**FEDERAL UNIVERSITY, KASHERE**

**FACULTY OF AGRICULTURE**

**DEPARTMENT OF ANIMAL SCIENCE**

Course Code: ANS 5206

Course Title: Animal welfare and product handling

No of unit: Two

Course Duration: Two hours

Status Compulsory

Prerequisite: Nil

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**Course description**

This course is very important for profitable animal production. This stems from the fact that a

Good understanding and judicious use of knowledge acquired from this course would lead to

Good handling of livestock product and their welfare

**GRADING SYSTEM FOR THE COURSE**

This course will be graded as follows:

Class Attendance In form of random quizzes 5%

Assignments 5%

Test(s) 20%

Final Examination 70%

**TOTAL 100%**

***Attendance:*** It is expected that every student will be in class for lectures and also participate in all practical exercises. Attendance records will be in the form of random quizzes to determine each person’s qualification to sit for the final examination. In case of illness or other unavoidable cause of absence, the student must communicate as soon as possible with the instructors, indicating the reason for the absence.

***Academic Integrity:*** Violations of academic integrity, including dishonesty in assignments, Examinations or other academic performances are prohibited. You are not allowed to make Copies of another person’s work and submit it as your own; that is plagiarism. All cases of Academic dishonesty will be reported to the University Management for appropriate sanctions in Accordance with the guidelines for handling students’ misconduct as spelt out in the Students’ Handbook.

***Assignments and Group Work:*** Students are expected to submit assignments as scheduled. Failure to submit an assignment by certain student as at when due will earn such student zero for that assignment. Only under extenuating circumstances, for which a student has notified the instructor in advance, will late submission of assignments be permitted.

***Code of Conduct in Lecture Rooms:*** Students should turn off their cell phones during lectures. Students are prohibited from engaging in other activities (such as texting, watching videos, *etc*.) during lectures.

**Animal welfare**

Animal welfare is the avoidance of abuse and exploitation of Animals by human through maintenance of appropriate standards of accommodation, feeding, management, disease control and the assurance of freedom from harassment, unnecessary discomfort and pain. The concerns for Animal welfare is based on believe that Animals also feel pain and therefore consideration should be given to their well-being especially when they are under the care of human. These concerns include how the Animals are slaughtered for food, how they are used in scientific research, how they are kept (as pets, in zoo, farms, e.t.c) and how human activities affects the welfare and survival of species.

**Welfare of Livestock in the Market**

Livestock marketing systems that have one or more agents between the producer and slaughter plant will usually result in more damage to livestock than market systems where animals are sold directly from the producer to butcher. There are two reasons for this:

• First of all, the agents or middlemen have little incentive to ensure that damage to livestock is kept to a minimum;

• Secondly every time an animal is handled by a different middleman, it increases the likelihood of injury and stress. Animals taken to the market before moving to the slaughterhouse will go through the stress of loading, transportation and unloading. Payment systems for people handling animals can greatly affect the way the animals are treated.

**Handling of Livestock**

The first principle of animal handling is to avoid getting the animal excited. It takes up to 30 minutes for an animal to calm down and its heart rate to return to be normal after rough handling. Calm animals move more easily and are less likely to bunch and be difficult to remove from a pen. Handlers should move with slow, deliberate movements and refrain from yelling. Animals may become agitated when they are isolated from others. If an isolated animal becomes agitated, other animals should be put in with it. Battery-operated prods are preferred to mains-current operated ones. The voltage used should not exceed 32 V and never be used on sensitive parts such as eyes, muzzle, anus and vulva. Instead of prods, other droving aids should be used such as flat straps, rolled-up plastic or newspaper, sticks with flags on or panels1 for pigs. Hesitant animals can often be enticed into pens or vehicles by first leading in a tame animal and the others will follow.

**Handling in crowd pens and races**

Overloading the crowd pen is one of the most common animal handling mistakes. The crowd pen and the alley that leads to it from the yard should be only half filled. Handlers must also be careful not to force animals to move by using crowd gates. Animals should walk up the race without being forcibly pushed. If they are pushed up too tightly with a crowding gate, handling becomes more difficult. Tightly packed animals are unable to turn around to enter the race. If animals refuse to enter the single file race, they may be hesitating because of a distraction ahead, such as a moving person.

**Flight zone**

An animal’s flight zone is the animal’s safety zone and handlers should work on the edge of the flight zone. If an animal turns and faces a person, the person is outside the flight zone. When a person enters the flight zone, an animal will turn away. If an animal in a pen or race becomes agitated when a person stands too close to them, this indicates that the person is in the flight zone and should move backwards away from them. The installation of solid sides on races and stunning boxes will help calm animals because they provide a barrier between the animals and people who approach too closely. The flight zone size depends on how wild or tame the animal is. Animals with a flighty temperament will have a larger flight zone. Animals that live in close contact with people have a smaller flight zone than animals that seldom see people. An excited animal will have a larger flight zone than a calm one. A completely tame animal has no flight zone and may be difficult to drive.

**Designs of handling facilities**

The risk of injury and stress during handling of livestock can be high, causing financial loss to producer, transporter and slaughter house. Examples are poorly designed pen fencing, too low or unstable loading ramps, exposure of livestock to heat and intensive sunshine. Properly designed and constructed facilities on farms, at auction yards and slaughter houses etc. will contribute significantly towards the safe handling of livestock, thereby reducing the risk of injuries and stress to animals and workers alike.

Bulls and boars should be individually penned, and if tied, they should be able to lie down. Water must be easily available. Troughs should be high enough or protected to prevent animals from falling in and drowning. In cold climates, pens should have walls and roofs to protect animals from weather stress. In the tropics, a roof is necessary for holding pens to protect stock, particularly pigs, from heat stroke and sunburn. Water sprays in the pig pens are useful to cool pigs down. In open pens without roof and shade, even free-range cattle may suffer.

**Partitions**

Rails made of tubular iron, wood or concrete should be smooth and without projections such as hinges, broken ends or wire. Spaces should be adjusted to prevent animals from getting through or stuck and injuring themselves

**Floors**

Pen floors should be non-slip and have a gradient of not more than 1:10. If animals slip, this causes bruises, fractures, dislocations and/or skin damage. Concrete floors should have patterns engraved, or covered in mesh to provide traction, at the same time facilitating cleaning. Failing this flat stone will suffice.

**Raceways**

Lanes are necessary for animals to walk or be led on/off vehicles and platforms into holding pens or slaughter facilities etc. Races should be narrow enough so that animals cannot turn around or get wedged beside each other. This results in animals becoming injured, if they panic or are manhandled. Race width for cattle should be approximately 76 cm, depending on breed and size.

Where possible, raceways should be curved to facilitate animal movement. Slaughterhouse and pre-stunning races should have solid sides to prevent animals balking

**Ramps and platforms**

Both these structures are necessary for loading and unloading livestock from transport vehicles or walking them to slaughter facilities. Ramps should have cross slating or steps (10 cm high x 30 cm deep) to facilitate walking and prevent slipping. The ramp should be sloped at an angle of 20 degrees or less.

**Animal Welfare during Transportation**

The need to transport food animals occurs essentially in commercial agriculture and to a lesser extent in the rural or subsistence sector. These animals need to be moved for a number of reasons including marketing, slaughter, re-stocking, from drought areas to better grazing and change of ownership. Typically, methods used to move animals are on hoof, by road motor vehicle, by rail, on ship and by air. Generally the majority of livestock in developing countries are moved by trekking on the hoof, by road and rail. Historically, livestock has been moved on foot, but with increasing urbanization of the population and commercialization of animal production, livestock transport by road and rail vehicles has surpassed this. Transport of livestock is undoubtedly the most stressful and injurious stage in the chain of operations between farm and slaughterhouse and contributes significantly to poor animal welfare and loss of production.

**Effects of transport**

Poor transportation can have serious deleterious effects on the welfare of livestock and can lead to significant loss of quality and production.

Effects of transport and movement include:

a. Stress

b. Bruising

c. Trampling: this occurs when animals go down due to slippery floors or overcrowding

d. Suffocation: this usually follows on trampling;

e. Heart failure: occurs mostly in pigs when overfed prior to loading and transportation;

f. Heat stroke: pigs are susceptible to high environment temperatures and humidity

g. Sun burn: exposure to sun affects pigs seriously

h. Bloat: restraining ruminants or tying their feet without turning them will cause this is Poisoning: animals can die from plant poisoning during trekking on hoof;

j. Predation: unguarded animals moving on the hoof may be attacked;

k. Dehydration: animals subject to long distance travel without proper watering will suffer weight loss and may die

l. Injuries: broken legs and horns

m. Fighting: this occurs mostly when a vehicle loaded with pig stops, or amongst horned and polled cattle.

**Methods of transport** Cattle The most appropriate methods of moving cattle are on hoof, by road motor vehicle or by rail wagon. Moving cattle on the hoof (trekking) is suitable only where road and rail infrastructure does not exist, or when distances from farm to destination are short. This method is slow and fraught with risks to the welfare and value of the animals. Rail transport is useful for short-haul journeys where loading ramps are available at railheads and communication is direct to destination. Road motor transport is by far the most versatile, the method of first choice and the most user friendly. The most satisfactory method of transporting cattle is by road motor vehicle. Moving by rail truck requires more careful management and trekking is satisfactory for well-planned distances. Sheep and goats are the easiest to transport and generally travel well on hoof, rail or road.

Double-deck trucks are also suitable.

**Double deck truck for transporting sheep/goats**

Pigs are difficult animals to transport, and the only satisfactory method is by road, although rail can be used under careful circumstances. Poultry Broilers and other poultry such as turkeys or ducks are best transported by road. Flocks of birds should be subdivided in small numbers in crates. Recommended are plastic crates, which can be stacked on top of each other on a vehicle and which can easily be washed after use. The lid of the crates is for loading and the opening at the side for removal of the birds Having selected the preferred method of transport of slaughter animals, it is necessary to take into account numerous factors in order to ensure the health and welfare of the animals.

**Types of vehicles**

Any vehicle used for the transport of slaughter livestock should have adequate ventilation, have a non-slip floor with proper drainage and provide protection from the sun and rain, particularly for pigs. The surfaces of the sides should be smooth and there should be no protrusions or sharp edges. No vehicle should be totally enclosed.

Ventilation: Transport vehicles should never be totally enclosed, as lack of ventilation will cause undue stress and even suffocation, particularly if the weather is hot. Poor ventilation may cause accumulation of exhaust fumes in road vehicles with subsequent poisoning. Pigs are particularly susceptible to excessive heat, poor air circulation, high humidity and respiratory stress. Well ventilated vehicles are necessary. The free flow of air at floor level is important to facilitate removal of ammonia from the urine.

**Floors**: Non-slip floors in all vehicles are necessary to reduce the risk of animals falling. A grid of cross slating made from wood or metal is suitable. The grid can be removable, so the vehicle can be used for other purposes. Other forms of non-slip surfaces such as grass or sawdust are not suitable. Additional balance for animals is provided by partitioning the interior of the vehicle with either wood or metal poles or solid boards. Broken floors will cause leg and other injuries. Vehicle floors should be level with off-loading platforms; otherwise animals will injure themselves climbing off or be manhandled in order to remove them.

**Floor space**: Livestock require sufficient floor space so that they can stand comfortably without being overcrowded. Overloading results in injuries or even death of livestock. Allowances should be made for breed and body size. If the floor area is too large for the number of animals, partitions should be used to avoid animals being thrown about.

**Sides:** The sides of vehicles should be high enough to prevent animals, particularly pigs, from jumping out and injuring themselves. Insides could also be padded at hip level with old tyres to reduce bruising of cattle. Also there should be no gaps through which a leg might protrude and be broken. Narrow entry doors can lead to considerable bruising of hips.

**Roof**: A roof is not necessary on a transport vehicle for bovines and small ruminants provided the animals are not exposed for hours in the hot sun. Vehicles for pigs should have roofs unless the pigs are to be transported in the early morning or late evening. Poultry should be protected from sun and rain. Transporting in cages or crates will protect them from physical injury. They should be large enough to allow all the birds to sit down and move their heads freely. Ventilation should be adequate. At the small-scale level in more primitive conditions animals are often transported under very unsuitable conditions, which may cause a great deal of pain or even death through suffocating, heat stress, dehydration etc.

**Pre-loading precautions**

There are a number of simple procedures that can be implemented prior to the loading of livestock, which will considerably reduce the risk of injury and stress.

1. No animal shall be transported unless it is fit for the intended journey, and all animals shall be transported in conditions guaranteed not to cause them injury or unnecessary suffering.

2. Animals that are injured or have physiological weaknesses shall not be considered fit for transport and in particular if:

(a) They are unable to move independently without pain

(b) They present a severe open wound

(c) They are pregnant females in the last stage of the gestation period or females who have given birth in the previous week

(d) They are new-born animals whose navel has not completely healed.

(e) They are pigs of less than three weeks, lambs of less than one week and calves of less than ten days of age, unless the distance is less than 100 km.

3. When animals fall ill or are injured during transport, they shall be separated from the others and receive first-aid treatment as soon as possible. They shall be given appropriate veterinary treatment and if necessary undergo emergency slaughter in a way which does not cause them any unnecessary suffering.

4. Sedatives shall not be used on animals to be transported unless strictly necessary to ensure the welfare of the animals and shall only be used under veterinary supervision.

5. Lactating females of bovine, ovine and caprine species not accompanied by their offspring shall be milked at intervals of not more than 12 hours

6. Pre-mixing of cattle or pigs leads to greater familiarity and less cases of fighting among animals. Cattle should be mixed in a pen 24 hours before loading. Fighting amongst pigs that are strangers is common, resulting in skin damage, wounds and stress. Pigs from different pens should be mixed together before loading. It is also advisable to smear pigs with litter or excreta from the same pen so that they smell similar.

7. Most animals can be fed and watered before transporting. However pigs should **not** be fed before transport as the feed ferments and the gas causes pressure on the heart in the thoracic cavity, leading to heart failure and death.

8. Do not mix horned and hornless animals in the vehicles as this causes bruising and injury. Different species should also not be mixed but sheep, goats and calves under 6 months can be mixed. Pigs should not travel with other species unless separated by a partition. Bulls should not be carried together with other stock unless separated by a strong partition.

9. Vehicles should be fitted with a portable ramp to facilitate emergency offloading in case of prolonged breakdowns.

**The welfare of Animals during transportation**

A number of factors must be taken into account during the journey so that the animals do not suffer, become injured or die.

1. Trekking—Only cattle, sheep and goats can be successfully moved on hoof, although certain risks are involved. The journey should be planned, paying attention to the distance to be travelled, opportunities for grazing, watering and overnight rest. Animals should be walked during the cooler times of the day. The maximum distances that these animals should be trekked depend on various factors such as weather, body condition, age etc., but the distance given in Table 1 should not be exceeded when trekked.

2. Time of the day—High environment temperatures will increase the risk of heat stress and mortality during transportation. It is important to transport animals in vehicles during the cooler mornings and evenings or even at night. This is particularly important for pigs. A combination of high humidity and high environment temperatures is especially deadly to pigs. Heat can rapidly build up to lethal levels in a stationary vehicle. Wetting pigs with water will help keep them cool.

3. Duration of journey—Where possible, journeys should be short and direct without stoppages. If the vehicle stops, pigs will tend to fight. Cattle and sheep/goats should not travel for more than 36 hours and should be offloaded after 24h for feed and water, if the journey is to take longer than that. There are recent moves in developed regions, seeking to limit the duration of livestock transports to 8 hours or less. Animals should have access to frequent drinks of water during long journeys, particularly in hot and humid conditions4. Driving—Vehicles should be driven smoothly, without sudden stops. Corners should be taken slowly and gently.

5. Wind—Wind blowing on wet animals being transported in cold weather causes a wind chill factor, where the body temperature is considerably reduced, resulting in severe stress or deaths.

**Animal welfare at abattoir**

The obligation in the conversion of food animals into edible products and useful by-products is to slaughter the animal in a human manner and to process the carcass in a hygienic and efficient way. At the time of slaughter, animals should be healthy and physiologically normal. They should be rested overnight particularly if they have travelled over long distance. However, pigs and poultry are usually slaughtered on arrival as time and distances travelled are relatively short and holding in pens is stressful for them. Animals should be watered during holding and can be fed, if required. The holding period allows for injured animals to be identified and for sick animals to be quarantined. When ready for slaughter, animals should be driven to the stunning area in a quiet and orderly manner without force. Animals should never be beaten nor have their tails twisted, in the case of stubborn animals, prodders can be used occasionally. Animals should be led in single file into the stunning area where they can be held in appropriate restraining device(s) before stunning.

**Restraint devices**

It is very important that slaughter animals should be properly restrained before stunning or bleeding. This is to ensure stability of the animal so that the stunning operation can be carried out accurately and properly. Different types of restraints are appropriate for different species:

**Cattle:** A stunning box is the most common method of restraining cattle. The size of the box should be just wide enough to prevent the animal from turning around. The floor of the box should be non-slip.

**Sheep/goats:** A properly constructed metal stunning box is appropriate. However, they can be restrained manually quite satisfactorily.

**Pigs**: A stunning box is suitable for pigs. Putting a few pigs in a small room is suitable but only for electrical stunning. On no account should pigs be restrained manually.

**Poultry:** Chickens are shackled by their legs onto a conveyor line. This must be done gently to avoid injury and stress

Animals should never be left standing for a prolonged period in a restraint device and must be stunned immediately after being secured. The operator must be adequately trained and supervised. In some countries, people who handle and stun animals have to be trained and licensed.

**Stunning methods**

It is desirable to render an animal unconscious before it is slaughtered in order to eliminate pain, discomfort and stress from the procedure. Most developed and many developing countries have legislation that requires pre-slaughter stunning, with the exception of authorized ritual slaughter like Kosher or Halal. In some circumstances, traditional slaughter may be exempt from pre-slaughter stunning.

Whatever the stunning method, the animal should be rendered unconscious for long enough so that bleeding results in enough loss of blood to cause death from lack of oxygen to the brain (cerebral anoxia). In other words, death should occur before the animal would have regained consciousness after stunning, had bleeding not taken place.

There are three main technologies used to effect stunning—Percussion, Electrical and Gas. Only the first two are commonly used in developing countries.

**1. Percussion stunning**: - This method produces a physical shock to the brain.

a. Captive bolt: This method works on the principle of a gun and fires a blank cartridge and it propels a short bolt (metal rod) from the barrel. The bolt penetrates the skull bone and produces concussion by damaging the brain or increasing intracranial pressure, causing bruising of the brain. The captive bolt is perhaps the most versatile stunning instrument as it is suitable for use on cattle, pigs, sheep and goats as well as horses and camels, and can be used anywhere in the world. There are several different manufacturers of captive bolt pistols, and after the initial expense, running costs are minimal. Users must ensure sufficient supply of cartridges, which may be different in caliber for stunning guns from the different manufacturers.

Another type of bolt has a flat, mushroom end, unconsciousness is achieved through percussion by strong blow to the skull. The brain is not penetrated, and as the animal is not killed, it is a method that is acceptable in many countries for Halal slaughter. When in use, the captive bolt is positioned on the correct spot on the animal’s head. Poor maintenance is a major cause of poor stunning and the guns must be cleaned and serviced regularly, according to the manufacturer’s instructions.

b. **Electrical Stunning**

Electrical stunning induce epileptic state in the brain. This state should last for long enough for bleeding to be carried out so that the animal dies from cerebral anoxia. A low voltage alternating electric current is applied by means of two electrodes, which are placed on either side of the brain using tongs. Since the brain of animals is small, the electrodes should be accurately and firmly placed high up on the sides of the head in sheep, goats and pigs.

Another way is to place one electrode under the jaw and the other on the side of the neck behind the ears. This type of head-only stunning is reversible and the animal will regain consciousness. For this reason, stunned animals should be bled **immediately** after stunning. Irreversible stunning causes cardiac arrest. Here a third electrode is placed elsewhere on the body. Electrodes are applied in the form of tongs. They should never be placed on sensitive areas such as the eye, inside the ear nor rectum. The tongs are placed either at the sides of the head below and behind the eye or above and below the head. Poultry can be stunned electrically using a manually operated device or using an automatic water bath. Here birds are dragged through a trough of water that is charged with a low voltage current.

New Zealand and some other countries have developed modern methods for electrical stunning of cattle to overcome these problems, in particular for beef exports to some Muslim countries or for installation in slaughterhouses in Muslim countries

**Tongs for electrical stunning of sheep or goats**

The Ranguiru system is a modified electrical stun, which is applied to Western-type cattle slaughter, where the animal is stunned through the brain and the heart stop beating. It is not accepted as Halal by Muslims.

The Wairoa process is a slaughter technique developed in New Zealand, which involves an electrical head-only stunning. This renders the animal insensitive to pain but able to recover if the slaughter cut is not made. The heart remains beating. The system is humane, safe for workers and generally accepted as Halal by Muslims

**Religious or ritual slaughter (Halal and Kosher)**

Most developed and many developing countries of the world require by law an animal to be rendered unconscious before it is slaughtered. This is in order to ensure that the animal does not suffer pain during slaughter. However, exceptions are made for the Jewish (Kosher) and Muslim (Halal) slaughter of livestock. Here stunning generally is not allowed and the animal is bled directly using a sharp knife to cut the throat and the main blood vessels. This results in sudden and massive loss of blood with loss of consciousness and death. However, many authorities consider that religious slaughter can be very unsatisfactory and that the animal may not be rendered unconscious and suffer considerable discomfort and pain in the slaughter process.

**A number of factors must be given serious consideration before this type of slaughter is acceptable: -**

1. Animals that are slaughtered according to Kosher or Halal requirements should be securely restrained, particularly the head and neck, before cutting the throat. Movement results in a poor cut, bad bleeding, slow loss of consciousness (if at all) and pain. This has serious implications for animal welfare. The knife that is used to cut the throat and the carotid and jugular blood vessels must be razor sharp.

2. Operator competence is of great importance in order to carry out satisfactory religious slaughter, and the authorities should license all slaughter personnel. A poor technique will result in great suffering and cruelty to the animal. Religious slaughter should be carried out paying attention to detail and ensuring the method, equipment and operators are correct. The slaughter process is slow.

The captive bolt gun is suitable for this stunning when using the mushroom shaped head of the bolt. The mushroom gun is an improvement on the plain bolt, as this bolt does not penetrate the brain and cause death. This should be more acceptable to the religious authorities, and its use would encourage more humane slaughter amongst Muslims in developing countries, thereby improving animal welfare.

Fortunately, many Muslim authorities accept some forms of pre-slaughter stunning. Many Muslim authorities permit electric stunning of cattle, sheep and poultry, whose meat is destined for Muslim communities, because the animals subjected to this stunning method would recover if no bleeding was carried out. Electric stunning is also the method of choice in meat exporting countries where stunning of slaughter animals is required by law, for export to Muslim countries. Similarly, Muslim minorities in countries with strict animal welfare regulations are allowed to use Halal slaughter methods, but in combination with electrical stunning.

**Bleeding**

Bleeding is the part of the slaughter process where the main blood vessels of the neck are severed in order to allow blood to drain from the carcass, resulting in the death of the animal from cerebral anoxia. The bleeding knife should continuously be sharpened. A blunt knife will prolong the incision and the cut ends of the blood vessels will be damaged. This may cause premature clotting and blockage of the vessels, delaying bleeding out and prolonging the onset of unconsciousness and insensitivity. Incisions should be swift and precise. In poultry, sheep, goats and ostriches, the throat is cut behind the jaw. The standard method for the bleeding of cattle is to open the skin at the neck between brisket and jaw through a 30-cm longitudinal cut. Then, for hygienic reasons, a clean knife should be used and inserted at a 450 angle in order to sever the jugular vessels. For all cuts, the jugular and carotid vessels should be completely severed. If all vessels are not cut, bleeding may be incomplete, causing excessive retention of blood in the tissue, which can result in early spoilage of meat.

A minimum of delay is required between stunning and bleeding for **two reasons**:

a. A prolonged delay in bleeding may result in a level of consciousness being regained particularly where animals have been stunned electrically. For example, poultry stunned electrically may regain consciousness within 1-3 minutes. Generally, bleeding of poultry should commence within 15 seconds of stunning. For other livestock, the interval between stunning and sticking/bleeding should also be kept very short. Periods of less than one minute are desirable.

b. Delayed bleeding will result in an increase of blood pressure, and blood vessels will rupture, causing muscle haemorrhage. This extra blood in the tissue will cause the meat to decompose more quickly, resulting in waste of meat.

**Carbon dioxide gas stunning**

The use of carbon dioxide (CO2) gas is a relatively new method of stunning suitable for pigs and poultry. However, it is applicable only at large industrial plants, as the sophisticated technical equipment is relatively costly to install. Basically, animals are stunned using various concentrations of CO2 in air. Concentrations of CO2 for the stunning of pigs are at least 80% in air for 45 seconds and poultry of 65% for 15 seconds. The acceptability of this method on welfare grounds has been questioned however. For some genetic types of pigs, it may be satisfactory, and for others may be stressful. Currently Argon gas is being tested for stunning purposes. It is assumed that Argon gas may have some advantages over CO2, but the costs may be higher.

**Animal Products:** These are the produces obtained from farm animals for the purpose of human needs. Table 1.1 shows the species of farm animals and their respective products.

**Table 1.1 Animals and their Productions:**

|  |  |
| --- | --- |
| **Animal** | **Products** |
| Poultry  Cattle  Sheep  Goat  Pig  Rabbit  Snail  Grass cutter | Meat, eggs, feathers  Meat, milk, skin  Meat, wool, skin  Meat, milk, mohair  Pork, lard, skin  Meat, pelt and skin  Meat  Meat |
|  |  |

Animal products have some deficient characteristics which include:-

1. Easy spoilage
2. Ease of contamination and causing infections
3. Transportation and distribution difficulties

**Preparation for Slaughtering in farm Animals**

i **Fasting**: The first step is to fast the animal by withdrawal of feed 24hrs before slaughtering. Starving the animal ensures that the bowel is emptied and meat is prevented from faecal contamination, promotes easy dressing and ensures free and complete bleeding.

ii **Slaughtering**: This is the act of killing the animal it can be done by

a Use of stun gun. This will render the animal unconscious making slaughtering painless and ensuring complete removal of blood. Chemical and electrical stunning can be done.

b. Use of knife to sever the jugular vein in the throat. It is recommended that sharp knife (if possible, pass the knife over flame) should be used to slaughter the animal.

c. Sticking: inserting sharp knife in the breast or brisket at angle 450 and cut off the carotid arteries and jugular veins.

i . **Dehairing:** Thus is the removal of hair especially in pigs.

**ii. Cutting**: A cut is made towards the foot of the animal from where it is blown, usually the point where cuttings had been made are tied.

iii. **Scalding**: Hot water is poured on the skin and a sharp knife or razor blade is used to scrape the hair in some cases, dehairing of cattle, sheep, goats, pigs and rabbits are achieved through the use of direct flame. However the use of tyres to singe animals is unhealthy as soot from tyre is casinogenic (causes cancer).

**iv. Defeathering**: This is the removal of feathers from birds, the steps involved are:-

a. Scalding by the use of boiled water, if defeathering is manual, immerse the bird in boiled water and cold water intermittently and then pluck the feathers.

b. Feather removal can be manual or mechanical.

**v. Evisceration:** This is the removal of intestine, lung, liver, gall bladder, crop and gizzards from the carcass.

**vi. Carcass Washing:** This procedure cleans the carcass from blood and other stains.

**vii. Cutting:** Cutting of Carcassinto parts arms, rib, blade, skin, sirloin, leg and breast.

**Viii. Snail:** Are dipped in boiled water to free the flesh from the shells after which the flesh washed with lime juice to remove the slimly material and then it is thoroughly washed with clean water, the shell of the snail could also be broken by a hard object, after which the snail flesh is evacuated and washed with lime juice.

**Carcass:** This is the body of a slaughtered animal for the purpose of human consumption. Carcass is obtained after the removal of external and internal offal (gut, gizzard, liver, lung, skin legs and head).

**Carcass Dressing Percentage (CDP):** is expressed as the ration of the dressed Weight (DW) to the Live Weight (LW) of the animal and value obtained expressed in percent.

i.e DP = DW x 100

LW

For example, if a West African dwarf goat of 45kg live weight has a carcass weight of 25kg, what will belts carcass dressing percentage.

DP = 25 x 100 = 55.6%

45

The dressing percentage is a function of the contents of gut, the nutrition of the animal, the weight of the hide or skin and the state of health of the animal.

**Processing and Cares of hides, skin and wool**

1. **Skin:** The skin is the thin layer of tissue forming the outer covering of the body of an animal e.g sheep and goats.
2. **Pelt:** Is the skin of an animal with the fur, wool or hair still on it.
3. **Hide:** Generally applied to the undressed skins of domestic animals such as cattle, horses, camel etc, the process of obtaining skin is to flay the animal immediately it is slaughtered, and stretch the skin on a board. Rabbit pelts are used for decorations, made into ornament toys, mats and keys holders. It can be used to make stuffed rabbits for children’s toys. Skin of goat is use for the taking drum. After flaying, the skin is stretched out, while the wood ash is rubbed on the surface and allowed to dry.

**Lather Production:** Leather is the production of hide and skin of animals to make leather, the hide and skin are tanned and processed to fashion for the market. Depending on the desired types of the final product the hides undergo a wide variety of processing steps.

**Tanning:** Is the process of carried out to stabilize hide and skin against degeneration from biotic and environmental effects.

**Tanning process include**

1. **Wetting and soaking:** enzymes might be added to speed up this process.
2. **Liming:** calcium hydroxide and sodium sulphide are used to remove the upper epidemis i.e upper layer, hair etc.
3. **Deliming:** Neutralizing the lime by adding a mild acid e.g lactic acid, boric acid.
4. **Degreasing:** Removal of fat especially on sheep skin using organic solvents.
5. **Pickling:** This is loosening the skin in slats and acid solution (Hcl or H204, Nacl.) to create avenue for tanning agents to work on.
6. **Tanning proper:** Chromium III salts or aluminum salt or Soda are use as tanning agents.
7. **Washing:** This use of water to the hide
8. **Dyeing:** to give required colour.
9. **Fat Liquoring:** To give smoothness, toughness and . It is achieved by adding lubricating fats.

**Ponmo:** This is the hide of cattle processed for human consumption; it is relished and very popular in the Southern States of Nigeria. The hide, after removal is thoroughly roasted. It is then cut into smaller piece and soaked in water. But it is a low nutritional value. Nigeria stands to gain huge foreign exchange from the export f hide instead of tanning hide into food. The processing of cattle skin into Ponmo should be therefore discouraged.

**Processing and Storage of Meat**

Meat quality: Ten major areas that have direct influence on meat quality

**Farm Management**

1. Age of animal
2. Management systems
3. Nutrition

**Handling and Slaughters Technique**

1. Handing prior to slaughter
2. Slaughter techniques
3. Cold chain during slaughter

**Storage, Distribution and Display**

1. Storage and Maintenance of the cold chain during distribution
2. Storage and display life
3. Method of display

**Hygiene**

1. Hygiene at all stages

**Farm Management**

1. **Age of the Animals** 
   1. **Influence of age on meat quality**

It is a well-established fact that the older an animal the tougher the meat. For this reason main stream livestock industries have established grades and/or names to account for the age of the animal. They have also established means for determining the age of the animal. Depending on the space it may be teeth development, degree of bone ossification or similar. Provided the animal meets the basic health criteria all meat is fit for human consumption, with different ages having different price structures.

1. **Management system :**

It is well known that range grazed cattle or sheep produce a different quality meat than their feedlot raised counterparts. However, the main reasons for differences in meat quality, uniformity of carcass and taste is nutrition based as the diets fed vary significantly between the systems.

* 1. **Farm System:**

Most range grazed cattle or sheep these days will be fed vitamin and mineral supplement fees which vary from a few vitamins and/or minerals to protein, energy and vitamin and mineral supplements that are balanced to match the estimated intake of the grazed material. The more intensive the system, the greater the control of a balanced feed intake, therefore the greater degree of high meat quality predictability. The variations in carcass and meat quality are taken care of by the carcass and meat grading systems and yield grading systems in place for the relevant specie. Similar variations are seen with poultry dependent on the management systems used.

* 1. **Stress:**

It will affect meat quality by affecting meat characteristics. Also trauma or any accidents (farm design, fences, spaces, adverse bird handling and other stress related factors) many caused Oedema or “jelly” substance on heart, thing or sternum which will affect carcass grade.

* 1. **Vaccination Program, antibiotics and hygiene**

Any evidence of disease symptoms in a carcass will affects its grade. Observing proper withholding times after vaccination and antibiotic injections is important to avoid residue in meat after slaughtering.

1. **Nutrition:**

The influence of nutrition on meat quality is well documented and never disputed with all species. Advanced nutritionists will tell you that the basics of livestock nutrition are the same for all specie – the skill comes in identifying the unique requirements and tolerances as they apply to each species. Increasingly discerning consumers, the influence of the globalization of agriculture, the increasing influence of supermarkets and marketing chains looking for absolute consistency have seen significant developments, over the last thirty years, in nutritional technology being used as a mechanism to improve meat quality. Taste, tenderness, Aroma, Color and uniformity are all affected by nutritional factors. Slow growing muscles will be less tender that an animal that grows muscles more quickly. It is important to differentiate between nutrition that “force” certain factors that may be considered “against nature” as opposed to “quality nutrition” that enables the species to develop naturally to the full genetic potential. The economic benefits to producers for achieving greater meat yields and earlier slaughter ages are also well documented in all species as being controlled by nutrition.

**Handling and Slaughter**

1. **Handling Prior to Slaughter**

Minimizing stress at all stages of production is continually emphasized and extremely important as it is associated with DFD (Dry Firm Dark) Meat and long term stressed animals result in high PH levels in the meat. However care needs to be taken to ensure that the method an animal has been raised has been taken into consideration as diet also impacts on both the consistency of the meat as well as the ability of an animal to handle stress.

Animal are generally brought to the slaughter plant the day prior to slaughter. Every effort needs to be made to ensue as stress free transport as possible. It is important that they have water available and protection from the elements.

1. **Slaughter Techniques:**

Factors that Influence meat quality during the slaughter process are:

* Method of stunning and/or kill
* Handling of animals post stunning/kill
* Whether animals is killed prior to bleeding or stunned prior to bleeding
* Speed and degree of bleed out.
* Muscle stimulation post stunning (now believed to have a negative impact quality)

1. **Cold Chain during Slaughtering and Processing:**

The influence on meat quality on maintaining the cold chain during slaughter and processing is bacterial.The faster the carcass is chilled, the greater the ability to control bacterial growth and therefore extend the shelf life. from a bacterial viewpoint some slaughter plants have all activities on the same floor, - EU and some other country regulations specify that slaughter, defeathering, deskinning and evisceration are all carried out in separate sections to minimize risks of cross contamination with these operations are separate, the cooling down process usually commences with the deskinning. This also has the advantage that the carcasses have cooled considerably by the time they enter the Chiller.

It is the general aim to chill the muscles to below 4oc degrees centigrade prior to deboning, where processing carried out with sufficient speed that the muscles temperatures do not rise above 4 degrees centigrade before returning to the Chiller or being blast frozen.

**Storage, Distribution and Display:**

1. **Storage and Maintenance of the Cold Chain:**

This area is one of the toughest areas to control in view of the fact that the distribution chain required dependency on freight haulers and is out of the direct control of the processor. Airlines will provide no guarantees. Certain trucks will turn off their refrigeration to “save” on fuel. The meat may take time to put into the display cabinet and so on. It is well documented that bacteria growth increases rapidly once the temperature of the meat rises above 4 degrees centigrade. In Europe if the meat temperature exceeds 4 degrees centigrade it is no longer allowed to be sold.

1. **Storage and Display Life:**

There are many methods of storing and packaging and these will influence the quality. Individual companies will need to investigate the best methods available to them for the particular market that they are serving and what is available to them in their own region. It needs to be understood that the nutrition qualities of the diet fed to any animal has a direct impact on the quality, color and display life of the meat. If adequate nutrients are provided in the diet, this can have a significant and positive impact on the meat quality, colour and display life .

1. **Method of Display:**

Meat can be displayed either frozen, fresh packaged or fresh in display cabinets with no packaging. Frozen clearly provides the greatest shelf life so long as the display freezers are maintained at the correct temperatures. The method of packaging can influence the shelf time of display when packaged. The method of packaging can also have a significant impact on display shelf life with the displays without packaging probably having the shortage shelf life. The meat should have a similar shelf life to other meats if:

* Temperatures are maintained correctly to minimize bacterial growth
* Slaughter techniques have been correct to minimize the stress.
* The pH levels are correct\
* Bacterial contamination has been kept to a minimum
* The cold chain has been maintained

**Hygiene**

1. **Hygiene at all Stages:**

Bacterial growth could probably be considered the Number one enemy to extended meat life and maintaining quality. HCCP – Hazard Critical Control Point – Systems are compulsory now in many regions – but whether or not they are compulsory, a good HCCP system should be implemented as part of a quality control program. All points of possible bacterial contamination need to be indentified at all stages of the slaughter and processing procedure. Controlling the pH levels of the meat, as well as correct maintenance throughout the cold chain, is instrumental in controlling bacterial growth. It is worth noting that meat must be free of pathogenic organisms (salmonella for example) and their toxins.

**Meat Handling Storage and Transportation**

**Refrigeration of Carcass:** Carcass should go into cooler as soon as possible and should be as dry as possible the objective is retard bacterial growth and increase shelf life of carcass, chilling meat, post mortem from 400c to 00c and kept it cool will give a shelf life of up to 3 weeks provided high standard of hygiene during slaughter and dressing is achieved, carcass most be place in cooler immediately after weigh they most hang on rays and never touch floor, after several hours the outside of the carcass could be touch, the most important things is the internal temperature to be cool. Temperature will be measured with a proper thermometer the range of the temperature will guide you to the rate of cooling, the rate of cooling varies with different factors.

1. The efficiency of color
2. The load
3. The carcass size;

As the general guide a deep muscle temp of 6 - 70c should be achieved in 26-36 hours of beef, 12-16 hour for pig and 13-30 hours for sheep carcass. Failure to bring the internal temperature quickly will result in rapid multiplication of bacterial deep in the meat and resulting in off-odor and bone taint, high air speed is need for rapid cooling but will lead to increases weight loss due to evaporation unless the relative humidity is high, however if the air is near the saturation point 100% relative humidity, then condensation will occur on the carcass surface, favoring mould and bacterial growth. Condensation will also occur if warm carcass are placed in the cooler partial filled with cooled carcasses, the cooler should not be over loaded beyond the maximum load specified by the manufacturer and space should be left between the carcasses to allow air circulation. Otherwise cooling should be inefficient and carcass surface will remain wet forming a slime, when filled a cooler should be closed and a door open as little as possible to avoid sudden raising in temperature, when empty a cooler should be clean before refilled personal hygiene during handling and uploading should be emphasize especially as handling through loading and uploading.

**Marketing of Meat under Refrigeration**

Chilled meat should be kept cool until its sold if the cool chain is broken condensation is formed and microbes growth rapidly, an ideal temperature for freezing of meat is just above the freezing temperature (-10c) and -30c for bacon (salted fork) the expected storage life give by international institute of refrigeration of various types of meat held at these temperature is as fallow;

|  |  |  |
| --- | --- | --- |
| **S/n** | **Types of Meat** | **Expected storage life at -10c** |
| 1.  2.  3.  4.  5. | Beef  Veal  Lamb  Pork  Edible offal | Up to 3 to 5weeks with strict hygiene  1-3 weeks  10-15 days  1-2 weeks  4 weeks (at 30c) |
|  |  |  |

Under commercial condition meat temperature are hardly kept at -10c to 0c actual storage are less

Than expected. The time will be reduce if relative humidity where greater than 90%, meat should be placed in the refrigeration immediately following received. You should trimmed and destroy any part that shown sign of maid growth and bacterial slimmer, hand must be thoroughly washed after handling such trimming and knife most be sterile in boiling water.

**Transportation of Meat:** Vehicle for transporting meat and carcasses should be consider as extension of refrigeneration storage in order to achieved cold chain the objective must be to maintain a meat temperature at 00c. Meat should be chilled to 00c before loading. Meat should be hang on rays not floor, meat truck should not be carry anything only meat.

**Carcass and meat handling without refrigeneration**

Where refrigeneration is unavailable due to financial and technical reason the shelf life of meat should be reduced to days or hours, slaughter and dressing should be near the selling point and must be quick and clean if carcass and meat are kept in well isolated room the temperature can be reduce with dry ice block, if these are available. Stock must be handle careful to avoid producing high PH. Room use for slaughter and handling meat should be clean and well ventilated but out of direct sunlight, dust free and vermin free, hot water 82oc must be available for clean all equipment and surface and personal most work very hygienically. You must receive all blood unto sieved container and provided separate skip on wheel for hooves, skin, green offal and trimming. Dressing on a vertical moist will be minimizing a contamination left nothing drops on the floor only into skip. Red offal must be away from meat handling facilities, intestine for human consumption must be thoroughly wash and clean.

**Storage and Transportation without Refrigeration**

Meat should be put on sale within any day, if it has to be held should be hang on the rays on the well linter, well ventilation, insect, rodent must be kept out, trace of offal should be on shelf not on floor, barrow for wheeling meat and carcass are better in use than shoulder. All staff must wear clean clothes and observed stick personal hygiene.

**Meat Processing:** Processed meat is meat which has undergone grinding, seasoning, color change, heat treatment, smoking, salting or a combination of some of these processes**.** Meat processing technology in Nigeria is grossly under develop, in spite of the large number of animals resources. This has resulted in a shortfall in animal protein intake in country. Dried meats and meat products, including dried fish constitute a significant proportion of processed animal protein today in Nigeria. The demand for meat and other animal product is estimated at 8-10% per annum. The national average beef intakes are well below 10kg/head/annum much below the levels recommended as adequate..Ordinary, fresh meat may be processed using techniques such as curing, canning, cooking, freezing, drying/smoking or the use of safe additives.

Example of processed meat;

1. Minced meat
2. In cooked whole meat product e.g salted meat
3. Uncooked ground meat product
4. Cooked whole meat canned meat, smoked meat
5. Corned beef
6. Meat floss
7. Roasted meat, Kilishi, Suya.

**Some Important of Non-meat ingredient for meat Production**

1. **Salt:** Is important ingredient in preparation of meat emulsion for infecting a typical flavor and for preventing a meat quality, a salt contend of most processed meat range 2.5 – 5% of final product a high salt content will produce as salting product to function as preservative, salt concentration in the product of about 17% is necessary.

2.**Nitrate and Nitrite** are curing agent the development of red pink color is the most obvious effect, in addition nitrite affect the flavor of the product through their action as antioxidant, they have bacteriostatic properties e.g sodium nitrate is an effective inhibitor of *clostridium bacterium*.

3.**Extenders:** They are added to lower quality product for economic reason, some of them improve binding properties in cooking, e.g are dried skimmed milk and milk protein, various cereals flour such as Oat, corn, rice and soybean product most extender are limited in 3% in dried stage or 10% after swelling.

4. **Seasoning:** Is a comprehensive term for ingredient with improved the flavor of processed meat salt and pepper formed the foundation upon which all the formulae are formed other ingredient such as spices herb are supplementing although are negligible, spices are aromatic substance of vegetable origin and include ginger, garlic, clove, pepper etc .

**Traditional Processing of meat products**

**Banda:** Banda is generally produced by subjecting the meat to heat and smoke and in few instances the meat may be precooked before treatment with smoke and heat .The meat used for this types of products if from beef, lamb, goat or chicken, such products may have a self-life of a few weeks to several months depending on the method of processing, storage and packaging .The problem usually associated with Banda production includes, poor yield, poor texture, and poor packaging, others include inefficient smoking kilns and flavor problems .

**Suya Meat Products:** Suya is traditional barbecue meat products and is termed tsire when staked on to a stick, it is referred to as Balangu when the meat product is slowly cooked over a glowing flame and season to taste. The major problem with suya is that is hawked by vendors who have little or no regards for personal hygiene. The windy conditions of the environment where suya is sold some times lead to product contamination. When suya is properly prepared, it contains approximately 60% protein.

**Kilishi:** Kilishi is a sun dried, roasted meat product. A finished kilishi product consists of about 46% meat and 54% non-meat. Ingredient; has about 50% protein 18% fat, 9.6% ash and 7.6% water and can be stored for over 60 weeks .

**Fish Processing technology:**

Processing of fish in Nigeria is essential due to the lack of infrastructure for the handling and marketing of fresh fish. Fish processing is employed to preserve fish for all types of market including distant markets. Different processing methods are employed but in many countries in Africa, processing methods are employed and efficiency especially during the glut period.

**Natural Drying:** Fish can be dried in the sun by using the sun’s energy to drive the moisture out. If they are very small they can be left whole, otherwise they should be split to increase the surface area sun drying has a number of disadvantages but the main advantage is that the energy is free. The sun’s energy is also used and solar driers and black box drying but these systems is usually only used experimentally).

**Mechanical drying:** Traditional drying by sun and winds is slow and at the mercy of the weather. With mechanical drying it is possible to control the temperature, humidity and air flow but fuel, e.g. electricity or oil, which is very expensive in many countries, is required to run the heaters and the fans.

**Smoking:** In many tropical areas fish are smoked over open fires or in simple kilns in order to accelerate the drying process. If the relevant humidity is high and salt is scarce, hot smoking, where the fish is cooked (and often charred), is the only method of preserving fish-wood or some other locally available combustible product is used.

**Salting:** Salting is often in conjunction which drying and smoking, if salt is rubbed into the flesh of the fish are placed the water is removed and salt passes into the flesh. As most bacteria cannot grow in salt concentrations above 6 percent, salting will therefore reduce bacterial action. **Canning:** The fish are subject to high temperatures to kill the bacteria and inactivate enzymes. Once the bacteria and enzymes are inactivated, the product must be protected from further bacterial contamination by being hermetically sealed within the can. The inside of the can must be resistant to its contents and the outside resistant to ambient conditions. Canning operations are generally successful only on a large commercial scale for species such as, sardines etc

**Factors affecting shelf life of meat and meat Product**

Though meat handling storage and preservation differ from one place to another the factor affecting are the same. There are endogenous are exogenous factors

**Endogenous Factors**:

PH value or the degree of acidity of product

The amount of water moisture available

**Exogenous Factors:**

Oxygen – sources of air

Microorganism

Temperature

Evaporation

**Milk processing and microbiology**

**Milk microbiology:** Bacterial growth is an increase in bacterial cell number rather than an increase in bacterial cell size. Generation time is the time taking from cell formation to cell division, bacterial growth can be categories into following phase:

1. Lag phase
2. Log phase
3. Stationary phase
4. Death phase
5. lag phase (adaptation)
6. Log phase (domination)
7. (depletion)
8. Death

(Phase)

0 a b c d time

1. **Lag Phase:** There is usually some delay in growth following inoculation of bacteria into a new medium. During this time the bacterial adapts to a medium and synthesize the enzymes.
2. **Log Phase:** Once the adaptation is over the bacteria start reproduction and their number kept multiply in geometric progressive. The bacterial cell is very active because of mitosis.
3. **Stationary Phase:** There is waste accumulation in this phase and the waste reaches toxic level with bring abort death.
4. **Death Phase:** There is cessation of cell formation and existing cell gradually die up.

**Factors Affecting Bacterial Growth:**

1. Temperature
2. Water supply
3. Nutrient availability
4. Oxygen supply
5. Acidity
6. **Temperature:** Bacteria can grow at all temperature from freezing point of water ,they can be classified as psychophysics they are cooled blooded and grow < 160c, theomorphic which growth temperature > 400c.
7. **Nutrient Bacteria:** bacteria need nutrient for their growth some need more nutrient than other some have specific required e.g Bacilli has lost the ability to synthesize nutrient than other e.g lactobacilli that has lost the ability to synthesize some component. Pseudomonas can synthesis nutrient from the very basic ingredient. Bacteria feed on organic matter.
8. **Acidity:** Bacteria that can tolerate low pH are called aciduric bacteria e.g lactic acid bacteria in milk which produces lactic acid and can close until pH of milk fall below 4 - 60c hence the bacteria die up.

**Bacteria in Milk:** Milk that is fresh from healthy cow contained few bacteria but contamination during handling. Milk is an ideal food therefore is a very good media for bacteria growth. Some bacterial are useful in the production causing milk to go sour naturally e.g Nono however can also carry pathogenic bacteria such as *Salmonella, Brucella.* Other bacteria can cause spoilage of milk e.g mould, yeast.There are several way of entry of bacteria into milk, e.g through, Cow, Air, Milk handling equipment once bacteria get into milk their number increases rapidly.

**Milk Pasteurization:** This is a process of heating a food which is usually liquid e.g milk to specific temperature for a specific length of time. This is most common process to destroy bacteria in milk, the milk is heated to a temperature sufficient to kill pathogenic bacteria pasteurization kill must pathogenic organism and extend the storage ability of the milk. Numerous time and temperature combination are recommended but the most usual is 720c for 15 second, following rapid cooling to below 100c, this is normally referred to the high temperature short time process, it is carried out in continuous process using a plate heats exchanger.

**Batch Pasteurization:** (low temperature and high time) this is use where milk quality is too small to justified the use of plate heat exchanger in batch pasteurization fixed quantity of milk are heated to 630c and hold at that temperature for 30 minutes, then the milk is cool to 50c. Longer time is required to complete the process.

**Importance of Pasteurization on Milk**

1. It is aimed at reducing the number of viable micro-organism e.g *brucella, salmonella, luteria, mycobacterium bovis.*
2. This process slows spoilage caused by microbial growth in the milk.
3. Pasteurization improves consumer safety.
4. It is improves shelf life of food i.e milk stores for a longer period.

**Effects of Pasteurization on Milk**

Pasteurization reduces the cream layer since some of the fat globules membrane are denatured, pasteurization inhibit the clustering of fat globules and consequently reduces the extent of creaming, however pasteurization does not reduce the fat content of milk though it reduces the quality of cream layer. It has little effect on the nutritive value of milk, the major nutrient are not altered, however there is loss of vitamin C and Vitamin B. fortification can solve the problem.

**Milk Sterilization:** In pasteurization, milk receives heat treatment to reduce the numbers of bacteria present. In sterilization milk is subjected to severe heat treatment that ensure almost complete destruction of the microbial properties. The product is then sold commercially. Time/temperature treatment of above 100c for 15- 40 minutes are used. The product has long shelf life than pasteurization milk.

**Milk Hygiene:** Milk is sterile when secreted into uninfected udder contamination occur during and after milking. Use mastitis control routine at each milking to reduce the proportion of infected cow and clinical mastitis cases. Avoid contamination by good housing, wash udder and treat prior to apply milking cups, use paper and towels for washing and drying.

**Udder Infection:** The essential requirement to maintain udder free from infection. E.g mastitis, manage the cow so that their udder and teat are clean. milk them in such a way that minimize bacterial contamination store the milk in clean container as possible at temperature with discourage bacteria growth until collected.

**Other Sources:** Under normal grazing condition cow udder will appear clean and therefore washing and dry will be unnecessary otherwise any visible dirt will be remove using clean water, individual pepper toil, with cloth and disinfected is added. Milk equipment must smooth, clean and disinfect the ancillary equipment, cooler, milkers using hot detergent and disinfecting solution.

**Milking Premises:** The milking premises should have a dry and suitable place equipped with a pipe of hot and cool water and washing trough, brushes, and work surface, storage rays and cardboard if necessary a vacuum pipeline connection in addition it is advisable to a diary thermometer with has a range of 00 - 10c.

**Daily Routine:** For cleaning and disinfection varies with a size and complexity with the milking installation both will include method of removing dirt and milk from the equipment then follow by disinfecting. It is important that any method of cleaning the equipment must drain as soon as possible.

**Principle of Cheese Making:**

Cheese: is a preserve of two insoluble constituents of milk, casein, which provide the framework and the fatty material present in variable proportions. The manufacturing process consists mainly of the following phases.

1. Coagulation
2. Curd separation
3. Moulding
4. Salting
5. Maturing (which produces, the rape cheese through the use of lactose, rise in pH, loss of water and proteolysis and lipolysis.
6. **Coagulation of Milk:** Is the process of precipitating and demineralized casein. This is achieved by
7. **Acidification of milk:** by addition lactic acid or other acid at pH 4 to 6.5. This method is widely used in eastern Mediterranean cheese making and produces a crumbly crud.

**2. Coagulation using of resin or another coagulating protease:** The protein casein is hydrophobic and insoluble, after hydrolysis by the resin it migrates. The enzymatic occur at various temperatures, (from 0-500C). The presence of ionized calcium is essential Resin contains chymosin + pepsin some sources of plant resin are also used and include:-

* Sap of unripe fruit
* Giant purple thistle
* Nettle extract
* Extract of Israel pumpkin
* Sodom apple leaf extract
* Castor seed extract

The pH range at which vegetable enzymes react very widely and the enzymes are stable at relatively high temperature with increasing activity up to about 700C.

**Salting:** It is usually carried out by brine saturated with salt (NaCl), this could be before moulding, when the curd is drained and milled. The Nacl affects the cheese in the following ways:-

1. Protection against spoilage microorganisms
2. Drain the serum
3. Enhance cheese flavor
4. Slows down enzymatic activities
5. Slightly increase protein solubility
6. Average concentration 1-2% in some case 3-4%

**Maturation:** The disappearance of the lactose is mainly the work of the lactic fermenting agents, which form lactic acid and flavor substance and to:

1. Influence aroma
2. Protect the medium by bowering of pH to 5.0 or below.
3. Solubilization of minerals linked to casein and modification of texture.

Whole Milk

Heat treatment

Skimming (agitation)

Cream Skimmed Milk

Cream

Commercial

12-35%

Cream for

Cream Butter making (35%)

Freezing

Mix formation Pasteurization

(cream, milk, (900C/30s)

Sugar, stabilizing

Agent) Lactic starter

Maturation

Pasteurization (6-160C/5-15hrs)

Homogenisation Churning and Washing (Kneading)

Freezing (-50C) Butter Butter Milk

Hardening (-50‑C)

Ice Cream

**Composition of Cow Milk**

|  |  |  |
| --- | --- | --- |
|  | **Composition (g/l)** | **Physical state of the components** |
| Water | 905 | Free water and bound water |
| Carbohydrates lactose | 49 | Solution |
| Fats | 35 |  |
| True fats | 34 | Emulsion of fat globule |
| Lecithin | 0.5 |  |
| Non-saponitiable sterols carotene and tocophenls | 0.5 |  |
| Protein | 34 |  |
| Casein | 27 | Micellar suspension |
| Whey proteins (globulins albumins) | 5.5 |  |
| NPN | 1.5 | Colloidal state |
| Mineral Salts   * Citric * Phosphoric acid * Hydrochloric | 9  2  2.6  1.7 |  |
| Total Dry matter | 127 |  |
| Non-fat dry matter | 92 |  |
| NPN-Non protein nitrogen  Source: Alias and Lindon (1999) |  |  |

**Poultry Product:** The term poultry product refers to wide variety of birds of different species and used for birds alive and slaughtered (dressed).

Poultry include: - Chicken, Turkeys, Ducks, Geese , Guinea fowl ,Pigeons ,peafowl, Ostrich

Principle species

The chickens are classified on the basis of utility economic value and game.

Meat type, Egg type, Dual purpose, Game, Ornamental

**Major products**

Meat, Egg, Feathers

**Egg:** This is a product of poultry. An egg is a completed diet; it is only vitamin C (ascorbic acid) that is absent in as egg is 55% albumen and 45% yolk by volume of weight. Egg is rich in protein, iron and fat.

**Use of Eggs:**

1. Egg is eaten as delicacy; it can be boiled, scrambled, poached or fried as omelets.
2. People that are allergic to meat found eggs as alternative.
3. Egg is a component of other food preparation e.g cakes, pancakes, egg roll etc.
4. Albumen from raw egg is used to treat burns.
5. Egg albumen from raw egg is used to treat burns
6. Egg albumen is used for hair and facial treatments

**Egg Processing**

Inthe tropics, eggs are picked and sold directly to market or they are picked and graded before being sold unless in extreme cases of soiling from dropping in the deep litter eggs are not cleaned on the farm. In an ideal situation the following steps are taken in egg collection.

1. **Egg Cleaning:** Eggs are washed in temperature controlled water with mild detergent and PH adjustment to remove contaminants like litter, blood, grease etc. they egg are then dried to remove excess moisture prior to packing unsatisfactory.
2. **Grading:** Eggs are grumped mainly according to size a hen just coming into lay produces small-sized eggs called ***PEEWEES OR PULLET EGGS***.

|  |  |
| --- | --- |
| **Grade of egg** | **Mean egg weight range (g)** |
| Pullet egg (peewee)  Small size  Medium  Large  Extra large  Jumbo | 40  50-58  59.6  68  76.5  176.5 |

Abnormal Eggs in shape, texture and colour are graded as well as eggs with double yolk are sorted out for hatch able eggs candling is done to remove eggs with meat or blood spots (candling is not for table eggs). Cracked eggs are removed. Eggs are packed in tray of 30 eggs etc.In standard farms, the cartons for eggs are labeled, the date of lay, grade quality of eggs and other codes are printed on the pack. The egg processing operation usually separates eggs in different kinds of eggs: products, egg white, egg yolk, and several blends or mixed, the liquid egg is pasteurized (heat is applied at certain temperature and set time). The pasteurized liquid egg can be packed as a final product or further processed by passing it into a spray dryer’s plant to produce egg powder.

Strict hygiene is essential to ensure there is no contamination of the products throughout the processing the products are therefore subjected to series of tests from time to time. Best of their candling quality eggs are put in to four grades.

**AA grade:** The AA grade which when broken a have clear thick white and well rounded yolk, then grade A has slightly less freshness as shown by less spherical yolk and more fluid white the different between these two grade is usually in significant. Eggs from these two grades are good for poaching friezing and boiling, it is also good for cooking shell.

**Grade B:** grade B egg has somewhat flattered yolk and the white separate more than of grade A, they are good for scrambling or mixing in a cooked mixture the white of grade B show less stability when whipped and may be different to separate from yolk without the later being broken.

**Grade C:** Grade C eggs have flat yolks and watering, white are the only suitable for cooling in sweet mixture.

**Egg structure and composition**

The commonly consume is that of chicken and other from ducks and geese. If to look the egg structurally, the egg is oval with outer shell membrane, the space between outer and inner shell membrane is called cuticle and there is spongy layer and the inner membrane, the air sac is attached to the yolk through the chalazae approximately the hen egg weight between 40-50g of which the shell and membrane accounted for about 5-8grams, the yolk 12-18g, the white 23-24g yolk is made up a concentric layer of yellow yolk separated by this layer of white yolk there is germinal disc which appear as a light colour spot at the surface layer, this where the growth begin when egg is fertilizer, the course layer is dense and continues into a top white strands that hold the yolk into a few suspension, this top white strand is a chalazae, the second layer is there and fluid and it is surrounded by third layer which is jelly the transparent for combining the white of an egg is usually divided into two, thick and thin layer and the proportion of thick to thin layer is varies from egg. It is very much affected by age as the temperature are in which the egg in held, the content of the egg are enclosed within two shell membrane which are levered in protecting outer shell, the outer shell it is porous enough to permit oxygen and other gasses to flow in and out of its own there is external gelatinous coating which cover the shell and it help to block bacterial and other contaminant from entry the egg. When first laid the egg is completely filled which it content that it cools down the content contract and an air space is form between the two shell membrane air space is usually located at large end of the egg and its less than 3cm in depth when first laid, however if the egg is kept for some time water evaporated from internal content and the air increase in size.

Assign Draw a typical egg structure

**Composition of Hen’s egg**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Whole egg | Vitellus (York) | Albumen (white) | Shell |
| Weight/g  Composition  (g/100g) | 60 | 18 | 36 | 6 |
| Water | 66 | 48 | 87 | - |
| Protein | 12 | 16 | 10.5 | 2 |
| Lipids | 11 | 34 | - | - |
| Carbohydrate | 0.5 | 0.4 | 0.6 | - |
| Mineral | 11 | 1.1 | 0.7 | 98 |

Functional properties of egg

1. Coagulating capacity
2. Anticystalizing and forming capacities of the egg white.

iii Emulsifying capacity of the egg yolk

**Egg Quality Evaluation**

Changes which occur during the storage of shell eggs include:-

1. Loss in weight, due chiefly to loss of moisture from the albumen but also partly due to loss of carbon dioxide, ammonia, nitrogen and hydrogen, sulphide gases.
2. Increases in air cell size, as moisture is lost, the volume of the air cell increases.
3. Decreases in specific gravity due to increase in air cell size.
4. Mottling on the surface of the shell due to uneven moisture.
5. Decrease in the amount of thick white due to breakdown of the glycoprotein ovomucin.
6. Changes in flavor.
7. Loss of carbon dioxide and increase in pH

Assignment: Read storage and preservation of eggs

**Poultry Meat:** Poultry meat consumption has been expanding steadily by the almost 20% over the last 5 years in Nigeria there is an estimated 123,000,000 poultry managed under both extensive and intensive system. Poultry meat become available after slaughter achieved through.

1. Traditional practice: Traditional Poultry slaughters occur occasionally especial during festival. Mostly involving free range birds kept by individual families one birds are slaughtered at a time, the birds to slaughter are kept apart in the night orchard and caught when needed. The slaughter takes place in the open with the person doing the slaughter laying the bird on its side and placing one foot of the wings (to one side) and the other foot on the legs are brought together). Using the hands the head is held on the neck cut using sharp knife. The blood is allowed to flow freely a hole dug in the ground. Once bled the chick is scalded in a pot of boiling water for minutes (2-5 minutes). This looser the quill the feathers, which are hand-flocked, pin feather scorched off by holding the bird over an open fire. The dressed bird in then cut open for evisceration before carcass is cut into pieces. The legs, thighs and wings are removes first before the body is cut open from the animal apart from the intestine, no part is wasted.

**Medium scale poultry slaughter and dressing:**

Under Small scale poultry product a small number to be handled within a working day are selected slaughters. The birds are fasted overnight (12hrs) to reduced possible contamination by ingested matter in the digestive tract; improve the tenderness of the flesh. However, water is providing to prevent dehydration, which makes the skin unattractive, dark dry and scaly after dressing.

**Equipment:**

* Containers (for scalding, feather waste) giblets, bird etc.
* Clean working table
* Thermometer (to measure of the scalding water)
* Shacklers (or metal device to sink the birds by their feet.
* Rope (to suspend the birds for slaughter)
* Knives (boring)
* shears (for cleaning giblets)
* Lung scraper and
* Whetstone (to keep knives and shear slaughter during the operation.

**Slaughter:**

1. A clean processing area is selected.
2. Screen from flies with a reading source of water.
3. Birds are suspended using the shackles/ rope tied to a convenient height for support, such as ceiling hook.
4. Blood should be drained properly after slaughter, if slaughtered by cutting the neck more blood is lost compared to stunning during which 40-50% blood loss is reduced.
5. Using neck dislocation:- it quick terminates the pumping action of the heart and limits blood drains birds kill through’ dislocation may be kept in cold storage only from four weeks under -100C to 8.300C.

A modified kosher is commonly used, which severs the jugular vein just below the head the windpipe and esophagus are left. Bleeding could also be achieved by piercing through the brain to the veins at the roof of the mouth.

**Scalding:** Scalding is done at different temperature/ time combination. Objective in to have bird that attractive and free from contaminations, the scalding temperature depend on the appearance and state of the bird. Depending on age and size of the bowl scalding temperature of 71-880C for 30-60 minutes are employed known as **Hard scalding** it facilitates fast plucking and use for poultry to be consumed immediate, sub-scalding employs temperature of 580C – 600C for 30 to 70 minutes during which the outer layer is broke but no adverse affect on the flesh. **Semi-scalding/Soft Scaling:** 500C -540C for 30 to 120 minutes. This leaves the skin intact and permits different method of chilling and packaging.

**Plucking/Defeathering:** Sometimes done without scalding by carried our soon after slaughter when the bird is warm, birds are usually hand-plucked but machines are used at industrial level.

**Evisceration:** Plucked birds are trimmed and for evisceration an incision is made between person nose and the vent of around to express the intestine. The gizzard is grasp and pull out,Shank and legs are removed, the gizzard is cut open and its internal lining the giblets comprising heart, gizzard and liver are cleaned and included in the carcass. The carcass weight 65 to 70% of the live weight after cleaning.

**Chilling:**

i Chilled immediately after dressing to reduce the body temperature to retard bacterial growth and slows down spoilage.

ii Make carcass easier to handle and cut.

iii The bird may be pre-chilled by immersing in a bowl of clean cold water.

iv The birds are chilled to 40C using ice, they are removed having to drain and then wrapped for freezing.

**Cutting Up**

Sometimes birds are cut up into parts for freezing the major cuts are

Breast (17.4%)**,** Two wings (8.21%)**,** Two legs (24.62%)**,** Back (12.05%)**,** Neck (12.05%) Giblets (3.51%)**.**The thighs alone rep 12.85% and the drumstick 11.67%, the remaining parts like ribs (5.94%) visceral and wastes (15.07%) shank (4.59%) and head (4.43%).

**Chemistry and Nutritive Value of meat**

Meats consist primarily of muscular tissue with amounts of fatty tissue verging not only with the breed age sex and diet of the animal but also with anatomical location. As a guide, the approximate composition of typical mammalian muscle is 75% water, 19% protein, 3.5% fat, 2.5% soluble and non protein material. A crude relationship between moisture (m) and protein) (p) contents of a given meat cut is low are the carbohydrate consent is negligible. A much simplified approximate composition of mammalian muscle is given in table 2.0

**Approximate composition of mammalian skeletal muscle**

|  |  |
| --- | --- |
| **Composition**  Water  Protein  Lipid  Carbohydrate  Non-protein substance  a. nitrogenous  b. inorganic  Soluble phosphorus  Potassium  Sodium  Magnesium  Calcium, zinc, frame mental  Vitamin  Water-soluble vitamin  Quantitatively minute | **Wet % Weight**  75.0  19.0  2.5  1.2  2.3  1.65  0.65  0.25  0.35  0.05  0.02  0.23  -  -  - |

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