**‘A’ LEVEL AGRICULTURE NOTES**

**LIVESTOCK PRODUCTION**

This is the branch of agriculture that deals with the studies of different types of animals which are domesticated and managed by man for the benefits that they have.

Livestock refers to all domestic animals which are kept by man for example cattle, goats, sheep, pigs, poultry, rabbits etc.

**Importance of livestock**

* Source of food in form of meat, eggs, milk and blood.
* Source of raw materials for agro based industries, for example hides and skins are used to produce leather products in leather tanning industries, milk is used in dairy processing plants to produce ice cream, yoghurt, cheese, butter etc. horns and hooves are used to make buttons.
* Source of income through the sale of animals or their products.
* Provide employment to those that rear animals and professionals like veterinary doctors who treat livestock.
* Source of foreign exchange through exportation of livestock products.
* Source of government revenue when taxes are levied on livestock and their products.
* Provide power in form of draught animals for cultivation and transportation of load on the farm.
* For religious and cultural purposes e.g. sacrifice to the gods and for paying dowry e.g. cows, goats and chicken.
* Contribute to diversification in farming
* For recreation and sport through cock fights, goat racing, horse rides etc.
* Poultry feathers are used in decoration and creating beautiful living environments.
* Production of biogas from fermentation of livestock wastes like urine and dung which is used for cooking, lighting and generating heat on the farm.
* Source of farm yard manure which is added to the soil to improve soil fertility.
* Some livestock are used in time telling for example cocks.

**Problems facing livestock industry**

1. Inadequate capital to purchase good breeds of animals, farm equipment and inputs like drugs and livestock feeds.
2. Poor record keeping which makes selection for breeding and culling of livestock difficult.
3. Insecurity for example cattle rustling which reduces the number of animals kept by farmers.
4. Limited extension services to train farmers on modern animal management practices and techniques.
5. Inadequate water and pasture for animals especially during the dry season which leads to poor yields and death of animals on the farm.
6. Livestock parasites and diseases which reduce productivity of animals and cause death of livestock.
7. Poor breeds of animals that take long to mature and give limited quantity of animal products.
8. Poor soils that cannot support good quality pastures hence poor condition of livestock fed on them.
9. Inadequate/shortage of ready market which makes it hard for the farmers to sell off their products.
10. Conservativeness of farmers i.e. farmers are unwilling to adopt modern farming methods.
11. Poor transport facilities which limit movement of livestock products from the production units to consumption centres.
12. High interest rates on loans given to farmers.
13. Unfavourable government policy i.e. high taxes imposed on the farmers.
14. Shortage of processing industries to add value to livestock products and prolong shelf life of products.
15. Religious beliefs for example Muslims do not keep pigs
16. Inadequate storage facilities for the products e.g. refrigerators for cooling milk.
17. Limited land area for animal rearing.
18. Expensive inputs for example livestock feeds and drugs.
19. Unstable prices of livestock products.

**Ways of improving livestock industry**

1. Providing proper transport infrastructure to enable farmers’ access markets for their products.
2. Establish disease control programs to help control the losses caused to the farmer when animals fall sick.
3. Encouraging better education of the farmers to equip them with knowledge in animal management.
4. Providing loans to farmers to purchase better breeds of livestock, livestock feeds, drugs and construct farm structures.
5. Expansion of extension services such that farmers are advised on the best livestock management practices.
6. Setting up demonstration centres to show farmers the best practices in animal management.
7. Establishing processing facilities to process livestock products such as milk to improve their quality and prolong their shelf life.
8. Carrying out controlled breeding and cross breeding to improve on animal productivity.
9. Planting improved pasture species to feed animals and improve their productivity.
10. Constructing valley dams to ensure availability of water to animals during the season.
11. By providing incentives to farmers e.g. subsidizing agricultural inputs so that farmers can enjoy higher profit margin.
12. Improving marketing facilities to enable farmers sell off their livestock products.
13. Encouraging farmers to practice mixed farming to integrate animal and crop husbandry where animals provide manure for maintaining soil fertility and crop wastes are utilized as livestock feeds.
14. The government should ensure good governance and political stability to allow farmers settle and concentrate on livestock rearing instead of running away from their homes because of political unrest.
15. Introducing paddock system of grazing so that animals can be controlled to reduce overgrazing.
16. Settled grazing should be encouraged so that more attention is given to animals for better production.

**FACTORS AFFECTING LIVESTOCK DISTRIBUTION IN UGANDA**

1. **Climate:** areas that receive adequate rainfall with cool climate are used for rearing exotic breeds of livestock while dry areas are basically for rearing indigenous cattle breeds.
2. **Religious factors;** some religions do not allow keeping certain animals e.g. Moslem do not keep pigs.
3. **Relief/Topography;** some areas with steep slopes may not favour rearing of many animals since they are prone to erosion.
4. **Type of vegetation:** grass land areas have more livestock than forested areas.
5. **Government policy:** the government may encourage the rearing of more animals by restocking or establishing processing plants or discourage keeping of livestock in an area through overtaxing farmers.
6. **Political stability/security in the area:** Cattle raids in areas with insecurity result into fewer/small numbers of livestock being kept.
7. **Population density:** Many animals are reared in areas with sparse population.
8. **Availability of transport:** Places with good transport facilities have easy marketing of livestock products which encourages rearing of many animals.
9. **Water availability:** Many animals are reared in areas with adequate clean water supply than those where water is scarce.
10. **Availability of feeds:** Livestock keeping is encouraged by presence of adequate feeds while scarcity of feeds discourages livestock keeping.
11. **Cultural/social factors:** Some tribes regard livestock as a sign of wealth and keep them in large numbers.
12. **Altitude:** High altitude areas with cool temperature favour rearing of exotic breeds.
13. **Prevalence of livestock parasites and diseases:** Tsetse fly infested areas and areas endemic for particular diseases like Nagana discourage livestock keeping. Areas free from parasites and diseases encourage livestock keeping.
14. **Land availability:** Many animals are kept in areas where land is abundant than where land is scarce.

**FACTORS AFFECTING THE PRODUCTIVITY OF FARM ANIMALS**

1. **Health status of animals:** Healthy animals are more productive than sick animals.
2. **Breed of the animals:** exotic breeds are more productive than indigenous breeds of cattle.
3. **Age of the animal:** Young and old animals are less productive than mature animals.
4. **Types of pastures available:** Good pasture species improve productivity of farm animals.
5. **Housing:** Animals that are properly housed are more productive than those housed in congested quarters since they suffer a lot of stress.
6. **Availability of water;** animals that are given adequate clean water are more productive than those with limited water supply.
7. **Climatic conditions:** harsh climatic conditions limit productivity of farm animals while cool climatic conditions improve productivity of farm animals.
8. **Level of management:** Well managed animals are more productive than poorly managed animals.
9. **Soil productivity/fertility:** Soils that are deficient of nutrients do not favour growth of pastures which are livestock feeds hence lowering productivity of animals. Soils that are rich in nutrients favour growth of pastures to provide feeds to animals hence improving productivity of animals.
10. **Availability of supplementary feeds:** Animals that have access to supplementary feeds to provide the nutrients that could be deficient in pastures or to give them extra feeds when pasture supply is limited/low generally perform better than those with no access to such feeds.
11. **Level of feeding:** Animals that are fed on adequate balanced feeds are more productive than those fed on inadequate feeds which are unbalanced.

**QUESTIONS:**

1. (a) Explain the effects of high temperature on animal production.

* High temperature stresses animals and lowering appetite hence reduces feed intake.
* Power output is reduced in work animals due to stress caused by high temperature.
* It leads to low breeding efficiency due to reduced spermatogenesis, ovarian function, estrus expression, oocyte and sperm health and cause embryonic death by animals.
* It leads to increased water intake by animals.
* Reduced egg hatchability in poultry due to dehydration.
* Loss in product quality e.g. reduced fat and protein content in milk and meat.
* Reduced milk and egg production in cattle and poultry respectively due to reduced feed intake.
* It leads to increased prevalence of livestock parasites and diseases e.g. ticks require high temperature in order for them to multiply quickly.
* It leads to death of animals due to heat stress.
* Reduced pasture growth, productivity and quality.
* Poor/very low body weight gain rate due to high energy loss.

1. **What are the effects of low temperature on animal production?**

* It increases feed intake in animals

This increases metabolic rate so that more heat is generated to maintain body temperature.

* Reduces water intake.
* Death of animals due to cold stress
* Reduces productivity as more energy goes to heat increament in the body.
* Reduces animal’s activity.
* Sexual activities are reduced in some species.

**THERMO REGULATION IN FARM ANIMALS**

Thermo regulation is the ability of an organism to maintain its body temperature either at a constant level or within an acceptable range.

Some animals have low ability to regulate their temperature while others have high ability to regulate their temperature.

***Why is it important to maintain a constant body temperature?***

* It allows enzyme controlled reactions to proceed efficiently at optimum body temperature.
* It allows animals to live in a wide range of environments irrespective of the prevailing temperature.
* It helps to maintain a high metabolic rate, so ensuring that sufficient energy is always available.

This in turn enables the animals to respond to stimuli faster, both of which are important for survival of organisms.

**Heat loss and heat gain**

To keep the body temperature constant, balance must be kept between the physical forces by which heat is gained and lost from the body.

**Ways in which heat is lost from the body.**

1. **By evaporation:** The change of liquid to vapour where animals have few or no sweat glands, cooling by evaporation of water takes place from the mouth and nose, birds lack sweat glands as their covering of feathers makes evaporation almost impossible. Birds open their beaks/panting.
2. **By radiation:** The diffusion of heat from a warm body to relatively colder objects through the air e.g. loss of heat from the body to the surrounding air when it is cold.
3. **By conduction:** The transfer of heat from a warmer to a cooler object in contact with each other e.g. from the body to the ground through feet.
4. **By convection:** The movement of air resulting from warm air being replaced by cooler air in air currents e.g. from the body surface to air in air currents.

**Ways in which the body gains heat;**

1. **By radiation:** e.g. from solar radiation, reflection of heat from the ground.
2. **By conduction:** e.g. from the ground through the feet.
3. **By convection:** e.g. from wind bringing hot air to the surface.
4. **From metabolism:** many of body’s chemical reactions release heat e.g. respiration.

**Factors that influence heat gain and loss in animals**

* **The rate of body metabolism:** body chemical reactions generate heat.
* **The surface area to volume ratio of the organism;** in general small organisms have higher surface area: volume ratio and tend to loose more heat than larger ones.
* **The temperature of the environment;** heat is gained when the environment is warmer than the body and lost when it is cold.
* **Other environmental conditions e.g. relative humidity and air currents;** at the same environmental temperature, heat loss is higher at low humidity and lower at high humidity and it also increases with increase in air currents.

**ENDOTHERMIC AND ECTOTHERMIC ORGANISMS**

1. **Endothermic / warm blooded / homothermic organisms:**

These are organisms which are able to maintain a constant body temperature irrespective of that of the surroundings. Such organisms mainly depend on heat generated within their bodies (metabolism) to maintain their body temperature constant.

Examples include mammals and birds.

**Advantages of being endothermic**

* It allows animals to live in a wide range of environments irrespective of the prevailing temperature.
* Enzyme controlled reactions can proceed efficiently at optimum body temperature.
* Organisms can maintain a high metabolic rate, so ensuring that efficient energy is available. This in turn enables animals to respond to stimuli faster and also move faster, both of which are important for their survival.

**Disadvantages of being endothermic**

* Animals require a high food consumption as most of the heat used for temperature is generated from within them by metabolism.
* When the environmental temperature is low, endotherms need to have efficient methods of preventing heat loss e.g. in winter season.
* When the environmental temperature is high endotherms need to have efficient cooling methods to prevent overheating e.g. in tropical areas.

1. **Ectothermic/cold blooded/poikilothermic organisms:**

These are organisms which cannot maintain a constant body temperature instead their body temperature varies with that of their surroundings. Examples include bees, fish, and crocodiles.

**Advantages of being ectothermic:**

* Food consumption is low in ectothermic organisms. This is because these organisms do not generate heat from their body’s metabolism in order to regulate their body temperature. The body temperature instead depends on that of the surroundings.
* Organisms do not need structural means such as hairs/fur, feathers on the skin or fat under the skin in order to prevent heat loss from their body. They instead use behavioral means which are easier for example basking in sun to gain.
* Organisms do not efficient physiological means of preventing excessive heat gain (overheating) for example, vasodilation and sweating. They use simple behavioural means such as moving in the shade and thermal gaping.

**Disadvantages of being ectothermic**

* The metabolic rate is usually low hence little energy is released leading to low response to stimuli when external temperature is low.
* Dependence on external temperature limits the activity of organisms if the temperature is in the extremes of cold and heat.

**WAYS IN WHICH FARM ANIMALS ADAPT TO HIGH TEMPERATURE**

1. **Vasodilation:** The blood capillaries near the skin widen (dilate) to allow more blood to flow near the surface so that more heat is lost from it by evaporation.
2. **Sweating:** Animals have sweat glands confined to areas of the body where fur is absent e.g. muzzle in cattle. The evaporation of water results in the loss of large quantities of heat thereby cooling the body.
3. **Reduced feed intake** to lower metabolic rate thereby reducing heat production in the body.
4. **Increased water intake** to cool the body.
5. **Relaxation of erector** **pilli muscles** thereby lowering the hair so that they lie flat on the body surface. The insulation is reduced and heat is easily lost through convection and radiation.
6. **Sheep develop light white coloured hair** on the skin to reflect heat.
7. **Animals reduce their activities** during hot days as a mean of reducing heat/temperature in their body.
8. **Indigenous cattle have well developed dewlap** to increase surface area for heat loss.
9. **Panting in birds / birds open their beaks.** This increases the breathing rate which leads to expulsion of large volumes of carbon dioxide taking out some heat hence cooling the body.
10. **Birds flap wings**, **bathe in sand/litter/dew, move in shade** to cool their body.

**Ways in which farm animals adapt to low temperature**

1. **Vasoconstriction;** Blood capillaries near the skin narrow which reduces the amount of blood flowing in them and thus heat loss is minimized.
2. **Shivering;** The skeletal muscles undergo rhythmic, involuntary contractions which produce more heat for temperature regulation.
3. **Increased metabolic rate;** to increase heat production. This requires increased food consumption.
4. **Contraction of erector Pilli muscle;** to raise the hair so as to increase the thickness of the layer of air trapped, improving insulation.
5. Migration from cold area to warmer areas especially bees.

**QUESTION:**

***Suggest ways in which the farmer can overcome the effects of high temperature in farm animals***

* Construction of animal shades on the farm.
* Planting more trees to provide shade and fresh air.
* Providing more watering points and giving animals water all the time.
* Providing water pool for wallowing animals such as pigs.
* Spraying animals with water to cool their body.
* Providing optimum ventilation on animal houses.
* Use of air conditioning gadgets in animal houses.
* Proper construction of animal houses with good heat –insulating materials.
* Ensuring optimum stocking rate inside the animal houses / avoid overcrowding of stock

**CLASSIFICATION OF LIVESTOCK**

Classification of livestock helps to show their evolutionary relationship to other animals, provides organisms with names that are internationally accepted by all biologists. It enables biologists to communicate information about organisms precisely worldwide.

The resemblances or differences in structure between various types of animals form the basis for classification.

During classification organisms are grouped into groups according to their resemblances and differences called ***Taxa.*** The members of each group have certain features in common which distinguish them from those of other groups.

The largest of these is called the ***kingdom***. The kingdoms are subdivided into ***phyla*** (singular phylum), the phyla into ***classes***, the classes into ***orders***, the orders into ***families***, the families into ***genera*** (singular genus), and the genera into ***species*** which are the smallest of the biological grouping.

* Genus is a group of organisms which show resemblance e.g. man, ape, gorilla, monkey all belong to the same genus.
* Species is a group of organisms which can interbreed and produce viable off-springs.

Each kind of animal bears a scientific name, made up of two words. The first indicates ***genus*** and the second, the ***species***. The genus name is written beginning with a capital letter and the species name is written beginning with a small letter. Both names are typed in italics but if written by hands must be underlined each one separately. This method of naming is known as ***binomial nomenclature***.

The vertebrates belong to phylum chordata.

The classes under vertebrates include:

* Mammalia (goats, sheep, cattle, pigs etc.)
* Aves (birds)
* Reptilia (crocodiles, lizards, snakes etc.
* Amphibia (frogs and toads)
* Pisces (fish)

The invertebrates comprise of the following phyla;

1. Annelida (Leech, earth worms)
2. Mollusca (snails, slugs, squids, octopuses)
3. Arthropoda (Bees, ticks, mites, locusts etc.)
4. Nematoda (Roundworm, lungworm)
5. Platyhelminthes (Tapeworm, liver fluke)
6. Coelenterate (Hydra, Jelly fish, sea anemone)
7. Echinodermata (star fish)

**Classification of cattle**

Kingdom - Animalia

Phylum - Chordata

Class - Mammalia

Order - Artiodactyla

Family - Bovidae

Genus - Bos

Species - taurus (humpless), indicus (humped)

**Classification of bees:**

Kingdom - Animalia

Phylum - Arthropoda

Class - Insecta

Order - Hymenoptera

Family - Apoidea (social insetcs)

Genus - Apis (Honey bee)

Species - Mellifera

**CATTLE**

Cattle are ruminant animals that are able to convert the less valuable plant materials into useful and nutritious products which man can benefit from such as milk, meat and hides.

**Terms used**

1. **Calf:** This is a young one of a cow
2. **Cow:** This is a female cattle
3. **Dam:** This is a mature cow that has produced off springs.
4. **Heifer:** This is a young cow that has not produced off springs.
5. **Sire:** This is a mature male cattle that has mated and produced off springs.
6. **Steer/Bullock:** A young male cattle that has not yet mated.
7. **Oxen:** This is castrated bull used for work on the farm.
8. **In calf cow:** This is a pregnant cow.
9. **Dry cow:** This is a cow that is not being milked in the last two months of pregnancy.

**BREEDS OF CATTLE**

A breed is a group of animals with similar characteristics which when allowed to mate, produce the young ones with similar characteristics as the parents. There are three of cattle;

1. Tropical / indigenous / local breeds.
2. Exotic / temperate breeds
3. Cross breeds

**Indigenous / tropical breeds** (Bos indicus)

These are humped cattle and they are of tropical origin.

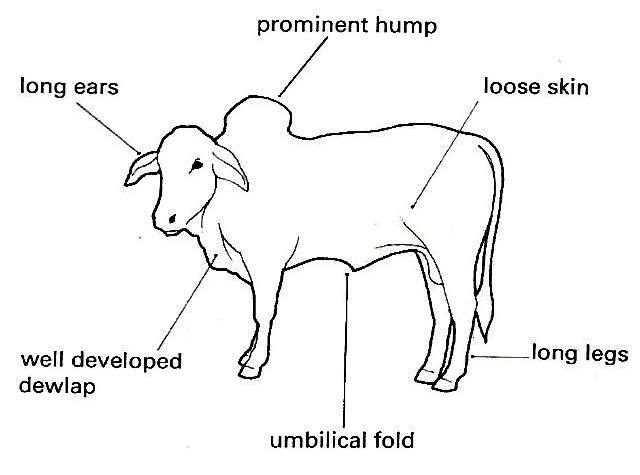
Examples of indigenous breeds of cattle:

* Boran
* Zebu
* Nganda cattle
* Ankole long horned cattle
* Sindhi
* Sahiwal

**Characteristics of indigenous cattle**

* They have prominent humps
* They have smaller in size compared to exotic cattle
* They take long to mature
* They are resistant to tick borne diseases.
* They have well developed dewlap and umbilical fold.
* They have few reproductive problems
* They are less productive in terms of milk and milk.
* They have good adaptation to high temperature and resistance to intense solar heat. The extended dewlap, umbilical fold and prominent hump gives the animal a large surface area per unit body weight to aid the dissipation of excess body heat.
* They are efficient converters of roughages into utilizable products.

**Fig.1 Showing important characteristics of tropical breed (Zebu)**



**Factors that have contributed to the success of indigenous cattle in tropics than exotic cattle**

* They have long legs which adapt them to walking long distances in search for pasture and water without getting tired and losing condition.
* They are better converters of roughages into utilizable products e.g. meat and milk.
* They have few reproductive problems and they can breed regularly for a long time.
* They are tolerant to tropical diseases and parasites.
* They are hardly and therefore can stand harsh tropical conditions because of adaptation to the conditions.
* They are tolerant to heat/high temperature due to presence of more and bigger sweat glands, large dewlap, short hair follicles to facilitate heat loss.
* They have low feed intake.

**Advantages of rearing indigenous breeds**

* They are tolerant to strong heat as a result of having a tough coat.
* They can walk long distances in search for water and pasture without losing condition.
* They are tolerant to tick borne diseases.
* They have fewer reproductive problems and can breed for a long time.
* They are usually cheaper to buy.
* They produce high quality products e.g. milk with high butter fat content, meat.
* They have tough muscles which make them good for draught purpose.
* They are hardly and can withstand harsh conditions.
* They are better converters of roughages into useful products.
* They can survive even on poor pastures.
* They are easily available.
* They are cheap to maintain.
* They have a high longevity.

**Disadvantages**

* They have long calving interval
* Most have silent heat periods
* They take long to mature
* They have a high temperament
* They are generally less productive than exotic cattle/ they produce low milk yields.
* They have low live weight i.e. are relatively small.
* They have low birth weight.

**Ways of improving productivity of tropical breeds of cattle**

1. By upgrading the local breeds through cross breeding them with exotic breeds to improve on their genetic characteristics.
2. Introducing better pure breeds of animals which are able to give high yields in terms of milk and meat.
3. Ensure proper control of diseases and parasites.
4. Provision of extension services to the farmers to improve on their knowledge and skills about livestock management.
5. Provision of adequate clean water to animals.
6. Improving security in the areas of cattle rearing in order to encourage more farmers to keep animals.
7. By encouraging farmers to conserve pastures during times of plenty for use during scarcity periods.
8. Ensuring that animals are properly housed to protect them from theft, predators and unfavourable weather.
9. Providing animals with adequate feeds which are balanced.
10. Provision of supplementary feeds to livestock.
11. Application of fertilizers to improve soil fertility to support growth of pastures to feed animals.

**Exotic breeds:** (Bos taurus)

These are humpless cattle which are of temperate origin.

Examples of exotic breeds of cattle:

* Jersey
* Friesians
* Galloway
* Hereford
* Aberdeen angus
* Guernsey

**Characteristics of exotic cattle:**

* They have faster rate of growth and maturity.
* They are less adapted to high temperature in the tropics.
* They are high yielding in terms of products e.g. meat and milk.
* They are highly susceptible to tick borne diseases.
* Their dewlap and humps are not well developed (prominent).
* They have many reproductive problems.

**Advantages of rearing exotic cattle**

* They mature quickly
* They have a high calving rate
* They generally have a better dairy temperament than local breeds
* They are have a high birth weight
* They have a high live weight

**Disadvantages/problems/limitations/challenges of rearing exotic cattle**

1. They require a high level of management which most farmers lack.
2. They are very susceptible to tick borne diseases such as East coast fever, Red water, Heart water, Nairobi sheep disease etc.
3. They produce low quality products such as milk and meat.
4. They have many reproductive problems.
5. They are expensive to buy and maintain
6. They require high quality feeds for high production.
7. They are less tolerant to high temperature and drought.
8. They require high level of hygiene in their environment.
9. They have shorter reproductive span (short longevity).
10. They require strict feeding routine
11. They require high quality feeds
12. They are not easily available

**Pre-requisites to the introduction of exotic cattle:**

1. Construct a perimeter fence so that animals from outside the farm cannot enter into the area and introduce ticks.
2. Ensuring sufficient grazing land on the farm so that animals do not move out in search of pasture where they can pick up the ticks.
3. Divide the grazing land into paddocks to facilitate the rotational grazing which breaks the lifecycle of ticks.
4. Proper distribution of watering points/water troughs on the grazing land to prevent animals walking long distances in search of drinking water where they can pick up the ticks.
5. Plant trees in the grazing land to provide shade to animals during the dry season.
6. Remove poisonous weeds from the grazing land and sharp objects which may cause harm to animals.
7. Introduce indigenous cattle first in the area to act as tick baits for at least 3 to 6 months so that the area can become tick free.
8. Spraying or dipping the “bait” animals regularly to control ticks.
9. Introduce exotic breeds of cattle in bits of a few at a time.
10. Regular spraying or dipping must continue after introducing exotic animals to control ticks. Relaxation may lead to heavy mortality.
11. Provision of drugs and basic veterinary equipment on the farm.

**Cross breeds**

Crosses and back crosses of Bos Taurus and Bos indicus cattle have been developed in East Africa for milk production.

This is aimed at upgrading milk production and developing heat tolerant dairy cattle capable of high production in areas where it is difficult to maintain pure breed exotic stock.

**TYPES OF CATTLE**

A type is a group of animals whose characteristics make them suitable for a particular purpose. The different types of cattle include;

* Dairy cattle
* Beef cattle
* Dual purpose cattle
* Work type/Draught cattle

1. **Dual purpose cattle/breeds**

These are cattle reared for both milk and beef production.

They are capable of producing a good quality of milk at their early ages and good quality meat at the end of their milking life. They are the best animals since they share characteristics of both dairy and beef animals.

Examples:

* Red poll
* Milking short horn
* Dexter
* Simmental
* Southern devon
* Welsh black

1. **Work/draught animals**

These are cattle which have tough and well developed muscles and are suitable for farm work such as ploughing and transportation.

Examples

* Zebu
* Boran

**Characteristics of draught animals**

* They have free moving limbs
* They have sound feet
* Easily trained and disciplined
* Have quiet temperament i.e. easy to handle/docile
* Have sharp ears/high hearing ability to pick the instructions/commands when they are working.
* Have well developed hump for easy yoking
* Able to grow and mature faster
* Able to tolerate harsh climatic conditions.
* Are strong and muscular.

1. **Beef cattle**

These are animals bred to produce large quantities of meat.

Examples of beef breeds

* Boran
* Hereford
* American Brahman
* Galloway
* Aberdeen angus
* Charolais

**Characteristics of beef cattle**

* They have blocky or square shape
* They are early maturing or reach slaughter weight early.
* They have long broad backs
* They are able to survive in draught without losing condition
* They have high conversion of feed into meat (beef)
* They have short strong legs to support the heavy body weight.
* They are able to tolerate parasites and diseases
* They should have high meat quality (well-marbled).
* They are able to tolerate heat
* They are hardy i.e. can survive on rough grazing.
* They breed regularly to increase size of the herd
* They have thick muscles to increase the quantity of beef produced (have deep body).

**Factors to consider when/before establishing a beef herd**

1. Availability of market; ensure ready market for beef.
2. Availability of feeds: a farmer should ensure that good quality nutritious pastures are available for animals to graze.
3. Availability of water: there should be adequate clean water for animals to reduce distances moved by animals searching for drinking water.
4. Extension services: they should be available to give advice to farmers where necessary.
5. Availability of land: there should be adequate land for pasture establishment and construction of farm structures.
6. Adaptability of the animals to the environment: Rear animals that can adapt to the climatic conditions of the area.
7. Security of the area: ensure that the area has good security to reduce losses through theft.
8. Health condition of the animal; rear animals that are resistant to parasites and diseases.
9. Government policy: there should be an enabling/favourable government policy to encourage farmers rear animals e.g. subsidizing on the prices of inputs.
10. Source of the stock: ensure that animals are obtained from a reliable source to avoid buying diseased animals.
11. Availability of capital: there should be adequate capital to buy animals, feeds, drugs and construct farm structures.
12. Breed: ensure good quality breeds of beef.
13. Physical condition of the animal to be bought: animals should be free deformities such as lameness.
14. Source of feeds: ensure that feeds are bought from a reliable source to avoid purchasing adulterated feeds.
15. Age of the stock; the animals available should not be too old since they have low returns.
16. Fertility of animals/reproductive potential of the animal: animals must have a high reproductive rate to increase size of the herd and replenish the numbers that are removed for sale/slaughter.
17. Size of the herd: one must have size of the herd that can match with available resources.
18. Growth rate/maturity rate of animals: ensure that animals that a fast maturing are reared.
19. Uniformity of the herd: the breed chosen should show uniformity of characteristics e.g. growth rate.
20. Availability of transport facilities: there should be good transport network to facilitate transportation of meat to the market and inputs from the market to the farm.

**FACTORS RESPONSIBLE FOR LOW BEEF PRODUCTION IN UGANDA**

* **Climate:** Long droughts that are rampant in many parts of Uganda have led to the scarcity of pastures and water hence decreasing animal productivity.
* **Poor soils:** potential areas for beef production have poor soils which cannot support quality pastures for animals.
* **Conservativeness:** many societies take pleasure in keeping large herds of cattle rather than quality hence low production from large numbers of poor quality animals in terms of beef.
* **Inadequate land:** most areas do not have enough grazing land due to competition between crops and animal production.
* **Inadequate extension services:** most farmers live in rural areas which are difficult to reach by extension staff. This denies them an opportunity of acquiring knowledge about beef production.
* **Poor quality feeds:** most are natural pastures which do not contain sufficient nutrients hence low output from beef animals.
* **Lack of export markets:** lack of export market for beef outside Uganda does not create urge to produce the beef. The farmers do not save much because the beef is consumed locally.
* **Genetic potential for indigenous cattle is poor:** little has been done improve the genetic potential through cross breeding.
* **Parasites and diseases:** majority of cattle in the country are not sufficiently protected or treated from various diseases which leads to high death rates.
* **Pastures are poorly supplied with water:** animals often have to walk long distances to watering places and this causes them to waste away.
* **Insecurity:** cattle raids and theft discourages livestock farmers.
* **Inadequate capital:** it is limited among farmers due to poverty, capital is required to purchase animal drugs, equipment, feeds etc.
* **Poor transport network:** this limits movement of beef from the farm to the market and inputs from the market to the farms.

**Strategies for improving beef production**

* Provision of adequate clean water for animals.
* Introduction of improved forage species in the natural grasslands.
* Improving infrastructures like developing roads and storage rooms.
* Disease and parasite control to improve quality of meat from animals.
* Provision of education/extension services to equip farmers with knowledge of animal husbandry.
* Provision of loans to farmers to invest in beef production projects.
* Setting up well organized livestock marketing facilities.
* Change in land tenure system from communal to individual ownership so that individuals can be encouraged to improve and manage land properly.
* Encouraging farmers to use supplementary feeds.
* The government should improve security to reduce cattle raids and theft which discourages farmers.
* Upgrading local breeds by crossing with pure breeds to improve quality and quality of meat.
* Introduction of better pure beef breeds in the country.
* Improving range land management through rotational grazing, controlled burning, controlled stocking, resting the pasture to allow pastures to recover from grazing, practicing deferred grazing to enable forage plants produce seeds which are then dispersed within the pasture, fertilizer application, weed control, slashing over grown pastures etc.
* Encouraging the establishment of feedlot cattle finishing system. This system involves buying immature stock from the pastoralists and fattening them in yards or feed lots. This system provides market to the pastoralists for their immature cattle.

**MANAGEMENT PRACTICES IN BEEF REARING**

1. Proper housing: animal houses should be spacious, well ventilated and provided with concrete floors for easy cleaning, adequate dry beddings to provide warmth and absorb excreta.
2. Watering of animals: This is done by provision of adequate and clean water in troughs daily.
3. Proper management of pastures: this ensures supply of good quality forage to the animals.
4. Selection and preparation of breeding stock: Heifers are selected and mated at the right body weight (250kg) and age (2 – 2½ years).

Mating should be planned such that animals calve just before the rainy season when there is abundant supply of pastures.

1. Proper health care: Provision of drugs and necessary veterinary equipment on the farm.

**Drugs, equipment and materials that need to be kept at hand in a ranch dispensary**

1. Healing oil; can be applied on wounds i.e. after castration and dehorning.
2. Cotton wool: for dressing wounds.
3. Sulphur drugs such as sulphi dimidine; a general drug for oral treatment or injection.
4. Stilboestrol: used in injections on cows after calving, if the after birth is retained and has to be removed.
5. Methylated spirit: for cleaning wounds and sterilization of instruments.
6. Terramycin spray; for skin wounds.
7. Chlorohexidine: for disinfecting e.g. cow’s udder.
8. Terramycin injectable solution; It has a wide spectrum and can be used as a general drug against bacterial infections.
9. Syringes and needles: for introducing drugs into blood stream of animals through injection.
10. Supplementary feeding: this should be restricted to calves and lactating cows.
11. Castration: this facilitates faster growth and production of good quality meat.
12. Identification: For record keeping, animals are identified by ear tagging, ear notching, branding or tattooing.
13. Dehorning: It’s done by chemical method, hot iron method, use of dehorning saw, dehorning wire etc. to reduce injuries to other animals through fighting, to the stockman and farm structures like fences.
14. Weaning: Weaning of calves is done as early as possible, at six to nine months of age. Early weaning requires concentrate feeding, otherwise calves should be weaned at twelve months of age. The weaning weight of the calf should be recorded and weaned calves kept in an enclosure from where they cannot get their dams.

**Factors to consider when selecting a good animal for beef production:**

1. Growth rate: the animal should have a high growth rate.
2. Resistance to diseases and parasites: It should be resistant to ticks and tick borne diseases.
3. Drought resistance/adaptability: should be able to adapt or tolerate harsh climatic conditions e.g. drought.
4. Feed conversion Efficiency: the animal should be able to convert much of the food eaten into meat.
5. Regeneration rate: It should be able to recover its weight in a shorter time especially from a serious disease.
6. Body conformation: It should have blocky shaped body with deep body to achieve high muscle/tissue than bones.
7. Meat quality/marbling ability: It should have a good proportion of fat and muscle. The meat should not be too lean or too fatty. Fats help to reduce dehydration, give flavor, hold the muscle together and resist microbial entry.
8. Reproductive rate: The animal should be able to calve regularly to increase the size of the herd.
9. Dressing/killing out percentage: It should have a high killing out percentage.

Dressing percentage/killing out percentage = x 100

The remaining weight of the carcass after removing the weight of internal organs, head, hide, feet and blood is known as dressed weight.

**SYSTEMS OF REARING BEEF CATTLE**

1. Pastoral (traditional) system:

This is the most common practice in Uganda and accounts for 80-90% of the beef produced.

* Cattle are grazed on communal land and there are is no control over the grazing areas.
* The pastoralists move from one place to another with their cattle, and their movements are dictated by weather as they search for fresh forage for grazing and water.
* Cattle breeds kept are predominantly the Ankole and Zebu cattle which are adapted to low quality pastures and have good resistance to Trypanosomiasis and tick borne diseases. The animals usually give poor yields of meat and milk.
* Large numbers of animals are kept
* There is no controlled breeding
* Animals are reared specifically for subsistence, as a source of livelihood for the pastoralists and for prestige.
* Pastoralists burn the grazing areas at intervals in order to destroy dry over grown grasses/forage and get fresh young and more palatable forage for their animals.
* At night, cattle are kept in enclosures so as to protect them from theft and predators.

**Characteristics of pastoral system**

* Local breeds of animals are kept.
* There is communal ownership of land.
* Grazing is communally done.
* Farmers have no permanent settlements and are always on the move looking for water and pastures for animals.
* Large number numbers of animals are kept.
* Many different types of animals are kept e.g. sheep, goats and cattle.
* Animals are mostly grazed on natural/unimproved pastures.
* Animals there is no controlled breeding because grazing is communal.
* They do not grow crops and there is no integration between crop growing + animal rearing.
* Animals give low yields due to poor breeds and poor pastures.
* It is carried out in more arid areas
* Overstocking of animals is common

1. **Ranching (commercial) system**

* Under this system, beef cattle are kept on privately owned and fenced extensive plots of grazing land known as ranches. Ranches are large privately owned farms where commercial cattle production is done.
* Animals are reared specifically for commercial purposes and are sold off when they attain the required market weight.
* Animals depend entirely on natural pastures.
* On most ranches, the major beef breeds are the Boran or crosses between the Boran cows and bulls of exotic beef breeds.

**Characteristics of ranching**

* Large areas of land
* Many animals are kept.
* There is little or no crop growing practiced
* More scientific methods of management are used than in pastoral nomadism.
* There is heavy capital out lay.
* Animals are kept specifically for sale.
* Only highly productive breeds of animals are kept.
* There is specialization especially in beef production.
* There is variety of animals kept than in nomadic pastoralism.
* Land is often individually owned and there is often no communal grazing.
* It is often carried out in the drier parts of the country.
* There is less movement of animals than in the nomadic pastoralism.

**ESTABLISHMENT OF A NEW RANCH**

In establishing a ranch, there are some basic facilities that are required. These include a kraal, shed, water supply usually around the kraal, sufficient land for grazing and production of fodder crops and supplementary feed crops such as grain.

* The area should be surveyed to determine the fertility of the soil, topography and rainfall reliability and locate where to construct permanent structures such as buildings.
* The area should be fenced by erecting both perimeter fences and paddocks.
* Construct watering points in the paddocks to avoid animals moving long distances searching for drinking water.
* Construct animals handling structures such as crushes, cattle dips, and spray races.
* Construct buildings like stores for inputs and products, houses for workers, administrative blocks etc.
* Construct roads for easy accessibility and movement in the ranch.

**RANCH MANAGEMENT**

The major objectives of ranch management are;

* To minimize calf mortality and losses due to diseases e.g. regular vaccination and proper sanitation.
* To reduce seasonal fluctuations in live weights of stock e.g. by regulating animal numbers so that they match with available forage or providing supplementary feeds.
* To maintain and improve feeding efficiency e.g. by preserving excess forage.
* To decrease annual fluctuations in stock number, e.g. by preventing disease outbreaks and ensuring that there is continuous forage supply all year round.
* To maximize reproductive performance towards the ideal of one calf per cow per year e.g. by making sure that there enough fertile bulls in the herd.

**MANAGEMENT ACTIVITIES CARRIED OUT ON A RANCH**

1. Rehabilitating the grazing area/range land by:
2. Slashing over grown herbage that was not consumed by animals.
3. Controlled burning to get rid of dry herbage, stimulate fresh growth and break dormancy of seeds of forage legumes.
4. Uprooting weeds that compete with forage plants for nutrients, moisture and light.
5. Over sowing with improved forage specie, especially in the bare patches caused by overgrazing.
6. Fertilizer application, especially nitrogen and phosphate fertilizers, so as to replenish the nutrients lost from the soil as a result of grazing.
7. Controlling distribution of animals by evenly distributing watering points and fencing.
8. Controlling breeding and calving times so that a number of animals can mature at the same time and be sold off at ago.
9. Supplementary feeding of lactating cows and calves.
10. Rounding up animals, especially during breeding seasons and calving times.

Rounding up refers to the time of bringing in animals at least twice a year, for example between April and June, October and December which could coincide with the breeding season and calving times.

**Reasons for rounding up animals on a branch**

* To do a physical assessment of the animals, and find out if they are gaining or losing weight.
* To castrate male calves with undesirable characteristics
* To establish the number of animals on the ranch, and regulate the number according to the carrying capacity of the ranch.
* To separate calves from their mothers so that they can be weaned.
* To identify the animals, usually by branding.
* To control livestock diseases and parasites through vaccination, dipping, dehorning and spraying.
* To cull and market the animals that have attained market weight.
* To identify and isolate cows that are about to calve down so that they can be given preferential treatment e.g. supplementary feeding.
* To identify and isolate heifers and bulls for replacement of aging breeding stock.

1. Keeping records: the most important are breeding, health, sales and purchases and general cattle records.

**Factors that determine the size of the herd**

1. Type of stock: Hardy animals that can survive under pasture scarcity can be kept in large numbers.
2. Economic factors: the more the capital available the large number of animals that can be kept.
3. Availability of reserve feeds: which enable a large herd to be carried out through dry periods when pastures is scarce.
4. Availability of water; Large number of animals can be kept where there is adequate clean water.
5. Topography: over stocking in hilly areas could result into serious case of erosion.
6. Type of pasture species: when pastures are nutritive many animals can be kept.
7. Productivity of the pasture species i.e. rate of accumulation of dry matter or forage for grazing, the higher the productivity of the pasture, the larger the number of animals that can be kept.

**PRODUCTS OF BEEF ANIMALS**

1. **MEAT**

It refers to all skeletal muscles and tissues that can be used as food.

Meat is composed of muscle, fat, connective tissue and bone.

Meat sis a highly perishable product that needs to be handled carefully and either sold off or preserved as soon as possible after slaughter.

**Slaughter house regulations**

These are regulations that govern the hygiene and general management of slaughter houses and also the welfare of the animals to be slaughtered. They include;

* Slaughter houses should be easy to clean
* There should be inspection facilities
* Provision for humane killing
* Waiting animals should not see those being slaughtered.

**Essentials of a good Abattoir/slaughter house**

1. Concrete floor: for easy cleaning
2. A slanting floor; to allow easy flow of blood
3. Main office; to allow easy meat inspection in order to determine the suitability of meat for human consumption.
4. Reliable power source; to facilitate stunning process.
5. A stunning area; to render animals senseless just before slaughter in order to reduce pain.
6. Resting area/room; abattoir should be designed in such a way to receive animals to be slaughtered and prepare them for slaughter process.
7. Flaying area; to facilitate flaying of animals.
8. Reliable source of water; for cleaning purposes.
9. Hanging area; carcasses from flaying area are put a hanging area and cut them into desirable sizes.
10. Disposal area/facility; to facilitate disposal of wastes.

**Procedure of slaughtering / butchering cattle**

* **Pre slaughter care/ handling;** Animals are held in a railage and they are rested and starved for 16 to 24 hours but should be given water for drinking. Starving animals allows emptying of the gut and reduces contamination and spoilage of meat.

Resting the animal conserves the stored body glycogen. After slaughter glycogen is converted to lactic acid which has a preserving effect on the meat.

* **Ante mortem inspection;** this the examination carried out on animals just before slaughter to find out if animals are deformed or have serious injuries.
* **Stunning;** this renders the animals senseless just before slaughter to reduce pain. It can be done by use of a hammer gun or electric shock.
* **Actual slaughter;** the neck of the animal is cut and it is allowed to bleed completely by hoisting it up. Adequate bleeding is essential to reduce meat spoilage. Blood can be collected and processed into blood meal for feed manufacture.
* **Skinning/flaying;** this is the process of removing the hide from the dead animal (carcass). It should be done with care to avoid damage to the hide and to avoid leaving a lot of meat or fat that can lead to deterioration.
* **Evisceration;** this is the process of cutting the carcass open to remove internal organs. The internal organs are carefully removed such that their contents do not contaminate meat.
* **Post mortem inspection;** meat is examined after slaughter to check for dangerous diseases such as tuberculosis and cysts of internal parasites such as tape worms and round worms.

If the inspection report indicates that meat contains dangerous diseases and parasites, the meat is declared unfit for consumption (condemned).

Condemned meat is buried or burnt.

* **Grading:** It is done basing on the amount of fat and degree of marbling (distribution of fat with in the muscles), texture and colour of meat. A pale colour indicates a poor quality meat.
* **Aging and tenderization:** this aims at making the meat palatable and tender. Meat is stored at cold room temperature of 200C and it may be kept 4 to 6 weeks. The enzymes already in meat break down some of the tissues and as a result meat becomes soft.
* **Preservation/curing:** It is done to avoid/reduce spoilage and to add flavor. The ingredients used include common salt, sodium nitrate or nitrite, sugar and spices. Meat can be preserved by salting, smoking, boiling, sun-drying, freezing etc.

**Qualities of good meat**

* It should have a pleasant smell
* It should have normal red colour
* It should have a moist and fresh appearance
* It should be free contaminants e.g. soil and dung
* It should not be too bony
* It should be well marbled
* Fats should be white or dirty white in colour
* It should not be dripping even when moist.

**How to determine quality of meat**

1. Observing its appearance, colour and texture
2. Considering the odour/smell of the meat
3. Determining the tenderness of the meat
4. Determining juiciness of the meat

**MEAT SPOILAGE**

Spoilage of meat is caused by invasion and growth of bacteria.

Spoilage of meat occurs mainly during handling, processing and storage.

**Factors that lead to meat spoilage**

* Incomplete bleeding; this leaves a lot of blood causing rotting of meat
* Dirty slaughter house leads to meat contamination.
* Poor handling: transportation of meat in unhygienic containers allows multiplication of micro-organisms leading to spoilage.
* Unsuitable storage facilities: rapid deterioration occurs when meat is kept in warm dirty store.
* Contaminating meat with contents of digestive tract due to poor evisceration. These contents contain micro-organisms that can decompose meat.

**Factors that influence the rate of meat spoilage**

1. Health status of the animal: Meat of diseased animals usually gets spoilt faster than that of healthy animals.
2. Moisture content of meat: high moisture content favours growth of microbes hence increasing the rate of meat spoilage.
3. Level of bleeding after slaughter: poor bleeding of slaughtered animals leaves much blood in meat increasing spoilage.
4. Handling conditions: transportation of meat in unhygienic containers allows bacteria attack hence increasing the rate of spoilage.
5. Environmental temperature: High temperature encourages rapid multiplication of putrefying bacteria that causes rotting of meat.
6. Slaughter conditions; unhygienic slaughter house leads to meat contamination and spoilage.
7. Preservatives used: application of preservatives like salt reduces the rate of meat spoilage significantly.
8. Rumen contents at slaughter: if the rumen is full, its contents will contaminate the meat hence encouraging bacterial growth on meat.

**Factors that make meat unfit for human consumption/factors that lower the quality of meat.**

1. Age of the animal slaughtered: meat from very old animals tends to be more fibrous and of low quality while that from very young animals tends to be too soft and unpalatable.
2. Animal diseases: some diseases of livestock such as anthrax and brucellosis make meat unfit for consumption because they also attack man.
3. Animal parasites: some parasites such as liver flukes, tape worms attack some desirable parts of animals like liver, stomach, spleen making meat unfit for consumption.
4. Poor bleeding of animals during slaughter: this leaves a lot of blood in meat which encourages rotting.
5. Drugs: Meat from animals which have just been on treatment is not good for consumption.
6. Ratio of fats to muscles in the meat: meat with high proportion of fats and bones than muscle is of poor quality and unfit for human consumption.
7. Unfavourable plants/pasture like Mexican marigold have undesirable smell which they introduce in meat when consumed by animals hence lowering the quality of meat.
8. Poor preservation which leads to rotting of meat.
9. Unhygienic slaughter house which leads to contamination of meat.
10. Poor evisceration which leads to contamination of meat with contents of internal organs.
11. Unhygienic transportation which may contaminate meat and lowers its quality.
12. Chemical poisoning of animals makes meat harmful to humans.

**Ways of ensuring production of high quality meat on the farm**

* Starve the animal for 24 hours to allow the emptying of the gut to avoid meat contamination.
* Check to ensure that healthy animals are slaughtered.
* Hoist the carcass to allow complete bleeding to reduce blood content in meat that may lead to meat spoilage.
* Transport the meat in a clean and appropriate containers
* Proper disease control.
* Proper parasite control
* Inspection of meat to confirm/certify meat for consumption.
* Castration of male animals to make meat tender.
* Proper/good feeding of the animals.
* Starve the animal for 24 hours to allow the conversion of glycogen into lactic acid which is a natural meat preservative.
* Store meat in a cool clean place to prevent multiplication of micro-organisms.
* Proper handling of offals to prevent meat contamination.
* Slaughter animals at the right age.
* Proper handling/avoid over working/beating the animals.
* Slaughtering and flaying animals from hygienic places to avoid contamination of meat.

**Nutrients contained in meat.**

1. Proteins
2. Fats
3. Vitamin B e.g. B1 and B3
4. Minerals such as iron, phosphorus and calcium.

**Meat byproducts**

1. Bones: they are burnt and crushed to produce bone meal containing Calcium and Phosphorus for feeding livestock.
2. Blood: It is collected from the animals, boiled and dried under the sun, then crushed or broken into small bits to make blood meal which is a feed ingredient.
3. Horns and hooves: they are collected and used in the industries for manufacture of buttons, glue, handles, combs.
4. Condemned meat: It is sterilized and converted into meat for dogs and pigs. It is boiled, dried and milled/crushed into meat powder.
5. Rumenal contents: They are dried and fed to other animals after mixing them with other feed ingredients.
6. **HIDES AND SKINS**

Hides are coats of big animals such as cattle while skins are coats of small animals such as goats.

Hides and skins are processed into leather by a process called tanning.

Some of the products made from leather are bags, shoes, covers for sofa sets, carpets and garments.

The quality of leather produced depends on the care and handling given to the animal and the hide before, during and after slaughter.

**Importance of hides and skins**

* Source of income after selling them.
* Provide employments for the people in tanneries and those making musical instruments.
* Source of leather for making shoes, bags, wallets, belts, jackets etc.
* Source of foreign exchange for the country through exportation of hides and skins.
* Some people use hides and skins as clothing.
* Provide food for some people
* Used for construction of huts and shades

**Causes of damage to hides and skins**

Damage to the hide and skins can occur at a number of stages namely; before slaughter when the animal is still alive, during slaughter, flying, drying, storage and during transportation.

1. **Damages during life time of the animal:**

* Poor feeding which denies animals nutrients for producing quality hides/skins.
* Bruises during transportation that may lead into blood clots.
* Damage by horns of other animals during fighting
* Indiscriminate branding which reduces value of the desired parts of hides and skins/branding on valuable parts of the hide or skin.
* Scratches by barbed wires and thorns.
* Attacks by skin diseases such as ring worm, mange.
* Attack by external parasites such as ticks which make holes in the hide/skin.
* Beating the animal using sticks leading to bruises and blood clots in the skin/hide.
* Warble flies damage hides and skins by boring them during their exit from the animals.
* Damage by yoke colluses on work type animals.

1. **Damages during slaughtering**

* Incomplete bleeding causing blood to remain in hide and encourage bacterial growth.
* Dragging the animal on rough surface/sharp objects which cut hides and skins.
* Dragging the carcass on rough ground leading to bruises.

1. **Damages during flaying**

* Using poor ripping lines which give the hide/skin an irregular shape.
* Delayed flaying causing difficulty to remove the skin/hide (rigor mortis).
* Poor flaying which leads to flay cuts
* Poor fleshing/improper flaying leaving meat pieces and fats which rot on the hide.
* Contamination of hide or skin with manure, blood or soil which reduces its quality.

1. **Damages during curing/drying**

* Poor drying which leads to rotting
* Delayed preservation which leads to rotting.
* Over stretching during drying leading to destruction of grains.
* Drying hides or skins on the ground which leads to contamination.
* Delaying to wash the hide or skin after flaying causing dung and blood to stick on it.
* Taking long to hang hides/skins for drying resulting into hair slip.

1. **Damages during storage**

* Baling hide or skin using wires which cut and damage hides and skins.
* Storing hides or skins in wet areas causes them to rot.
* Attack by storage pests like rats and beetles which eat parts of the hide.
* Improper folding with hair out causing hair slip.
* Placing the hide or skin on the ground instead of racks leading to rotting due to absorption of moisture.

1. **During transportation**

* Poor transport which exposes hides and skins to bad weather leading to rotting.
* Contamination by oil or grease
* Rubbing due to poor handling during loading and offloading.
* Sliding over each other which results into hair slip.

1. **Fraudulent practices** e.g. leaving hides and skins out over night to increase weight which leads to rotting.

**Ways of ensuring production of high quality hides and skins.**

* Dehorning animals to reduce damage during fights.
* Branding animals only on recommended parts/less valuable parts of the hide/skin such as lower part of the thigh, cheek, forehead etc.
* Using plain wire fences and woven wire fences which do not have barbs that damage hides.
* Weeding the farm to remove thorny plants damage hides.
* Ensuring proper bleeding by hoisting the animals to reduce blood content in the hides/skins.
* Eviscerating the carcass properly to reduce contamination of hides/skin with contents of internal organs.
* Ensure proper feeding of animals to provide nutrients required for development of hides and skins.
* Flaying animals from a clean place to reduce contamination with soil, dung and manure.
* Ripping should be done with care to avoid the skin having a poor pattern.
* The animal should be given plenty of drinking water before slaughter to make skinning easier.
* Using sharp knives but not pointed to reduce cuts on hides/skins during flaying.
* Using sisal instead of wires when baling hides and skins to avoid damaging them.
* Transporting animals in a well-designed vehicles that reduce bruising of hides and skins.
* Controlling external parasites such as ticks by spraying using suitable chemicals.
* Casting animals on grass surface to avoid physical damages.
* Washing and scrubbing the hide/skin after flaying to remove dung and blood.
* Proper handling of hides and skins during loading and offloading to avoid rubbing.
* Transporting hides and skins in covered trucks to avoid wetting of hides and skins by rain.
* Controlling skin diseases as soon as they appear such as mange, ring worm using recommended chemicals.
* When drying the hide/skin should be suspended in air on wooden frame instead of drying them on the ground to avoid contamination.
* Hides/skins should be stacked on racks so that they are raised off the ground to reduce dampness.
* Treat hides/skins with suitable chemicals to reduce damage by storage pests such as cockroaches, rats and beetles.
* Store hides/skins in well ventilated and leak proof shelter to reduce damage due to dampness.
* Trimming hides and skins to remove irregular flaps
* Carry out fleshing to remove meat pieces and fats from the hide/skin
* Hides/skins should be stretched evenly during drying to avoid distortion and damage to the pattern.

**Procedure of preparing hides and skins for sale**

* Washing hides and skins to remove dung, dirt and blood.
* Hang up the hides and skins for water to drain off.
* Fleshing to remove fats and meat from hides and skins.
* Preservation by adding salt or sun drying.
* Trimming to remove odd flaps to give hide/skin an even shape.
* Add recommended pesticides to avoid attack by cockroaches, rats and beetles.
* Carryout grading according to quality and size (weight).
* Fold along the back line with the inside out to avoid spoilage.
* Baling using hoop iron to avoid damage on hides and skins.
* Weigh the hides and skins to establish value
* Store properly to avoid spoilage.

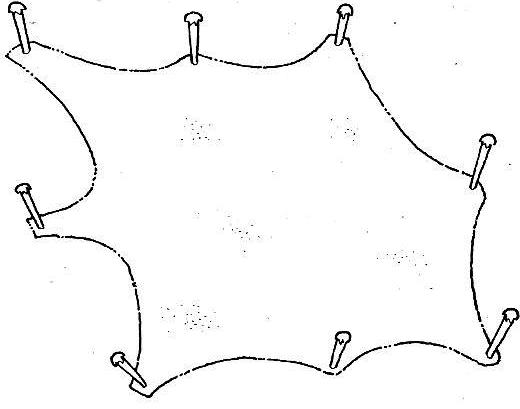
**PRESERVATION OF HIDES AND SKINS**

1. **Air drying**

There are several methods of air drying which include:-

1. Ground drying; the skin is spread on the ground and pegged

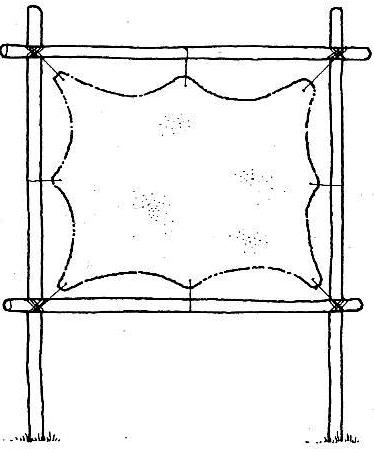
The skin should be stretched evenly to avoid distortion and damage to the pattern.



Poor quality skins and hides may be produced due to;

* Hides dried on the ground are often hard on the outside and soft inside.
* Parts which get into contact with the ground tend to putrefy.
* There are common cases of cracking of hides/skins due to over drying and the temperature from the soil.
* There is a tendency of fat melting, spreading into the hide which leads to low quality products.

1. Suspension drying: hides are suspended on frames so that all the hides receive free circulation of air and they get uniform heating from the sun’s rays.



1. Line drying: the skin/hides are dried on wires.
2. **Brining/salting:** Salt is added up to 30 to 50% of the green weight of the hide. The salt absorbs moisture from the hide/skin such that putrefaction doesn’t take place.

**Guiding questions**

1. (a) Explain the causes of low beef production in Uganda. (12 marks)

(b) Suggest the measures that can be taken to improve beef production

in Uganda. (08 marks)

1. (a) Explain the factors to consider when establishing a beef herd. (12mks)

(b) Explain the measures the government should take to improve beef

production in the country. (08 marks)

1. (a) Outline the steps to follow when preparing hides for sale. (08 marks)

(b) Explain how the quality of hides and skins may be lowered. (12 marks)

1. (a) Explain why local breeds of cattle have been more successful in tropics

than exotic breeds. (10 marks)

(b) Suggest the measures that can be taken to improve the productivity

of indigenous breeds of cattle. (10 marks)

1. (a) Give reasons why output of indigenous cattle in Uganda is low. (6mks)

(b) What measures would you advice the government to take in order to

improve on the production of animals in the country? (14 marks)

1. (a) Describe the procedure of butchering cattle on the farm. (12 marks)

(b) How can production of high quality meat be ensured on the farm? (8mks)

1. (a) Explain the considerations to be made when choosing a good animal for

beef production. (10 marks)

(b) What factors may make meat unfit for human consumption? (05 marks)

(c) Outline the essential features of a good abattoir. (05 marks)

1. (a) Explain the factors to consider when choosing a breed of cattle to rear on

the farm. (10 marks)

(b) What are the challenges of rearing exotic breeds of cattle in Uganda?

1. (a) Describe the causes of low quality hides and skins from pre-slaughter

up to flaying. (10 marks)

(b) Explain how you can reduce the damages on hides and skins from pre-

slaughter up to flaying. (10 marks)

1. (a) Explain the factors that determine the size of the herd on the farm. (12mks

(b) How would you ensure adequate supply of good forage for grazing on a

range land? (08 marks)

1. **DAIRY CATTLE**

These are animals that are bred for milk production.

Examples of dairy cattle

* Friesian (Black and white)
* Jersey (Brownish grey, dark muzzle or blackish brown)
* Ayrshire (Red and white)
* Guernsey (Golden with clearly defined white markings)
* Brown swiss (Brown)
* Sahiwal (Reddish brown)
* Jamaica Hope

**Characteristics of a good dairy cow**

* It should have a wedge shape
* It should have a long lactation period
* It should be able to produce a lot of milk.
* It should have a prominent milk vein
* It should have low temperament/docile
* It should have a large abdomen to accommodate enough food.
* It should have a large udder
* It should have a high longevity/ability to stay in production for long.
* It should have a high fecundity/calve regularly.
* It should be a good converter of feeds to milk.
* Hind limbs should be set wide apart to accommodate a large udder.
* It should have strong hind legs for supporting big udder.
* It should have a high appetite.

**Importance of dairy farming**

1. Provides income to the farmer all the year around from milk sales.
2. Source of food for both the rural and urban dwellers in form of milk.
3. Manure from dairy cows could be used to produce biogas.
4. Manure (dung and urine) from dairy cows can be used to improve soil fertility.
5. Provision of employment to the farmers and to people involved in processing and marketing of milk and milk products.
6. Dairy cows keep our environment clean by feeding on crop residues and agro-industrial wastes.

**Limitations of dairy farming**

* It is labour intensive/high labour requirement in terms of feeding animals, cleaning shelter and milking animals.
* Requires a lot of capital to buy livestock, equipment, putting up shelter and planting forages.
* Insufficient feeds which leads to low milk yields.
* Milk is highly perishable.
* Unfavourable climatic conditions which don’t favour growth of pastures to feed animals.
* Lack of ready market for milk especially in rural areas.
* Low prices for milk which makes farmers unable to purchase expensive inputs such as drugs, supplementary feeds and to pay hired labour.
* Poor managerial skills which leads to heavy losses.
* Diseases such as tick bone diseases which are very difficult to treat and in most cases infected animals die.

**Factors to consider when establishing a dairy herd.**

1. Capital: adequate capital is needed in the construction of farm structures, purchase of land and animals.
2. Size of land; enough land is required for grazing animals as well as production of fodder.
3. Availability of labour: dairy farming requires a lot of labour to milk animals, feed animals, clean animal quarters and plant fodder.
4. Water availability: water should be available to cows in sufficient quantities because water is required for milk synthesis.
5. Market: It is advisable to establish a dairy farm in an area where there is ready market for milk.
6. Security: A dairy farm should be established in a secure place to prevent theft.
7. Availability of feeds: Dairy animals require high quantity and quality feeds to maximize production.
8. Government policy: the government policy should be encouraging dairy farming through the provision of good breeds of cattle.
9. Transport network: there should be reliable transport/good roads so that the farmer can easily move farm products to the market and bring back inputs.
10. Class of animals/age of animals; it is advisable to avoid starting with mature cows as those who sell them off do so due to certain reasons such as low production, sickness, infertility, nervousness etc.
11. Breed: choose a breed which fits the market demand and the climatic conditions of the place.
12. Availability of extension services; to give advice to farmers where necessary.
13. Reproductive ability/fertility of animal; choose animals with high fertility rate.
14. Resistance to parasites and diseases; the animals should be able to tolerate parasites and diseases in order to reduce costs of treating animals and losses due to death.

**Factors to consider when choosing a breed of animals for milk production**

* Feeds available; a large breed like Friesian requires high quantities of feeds, small breeds like Jersey can be kept in an area where pastures are scanty.
* Climatic conditions; different breeds have different levels of adaptability to various localities, for example the Friesian will adapt readily to cool highland areas.
* The available market for milk and milk products; if there is a high demand for butter, choose a breed which yields milk with a high butter fat content.
* Breeding qualities; It is important for continued productivity, for example the Friesian calves regularly and rarely has calving difficulties.
* Management factors; Friesian has good temperament that allows easy handling and milking, whereas the Ayrshire is less easy to handle though it has superior adaptability.
* Availability of a particular breed in the locality; choose a breed which is readily available.
* Capital available; some breeds are more expensive than others so choose a breed which can match with available capital.
* Longevity; choose a breed which can produce milk for a long period of time.
* Farmer’s preference; a farmer should choose a breed which he or she wants.

**Factors to consider when selecting dairy cattle for improvement**

* Physical fitness; animals selected should be free from any physical defects such as one eyed, limping, weak backline, irregular number of teats etc.
* Feed conformation; select animal according to its body appearance e.g. it should have a wedge shape.
* Feed conversion efficiency; select animals that have a high feed conversion efficiency/efficiently convert feeds into milk.
* Age; young animals that have not calved or produced for more than three times should be selected because they have a long productive life than old ones.
* Level of performance/milk yield; only animals that produce high milk yields should be selected.
* Quality of products; select animals that produce milk with high butter fat content.
* Temperament; select animals which are docile to ease handling during milking.
* Mothering ability; select animals with good ability to give birth to live offsprings.
* Adaptability; select animals that are well adapted to the prevailing climatic conditions of the area.
* Health standards of the animal; select animals that are not susceptible to diseases/animals that show resistance to diseases.
* Reproductive efficiency; select animals that can calve regularly.
* Longevity; select animals that have ability to live for long since they don’t required constant replacement.
* Historical background/pedigree; select animals with good ancestral records.

**GENERAL MANAGEMENT OF DIARY CATTLE**

Good dairy management is essential if the farmer is to maximize milk production from dairy cows.

The following practices are of great importance as far as management of dairy cows is concerned.

1. Regularity of care; It is advisable to adhere to a given routine when handling dairy cattle so that they can become used to that routine. Practices that can be carried out on a routine basis include feeding, spraying, drenching, milking and grooming.
2. Kindness to the animal; Rough handling of animals like beating reduces the milk yields and can even cause injuries that are expensive to treat.
3. Grooming; Keeping hind quarters of animals off dung, loose hair and any dirty by brushing leads to clean milk production and also facilitates mating.
4. Exercise; Animals need light exercise for good health but long distances of movement should be avoided as it leads to wastage of energy that would be used in milk production.
5. Hoof trimming; over grown hooves should be trimmed to avoid difficult in movement and lameness.
6. Identification; It is done at calf stage, to enable the farmer to keep records of individual animals.

The methods of identification include ear tagging, branding, tattooing etc.

1. Dehorning; It is advisable to dehorn dairy cattle when still young using chemicals (e.g. caustic potash or caustic soda), hot iron rod, or an electric dehorner.

The purpose of dehorning is to efficiently utilize space at feeding and drinking troughs and in transit, make animals easy to handle and to avoid fights that cause damage to hides.

1. Provision of adequate water; animals need enough water since the highest percentage of their body is water. Excessive loss of water from the body reduces milk yields.
2. Proper feeding; diary animals should be given adequate and highly nutritious feeds to improve and maintain a high level of production.
3. Maintaining a high breeding efficiency; Breeding efficiency is a measure of the ability with which the herd is able to reproduce and increase.

High breeding efficiency in a herd can be maintained by;

* Practicing general sanitation programme to avoid spread of diseases.
* Controlling breeding diseases
* Taking care to detect cows on heat.
* Inseminating the cow at the right time.
* Carrying out pregnancy diagnosis to identify animals that have conceived so that those which have failed can be returned to service.
* Keeping accurate breeding records to enable the farmer predict fertility.
* Giving cows 60 days resting period after calving before they are bred again. This is to allow the uterus to return to normal.
* Buying replacement stock from healthy herds.

1. Record keeping; the importance of keeping good records in dairy farming include;

* Records enable the farmer to feed animals according to their production level so as to maximize profit.
* At national level, dairy records enable carrying out livestock census. This enables evaluation of the country’s wealth.
* Records enable the farmer to identify and cull unproductive animals.
* Records enable the farmer to find out whether he/she is making profit of loss.
* Records show the history of herd which help in pedigree selection.
* They enable farmers to obtain loans from banks.
* They enable the farmer to design a breeding programme that can enable him/her achieve high breeding efficiency.
* Records enable the farmer to predict income expected and then plan accordingly.
* Records enable the farmer to evaluate the performance of the herd in terms of production, health and breeding efficiency and then be able to plan for improvement in case the current level of performance is not satisfactory.
* Records facilitate fair tax assessment.
* Identification records enable the farmer to know each animal so that in case of theft he/she is able to identify the animal lost.

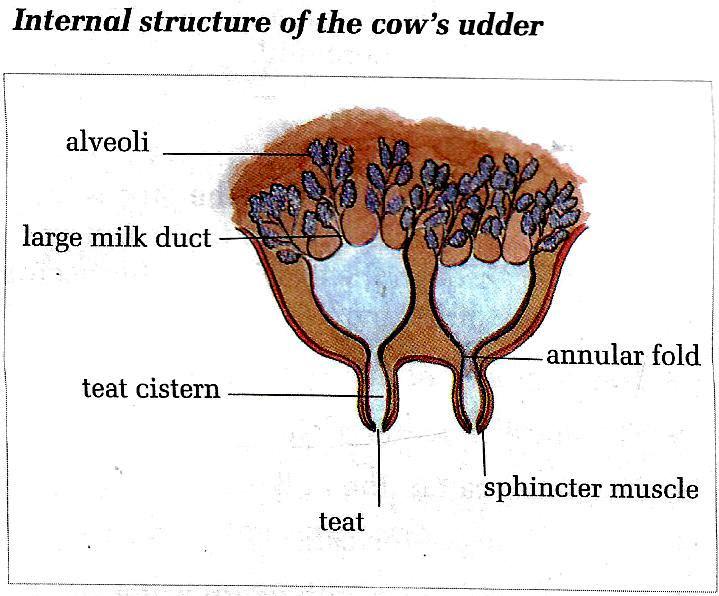
**Types of records kept by a dairy farmer**

1. Health records; these show the diagnosis of a disease and the treatment given.
2. Breeding records; these show the sire used, date of service, method of service, expected date of calving, actual calving date, sex of the calf, birth weight etc.
3. Feeding records; these show the kind and quantity of feeds given to the animal per specific period of time.
4. Milk production records; these show how much milk each animal produces daily and the total for each day and month.
5. Labour records: these show the number of employees, type of work done, salaries etc.
6. Sales records: these show the quantity of milk sold, number of animals sold.
7. Inventory; these show the assets a farmer has e.g. number of animals, dairy equipments and their value.
8. Calving records; these show the number of calves per dam as per season.
9. Identification records; animals are given numbers or names that facilitate identification of animals.
10. Operation/routine records; these show dehorning dates, deworming dates, etc.

**Requirements for successful dairying**

1. High standard of management
2. Good feeding of the animals
3. Proper disease control
4. Good stockman ship to look after animals.
5. Equipment for feeding, disease control, milking, milk storage and cooling
6. Processing and marketing facilities.

**MILK PRODUCTION**



The udder is located outside the body just between the hind legs and is attached to the body by ligaments and abdominal muscles. It is composed of four separate compartments called **quarters** and each quarter has a teat.

The udder consists of countless tiny sac like cavities called **alveoli**.

The inner lining of each alveolus is lined with milk secreting cells.

The alveoli open into **small ducts** which converge into large ducts called **gland cistern**, which is connected to another cavity **teat cistern**. At each convergence there is a **sphincter muscle** which holds the milk and will not release it unless the cow is stimulated.

**LACTATION**

It refers to milk production by a female animal (cow).

It starts after calving when the calf suckles. A hormone known as prolactin produced by the pituitary gland stimulates the udder to begin producing milk.

Lactation consists of two stages namely;

1. Milk synthesis/milk secretion
2. Milk let down

**Milk synthesis:**

This is the process of manufacturing milk which takes place in the alveoli of the udder. The cells of the alveoli extract nutrients from the blood stream and use them to manufacture milk under the control of Leutenising hormone. The nutrients include amino acids, sugars, vitamins, minerals, fats and water.

Amino acids are used to make milk protein (casein), sugars (glucose and galactose) are used to make milk sugar (lactose). Then casein, lactose, fats, minerals, vitamins and water are turned into milk.

**Milk let down:**

This is the down flow of milk from the alveoli to the lower parts of the udder (gland cistern and teat cistern).

The hormone known as **oxytocin** which is secreted by the pituitary gland is responsible for milk let down.

The effect of oxytocin hormone last for about 5 to 9 minutes. Therefore, milking should be done as soon as possible after stimulation.

**Conditions for milk let down**

* Suckling of the calf.
* Approach of milking time
* Presence of the calf at the milking site/sight of the calf
* Noise or rattling of the milking utensils such as buckets.
* Massaging the udder/washing the udder with warm water.
* Giving the cow dairy meal/concentrates at the time of milking.
* Massaging teats with milking salve.
* Attachment of teat cups on the teats.

**The process of milk let down / milk ejection reflex**

* When the cow is stimulated by massaging the udder with warm water, suckling by the calf etc, a message is sent to the brain through the spinal cord.
* The pituitary gland secrets a hormone known as oxytocin which is released into the blood stream.
* On reaching the udder, the hormone causes the muscles surrounding the alveoli to contract and squeeze milk out of the alveolar cavities through the ducts and cisterns.
* The action of suckling or milking force milk out of the teat.

**Milk hold up:**

This refers to failure of the cow to release milk.

Exciting or frightening the cow will prevent a complete response to the milking stimulus. A hormone known as adrenaline, secreted by adrenal glands is responsible for milk holdup/suppresses milk let down.

Therefore, cows must be handled quietly and gently especially at milking time.

**Factors that encourage milk hold up**

1. Rough handling of the animal by beating
2. Presence of strangers around the milking parlour.
3. Unusual noise e.g. barking of dogs
4. Pain during the milking process caused by mastitis or injury to the teats.
5. Failure to provide dairy meal when the cow is used to it.

**The process of milk hold up**

* When the cow is frightened / excited / becomes nervous due to unusual noise, rough handling, strangers around the milking shed, a message is sent to the brain.
* The brain instructs the adrenal gland to secret adrenaline or espinephrine.
* Adrenal makes the blood vessels to constrict.
* Constricted blood vessels cut off blood supply containing oxytocin to the udder and its influence.
* Adrenaline also induces the production of vasopressin which induces pressure on the annular fold and sphincter muscles.
* This makes the opening between the annular fold to close the teat cistern.
* This stops downward flow of milk hence milk hold up.

**Composition of milk from exotic cattle**

|  |  |  |
| --- | --- | --- |
|  | **Component** | **Percentage composition** |
|  | Fats | 3.7 |
|  | Sugar (Lactose) | 4.8 |
|  | Proteins (casein) | 3.2 |
|  | Minerals (ash) | 0.7 |
|  | Water | 86.6 |
|  | Total solids | 1.0 |

**Qualities of a good udder**

* Large capacity
* Teats should be of even size.
* Should have four regularly placed teats
* A prominent milk vein to ensure a good supply of blood to the udder.
* Soft skin with fine fur.
* Should not be pendulous since pendulous udders are prone to injury by long blades of grass and to mastitis.

**Abnormalities of the udder**

* Blood in milk due to mastitis or a broken blood vessel.
* Congestion of the udder, swelling of the udder due to accumulation of fluids before calving. It can be controlled by pre milking.
* Failure of milk let down; when milk let down reflex fails especially in newly calved heifers. It can be treated by injection of oxytocin.
* Mastitis; an inflammation of the udder caused by bacteria.

**Question:**

State the cause, symptoms, factors that predispose animals to mastitis, mode of spread, ways of preventing and treating mastitis.

**Solution**

1. **Cause of mastitis:**

It is caused by bacteria especially streptococcus and staphylococcus.

1. **Symptoms of mastitis:**

* Blocked teat canal.
* Abnormal milk stained with blood or pus.
* Milk may be thick or watery
* The udder is swollen/inflamed
* Reduced milk production
* Affected udder may become dead and produce no milk.
* Milk with clots or flakes
* In several cases affected animals may die
* Pain in the udder/teats

1. **Mode of spread of mastitis**

* Milker’s hands
* Infected teat cups of the milking machine
* Through udder towels which have been used on infected animals.
* Through flies

1. **Factors that predispose animals to mastitis**

* Stage of lactation; it is more common at the beginning of lactation
* Age of cattle; older animals are more prone to mastitis due to an ageing immune system.
* Level of milk yield; high milk yielders are more prone to mastitis than the low yielders.
* Injury to udder and teats; this leads to wounds which act as entry points for pathogens.
* Unhygienic practices; milking infected animals with health ones increases the chance of spread of mastitis.
* Pendulous udder; this is more prone to mastitis.
* Incomplete milking; the milk that remains in the udder provide food to the bacteria that causes mastitis.
* Genetic factors; the disease may be passed on from one generation of animals to another along a family.

1. **Control/prevention of mastitis**

* Regular use of a strip cup to detect mastitis before actual milking.
* Proper disposal of contaminated milk to prevent spread of pathogens.
* Culling susceptible and non-responsive cases.
* The teat cups should be rinsed and disinfected immediately after milking each cow.
* Proper care and maintenance of all parts of the milking machine.
* The milker should ensure that his hands are clean and washed in water with a disinfectant as he moves from one cow to another.
* Check for injuries on the udder and treat them.
* Milking healthy cows first and infected cows last and discard the milk.
* Applying milking salve on teats to avoid injuring them prior to milking.
* Ensure that milking is complete to remove all the milk that would encourage growth of microbes.
* Treat early by infusion of antibiotics into the udder to stop spread of the disease.

1. **Treatment of mastitis**

* Infusion of an antibiotics into the udder.
* Intravenous or intramuscular injection of antibiotics such as streptomycin.

**MILKING PROCEDURE**

Milking is the process of removing or harvesting milk from the cow’s udder into the bucket. The milking procedure involves three main stages

1. Preparation
2. Actual milking
3. Stripping
4. **Preparation for milking**

It involves preparation of the milking place and utensils, the cow and the milker.

1. **Preparation of milking place and utensils**

* Clean the milking place/shed to avoid contaminating milk.
* Remove plants with strong smell/odour around the milking shed e.g. garlic, Mexican marigold to avoid tainting milk.
* Assemble the milking equipments such as milking pails, milk churns, milking buckets, milk sieves, milk strainers etc.
* Clean the milking equipments with clean water and dry them in sunshine.

1. **Preparation of the milker**

* The milker should be healthy to avoid transmission of infectious diseases such as tuberculosis.
* The milker should trim his/her finger nails to avoid injuring the teats of the cow and contaminating the milk.
* The milker should wash and dry his/her hands before milking to prevent contaminating the milk.
* The milker puts on the attire for milking i.e. clean overall and gumboots.
* The milker puts on/wear a cap to prevent hair falling into the milk.

1. **Preparation of the cow**

* Gathering cows into the milking yard at least 30 minutes before milking starts to enable them settle and calm down.
* Placing a certain amount of dairy meal into a feed trough for the animal to eat to occupy it and ease handling.
* Secure/tie hind legs with a milker’s rope to avoid kicking and stepping in the milk bucket.
* The hind quarters of the cow are brushed to remove loose hair, dust and manure.
* Washing the udder and teats with warm water.
* Dry the udder with a towel. Individual disposable paper towels may be used to minimize spread of mastitis.
* Smear milking salve on the teats to avoid friction and cracking of teats while milking.
* Draw a few streams of milk from each teat into a strip cup to detect mastitis. Presence of clots or blood stains indicate mastitis.

1. **Actual milking**

Milking should commence immediately after washing and drying the udder to utilize the short lived effect of oxytocin hormone.

**Methods of milking/milking systems**

1. **Hand milking**

* The top of the teat is held between the index finger and thumb so that it is closed to prevent milk from flowing upwards into the udder.
* Compressing the other fingers against the rest of the teat. This forces the milk trapped in the teat cistern to flow out through the teat canal.
* The fingers are relaxed to allow the teat canal to refill.

**Advantages of hand milking**

* Spread of mastitis is limited as compared to machine milking where mastitis is easily spread through teat cups.
* It has low initial capital and therefore peasants can afford it.
* It cannot be limited by power therefore more applicable to rural areas with no power.
* Injury to the teats is not common as witnessed in machine milking due to faulty machines.
* It is economical to use on small herd.

**Disadvantages**

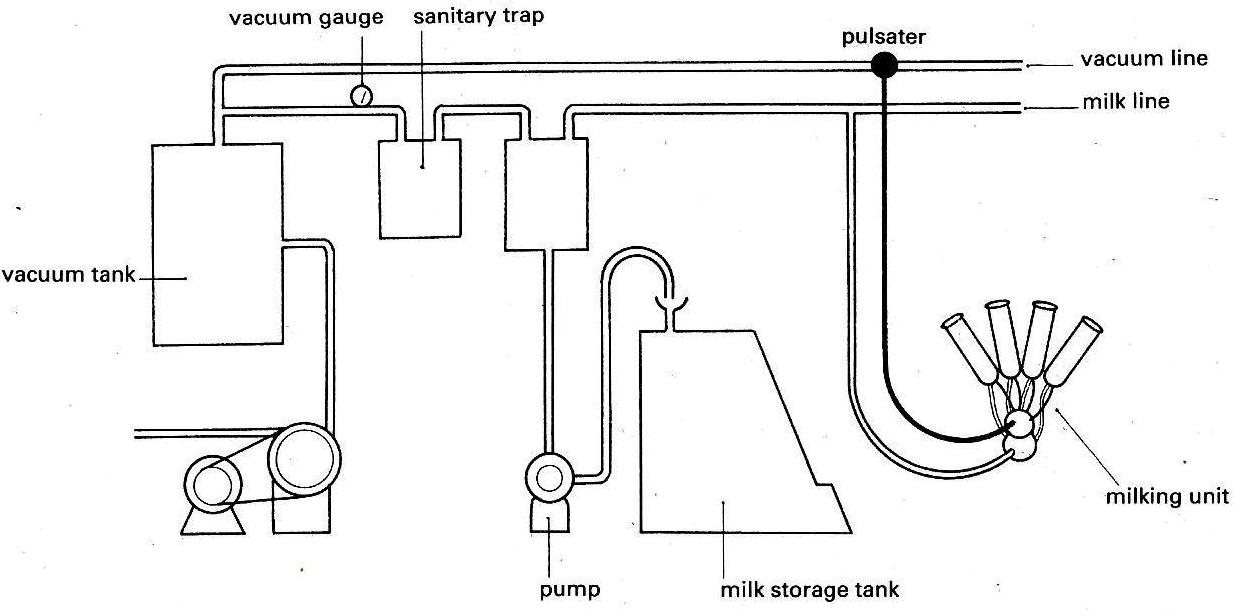
* It is very slow in operation and therefore cannot cope with large herds.
* Efficiency declines with increase in time worked.
* It is difficult to have complete milking hence a farmer stands to lose.
* It increases labour costs as more people are employed.
* It is difficult to produce clean milk as milk comes into contact with the outside.
* It is tiresome.

1. **Machine milking**

Machine milking is recommended for use where the dairy herd is large and would necessitate many milkers.

It is operated using an electric motor or small engine.

**Components of a milking machine.**



* **Vacuum supply unit:**

It provides a source of vacuum to the end of the teat to cause milk to flow out of the teat.

It also provides the energy to activate the liner and massage the teat.

The vacuum pump creates the necessary vacuum within the milking machine system.

* **Pulsation unit:**

Produces an intermittent vacuum by allowing air to enter into the space between the teat cup rubber liner and the casing, and then withdrawing the air into the vacuum system.

* **Milking unit:**

It performs the milking operation. It is made up of the teat cups, milk collecting tubes and pulse tubes. The pressure inside the teat cups is lowered forming a vacuum, while that inside the teat remains unaltered. The difference in pressure is sufficient to allow milk to flow out.

* **Milk collection unit:**

It is made up of the milk-flow line and the storage tank. A device attached on to the milk-flow line indicates to the milker when milking is over.

A cooling unit is also attached on the storage tank to cool the milk immediately after milking to retard bacterial growth that would spoil the milk.

**Advantages of machine milking**

* Less labour is required
* It is quick
* Clean milk is produced as it does not come into contact with the outside.
* Can easily cope up with a large piece of work without getting tired.

**Disadvantages**

* It needs skilled labour to operate the machine which may be difficult to attain.
* Faulty machines can cause injury to teats.
* The machine is expensive to purchase and install.
* It is limited by power supply and cannot work in places without power.
* It doesn’t empty the udder completely, hence requiring the milker to carryout stripping.
* Diseases like mastitis can easily spread since the animals share the same teat cups and due to injuries caused by the machine.
* It is not economical to use on a small herd.

1. **Stripping**

This is necessary so as to get the last milk from the udder.

The udder quarters are massaged and squeezed to ensure that the udder is completely emptied.

It also controls mastitis since it denies the bacteria which would have attacked the udder milk to feed on.

**Rules for good milking**

* Avoid exciting the cows before and during milking as it leads to milk hold up.
* Prepare and assemble all the milking equipments in advance to ensure that the milking period is not interrupted.
* The milking period should not be interrupted.
* Milk at the same time every day to get the cows used to the routine.
* Prepare the cow for milk let down by washing the teats with warm water.
* Use a strip cup to test for udder infection for clean milk production.
* Begin milking soon after preparing the cow to utilize the maximum effect of oxytocin hormone.
* Strip the udder clean to get the last milk.

**Activities after milking**

* Weighing and recording the amount of milk harvested from the cow. This is done when milk is still in the bucket or pail.
* Sieving the milk as it is poured into the milk can to remove foreign matter.
* Covering milk well to prevent dust and flies from falling in milk.
* Cleaning the milking place and the milking utensils thoroughly.

**QUALITY MILK PRODUCTION**

The following properties contribute to milk quality;

1. Safety; freedom from bacteria likely to cause diseases in man or animals.
2. Nutritive quality; milk must have most of the nutrients it is supposed to have.
3. Cleanliness; must be free from dirt, bacteria, blood or pus from the udder.
4. Flavor; must be free from any taint or odours.
5. Keeping quality; it refers to the length of time the milk will remain fresh. Keeping quality is determined by the amount of bacterial contamination and the temperature at which the milk is kept.

**Sources of milk contamination**

* Unhygienic person
* Unclean water that may be used to wash the udder or equipments.
* Flies and other insects that may fall into the milk.
* Accidental addition of chemicals such as acaricides, insectcides, drugs, paraffin etc.
* Feeds with strong smell supplied during milking e.g. silage.
* Drugs, vaccines administered during lactation.
* Dirty equipments e.g. towels, milk cans, buckets/pails and strainers.
* Unhygienic environment e.g. dusty environment.
* Blood or pus from infected udder.
* Addition of water or solids like flour by evil minded persons.
* Mixing good milk with that from cows suffering from mastitis.
* Improper storage.
* Feaces, urine, hair from the cow fall and contaminate the milk/dirty animals.

**CAUSES OF OFF FLAVOURS/UNPLEASANT FLAVOURS IN MILK**

1. Feed flavours; these arise from certain plants like Mexican marigold and garlic in pastures which taint milk.
2. Cowy and barny odours; these are due to cows in haling foul odours from unclean conditions such as accumulating manure, beddings etc.
3. Salty taste; in milk from cows with mastitis or cows in late pregnancy.
4. High acid/sour taste; this is due to bacterial contamination producing acidity in milk.
5. Oxidation flavour; arises as a result of exposure of milk to sunlight or allowing milk to come in contact with bare iron and copper.
6. Foreign flavours; these arise as a result of accidental addition of foreign materials such as medicants, petrol, paraffin, disinfectants etc.
7. Foully flavours; these arise from dirty milking utensils.
8. High colostrum levels in milk/hormones

**Reasons why milk is highly perishable**

* It has balanced composition of nutrients which are ideal for growth of microorganisms.
* It contains fats which can easily go rancid.
* It readily absorbs smell or odours.
* It has a high water content which provides moist conditions for growth of micro-organisms.

**Precautions to take to produce clean milk on the farm**

* Keeping milking animals healthy i.e. free from tuberculosis, brucellosis, mastitis etc.
* The milking parlour/shed and the surrounding should be clean to avoid contamination of milk.
* The teats should be smeared with milking salve before milking to prevent friction and cracking of teats.
* Use clean utensils to avoid contamination of milk.
* Use a strip cup to detect mastitis
* Do not feed animals on silage before and during milking to avoid tainting milk.
* Wash the udder and teats with warm water to stimulate milk let down and dry it using a clean towel.
* Milk should be filtered/strained to remove foreign materials.
* Remove plants with strong smell/odour around the milking parlour to avoid tainting milk.
* Cover the milk well to prevent dust and flies falling in milk.
* Milk should be stored in a cool and clean place to prevent multiplication of micro-organisms in the milk.
* The milker should always wear clean clothes and a cap on his/her head to prevent human hair from falling into the milk.
* The milker should be healthy i.e. free from diseases such as tuberculosis and typhoid.
* The nails of the milker should be trimmed or kept short to avoid injuring teats and contaminating milk.
* Cows with mastitis should be milked last so as to avoid infecting the healthy ones and the milk poured away.
* The milker should wash and dry his hands before milking to avoid contaminating milk.
* Milk should be delivered to milk plants/consumers immediately if the farmer does not have cooling facilities for milk.
* Use aluminium/plastic utensils to avoid contamination of milk.

**Factors affecting milk yields and composition**

1. Breed of the animal; exotic breeds produce more milk than indigenous breeds but indigenous breeds produce milk with a high butter fat content compared to exotic cattle.
2. Age of the animal; heifers/cows that are lactating for the first time produce less milk but with high butter fat content and dams produce more milk with low butter fat content.
3. Health of the animal; diseases such as mastitis lower the quantity and quality of milk.
4. State of pregnancy; milk yield decreases towards drying off stage. This is due to increased demand for nutrients by the growing foetus.
5. Water supply; water forms the biggest proportion of milk and therefore, inadequate water supply to the cow leads to reduced milk yield.
6. Temperament of the animal; cows that are calm during milk give more milk than nervous animals. Nervous cows produce adrenaline hormone which suppresses milk let down.
7. Stage of lactation; milk yield increases as the lactation period advances and drops towards drying off.
8. Heat period/oestrus; there is a drop in quality and quantity of milk during this period due to reduced feed intake.
9. Season of the year; milk yield is low during the dry season due to shortage of water and pasture for animals but milk has a high butter content.
10. Handling of the cow at the time of milking; rough handling causes excitement and nervousness in cows, which in turn result into milk hold up.
11. Frequency of milking; the more the number of times a cow is milked daily the higher the quantity of milk produced because emptying of the udder creates room for more milk to be synthesized.
12. Competence of the milker; milking is supposed to be completed within 7 to 8 minutes when oxytocin hormone is still active. If the milker is unable to complete the milking within this period, some of the milk will remain in the udder.
13. Type of feed eaten; lactating animals fed on roughages produce milk with high butter fat content.
14. Conditioning of the cows to the milking routine; milking animals at irregular time affects the milk yield because cows are unable to get used to such kind of routine and therefore do not respond as expected when the milking time approaches.
15. Exercise; animals having more exercise tend to produce milk with less butter fat content compared to those without exercise.
16. Temperature; high temperatures reduce milk yields due to increased evaporation of water from the animal’s body and also due to reduced feed intake.

**DETERMINING THE DENSITY/SPECIFIC GRAVITY OF MILK**

The density/specific gravity of milk is determined by a lactometer.

**Steps:**

* A suitable container e.g. a measuring cylinder is filled with milk sample.
* Insert/dip the lactometer into the milk and allow it to float.
* When the lactometer reaches stationery position, the reading is taken at the meniscus on the stem.
* Normal milk has a specific gravity of 1.032. If higher, solids such as flour or ripe bananas have been added to milk and if lower, water has been added.

**PROCESSING OF MILK**

Milk is highly perishable and its quality deteriorates very quickly if it is maintained at room temperature. Milk is processed to improve its appearance, palatability and lengthen its shelf life.

Raw milk can be processed in the following ways.

1. Cooling/Refrigeration; this prevents multiplication of micro-organisms that may spoil the milk.
2. Homogenization; this involves breaking down the fat globules in milk into smaller droplets so that they can be uniformly mixed in milk. The milk then assumes a uniform texture and a uniform white colour.

It’s done by passing the milk at high pressure through the pore in a homogenizer.

1. Blending/standardization; It involves mixing milk of high butter fat content with that of low butter fat content (skim milk) so as to get milk with the standard butter/definite fat content.
2. Centrifuging; this is done to remove sediments and dirt.
3. Pasteurization; It involves heating milk to a certain temperature for a specific period of time to kill harmful micro-organisms without changing its composition, flavor and nutritive value.

Basing on time-temperature combination, pasteurization can be classified into three methods.

1. **Low Temperature Holding (LTH)**

Milk is heated to 630C and maintained at this temperature for 30 minutes, rapidly cooled, and then stored at temperature below 100C.

1. **High Temperature Short Time (HTST)**

Milk is heated to 720C and maintained at this temperature for 15 seconds then rapidly cooled to 100C.

1. **Ultra-High Temperature pasteurization (UHT)**

Milk is heated to 1380C for 2 – 4 seconds, followed by cooling to 200C, and is then packed in sterile containers. This method allows the milk to be stored at room temperature for some months.

1. Skimming; It involves removing fats from milk and remain with milk containing 0.1% fat content.
2. Condensing: Milk is first heated to a certain temperature followed by removing some of the water from the milk. This is done to reduce the bulkiness of fluid milk during long distance transportation.

Sugar can be added to the condensed milk to produce condensed sweetened milk.

1. Evaporation; Raw milk is first homogenized and then extracting some of the water from milk. The evaporated milk is packaged into containers and then sterilized.
2. Fortifying; It refers to addition of minerals, vitamins and lactose to milk to increase its nutritive quality.
3. Culturing; It involves addition of specific bacteria to pasteurized milk to impart desired flavor.

The bacteria break down lactose into lactic acid. Cultured milk is used in the production of yoghurt.

1. Drying; milk is first partially condensed and then dried in a thin film on the surface of the metal roller that is heated from the inside by steam (roller drying). Dried milk can also be made by spraying partially condensed milk directly into a blast of hot dry air, which carries it across the drying chamber (spray drying).

Powdered milk can later be reconstituted to liquid milk.

**Types of processed milk**

1. **Skim milk;** this is where fat has been removed and it usually has 0.1% fat content.
2. **Cream;** raw milk is centrifuged to form cream which is then skimmed off. Cream has 15 to 40% fat content.
3. **Pasteurized milk;** milk is heated to a certain temperature for a specific period of time to kill bacteria and make it safe for consumption.
4. **Blended/standardized milk**; milk from different farmers is blended to form a definite fat percentage.
5. **Evaporated milk;** milk is first homogenized then some water is extracted from it.
6. **Condensed milk;** milk is first pasteurized then some water is removed from it.
7. **Condensed sweetened milk;** water is removed by heating under controlled temperature, then sucrose is added to milk.
8. **Cultured milk;** specific bacteria are added to pasteurized milk to add the desired flavor.
9. **Homogenized milk;** milk is passed through a small pore in a homogenizer at high pressure, fat globules are broken down and properly mixed in milk.
10. **Fortified milk;** minerals, vitamins and lactose are added to milk to improve its nutritive value.
11. **Dried milk;** this is made by spraying partially condensed milk directly into a blast of hot dry air which carries it across a drying chamber.

**MILK PRODUCTS**

1. **Yoghurt**

This is a semi solid food prepared by fermenting milk using bacteria.

Flavours and sugars may be added to modify the taste.

**Procedure of making yoghurt**

* Milk is first blended and homogenized
* Milk is subjected to heat treatment for 5 minutes to kill micro-organisms.
* The heated milk is cooled to the inoculation temperature.
* Inoculate/culture the milk.
* Allow fermentation to take place
* The yoghurt is cooled and packed

1. **Cheese**

Cheese can be prepared from whole milk, skim milk or cream.

**Steps/procedure**

1. Curdling the milk; curdling causes the milk protein to coagulate and form a precipitate. Curdling is brought about by rennin enzyme that is added into the milk and streptococcus lactis bacteria added to milk to convert lactose into lactic acid. The watery fluid that remains after the precipitation of the curd is called ***whey***. The curd contains all of the milk protein and most of the fat, minerals and vitamins.

1. **Removal of moisture from the curd;** the curdled milk is put in moulds with small holes at the bottom so that whey drains off. The curd is then removed from moulds and sliced into cubes using curd knives.
2. **Salting;** table salt is added to the drained curd or on to the surface of the curd after cutting it to desired shapes to impart a good flavor and taste to cheese, increase the keeping quality of cheese and protect the curd from micro-organisms which can cause decay.
3. **Ripening;** the pressed curd is then cured under controlled temperature and humidity for varying length of time (6 weeks to 6 months) depending on the quality of cheese desired) to produce cheese.

During ripening, specific micro-organisms are rubbed on the surface of the curd so that they convert lactose, proteins and fats into acids, alcohols and other compounds which contribute to the desired flavours and aroma in the cheese.

1. **Butter:**

It is a solid fat made from milk cream. Butter is made from fresh or sour cream using a machine called ***butter churn***.

**Preparations of butter**

* Milk is placed in a bowl/container for 24 hours.
* Cream collects on top and it is skimmed off.
* A muslin cloth is placed in the butter churn and then filled with cream to one-third of its capacity.
* Cream is then churned and fat globules collect in the middle.
* Churning is temporarily halted and cold water is added to a rate of 0.6 litres of water for every 4 to 5 litres of cream.
* Churning resumes/is done again until the butter fat globules become very small.
* Churning is then stopped and butter milk (liquid portion) is poured out of the churn through the muslin cloth.
* More cold water is added and churning continued, to remove the remaining butter milk, which also drained off through the muslin cloth.
* Salting of butter to prevent spoilage of butter by micro-organisms and to impart good flavor to butter.

1. **Ghee:**

This is made from butter, fresh cream or sour cream. Ghee is essentially butter fat prepared by heating and drying so that moisture is removed. It has a longer keeping quality than butter.

**Preparation of ghee from fresh milk cream**

* Cream is first washed by mixing it with water at the rate of 11.4 litres of water per 4.5 litres of cream.

This is done to remove casein from the cream. If not removed, casein sticks on to the sides of the pan and gets burnt during heating, leading to production of low quality ghee.

* The washed cream is then boiled to 1200C and stirred to produce ghee.
* The ghee is removed from the fire, filtered through a muslin cloth into a clean container and then stored at room temperature.

**Preparation of ghee from sour cream**

* Cream is left to stand for 24 hours to 48 hours so that it becomes sour.
* Sour cream is put in a pan and boiled as in the case for fresh cream to evaporate the water.

Washing the cream is not necessary because the casein in sour cream doesn’t stick onto the sides of the pan.

1. **Cream:**

This is a thick, light yellow portion of milk. Cream contains the same constituents as milk but has higher butter fat content (10 – 70 percent by weight). The common use of cream is to make butter.

The process of separating or removing cream from whole milk is called ***skimming***. The liquid that remains after removing all the cream is called skim milk.

**Preparation of cream**

There are two methods of preparing cream

1. **Hand method**

Raw milk is placed in the container and left undisturbed for 12 to 24 hours. The fat layer settles on top and then skimmed off.

This method is inefficient because chances of milk becoming sour are high, and also it is not possible to remove all the cream from milk.

1. **Mechanical method**

Spinning the milk shortly after milking in a machine called the cream separator speeds up the separation of fat/cream from raw milk.

Raw milk is poured into the cream separator and passes in a continuous flow through plates revolving at about 80 to 100 revolutions per second.

The centrifugal force separates the fat globules from skim milk.

This method is quicker and more efficient than the hand method.

1. **Ice cream**

It is a frozen dessert made of milk, cream, sugar and flavouring.

Its production consists of the following steps;

* Ingredients and gelatin are poured into a tank, followed by thorough mixing and pasteurization.

Gelatin is used as a stabilizer to give the product a smooth consistency.

* The mixture is the homogenized to break up particles of butter fat.
* The mixture is cooled, piped to a freezing tank and stirred vigorously or beaten until it is smooth.
* The ice cream then emerges from the freezing tank partially frozen, and is packed into containers that are stored in a refrigerated room until it’s completely frozen and hard.

**GUIDING QUESTIONS**

1. (a) Explain the procedure of milking a cow by hand method with emphasis   
    on the milking technique. (09mks)

(b) Describe the various stages in the processing of fluid milk for marketing.   
 (06mks)

(c) Outline the causes of the major off-flavours in milk. (05mks)

1. (a) Describe the milk ejection reflex in a dairy cow. (08mks)

(b) Explain the factors that affect the quality and quality of milk produced

by a cow. (12mks)

1. (a) Describe how a high quality of milk can be maintained. (10mks)

(b) Describe how a dairy cow holds milk (10mks)

1. (a) Explain how different off flavours arise in milk. (08mks)

(b) Describe the different forms of processed milk. (12mks)

1. (a) Sate the causes of milk contamination on the farm. (08mks)

(b) Describe how a lactometer is used to determine whether milk

is adulterated or not. (06mks)

(c) Describe the procedure of making good quality yoghurt. (06mks)

1. (a) Outline the conditions that encourage each of the following on a dairy

Farm.

1. Milk hold up. (04mks)
2. Milk let down (06mks)

(b) Describe the role of hormone in milk production. (10mks)

1. (a) Suggest the milking techniques that maximize milk production. (04mks)

(b) Explain the physiological factors that affect milk yields and composition.   
 (08mks)

(c) Explain the stages involved in preparation of cheese on a dairy farm.   
 (08mks)

1. (a) Explain the factors to consider when selecting a dairy cow for breeding.   
    (10mks)

(b) Give reasons why milk is a highly perishable product. (04mks)

(c) Explain the meaning of the following terms as applied in milk processing   
 (06mks)

1. Fortification
2. Homogenization
3. Pasteurization
4. Culturing