Economic Characteristics of the Farm Household Heads

Table 1 shows the result of the socio-economic characteristics of the sampled respondents. It reveals that 75.4% of the sampled respondents were males while 24.6% were females. Twenty-nine respondents representing 25.4% were within the age range of 41-50 age with the mean age of 48 years. This by implication means that the respondents were within the economically active age. Majority (72.8%) of the respondents were married and had one form of formal education or the other (primary; 25.4%, secondary; 34.2% and tertiary; 15.8%). The lower percentage of those that attended tertiary institution could be attributed to the fact that the study was carried out in rural communities where only opportune persons are most likely to attain higher levels of education. The table also shows that majority (62.3%) of the sampled respondents had household size less than or equal to 10. The distribution of respondents by years of experience in farming reveals that 49.9% had 21 to 30 years farming experience and a mean of 21 years. The distribution of the respondents by farm size shows 23.6% had 2.1 to 3.0 hectares with a mean of 2.5 hectares while their distribution by annual estimated income reveals 35.9% having ₦301,000 to ₦400,000 with the mean of ₦323,272. The higher annual estimated income may be as a result of higher prices of farm produce during the 2017 when data were collected.

Analysis of Factors Influencing Farm Household Total Expenditure

Table 2 shows the linear regression result for farm household total expenditure. Annual estimated income (X_7) and household

expenditure on farming activities (X_6) carried positive signs, and both significant at 1% level of significance while farm size (X_5) carry negative sign and significant at 10%. These indicate that annual estimated income and household expenditure on farming activities have direct relationship with farm household total expenditure while farm size has inverse relationship. These mean that as annual estimated income and household expenditure on farming activities increase, farm household total expenditure also increases and vice versa. This finding supports Tshediso (2012), Lorlamen *et al.*, (2014) and Oladimeji, *et al.*, (2015) who conducted separate surveys at different locations and time but all reported that household income has direct relationship with household food consumption expenditure which is an integral part of household total expenditure. As farm size increases, farm household total expenditure decreases. This is possible in situations where farmers are very poor and rely on family labour and farm income. This finding agrees with Canagarajah, *et al.*, (1997) who found that the average per-capita expenditure of a rural poor household was one-fifth of the non-poor and of the extremely poor, 85% live in rural areas and more than two-thirds live on farm.

Furthermore, the result shows that age of farm household heads, education and farming experience have direct but insignificant relationship with household total expenditure. This does not agree with the finding of Aminu, *et al.*, (2016) who reported that there is a direct and significant relationship between age, educational level of household heads and household food expenditure. Gender and the

household size have inverse and insignificant relationship with the dependent variable. This is possible because of the high poverty level of the farm households. It did not tally with Umeh and Asogwa (2012) who revealed that household size has direct and significant relationship with household non food expenditure.

CONCLUSION AND RECOMMENDATIONS

The study analyzed the factors that influence total expenditure among farm households in Adamawa State, northeast Nigeria. It found that 49.9% of the farm household heads had 21 to 30 years farming experience and their mean farm size is 2.5 hectares while 35.9% have their annual estimated income of ₦301,000 to ₦400,000. The study also found annual estimated income, household expenditure on farming activities and farm size as the main factors influencing farm household total expenditure in the study area. Based on these findings therefore, the study recommends that governments should come up with laws that will enable real farmers access the required hectare of land to break the communal ownerships prevalent in the rural areas. This will improve the taxable capacity of potential large-scale farmers and the governments in turn gain revenue in form of tax. Also, National and State poverty alleviation programmes should properly target rural dwellers with supervisory staff to raise the income level of farm households so that they can invest in non-crop farming activities in addition to the crop farming activities and use these investments to expand their agricultural production.

Table 1; Socio-Economic Characteristics of Farm Households (n = 114)

Characteristics	Frequency	Percentage (%)	Mean
Gender			
Males	86	75.4	
Females	28	24.6	
Age (Years)			
20 – 30	12	10.5	
31 – 40	21	18.4	
41 – 50	29	25.4	48
51 – 60	31	27.2	
Above 60	21	18.4	
Marital Status			
Single	3	2.6	
Married	83	72.8	
Divorced	11	9.7	
Widow	17	14.9	
Household Size			
≤ 10	71	62.3	10
11 – 20	34	29.8	
21 – 30	8	7	
> 30	1	0.9	
Educational Level			
Not been to School	8	7	
Technical/Vocational Education	20	17.5	
Primary School	29	25.4	
Secondary School	39	34.2	
Tertiary Institution	18	15.8	
Farming Experience			
≤ 10	11	9.7	
11 – 20	37	32.5	
21 – 30	57	49.9	21
> 30	9	7.9	
Farm Size (Hectare)			
≤ 1.0	12	10.5	
1.1 - 2.0	36	31.6	
2.1 - 3.0	30	26.3	2.5
3.1 - 4.0	19	16.7	
> 4.0	17	14.9	
Annual Estimated Income (₦) of Farm HH Heads			
≤ 100,000	8	7	
101,000 - 200,000	10	8.8	
201,000 - 300,000	19	16.7	
301,000 - 400,000	45	39.5	323,272
> 400,000	32	28	

Source; Field Survey, 2017

Table 2; Regression Estimates of Factors Influencing Farm Household Total Expenditure (Linear Function)

Independent Variable	Parameter	Coefficient	T – Ratio
Constant	α_0	- 4271.35	- 0.159
Gender (X_1)	β_1	- 1487.93	- 0.128
Age (X_2)	β_2	91.68	0.148
Education Level (X_3)	β_3	1779.67	1.580
Household Size (X_4)	β_4	- 2447.99	- 0.277
Farm Size (X_5)	β_5	- 4447.31*	- 1.934
Farming Experience (X_6)	β_6	430.95	0.697
Annual Estimated Income (X_7)	β_7	0.521***	13.311
Farm HH Expenditure on Farming Activities (X_8)	β_8	0.960***	6.311
R^2		0.850	
F- statistics		76.834***	

Source: Field survey, 2017. * Significant at 10% level, *** Significant at 1% level

REFERENCES

- Adebayo, A. A. (1999). Climate 1: Sunshine, Temperature and Relative Humidity, In; A. A. Adebayo and A. L. Tukur (Eds), *Adamawa State in Maps*. Paraclete Publishers, Yola-Nigeria
- Adebayo, A. A., L. Tukur (1999). *Adamawa State in Maps*. Paraclete Publishers, Yola-Nigeria
- Aminu, F. O., Adebajo, O. A. and Mohammed, H. A. (2016). Determinants of Food Expenditure Patterns among Households in Oshodi-Isolo Local Government Area of Lagos State, Nigeria. *Nigerian Journal of Agriculture, Food and Environment*. 12(2):98-102
- Babalola, D. A. and Isitor, S. U. (2014). Analysis of the Determinants of Food Expenditure Patterns among Urban Households in Nigeria: Evidence from Lagos State. *IOSR Journal of Agriculture and Veterinary Science (IOSR-JAVS)*, 7(5): 71-75.
- Canagarajah, S., Ngwafon, J. and Thomas, S. (1997). *Evolution of Poverty and Welfare in Nigeria, 1985-1995*. World Bank Policy Research Working Paper 1715. Washington D. C.
- Delgado, C.I., Hopkins, J., and Kelly, V.A. (1998). Agricultural growth linkage in Sub-Saharan Africa, Research report number 107. *International Food Policy Research Institute, Washington D.C., USA*
- Euromonitor International, (2012). Understanding the Global Consumer for Health and Wellness. *Global SPA and Wellness Summit 2012*.
- Iorlamen, T. R., Abu, G. A. and Lawal, W. L. (2014). Assessment of Expenditure on Food among Urban Households and its Implication for Food Security: Evidence from Benue State, Nigeria. *African Journal of Food, Agriculture, Nutrition and Development*, 14(2): 8748-8760.
- NPC, (2006). National Population Census, Federal Republic of Nigeria Official Gazette, Vol.94, Lagos. 244pp.
- Oladimeji, Y. U., Abdulsalam, Z., Damisa, M. A. and Omokore, D. F. (2015). Analysis of Food Consumption Pattern among Rural Fishery Households: A Panacea to Poverty Alleviation in North Central Nigeria. *Asian Journal of Agricultural Extension, Economics & Sociology*, 6(2): 102-110.
- Pradhan, B. K., Ray, P., Sahija, M. A. and Veakantram, S. (1998). Income, Expenditure and Social Sector Indicators of Households in Rural and Urban India, *A Paper presented at the Micro-Impact of Macroeconomics and Adjustment Centre. Third Annual Meeting, India*
- Thirumarpan, K. (2013). Determinants of Household Food Expenditure among Rural Households of Ampara District. Proceedings, 04th International Symposium, SEUSL, Social Science and Humanities, 325-330.
- Tshediso, J. S. (2012). Socio-Economic Determinants of Household Food Expenditure in a Low Income Township in South Africa. *ISSN 2039-2117 Mediterranean Journal of Social Sciences*. 3 (3): 87
- Umeh, J. C. and Asogwa, B. C. (2012). Determinants of Farm Household Food Expenditure: Implications for food security in rural Nigeria. International Conference on Ecology, Agriculture and Chemical Engineering (ICEACS'2012) December 18-19, 2012 Phuket (Thailand), 212-217.

EVALUATION OF FOUR CULTIVARS OF SESAME (*SESAMUM INDICUM* L.) FOR EARLINESS AND YIELD IN TUMU, GOMBE STATE, NIGERIA

*Mshelia, J. S., Degri, M. M. and Agesa, G.

Department of Agronomy,
Federal University of Kashere,
PMB. 0182, Gombe State, Nigeria.

* Correspondence Author: email: hyelduna@gmail.com

ABSTRACT

Trials were conducted at the Teaching and Research Farm of the Leventis Foundation Agricultural Training School, Tumu, Gombe State to evaluate four varieties of sesame (Sesamum indicum L.) for earliness and yield. The four varieties were: NICRIBEN- 01M, NICRIBEN- 02M obtained from National Cereal Research Institute, Badegi, Niger State, Ex- Sudan and Kenenawa from Sasakawa-SG 2000, Nigeria. Data were collected on days to 1st and 50% flowering; days to 1st and 50% capsule formation, days to maturity, number of capsules per plant, seed yield per plant and seed yield per hectare. NICRIBEN-01M was found to mature earlier and give higher yield than the other three varieties. It is therefore recommended that farmers in the area can gain more from sesame production by growing NICRIBEN- 01M.

Keywords: Sesame, Earliness, Tumu, Kenenawa

INTRODUCTION

Agriculture is playing a vital role in Nigeria's economic diversification and are crop that could lead Nigeria into economic limelight is the sesame crop which referred to black gold. Sesame (*Sesamum indicum* L.) also known as benniseed, is a member of the family Pedaliaceae and is thought to have originated in Africa and India (Bedigian, 1984, 1988, 1998, 2000, 2003, 2006 and 2010; Morris, 2002). It is considered to be the oldest oil seed crop known to man and is now grown in many parts of the world (Oplinger *et al.*, 1990; Kafiriti and Deckers, 2001; Encarta, 2006; Mahafani, *et al.*, 2007).

World production statistics show that India and China are the largest producers of sesame, followed by Burma, Sudan, Mexico, Nigeria, Venezuela, Turkey, Uganda and Ethiopia in descending orders of production (Oplinger *et al.*, 1990; ICAR, 2006). Nigeria is the sixth largest producer in the world. World production is put at 60 million metric tonnes on an estimated area of 165,123 hectares of land in 2005 (USDA, 2000; Singh *et al.*, 2003; and Zhau and Arora, 2008). Benue and Nasarawa states are the leading producers in Nigeria, followed by Plateau, Kwara, Niger and Adamawa states. Others are Borno, Gombe, Jigawa, Federal Capital Territory (FCT), Yobe, Zamfara, Taraba, Kebbi, Sokoto

and Cross River (Kabiru, 1998; Iwo and Idowu, 2002 and Busari, *et al.*, 2005).

Worldwide yield averaged 430kg^{ha}⁻¹ in 1986; however, yields as high as 2250 kg^{ha}⁻¹ has been reported in test plot in Texas-USA (Breigham, 1985). In Nigeria, the average yield is 300kg^{ha}⁻¹ while improved cultivars grown under improved production management yield up to 600-800 kg^{ha}⁻¹.

Sesame is believed to be of African origin. (Bedigian, 2003). It is considered to be the oldest oilseed crop known to man and is grown in many parts of the world (Kafiriti and Deckers, 2001 and Mahafani *et al.*; 2007). The crop begins flowering as from 2 to 3 months after sowing, which continue until the uppermost flower opens. The fruit is an oblong capsule containing numerous small, oval, yellow, red, brown or black seeds depending on the cultivar (Davidson 1999 and McCormick, 2001). In Nigeria, commonly grown varieties include cross No. 3, Yandev 55, X30/115, 65B, 65A – 36, NICRIBEN-01M, NICRIBEN-02M, and NICRIBEN-03L released to farmers by National Cereal Research Institutes (NCRI) Badegi. Others are Pbt1-1 from India, E8, Ex-Sudan and Kenenawa (Olowe *et al* 2003).

World production is put at 4.8 million metric tonnes. Nigeria is the seventh largest producer in Africa. The crop thrives well in northern Nigeria being drought tolerant crop,

but is also grown in southern states like Ebonyi and Cross-River states.

Nigeria produces about 300,000 tonnes annually with states like Benue, Taraba, Jigawa, Niger and Bauchi leading. Sesame has a ready market. About 95% of the production is exported. Major destination for Nigeria sesame seeds are china, Turkey, Japan and India. Other countries like Poland, Netherlands also receive Nigerian sesame seeds in smaller quantities. The Middle East countries such as UAE, Saudi Arabia and Kuwait have also shown increases interest and demand for Nigerian sesame seeds. This new frontier in sesame exportation market could provide better pricing culminating in improved rewards for the sesame farmer. Yet the improvement of production through the use of appropriate cultivar for Gombe area is possible. Accordingly, the research focused on evaluation of varieties for suitability to Gombe area under rain-fed condition.

MATERIALS AND METHODS

Fold trails were conducted during the rainy season of 2017 at the Teaching and Research farm of Leventis Foundation Agricultural Training School Tumu, Gombe State. The treatment consisted of four varieties of sesame (NICRIBEN-O1M, NICRIBEN-O2M and Ex-Sudan and Kenenawa) laid out in a Randomized complete Block design (RCBD) and replicated three times. The seeds were obtained from National Cereals Research Institute Badegi (NICRIBEN-O1M and NICRIBEN-O2M), and Sasakawa (Ex-Sudan and Kenenawa). The seeds were sown at 60cm inter-row and 30cm intra-row plot sizes were 4m X 5m.

Data were collected on days to first and fifty percent flowering, days to first and fifty percent capsule formation, number of branches per plant, number of capsule per plant, plant height, yield per plant, and yield per hectare. These were taken from five randomly tagged plants in plot.

Days to 1st and 50% flowering: plots were monitored from germination to the day the first flower was sighted in each plot and

the day 50% of plants in each plot have flowered, the average was calculated to determine the number of days to 1st and 50% flowering. Days to 1st and 50% capsule formation: plots were monitored daily for the appearance of 1st fruit and the day 50% of the plants have formed capsules, the average was calculated to determine the number of days to 1st and 50% capsule formation. Number of branches per plant: five plants were tagged randomly from each plot and at maturity the numbers of branches from the tagged plants were counted. The average was calculated to determine the number of branches per plant.

Plant height: from the five tagged plans, metre rule was used to measure the height of the plants from ground level to the apex of the plant, the average was calculated to obtain the mean plant height at maturity.

Days to maturity: this was determined by counting the number of days from planting to when the crop was harvested, this in sesame is reached when the lower five capsules open. Number of capsules per plant: at maturity, the five tagged plants harvested and the number of capsules from all the plants were counted and averaged to get the number of capsules per plant.

Yield per plant: the capsules from the tagged plants were harvested and threshed and the seeds were weighed to divide by five to obtain the yield per plant.

Yield per hectare: this was obtained by harvesting plants from the net plot (1m x 1m), threshed and weighed. Yield per hectare was then calculated using the formula:

$$\text{Yield/hectare (t)} = \frac{\text{yield/plot(t)}}{\text{area of net plot(m}^2\text{)}} \times 10,000$$

Data collected were subjected to Analysis of variance (ANOVA) as described by Gomez and Gomez (1984) using mixed model procedure for statistical Analysis system (SAS) Version 8. Significant means were separated using

Least Significant Difference (LSD) at 5% level of significance.

RESULTS AND DISCUSSION

The results showed that days to 1st and 50% flowering were influenced by varietal differences where kenenawa took longer (41.67 and 47.67 days respectively) which were statistically higher than all other varieties (Table 1), NICRIBEN-01M and

NICRIBEN- 02M followed in number of days to 1st flowering while Ex- Sudan commenced flowering earlier than all the other varieties (39.33days). However, days to 50% flowering was shorter (45.67) in NICRIBEN- 01M followed by NICRIBEN -02M and EX- Sudan (46.60 and 46.67 respectively) which were statistically at par and shorter than kenenawa which took longer (47.67 days) to reach 50% flowering.

Table 1: Days to 1st and 50% flowering, 1st and 50% capsule formation.

Varieties	Days to 1 st flowering	Days to 50% 1 st capsule formation	50% capsule formation
NICRIBEN-01M	40.00ab	45.67c	47.00a
NICRIBEN-02M	40.33ab	46.60b	47.33a
Ex-Sudan	39.33b	46.67b	46.33b
Kenenawa	41.67a	47.67a	47.67a

Means with different letters in the same column are significantly different at $P < 0.05$

There was a varietal difference in number of days to 1st and 50% capsule formation (Table 1). Ex- Sudan commenced capsule formation earlier than all other varieties (46.33 days) while all other varieties took longer time to start producing capsules and was statistically at par and significantly higher. Ex – Sudan also reached 50% capsule formation earlier than the other varieties (52.33 days) and was statistically lower than the others; it was followed by NICRIBEN-01M and kenenawa (53.00 days). Days to 50% capsule formation was higher in NICRIBEN-02M.

The results showed that days to maturity, branches per plant and plant height were all influenced by varietal differences (Table 2). NICRIBEN – 01M was the first to mature (94.67 days), followed NICRIBEN – 02M and kenenawa (96. 00days) and were statistically different from Ex- Sudan which took significantly longer time to mature (98.00 days). Number of branches per plant was higher in Ex- Sudan (9.00), but statistically at

par with NICRIBEN-01M and kenenawa ($p < 0.05$) and significantly higher than NICRIBEN – 02M. There were varietal differences in plant height where NICRIBEN-02M produced significantly taller plants (1.22m) followed by EX- Sudan (1.18m), NICRIBEN- 01M (1.13m) and kenenawa (1.04m) in descending order.

As shown in Table 3, number of capsules per plant, yield per plant and yield per hectare were all influenced by varieties. The highest number of capsules per plant (88.33) was from NICRIBEN -01M and was significantly higher than NICRIBEN – 02M (70.31), followed by Ex- Sudan (68.33) while kenenawa recorded the least capsules per plant with 56. 67 capsules per plant. Yield per plant also followed the same sequence although NICRIBEN – 02M and Ex –Sudan were statistically at par and not significantly different from NICRIBEN -01M which produced the highest yield per plant (13.33g), while kenenawa produced the least yield per plant (12.00g).

Table 2: Number of Branches per Plant, Plant Height and Days to Maturity

Variety	BPP	PHt (m)	Days to maturity
NICRIBEN-01M	7.33ab	1.13a	94.67a
NICRIBEN-02M.	5.00b	1.22b	96.00b
Ex-Sudan	9.00a	1.18c	98.00c
Kenenawa	7.00ab	1.04d	96.00b

Means with different letters in the same column are significantly different at $P < 0.05$

BPP = Branches per Plant, PHt = Plant Height.

As shown in Table 3, number of capsules per plant, yield per plant and yield per hectare were all influenced by varieties. The highest number of capsules per plant (88.33) was from NICRIBEN -01M and was significantly higher than NICRIBEN - 02M (70.31), followed by Ex- Sudan (68.33) while kenenawa recorded the least capsules per

plant with 56. 67 capsules per plant. Yield per plant also followed the same sequence although NICRIBEN – 02M and Ex –Sudan were statistically at par and not significantly different from NICRIBEN -01M which produced the highest yield per plant (13.33g), while kenenawa produced the least yield per plant (12.00g).

Table 3: Number of Capsules per Plant, Yield per Plant and Yield per Hectare as influenced by varieties in sesame

Variety	CPP	YPP	YPH(kg)
NICRIBEN – 01M	88.33a	13.33a	861.13a
NICRIBEN-02M	70.31b	12.73ab	500.03b
Ex-Sudan	68.33c	12.63ab	305.57c
Kenenawa	56.67d	12.00b	166.63d

Means with different letters in the same column are significantly different at $P < 0.05$

CPP = Capsules per Plant, YPP = Yield per Plant (g), YPH = Yield per Hectare (kg)

The growth parameters considered in this study include plant height, branches per plant and days to maturity. The highest number of branches per plant was observed in Ex-Sudan, followed by NICRIBEN-01M, Kenenawa and the least in NICRIBEN-02M. This attribute is one of the characteristics that determine varieties characteristics in sesame. As reported by Kafiriti and Deckers (2001), some varieties of sesame are non-branching while others are branching type. Khan *et al* (2009) reported that population density influenced branching in sesame. Though this research used only one population density, the range is within the one reported by Khan *et al* (2001) to have produced fewer branches.

Plant height was also reported to be highest is NICRIBEN-02M, which was reported to be of intermediate growth habit (Kabir 1998). Variation in morphological characteristics among different cultivars of sesame have also been reported earlier (Ahmed *et al*, 2005). Similar findings were also reported by Ahmed *et al* (2012) that there were considerable variations in plant height and branching habit among sesame cultivars. Plant height is also influenced by Soil fertility level as reported by Abdalsalam and Al-Sheban (2010)

Phenological Characteristics.

These include members of days to 1st and 50% flowering and number of days to 1st and 50% capsule formation. Ex-Sudan was the first to start producing flower but reached

50% flowering later than NICRIBEN-01M. This also had impact on the final yield where Ex-Sudan gave less yield per plant and per hectare than NICRIBEN-01M and NICRIBEN-02M. This was in agreement with the finding of Idoko *et al* (2018) who reported shorter days to 50% flowering in Ex-Sudan, more number of capsule per plant and higher yield per plant at Makurdi which was attributed to longer season. The variations in phenological characteristics in crop is responsible for their variation in yield and maturity rate. Ogbonna and Ukaan (2012) also reported similar findings that NICRIBEN-02M took shorter days to reach maturity. Kafiriti and Deckers (2001) reported that sesame is an indeterminate crop which will continue to flower up to the time of harvest; hence ripening of the lower capsule will determine when to harvest the crop to avoid shattering.

Number of capsules per plant, yield per plant and yield per hectare were the yield parameters considered in this study. As shown by the result all these parameters were influenced by varieties. The result showed that the number of capsules per plant, and yield per plant reflected on the final yield obtained from each of these varieties. As observed the highest number of capsules per plant was from NICRIBEN-01M which incidentally gave the highest yield per plant and yield per hectare followed by NICRIBEN-02M, Ex-Sudan and Kenenawa in descending order. NICRIBEN-01M gave 88.33 capsules per plant, 13.33g yield per plant and 861.13kg seed yield per hectare which were all higher than the other varieties similar results have been reported by workers such as Ogbonna and Ukaan (2012) and Idoko *et al* (2018) that sesame plants that gave higher capsules per plant resulted in higher seed yield per plant and yield per hectare. Haruna *et al* (2011) also reported that number of capsules per plant in sesame correlate positively with seed yield per plant and per hectare.

CONCLUSION

Based on the result of this study, it could be concluded that NICRIBEN-01M performs better in Tumu area of Gombe State, and can be recommended for farmers in the area though more research is needed in area of plant population density, sowing date and fertilizer rates.

Acknowledgement

We appreciate the authorities of the Leventis Foundation Training School Tumu, for allowing us to carry out the research on their farm.

REFERENCES

- Ahmed, M. E; E. M. El- dey, A. A. Jabereldar, S. E.Ahmed and A. A. Ahmed (2012) Determination of Suitable Variety and Seed Rate of Sesame (*Sesamum indicum* L.) in Sand Dune of Kordofan, Sudan. *International Journal of Agriculture and Forestry*. 2(4):175 - 179
- Ahmed, R; T. Mahmoud, M. F. Saleemaud and S. A. Ahmed (2005) Comparative Performance of Two Sesame (*Sesamum indicum* L.) Cultivars Under Different Row Spacing. *Pakistan Journ. of Plant Science*. 1(5): 546 - 547
- Bedigian, D. (1984) *Sesamum indicum* L. Crop Origin, Diversity, Chemistry and Ethnobotany. PhD Dissertation. University of Illinois. Urban Chanpagn
- Bedigian D. (1988) *Sesamum indicum* L. (Pedalianaceae) Ethnobotany in Sudan, Crop Diversity, Lignans, Origin and Related Taxa. In Goldblatt, and p.p. lowry (eds): *Modern Systematic Studies in African Botany* 25: 315 – 321. AETFAT Monographs in Systematic Botany, Missouri Botanical Garden State. Louis. M. O.
- Bedigian D. (1998) Early history of sesame cultivation in the near East and Beyond. In Damania, A. B., J. Valkoun, G. Willox and C. O.Qualset (eds): *The Origin of Agriculture and Crop Domestication*. The Harlan symposium. ICARDA. Aleppo. CGIAR pg. 93 – 101.
- Bedigian D. (2000) Sesame. In Kiple, K. F. and C. K. Ornelas – Kiple (eds): *The Cambridge World History of Food*. Cambridge University Press. N. Y. Vol. 1; 411 – 421.

- Bedigian D. (2003) Evolution of Sesame Revisited: Domestication, Diversity and Prospects. *Genetic Resources and Crop Evolution* **50**: 779 – 787.
- Bedigian D.(2003) Sesame in Africa, Origin and Dispersals. In Meuman K. A. Butter and S. Kahlheber (eds) Food, Fuel and Yields - Progress in African Archaeobotany. Africa Prachistoria Heinrich – Barth – Institute, Cologne pg. 17 – 36 .
- Breigham, R.D. and J. K. Young (1985) Sesame performance tests at Lubbock. Tx. Agric.Expt. Stat. Progress Rept. 4131. 6p.
- Busari L. D., V. I Olowe, and A. A. Idowu (2005) Sesame In. *Major Legumes and Oil – Seeds of Nigeria: Principles of Production and Utilization*. Idem, N. U. A and F. A. Showemimo (eds). Pp. 137 – 167.
- Davidson, A. (1999) The Oxford Companion to Food. London: Oxford University Press.
- Encarta (2006) Sesame seed pods. Microsoft. 1993- 2005. Microsoft Cooperation.
- Gomez, A. K. and A. A. Gomez (1984) *Statistical procedure for Agricultural Research* 2nd ed. John Willy and Sons 680pp.
- Haruna, I. M; L. Aliyu, O. O. Olufajo and E. C. Odion (2011) Contribution of Some Yield Attribute to Seed Yield of Sesame (*Sesamum indicum*. L) in the Northern Guinea Savannah of Nigeria. *Asian Journal of Crop Science* **3**:92 - 96
- Idoko, J. A; P. D. Daba and T. R. Ugoo (2018) Effect of Intra – row Spacing on the Growth and Yield of Sesame (*Sesamum indicum*. L.) in Makurdi, Nigeria. *International Journ. Of Agronomy and Agricultural Research*. 12(1): 69 – 76
- Indian Council on Agricultural Research (ICAR; 2006) Sesame. In Handbook of Agriculture: Facts and Figures for Farmers, Students and all Interested in Farming. Arura T.K. and P. Sudhir (eds) Directorate of Information and Publications of Agriculture Pp 972-978.
- Iwo, G. A. and A. A. Idowu (2002) Impact of Research and Development on Sesame Towards Poverty Alleviation in Nigeria. *NOMA* vol. 16: 15-21.
- Kabiru, A. (1998) Status of Beniseed Production in Jigawa State. In Proc. of National Workshop on Beniseed. March 3-5, 1998. Pp 136-140.
- Kafiriti, E. M.; and J. Deckers (2001) Sesame, in Crop Production in Tropical Africa. DGIC; Ministry of Foreign Affairs, External Trade and International Cooperation Brussels, Belgium, Raemackers, R. H. (ed) p797-803.
- Mahafani, R. K; I. S. Bisht and B. S. Dhillon (2007) Establishment of a Core Collection of World Sesame (*Sesamum indicum* L.) Germplasm Accession. *SABRAO Journ. of Breeding and Genetics*. **39** (1): 53-64.
- McCormick Sesame Seeds (*Sesamum indicum* L.) (2001). Consumer Products. www.mccormick.com/retail.Nsf/4c144.enu02/v5-153.html. Accessed 12/22/2006.
- Morris, J. B. (2002) Food, Industry, Nutraceuticals and Pharmaceutical Uses of Sesame Genetic Resources. Pp 153-156 in J. Janick and Whipley (eds). Trends in New Crop and New Uses. ASHS Press, Alexandria V. A. <http://www.hort.purdue.edu/newcrop/enu02/v5-153./html>.
- Ogbonna, P. E. and S. I. Ukaan (2012) Yield Evaluation of 13 Sesame (*Sesamum indicum* L.) Accessions in the Derived Savannah Agro-ecology of South-eastern Nigeria. *African Journal of Agricultural Research* Vol. 7(43), pp. 5772-5778: Available online at <http://www.academicjournals.org/AJAR> Accessed 12/5/18
- Oplinger, E. S.; Putnam, D. H.; Kaminski, A. R.; Hanson, C. V.; Oelke, E. K. Schuller, E. E. and Doll J. D. (1990) Sesame. <http://www.hort.purdue.edu/newcrop/afem/sesame.html>.
- Singh, C; P. Singh and R. Singh (2003) *Modern Techniques of Raising Field Crops*. Oxford and IBH publishing Co. PVT Ltd. New Delhi. 478pp.
- USDA (2000) Crop Profile for Sesame in the United States: General Production Information.

EFFECT OF VARIETIES AND WEED CONTROL METHODS ON GROWTH OF CUCUMBER (*Cucumis sativa* L.) IN SUDAN SAVANNAH OF NIGERIA

¹*Aliyu, D., ¹Muhamman, M. A., ²Muhammed I. B. and ²Lado, A.

¹Department of Agronomy Federal University of Kashere, Gombe State

² Department of Agronomy Bayero University, Kano.

*Corresponding Author's email: dahirualiyyu66@gmail.com

ABSTRACT

Field trials were conducted in 2014 rainy season on the Teaching and Research Farm, Faculty of Agriculture, Bayero University Kano (11°58'N, 8°26'E and 475m above sea level) and Kano Institute of Horticulture Bagaud Kano (Latitude 11°33'N and Longitude 8°23'E) The aim of the study was to evaluate the performance of cucumber (*Cucumis sativa* L.) as influenced the weed control methods in Sudan Savannah of Nigeria. The treatments consisted two cucumber varieties (Ashley and Marketmore), twelve (12) weed control methods (Pendimethalin at 1.5 kg ha⁻¹ a.i., Pendimethalin at 1.0 kg ha⁻¹ s.i., Pendimethalin at 1.0 kg ha⁻¹ a.i followed by Fluazifop-P-butyl at 1.0 kg a.i., Pendimethalin at 1.5 kg ha⁻¹ a.i. Followed ha⁻¹ by Fluazifop-P-butyl at 1.5 kg ha⁻¹ a.i , Pendimethalin at 1.5 kg ha⁻¹ a.i followed by supplementary hoe weeding (SHW), Pendimethalin at 1.0 kg ha⁻¹ a.i followed by Supplementary Hoe Weeding, Fluazifop p-butyl at 1.0 kg ha⁻¹ a.i., Fluazifop p-butyl at 1.5 kg ha⁻¹ a.i., hoe weeding at two weeks after sowing (2WAS). followed by Fluazifop p-butyl at 1.0 kg ha⁻¹ ha⁻¹, hoe weeding at 2WAS followed by Fluazifop p-butyl at 1.5 kg ha⁻¹ a.i , Weedy Check and two hoe weeding at 2 and 4WAS). The experiment was laid out in a split plot design with cucumber varieties assigned to the main plot and weed control methods to the sub-plots. Data were collected on vine length, number of branch per plant, number of leaves per plant, leaf area. Data generated were subjected to analysis. The result revealed that cucumber Ashley out yielded Marketmore and exhibited higher growth and vine length, number of leaves per plant, number of branches per plant and leaf area per plant. Ashley also responded better to weed control method pre-emergence application of Pendimethalin at 1.0 kg ha⁻¹ a.i. followed by Fluazifop control weed better than other weed control methods, and were also found to record higher growth component. Thus, Ashley was recommended for the study area and pre-emergence application of Pendimethalin at 1.0 kg ha⁻¹ a.i followed by Fluazifop should be use in the control of weed.

Key words: weed control methods, cucumber variety, growth characters.

INTRODUCTION

Cucumber (*Cucumis sativa* L.) is the second most important cultivated vegetable of the family Cucurbitaceae after melon, It had been in cultivation since 3,000 years ago (Wehner and Guner, 2004) the crop has not been ranked in Africa probably because of insufficient yield and limited use (Eifediyi and Remison, 2009). Cucumber is fast becoming popular in West Africa since it is a useful ingredient in the preparation of salads. It is grown in home garden (Norman, 1992). Currently cucumber is becoming commodity in both Northern and Southern part of Nigeria (Ogbodo et al., 2010). Many varieties of cucumber exist with varying shapes and sizes, skin colour and carotene content (Simon, 1992). The variation in the performance of cucumber varieties has been widely documented by many scholars (Axelson and Fors, 1980; Manyong, 1997), which could be

as a result of genetic composition or environmental factors. Correlation among traits and with yield is important in indirect selection of variety for yield (Machikowa and Laosuwan, 2011). Growth response can be expressed in various parameters of plant growth measurements. Some of these growth measurements parameters are the increment of the plant height, leaf area, branch length, and shoot diameter. Pyne et al. (2005).

Weeds are naturally occurring plants that are injurious in agricultural system (Worsham, 1991). Most weeds are opportunistic, filling in voids in the farm and can only grow or exist if there is space for them. Weeds harbor insects and disease organisms, serves as alternate host to pest and compete with crop nutrient, moisture light and space (Anderson, 1987). They may increase insect and diseases damage to crops as well decrease the quality of crops (Akobundu, 1987). Hence, managing

the weeds meticulously in early stages is an imperative task to get higher weed control. Herbicides when used with one or two hand weeding showed improved control of weeds. The control of weeds either through herbicide alone or in combination with hand weeding registered higher net returns investment compared to weed free check (Ved Prakash et al., 2000). Spraying of pre-emergence herbicides keeps the crop in weed free conditions during early stages. Then, at later stages hand weeding or application of post emergence herbicides helps to reduce the cost of weeding and keep the weed population below economic threshold level throughout the crop growth period. The minimum weed free period in cucumber has been estimated as first 3 to 4 weeks after planting (Stall, 2009). Thus aim of this study was to evaluate the growth and development of cucumber variety as influenced by weed control methods in Sudan savannah ecological zone of Nigeria.

MATERIALS AND METHODS

Research was conducted at the Teaching and Research Farm of Faculty of Agriculture, Bayero University, Kano. (Latitude 11°58'N and Longitude 8°25'E) and Research Farm of Institute of Horticulture Bagauda, Kano (Latitude 11°33'N and Longitude 8°23'E). The experiments were carried out during 2014 rainy season. The experiments consisted of twelve methods of weed control (Pendimethalin at 1.5 kg ha⁻¹ a.i., Pendimethalin at 1.0 kg ha⁻¹ s.i., Pendimethalin at 1.0 kg ha⁻¹ a.i followed by Fluazifop-P-butyl at 1.0 kg a.i., Pendimethalin at 1.5 kg ha⁻¹ a.i. followed by Fluazifop-P-butyl at 1.5 kg ha⁻¹ a.i, Pendimethalin at 1.5 kg ha⁻¹ a.i. followed by supplementary hoe weeding (SHW), Pendimethalin at 1.0 kg ha⁻¹ a.i followed by SHW, Fluazifop p-butyl at 1.0 kg ha⁻¹ a.i., Fluazifop p-butyl at 1.5 kg ha⁻¹ a.i., hoe weeding at two weeks after sowing (2WAS) followed by Fluazifop p-butyl at 1.0 kg ha⁻¹, hoe weeding at 2WAS followed by Fluazifop p-butyl at 1.5 kg ha⁻¹ a.i, Weedy Check and two hoe weeding at 2 and 4WAS). With cucumber varieties (Cucumber Ashley and Cucumber Market more). The experiment was laid out in split plot design with cucumber variety allocated to main plot while weed control method placed in a sub plot.

They were then replicated three times. The gross plot consisted of 6 ridges of 0.75m apart and 4m long giving total area of 13.5m², the net plot consisted of two inner rows giving total area of 6m² each, an alley of 0.5m was left between the plot and in between replication. The land was harrowed and then ridges of 0.75m apart were made. Cucumber seeds were sown at the rate of three seeds per hole and later thinned to one plant per stand and intra row spacing of 1m apart. Herbicide was applied as per treatment basis using knapsack sprayer fitted with green deflector nozzles at a pressure of 2.1kg/m² using sprayer volume of 15liter ha⁻¹. The herbicide was applied in the morning when the weather was calm to avoid wind draft. Hand hoe weeding was done as per treatment basis while weed check plot was not weeded throughout the experiment. N.P.K (15:15:15) fertilizer at the rate of 80 kg N/ha¹ 40 kg P ha¹ and 40 kg K ha¹ was applied at 21 days after sowing by side placement method. Insect pest was controlled at two weeks' interval using Cypermethrine 10% EC at the rate of 0.05kg ha⁻¹. Data were taken on five randomly selected and tagged plants of the two inner rows. The data for crop growth and development were collected using agronomic procedures that included vine length, number of leaves per plant number of branch per plant leaf area; Data were subjected to analysis of variance appropriate for split plot design using SAS system for window (SAS 2000) Means were separated using DMRT.

RESULT AND DISCUSSION

The effect of variety and weed control on the vine length at 4 and 6 WAS is presented in Table 1: Variety significantly influenced vine length at both sampling periods and locations, where Ashley variety significantly produced the longest vine length across all the sampling periods. Weed control method had significant effect on vine length in both location and throughout growing period. During sampling at 4 WAS Pendimethalin at 1.0 kg ha⁻¹ followed by Fluazifop at 1.0 kg ha⁻¹ significantly produced the longest vine length, which was statistically different from all other weed control methods in both locations. Weedy check significantly produced the shortest vine length which is statistically similar with Pendimethalin at 1.5 kg ha⁻¹ and

Pendimethalin at 1.5 kg ha⁻¹ followed by Fluazifop at 1.5 kg ha⁻¹. Sampling at 6 WAS indicated that Pendimethalin at 1.0 kg ha⁻¹ followed by Fluazifop at 1.0 kg ha⁻¹ and were the same with weed free check thus, produced the longer vine length. Weedy check produced shortest vines, which is statistically similar with Pendimethalin at 1.5 kg ha⁻¹ followed by Fluazifop at 1.5 kg ha⁻¹ and Pendimethalin 1.5 kg ha⁻¹, at both Locations. This was due to lesser crop–weed competition at earlier stage for growth resources, thus providing favorable environment to crop for better expression of growth, as earlier reported by of Y. M. Kwaga *et al.* (2015). No significant interaction between variety and weed control method recorded in vine length.

The effect of variety and weed control method on number of leaves per plant is presented in Table 2: Variety significantly influenced number of leaves at both locations and sampling periods. Ashley variety significantly produced higher number of leaves across the sampling periods and locations. Weed control method had significant effect on number of leaves per plant. During sampling at 4 WAS Pendimethalin at 1.0 kg ha⁻¹ followed by Fluazifop 1.0 kg ha⁻¹ and weed free check significantly produced higher number of leaves. Sampling at 6 WAS indicated that Pendimethalin at 1.0 kg ha⁻¹ followed by Fluazifop at 1.0 kg ha⁻¹ significantly produces higher number of leaves. However, weedy check significantly recorded the lowest number of leaves in both Locations at both sampling period. Similar findings were reported by M.S. Garko *et al.* (2016). No significant interaction between variety and weed control method recorded in number of leaves per plant.

The effect of variety and weed control method on number of branches per plant at 4 and 6 WAS, is presented in Table 3. Variety significantly influenced the number of branches across all sampling period in both locations; as found This result were collaborated with work of Verma and Singh (1997), Yumnam *et al.* (2009) and Tripathy *et al.* (2013). Ashley variety significantly produced higher number of branch throughout the growing period and in both locations. Similarly weed control method had

significant effect on number of branch per plant in both locations and throughout growing period, higher number of branches was recorded from Pendimethalin at 1.0 kg ha⁻¹ followed by Fluazifop at 1.0 kg ha⁻¹ and weed free check. Weedy cheek and application of Pendimethalin at 1.5 kg ha⁻¹ followed by Fluazifop 1.5 kg ha⁻¹ were statistically the same, and produced lowest number of branches. No significant interaction between variety and weed control method recorded in number of branch per plant.

The effect of variety and weed control method on leaf area per plant at 4 and 6 WAS, was presented in Table 4: Variety significantly influenced leaf area per plant throughout growing period in both locations. Ashley significantly produced the higher leaf area than Marketmore in both locations at both sampling period. Pendimethalin 1.0 kg ha⁻¹ followed by Flazifop 1.0 kg ha⁻¹ recorded the highest leaves area. However, Weedy Cheek and Pendimethalin at 1.5 kg ha⁻¹ were statistically similar and recorded lower leaf area at both location. At 6 WAS the result Shows that Pendimethalin at 1.0 kg ha⁻¹ followed by Fluazifop at 1.0 kg ha⁻¹ had produced the higher leaf area, while weedy check and Pendimethalin at 1.5 kg ha⁻¹ recorded the lowest at BUK. Similar results were observed at Bagauda, which could be due to the ability of Metolachlor in preventing weed emergence and the effects of Fluazifop in suppressing weed growth. The lower mean values recorded at weed check was because of the higher weed density recorded as reported by Dadari *et al.* (2005) and Bailey *et al.* (2000). There is no significance interaction between variety and weed control method on leaves area per plant.

CONCLUSION

The research on effect of variety and weed control method on growth of cucumber showed that Ashley significantly recorded superior growth attribute and could therefore be recommended to farmers in the study areas. Application of Pendimethalin at 1.0 kg a.i./ha followed by Fluazifop at 1.0 kg a.i./ha gave higher suppressing of weeds in cucumber and these rate could also be recommended for increased cucumber production in the study areas.

Table 1: Effect of Variety and Weed Control Method on Vine Length of Cucumber Varieties at BUK and Bagauda, 2014 Rainy Season.

Treatment	BUK (WAS)		BAGAUDA (WSA)	
	4	6	4	6
Varieties				
Ashley	37.24a	52.68a	44.53a	68.63a
Marketmore	23.19b	37.18b	32.63b	51.90b
SE	0.970	1.330	0.790	1370
Weed control method (WCM)				
Pendimethalin @ 1.5 kg a.i./ha	09.68hi	15.70fg	22.22g	37.70hi
Pendimethalin @ 1.0 kg a.i./ha	29.53ef	58.47c	38.82e	59.78def
Pendimethalin@ 1.0 + Fluazifop @ 1.0 kg a.i./ha	66.78a	87.95fa	61.33a	92.50a
Pendimethalin @1.5 + Fluazifop @ 1.5 kg a.i./ha	12.55hi	18.95fg	29.13f	46.50gh
Pendimethalin @ 1.5 kg a.i./ha +SHW	39.15cd	62.32b	45.03cd	69.17cd
Pendimethalin @ 1.0 kg a.i./ha +SHW	43.17c	68.36b	47.12c	75.60bc
Fluazifop-p butyl @ 1.0 kg a.i./ha	23.28fg	29.02de	37.23ef	54.27efg
Fluazifop-p butyl @ 1.5 kg a.i./ha	16.96h	24.00ef	32.30fg	49.58fgh
HW + Fluazifop @ 1.0 kg a.i./ha	35.71ed	58.47b	41.10ef	64.13de
HW + Fluazifop @ 1.5 kg a.i./ha	25.33f	37.50cd	37.10ef	58.32efg
Weedy checks	08.08i	12.57g	17.23h	32.55i
Weed free check	52.33b	78.73a	55.25b	81.10b
SE ±	3.000	4.680	1.700	2.380
Interaction				
V * WCM	NS	NS	NS	NS

Means with the same letter(s) in the same column are not significantly different ($P > 0.05\%$) Using (DMRT) NS = not significant, WAS = weeks after sowing, HW = Hoe weeding, SHW = supplementary hoe weeding.

Table 2: Effect Variety and of Weed Control Method on Number of Leaves of Per Plant Cucumber Varieties at BUK and Bagauda, 2014 Rainy Season.

Treatment	BUK (WAS)		BAGAUDA (WSA)	
	4	6	4	6
Varieties				
Ashley	10.10a	17.44a	10.34a	15.70a
Marketmore	9.82b	11.33b	8.39b	11.40b
SE	0.570	0.680	0.310	0.610
Weed control method (WCM)				
Pendimethalin @ 1.5 kg a.i./ha	3.97e	5.30f	6.42de	9.42ef
Pendimethalin @ 1.0 kg a.i./ha	6.80de	12.48d	8.33cd	8.77ef
Pendimethalin@ 1.0 + Fluazifop @ 1.0 kg a.i./ha	16.12a	34.83a	15.99a	24.50a
Pendimethalin @1.5 + Fluazifop @ 1.5 kg a.i./ha	3.88c	4.65ef	6.72de	7.05f
Pendimethalin @ 1.5 kg a.i./ha +SHW	9.10cd	18.85c	10.00bc	13.00cd
Pendimethalin @ 1.0 kg a.i./ha +SHW	9.82cd	20.00bc	11.27b	13.07cd
Fluazifop-p butyl @ 1.0 kg a.i./ha	6.40de	7.66def	8.48cd	11.5def
Fluazifop-p butyl @ 1.5 kg a.i./ha	5.33de	22.33bc	8.00de	10.08ef
HW + Fluazifop @ 1.0 kg a.i./ha	11.60bc	19.45c	8.93cd	15.53d
HW + Fluazifop @ 1.5 kg a.i./ha	6.80de	10.55de	8.38cd	12.33de
Weedy checks	3.53e	4.97f	5.87e	7.05f
Weed free check	14.85ab	25.50b	13.97a	17.32bc
SE ±	1.410	3.090	0.880	1.520
Interaction				
V * WCM	NS	NS	NS	NS

Means with the same letter(s) in the same column are not significantly different ($P > 0.05\%$) Using (DMRT) NS = not significant, WAS = weeks after sowing, HW = Hoe weeding, SHW = supplementary hoe weeding.

Table 3: Effect of Variety and Weed Control Method on Number of Branches Per Plant of Cucumber Varieties at BUK and Bagauda, 2014 Rainy Season.

Treatment	BUK (WAS)		BAGAUD (WSA)	
	4	6	4	6
Varieties				
Ashley	8.86a	13.93a	9.72a	13.00a
Marketmore-	5.53b	9.61b	6.89b	9.47b
SE	0.320	0.520	0.270	0.560
Weed control method (WCM)				
Pendimethalin @ 1.5 kg a.i./ha	3.60fg	4.21e	5.00fg	8.10ef
Pendimethalin @ 1.0 kg a.i./ha	5.88def	10.72c	7.60de	10.22def
Pendimethalin @1.0 kg + Fluazifop @ 1.0 kg a.i./ha	13.75a	28.38a	13.35a	20.32a
Pendimethalin @1.5 + Fluazifop @ 1.5 kg a.i./ha	3.53fg	4.32e	6.22efg	7.00ef
Pendimethalin @ 1.5 kg a.i./ha +SHW	7.65bcd	15.55b	9.05cd	14.61bc
Pendimethalin @ 1.0 kg a.i./ha +SHW	8.52bc	18.73b	9.87bc	12.70bc
Fluazifop-p butyl @ 1.0 kg a.i./ha	5.82def	6.12de	7.62de	9.72def
Fluazifop-p butyl @ 1.5 kg a.i./ha	4.57efg	5.05e	6.80efg	8.88def
HW + Fluazifop @ 1.0 kg a.i./ha	9.77bc	15.11b	7.97cde	11.13cde
HW + Fluazifop @ 1.5 kg a.i./ha	6.42de	9.78cd	6.60efg	9.10def
Weedy checks	2.38g	4.37e	4.50g	5.85f
Weed free check	14.47a	18.88b	11.22b	17.15ab
SE ±	0.840	2.490	0.82	1.340
Interaction				
V * WCM	NS	NS	NS	NS

Means with the same letter(s) in the same column are not significantly different ($P > 0.05\%$) Using (DMRT) NS = not significant, WAS = weeks after sowing, HW = Hoe weeding, SHW = supplementary hoe weeding.

Table 4: Effect of Variety and Weed Control Method on Leaves area Per Plant of Cucumber Varieties at BUK and Bagauda, 2014 Rainy Seasons.

Treatment	BUK (WAS)		BAGAUD (WSA)	
	4	6	4	6
Varieties				
Ashley	43.71a	62.53a	86.48a	10.48a
Marketmore	38.73b	49.94b	73.89b	87.95b
SE	0.380	1.320	1.710	1.420
Weed control method (WCM)				
Pendimethalin @ 1.5 kg a.i./ha	19.60k	26.87gh	53.80gh	69.92h
Pendimethalin @ 1.0 kg a.i./ha	43.50f	62.15de	76.70cde	97.50de
Pendimethalin @1.0 + Fluazifop @ 1.0 kg a.i./ha	74.40a	101.62a	136.38a	156.50a
Pendimethalin @1.5 + Fluazifop @ 1.5 kg a.i./ha	22.60j	29.60g	58.93fgh	75.35gh
Pendimethalin @ 1.5 kg a.i./ha + SHW	52.87d	70.43cd	86.80c	106.05cd
Pendimethalin @ 1.0 kg a.i./ha + SHW	60.80c	57.60c	112.00c	106.40b
Fluazifop-p butyl @ 1.0 kg a.i./ha	33.95h	46.03f	62.88fg	92.20ef
Fluazifop-p butyl @ 1.5 kg a.i./ha	26.63i	36.57f	66.28fg	85.05fg
HW + Fluazifop @ 1.0 kg a.i./ha	48.37g	66.60de	81.45cd	103.47de
HW + Fluazifop @ 1.5 kg a.i./ha	38.37g	57.53e	70.46def	96.40de
Weedy checks	16.98k.	17.43h	46.33h	69.92i
Weed free check	73.55b	85.55b	116.40b	133.20b
SE ±	2.840	5.060	26.640	2.760
Interaction				
V * WCM				

Means with the same letter(s) in the same column are not significantly different ($P > 0.05\%$) Using (DMRT) NS = not significant, WAS = weeks after sowing, HW = Hoe weeding, SHW = supplementary hoe weeding.

Table 5: Physico-chemical Properties of the soil at Experimental site, 2014

Soil Properties	BUK 0-30	Bagauda 0-30
Physical (%)		
Sand	78	50
Clay	9	28
Silt	13	22
Textural class	Sandy clay	Sandy clay loam
Chemical		
PH(H ₂ O)	7.12	7.34
Organic carbon (gkg ⁻¹)	7.82	13.20
Total Nitrogen (gkg ⁻¹)	0.13	0.28
Available P (mgkg ⁻¹)	13.6	23.20
Exchangeable base		
Ca	3.76	4.95
Mg	0.39	0.95
K	0.36	0.18
Na	0.41	0.47
CEC	6.40	9.12

REFERENCES

- Akobundu I.O (1996). Principles and Practice for Integrated Weed Management in Developing Countries *Proceeding of 2nd Int. Weed Control Congress* Volume II: 1591-1600
- Akobundu, I.O. (1987). Weed Science in the Topic: Principles and Practice, John Wiley and Sons, Chichester.
- Anderson, I.O (1987). Weed Crop Competition in Weed Science Principle, 2nd edition Pp 15-33. West Publishing Company. St. Pill Minn USA.
- Ayotamuno, Akor, Tome, Esset, Unmah and Idike (2000) Relating Com Yield to Water use During the Dry Season in Port Harcourt area Nigeria. *Agricultural Mechanization in Asia, Africa and Latin America*, 31 (4): 47-51.
- Axelson, F. and Fors, L. (1980). Konkard and Kornett, Two F₁ Hybrid Cultivars of Gherkin from Inbullsholm Plant Institute. *Horticultural Abstracts* 51: 866
- Bailey, W. A., J. W. Wilcut, J. F. Spears, T. G. Isleib, and V. B. Langston. (2000). Diclosulam Does not Influence Yields in Eight Virginia Market-Type Peanut (*Arachis hypogaea*) Cultivars. *Weed Technol.* 14:402-405.
- Dadari, S.A. and Mani. H (2005). The Effect of Post Emergence Weed Control on Irrigated Wheat in The Sudan Savannah of Nigeria. *Crop Protection*. 24: 842-847.
- Duncan, D.B.(1995). Multiple Range and Multiple Test Biometric 11:1-42.
- Eifediyi EK, Remison SU (2009). Effect of Time of Planting on Growth and Yield of Five Varieties of Cucumber. *Report and Opinion* 1(5):81-90.
- Garko, M.S., Mohammed, I. B, Yakubu, A.I, Muhammad, Z. Y. (2016) Performance Of Groundnut (*Arachis hypogaea* [L]) Varieties Influence By Weed Control Treatments. *International Journal of Scientific and Technological Research*, Volume, 5. Pp 134 -140
- Machikowa T, Laosuwan P (2011). Path Coefficient Analysis for Yield of Early Maturing soybean. *Songklanakarin Journal of Science and Technology* (33)4:365-368.
- Manyvong V (1997). Cucumber Varietal Trial ARC/AVRDC Training Workshop, Thailand.
- Kwaga, Y. M, Simon, M and B and Kwada S. B. (2017) Effect of Different Rates of Pendimethalin on Weed Control in Bambara Groundnut (*Vigna subtranean* [L.]) In Semi - arid Savannah, Nigeria. *Global Advanced Research Journal of Agricultural Science*. 4 (12) Pp 905 -910
- Norman J.C. (1992) Tropical Vegetable Crops Arthur H. Stockwel Ltd. Pp 107-108
- Ogbodo, E. N; Okorie, P. O & Utobo, E. B. (2010). Introducing Cucumber for Cultivation at New Different Zone in Ebonyi State, Southeastern Nigeria. *Libyan Agriculture Research Center Journal International*, 1 (6): 336-343.
- Pyne, E., Nerson, T., Bange, G., 2005. Measurement of Leaf Area Using The Non-Destructive Methods. *Journal of Apply Ecology* 6, 81-88.
- Stall W.M (2009). Weed Control in Cucumber [online]. Available at <http://edis.ifas.ufl.edu/wg029> (Retrieved 18 July, 2011)
- Swinton S.M. Buhler D.D, Forecella F, Gunsolus J.L, King R.P (1994) Estimation of Crop Yield Loss Due to Interference by Multiple Weed Species. *Weed Science* 42:103-10
- Ved Prakash, Pandey, A.K., Singh, R.D. and Mani, V.P. 2000. Integrated Weed Management in Winter Onion (*Allium cepa* L.) Under Mid Hill Conditions of North- Western Himalayas. *Indian Journal Agronomy*, 45 (4):816-21.
- Verma S.K. and Singh T. 1997. Weed Control in Kharif Onion (*Allium Cepa* L.). *Indian J. Weed Sci*, 28 (1&2) : 48-51.
- Welner, T.C., Gunner, N., (2004) Growth Stage, Flowering pattern, uses yield and Harvest Date Prediction of Four Type's Cucumber Tested at 10 Planting Dates. *Acta hort.* 637 ISHS.
- Yumnam, A., Mandal, A.R., Thapa, U., Maity, T.K. and Bhattacharya, S.P. 2009. Studies on Weed Management in Onion (*Allium cepa* L.). *J Crop Weed*, 5 (1): 324-25

Appendix 1: Meteorological Data during 2014 Rainy Season at Bagauda

Months	Rainfall (mm)	Max. Temperature (°C)	Min. Temperature (°C)	Relative Humidity
May	17.00	35.04	27.15	41.06
June	4.79	32.25	24.45	46.56
July	29.33	31.90	22.91	57.61
August	55.07	29.90	23.63	62.54
September	23.81	31.49	23.69	52.43
October	45.20	32.60	22.71	59.87
Mean	29.2	32.69	24.09	53.35

Source: Meteorological Station, National Research Institute for Horticulture, Sub-station Baguda, Kano

Appendix 2: Meteorological Data during 2014 Rainy Season at BUK

Months	Rainfall (mm)	Max. Temperature (°C)	Min. Temperature (°C)	Relative Humidity
May	2.19	36.75	23.86	29.52
June	1.02	36.09	23.53	37.472
July	5.31	32.42	21.85	51.71
August	10.03	30.29	20.14	61.52
September	4.47	31.49	20.64	90.83
October	0.8	34.33	18.71	45.38
Mean	29.2	32.69	24.09	53.35

Source: Meteorological Station, Soil Science Department, Bayero, University Kano.

INFLUENCE OF SOURCE – SINK ON COWPEA (*Vigna unguiculata* L. WALP) PERFORMANCE

¹*Odeleye I. S., ²Odeleye F.O. and ²Muhamman M. A.

¹Department of Agronomy, Federal University of Kashere, Gombe State, Nigeria

²Department of Crop Protection and Environmental Biology, University of Ibadan, Ibadan, Nigeria

*Corresponding author: odeleye.idowu@gmail.com

ABSTRACT

This study was carried out to determine the effects of defoliations at different stages of growth and yield of cowpea (*Vigna unguiculata* (L) Walp). Defoliations at different intensities such as 33%, 50%, and 67% during the vegetative and reproductive stages (3 weeks – 8 weeks after sowing) affected seed yield. However, 50% defoliation at the vegetative stage significantly increased the number of pods per plant and number of seeds per pod respectively. Defoliation (50% and 67%) during the reproductive stage of growth was very detrimental to seed yield because it lowered the number of seed per pods and the seed weight. The magnitude of yield reduction was dependent on the stage of crop development and degree of defoliation. The results gotten from this experiment suggest that cowpea grown under a tropical environment can not compensate for foliage loss during the reproductive stage as it reduces the yield quality of cowpea.

Keywords: Defoliation, Growth Stages, Yield

INTRODUCTION

Cowpea (*Vigna unguiculata* (L) Walp) is an indigenous legume to sub-Saharan Africa and is mainly grown in the dry savanna areas as an intercrop with millets, sorghum, groundnut and maize. According to Boukar, *et al.*, (2013) it is of major importance in the livelihood of millions of relatively poor people in the developing countries of the tropics including Nigeria. The green leaves are responsible for the manufacture of food stored in various parts of the plants in the presence of sunlight through photosynthesis. The phenomenon of assimilate partitioning is also based on plant leaves without which it cannot occur since they are the main source. Hence, it is from the plant leaves that photosynthetic products are translocated to other organs where they are utilized as building blocks for various cell constituents in developing other plant parts or deposited as storage produce (Saidi *et al.*, 2007). Sometimes, a rapidly expanding plant leaf imports the assimilate it need for initial growth, but as soon as it is fully expanded and autotrophy is established it becomes a net exporter of assimilates. Many biotic factors such as insects, animals and diseases and abiotic factors such as hail and storm could defoliate cowpea during cultivation. Defoliation by these factors could be simulated by artificially defoliating cowpea plants during cultivation.

Studies on the effect of defoliation have shown that cowpea sources can be manipulated at different stages of growth and development (Ibrahim, *et al.*, 2010). This manipulation in source can be seen in the leaves such as the number of leaves which brings about different percentages or degree of manipulation of the source. Other workers have demonstrated that leaf manipulations may have influence on the photosynthetic efficiency of the plant (Odeleye *et al.*, 2003). In order to study the effect of source on growth and yield in cowpea, this study was carried out to investigate the effect of defoliation at different growth stages and development on the performance of cowpea.

MATERIALS AND METHODS

Study Site:

This experiment was conducted at research farm of the Department of Crop Protection and Environmental Biology, University of Ibadan, Ibadan, Oyo State, Nigeria (7° 24' N, 3° 54' E, 234m) during the period of July to October 2010.

Source of planting materials:

The cowpea variety used for the study was IT04K-217-5 obtained from International Institute of Tropical Agriculture (IITA) Ibadan. It's an early maturing, indeterminate type which matures 95 days after sowing.

Experimental Design and Treatments:

The experimental design was arranged in a Randomized Complete Block Design with factorial combination of three growth stages (vegetative, flowering and podding) and four defoliation intensities (0%, 33%, 50% and 67%) with four replications. The layout having a total land area of 13m x 6m consisted of four plots each is 2m x 5m and 1m alley ways. Sowing was done on the 10th July, 2010 at a spacing of 50cm X 60cm. Three to four seeds were sown per stand and established seedlings were thinned to one per stand two weeks after sowing. The defoliation at the vegetative stage

of growth was carried out three weeks after sowing. The flowering and podding stage defoliations were carried out at 7 and 8 weeks after sowing respectively. The undefoliated cowpea plants were left as control.

The 33% defoliation was achieved by removing one lateral leaflet from each leaf on the plant, 67% defoliation by removing the two lateral leaflets from each leaf on the plant and 50% defoliation by removing one lateral leaflet from half of the leaves and the two lateral leaflets from the other half of the leaves on each plant (Figure 1).



Figure 1. Illustration of Cowpea Defoliation patterns in 2010 at Ibadan, Nigeria

Data Collection:

Number of leaves per plant, Plant height, Number of branches per plant, Leaf area per plant, Number of nodes per plant, Number of pods per plant, Number of seeds per pod, 100-seed weight.

Data Analysis:

Analysis of variance was carried out for each of the parameters. This was done to determine if there were significant effects in the different treatments. Least Significant Difference test (LSD) ($P \leq 0.05$) was used to compare the means of the treatments and also to determine the degree of effect among the various percentages of defoliation.

RESULTS

The effects of defoliation across growth stages on growth parameters of cowpea as presented in Table 1 showed that there were significant increase ($P \leq 0.05$) in number of leaves per plant during podding stage with

mean (58.04). The plant height and leaf area showed no significant differences ($P \leq 0.05$) across the growth stages. However, defoliations at vegetative stage significantly increased the number of branches per plant and number of nodes per plant with mean 4.71 and 31.38 when compared with flowering and podding stages respectively.

However, across the defoliation intensities as presented in Table 1 cowpea plants were defoliated at 33%, 50% and 67% compared with the control ($P \leq 0.05$). The number of leaves per plant at 33% defoliation and mean value of 55.67 were significantly lower than the control (69.89) but higher significantly than 50% and 67% with mean values of 46.04 and 39.83 respectively. Defoliation intensities did not affect Plant height of cowpea significantly ($P \leq 0.05$) across growth stages. The numbers of branches per plant were not significantly different ($P \leq 0.05$) across defoliation levels but differ significantly from the control. The numbers of nodes per

plant were not significantly different ($P \leq 0.05$) across defoliation levels but 67% defoliation differed significantly from the control. Defoliation by 50% were significantly higher

($P \leq 0.05$) than 67% for the leaf area but not significantly different from 33% defoliation and control.

Table 1. Effects of defoliation rates at three growth stages on growth parameters of cowpea in 2010 at Ibadan, Nigeria

Stages of growth		Number of Leaves	Plant height	Number of Branches	Number of Node	Leaf Area
Vegetative		41.46	66.21	4.71	31.38	110.01
Flowering		42.04	66.05	3.96	27.46	111.23
Podding		58.04	63.08	3.50	27.83	110.25
LSD		6.5	9.2	0.63	3.5	11.84
(P= 0.05)						
Defoliation						
Control		69.89	61.88	6.13	31.75	115.18
33%		55.67	60.67	4.38	29.00	110.08
50%		46.04	59.83	4.13	28.79	116.9
67%		39.83	65.29	4.13	27.88	104.52
LSD(P=0.05)		6.53	9.17	0.63	3.5	11.84
Interaction						
Growth Stg	Defoliation					
	Control	69.875a	61.875abcd	6.125a	31.750ab	115.175ab
Vegetative	33%	51.275cde	68.375abc	4.250bcd	24.625c	115.163ab
	50%	40.000ef	55.250bcd	3.625cd	26.375bc	109.637ab
	67%	33.125f	75.000a	4.625bc	31.125abc	105.238ab
Flowering	33%	50.875cde	65.750abc	4.000bcd	28.500abc	111.438ab
	50%	41.000def	63.875abcd	4.625bc	29.125abc	122.688a
	67%	34.250f	69.875ab	3.250d	24.750c	99.575b
Podding	33%	64.875ab	47.875d	4.875b	33.875a	103.625ab
	50%	57.125bc	60.375abcd	4.125bcd	30.875abc	118.375ab
	67%	52.125cd	51.000cd	4.500bc	27.750abc	108.750ab
		Ns	Ns	S	S	Ns
LSD (P=0.05)		11.6	17.5	1.1	6.7	21.0

Table 2 showed the effects of defoliation across growth stages on the yield parameters of cowpea. The number of pods per plant at podding stage were the highest and significantly higher ($P \leq 0.05$) with mean value of 11.17 than vegetative stage which had a mean (8.25). Meanwhile, the number of seeds per pod were significantly increased ($P \leq 0.05$) for defoliation at flowering stage with a mean value of 11.50 which is significantly higher than defoliation at vegetative and podding growth stages. The effect of defoliation on 100 seed weight showed significant increase ($P \leq 0.05$) at vegetative growth stage with mean value of

20.49 than at flowering and podding stages with mean of 18.89 and 17.99 respectively.

The effects of defoliation intensities on the yield parameters of cowpea as shown in Table 2. Defoliation of 50% had the highest effect on number of pods per plant with mean value 10.6 which is significantly higher than the control but not significantly higher than 33% and 67% defoliation levels. More so, 50% defoliation with mean value (11.1) significantly increased the number of seeds per pod when compared with 67% and the control with mean (10.2 and 9.6) respectively but not significantly different from the 33% defoliation level.

However, 33% defoliation had the highest mean value of 20.1 across defoliation levels which is

significantly lower ($P \leq 0.05$) than the control which had mean value (22.6).

Table 2. Effects of defoliation rates at three growth stages on yield parameters of cowpea in 2010 at Ibadan, Nigeria

Treatment		Number Pod	Number of Seed/Pod	100Seed Weight
Growth Stages				
Vegetative		8.25	10.88	20.49
Flowering		8.42	11.50	18.89
Podding		11.17	9.25	17.99
LSD		2.9	0.77	0.65
(P= 0.05)				
Defoliation				
Control		6.4b	9.6b	22.6a
33%		9.3a	10.4ab	20.1b
50%		10.6a	11.1a	19.7b
67%		7.9ab	10.2b	18.6c
LSD(P=0.05)		2.9	0.7	0.6
Interaction				
Growth Stg	Defoliation			
Vegetative	Control	6.375b	9.625cd	22.616a
	33%	7.250ab	11.125b	20.911b
	50%	11.125ab	10.750bc	21.143b
	67%	6.375b	10.750bc	19.411c
Flowering	33%	8.375ab	10.250bc	21.128b
	50%	9.625ab	12.875a	19.587c
	67%	7.250ab	11.375b	18.963cd
Pod ding	33%	12.375a	9.750cd	18.150de
	50%	11.000ab	9.500cd	18.325de
	67%	10.125ab	8.500d	17.488e
		Ns	S	Ns
LSD (P=0.05)		5.3	1.3	1.1

DISCUSSION

Defoliation in cowpea as presented in the study showed that cowpea losses increase with defoliation intensities. This could be as a result of a reduction in photosynthates and reduced nutrient mobility. Similarly, Ibrahim, U. and Ajayi F. A., (2008) studies on defoliation showed that crop yield loss increased with increasing level of defoliation. Hence, damage such as defoliation inflicted on cowpea plant is known to engender compensatory flowering and pod production as described by (Pastore, *et al.*, 2013). Such tendencies were demonstrated in this study by the decreasing effects of defoliation across the growth stages on the number of pods per plant, number of seeds per pod and 100 seed weight of cowpea. The effects were more pronounced at 67% defoliation levels across all the growth stages.

Ntombela (2013) demonstrated that defoliation of cowpea leaves in vegetative phase did not significantly reduce grain yield. This is in line with the results from this studies which indicate that defoliation at vegetative stage did not significantly ($P \leq 0.05$) reduce grain yield in cowpea. But at podding stage are significantly limiting factors to increase and sustainable cowpea production. This corroborates the findings of Asiwe (2009) that insect's pest defoliation of cowpea leaves at flowering and podding stages are significant limiting factor to increase cowpea grains production.

Defoliation in cowpea affects the rate of assimilate partitioning and grain yield. This was observed in this experiment to be more significant at the reproductive phase of development as it affects the number of pods, number of seed per pod, and the weight of 100 seeds produced per plant. In this study, the plants treated 67% defoliation had the lowest values of yield parameters. This indicates that the severest defoliation caused the highest level of yield reduction as a result of reduced photosynthesis and hence assimilates production. However, 50% defoliation at the vegetative stage was observed in this experiment as significantly effective ($P \leq 0.05$) in the inducement of flowering and podding.

However, defoliation in cowpea and at vegetative stage of growth could be due to pests but if controlled from reaching economic injury level and the cowpea plant is well managed, may perhaps be converted into a beneficial quality on the eventual yield of the plant. Therefore, in the production of cowpea, 50% defoliation during the vegetative phase of growth can be recommended to induce reproductive phase

development and significantly increase the number of pods per plant and the number of seeds per pod.

ACKNOWLEDGEMENT

I want to use this medium to appreciate the entire staff and the Department of Crop Protection and Environmental Biology, University of Ibadan, Ibadan, Nigeria for their technical support.

REFERENCES

- Asiwe, J.A.N (2009). The impact of phosphate fertilizer as a pest management tactic in four cowpea varieties. *Afri. J Biotechnol.* 8: 1684-5315.
- Boukar, O., Bhattacharjee, R., Fatokun, C., Kumar, P. L., & Gueye, B. (2013). Cowpea. In *Genetic and Genomic Resources of Grain Legume Improvement* (pp. 137-156). <https://doi.org/10.1016/B978-0-12-397935-3.00006-2>
- Ibrahim. U, S. R. and F. A. jayi. (2008). Effect of Defoliation At Different Growth Stages on Yield and Profitability of Cowpea (*Vigna Unguiculata* (L .) Walp .). *Electronic Journal of Environmental, Agricultural Journal*.
- Ibrahim, U., Auwalu, B. M., & Udom, G. N. (2010). Effect of stage and intensity of defoliation on the performance of vegetable cowpea (*Vigna unguiculata* (L .) Walp). *African Journal of Agricultural Research*, 5(18), 2446-2451. Retrieved from <http://www.academicjournals.org/AJAR>
- Ntombela, Z. (2013). Growth and yield responses of cowpeas (*Vigna unguiculata*) to water stress, MSc Thesis,.
- Odeleye F.O., A.O. Togun and T.O. Tayo (2003). The effect of light intensity and Defoliation on the growth and yield of three soyabean (*Glycine max* (L) merrill) varieties in south west Nigeria.
- Pastore, C., Zenoni, S., Fasoli, M., Pezzotti, M., Tornielli, G. B., & Filippetti, I. (2013). Selective defoliation affects plant growth, fruit transcriptional ripening program and flavonoid metabolism in grapevine. *BMC Plant Biology*, 13(1). <https://doi.org/10.1186/1471-2229-13-30>
- Saidi, M., Ngouajio, M., Itulya, F.M. & Ehlers, J. (2007). Leaf harvesting initiation Time and frequency affect biomass partitioning and yield of cowpea. *Crop Science* 47, 159-1166.