MERRYLAND HIGH SCHOOL- ENTEBBE S.4 2020

Dairy production and management

This is the rearing of livestock mainly for milk production on the farm.

Benefits of dairy farming /production

- It offers employment opportunities for farmers who rear dairy animals.
- It generates income to farmers through the sale of milk.
- Diary animals are able to convert fibrous feed materials which would be useless into high food value products to man like milk.
- It's a source of farm yard manure for soil fertility
- The diary animals are more efficient in production than the beef cattle, goats, pigs and poultry.
- The animals are later fattened to produce good quality beef or meat after their milk production period.

Problems of dairy production

- High labour is required on the farm e.g. for animal grazing, milking etc.
- It is expensive since it requires a lot of capital to start it.
- Milk produced is highly perishable for marketing.
- Requires plenty of skills, knowledge, modern equipment etc.
- Involves very many risks in farming like price fluctuations

Requirements for successful dairying

- High standards of management.
- Good feeding of the animals.
- Proper disease control.
- Good stockmanship to look after the animals.
- Availability of equipment for feeding, disease control, milking, milk storage, cooling.
- Processing and marketing facilities.
- Water availability.
- Good breeds of animals.

4.9.1 Milk production

Milk is a whole fresh secretion obtained from complete milking of one or more healthy cows excluding that obtained in 13 days before and 5 days after calving which is called **colostrum**.

Nutritional value /composition of milk

Milk is considered as a food containing most of the food values especially for babies because it contains the following:

- fats -3.7%
- sugar (lactose)-48%
- proteins (mainly casein)-3.2%
- minerals (especially calcium and phosphorous)-0.7%
- water-87.6%
- Other solids -12.4%

Note

However, milk lacks iron, copper, vitamin C.

Most of the components of milk are synthesized in the udder by the secretory cells called the alveoli i.e.

- Proteins mainly casein is formed by the union of the amino acids.

- Sugar mainly lactose is formed from 2 simple sugars i.e. glucose and galactose.
- Fats mainly from glycerol and fatty acids.

Qualities of good milk

- It should have a good flavor (taste).
- It should be clean pure without any foreign materials i.e. fur, flies etc.
- It should have a good keeping quality i.e. can stay for a long time without getting bad.
- It should have a high safety to the consumer such that it has no germs that cause diseases to man e.g. TB.
- Should have a chemical composition which is within expected standards.

Reasons why milk is highly perishable

- It has high water content in it that allow survival of microorganisms.
- Contains fats which easily go rancid (bad).
- It has a well-balanced composition of nutrients that is ideal or good for the prolific growth of a wide range of micro-organism.
- It readily absorbs smell or odours.
- It is rich in carbohydrates, proteins, fats, minerals and vitamins for microbial growth.

The udder

This is a mammary gland organ of a female farm animal where milk is manufactured by cells lining the empty spaces of the secretory glands.

The udder as a whole is suspended by strong ligaments (muscles) from the pelvic bone and the abdominal muscle.

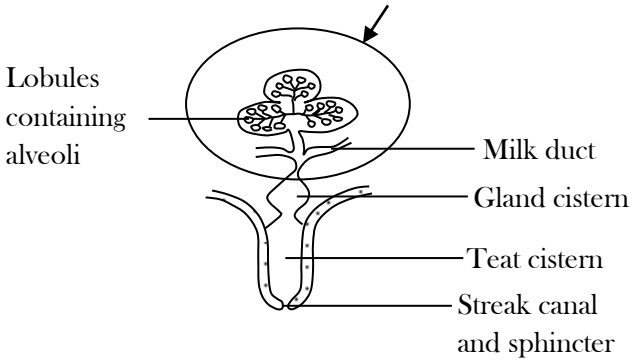
The structure of the udder of a cow

The udder is located outside the body just between the hind legs and it is attached to the body by ligaments and abdominal muscles.

It is composed of four quarters each with one teat. The internal structure of the udder consists of countless tiny sac-like cavities called **alveoli**.

The inner lining of each alveolus is lined with milk secreting cells and a small duct leads from each alveolus. Clusters of alveoli make up a lobule which is drained by a larger duct.

A group of lobules make up a lobe and many lobes form one udder quarter. Milk ducts from lobes open into a large cavity called the gland cistern which eventually opens into the teat canal and then outside. At each of the convergences (cisterns), is a sphincter muscle which holds the milk and will not release it until the cow is stimulated. Oestrogen is responsible for the development of the secretory cells.



Hormones found in the udder control the growth of the udder, a process called

mammogenesis. Formation of the udder in the foetus starts immediately between 4-6 weeks after conception.

It forms the ectodermic cells which form the mammary buds and remain in this form until birth.

At puberty, the following hormones are responsible for the formation of the udder;

- **Oestrogen;** It is responsible for the formation of the duct system.
- **Progesterone;** This is responsible for the development of the alveoli system.
- **Prolactin hormone;** This is produced by the pituitary gland and it is important in the initiation of lactation period at calving time.

Qualities of a good udder

- It should have four well developed and spaced teats in each quarter.
- It should be soft (pliable) to touch.
- It shouldn't be liable to infection like mastitis and parasites like ticks.
- Shouldn't be pendulous.
- Its veins should be prominent.
- Should be big or large enough to hold more milk.

Abnormalities of the udder

- Blood stains in milk usually due to mastitis disease or broken vessels.
- Congestion i.e. the udder swells before calving as well as when milking is skipped; treatment is by re-milking.
- Inflammation (swelling of the udder) due to bacterial infection like mastitis.
- Failure of milk let down especially among the newly calved heifers; this can be treated by the injection of oxytocin hormone.

Lactation in farm animals

Lactation is the production of milk by farm animals.

The period of milk production by a farm animal is referred to as lactation period.

It's divided into the following processes:

- Milk synthesis.
- Milk secretion.
- Milk letdown.
- Milk hold up.

Milk synthesis

This is the process of manufacturing milk which takes place in the alveoli of the udder.

Milk secreting cells extract the materials for milk synthesis from blood and use them to manufacture milk. The materials include amino acids, fats, sugars, minerals, vitamins and water.

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

After the manufacture, milk then flows out of the alveolar cavity through the milk duct into larger ducts which lead to the gland cistern, then to the teat cistern and removed during suckling or milking.

When the udder is emptied, the milk secreting cells begin to make more milk hence the more the cow is milked, the more the milk it will give.

Milk secretion

This is the release of the milk by secretory cells into the alveoli in the udder. It is the udder which influences the hormones especially those from the anterior pituitary gland like;

- Luteinizing hormone which stimulates the release of milk from the secretory cells into the alveolar cavity.
- Prolactin: this initiates the lactation period in animals and prolongs it.
- Progesterone hormone: a fall in the level of progesterone in the body initiates milk secretion and this happens prior to parturition (birth).

The secretory cells go through a definite process of milk formation.

As the process of digestion and absorption of food takes place, more raw materials are brought to the udder by blood.

Milk letdown

Before milking, the udder is full with milk and during milking as the udder gets empty, secretory cells begin filling milk into the lumen again.

Therefore, milk has to be removed completely from the alveolar cavity, mammary duct, gland cistern, teat cistern into the teat canal to the outside.

Milk letdown is controlled by oxytocin hormone produced by the posterior pituitary gland when the cow is stimulated.

Conditions that encourage milk letdown

The cow lets down the milk when she receives the following stimuli:

Washing and massaging the udder with warm water and a towel. The warm water also assists to kill the bacteria around the teats.

- The approach of milking time which is regular.
- Suckling of the teats of by the calf.
- The sight of the calf/presence of the calf for the cow to see.
- Presentation /provision of feeds before the cows are milked e.g. dairy meal.
- Seeing other cows being milked at that time.
- Noise made by milk drops from other cows.
- Attachment of the teat cups of the milking machine onto the teats
- Rattling of the milk utensils

How the cow lets down her milk

When the cow is stimulated either by any of the above stimuli, a message is sent to the anterior pituitary gland in the brain.

Oxytocin hormone is released into the blood stream of the cow. Oxytocin causes muscles surrounding the alveoli to contract hence forcing milk into the gland cistern through the ducts.

The action of milking/suckling causes the milk to pass through the gland cistern, teat cistern through the annular fold.

The milk goes down further and flows out freely to the teat canal.

Note

The effect of oxytocin hormone to let down milk lasts for a few minutes (about 4minutes) so milking must be done rapidly.

(space for diagram)

Milk hold up

This is the process by which the cow fails to let down her milk even if it is properly stimulated.

It is brought about by the action of **adrenalin** produced by the adrenal gland. Adrenalin opposes the action of oxytocin hormone hence causing blood vessels to contract.

The adrenalin hormone can be produced when the animal receives the following stimuli;

- Rough (poor) handling or unkind treatment given to the animal i.e. beating of the animal by the milker when milking.
- Presence of strangers i.e. visitors (new people) around the milking parlour.
- Unusually loud noise which is queer (strange) to the animal.
- Over excitement of the animal during milking.
- Painful wounds on the teats due to poor milking techniques.
- Barking of the dogs or other animals in the surrounding.

Quality milk production /procedure taken to produce clean and safe milk on the farm

In order to produce clean and safe milk with a reduced number of bacteria, it's necessary to follow the following procedure;

- Clean the milking parlour (shade) or surrounding where milking is going to take place to remove contaminants like dust, poisonous plants etc.
- Wash and sterilize milking utensils well by drying them under the sun.
- Always use clean and sterilized utensils especially aluminium utensils with smooth inner surfaces for milking.
- Clip off the long hair around the udder to avoid it from falling into the milk.
- Healthy cows which are free from mastitis, TB, brucellosis should be milked first.
- The milker should wash his /her hands clean first and dry them before milking.
- The milker should put on clean clothes and also wear a clean cap to prevent the hair from falling into the milk.
- He should be healthy to avoid transmission of infectious diseases like TB and should also cut his finger nails short to prevent injury or harm on the teats of the cow.
- Wash the udder of the cow with warm water and clean it with a clean towel or cloth to remove dirt and the towel is disposed off after use, to avoid spread of mastitis.
- Brush or clean the hind quarters of the cow to remove loose hair or dust and dung crusts.
- Feeds like mineral /dairy blocks or cubes/mac-lick blocks are put in the trough to keep the animal busy and to reduce excitement during milking.

- Always milk the animals with mastitis last and have their milk poured away.
- The first drops of milk are drawn from each teat into the strip cup to detect mastitis.
- Stripping also helps to get rid of the first milk that has a lot of bacteria.
- Materials with bad flavor, taste and smell e.g. plants like onions, oranges, garlic etc. must be removed from the parlour and should not be fed to milking animals.
- Filter /strain milk after milking to remove foreign materials like hair, dust, insects etc.
- Cover the milk in the milking pail or bucket to prevent dust and files from contaminating it.
- Store the milk quickly in a cool and dry place to reduce multiplication of microorganisms or it can be boiled and then allowed to cool down.
- Wash and sterilize all utensils used for milking with steam or chemical detergents like soap and hang them over the sun on a rock in the store while facing upside down to prevent dust from settling in them.
- Scrub and clean the parlour or shade after milking.
- Measure and record all the milk produced in liters before sale or final consumption.

Milking materials and equipment

- **Udder towel/milking towel**: is used for washing and drying the udder. if the animals are many, towels can be disinfected or dipped in hot water before they are used on another animal.
- **Milking stool:** This is a round wooden chair /seat usually with 3 legs sat on by a milker when milking.
- **Milk strainer**: Is used for filtering or sieving foreign materials like hair from milk.
- **Filtering pads:** These are also used for filtering or straining milk. They are more efficient and hygienic than ordinary white cotton cloth that is used by some farmers.
- **Milking jelly or salve**: This is smeared on the teats to prevent cracking due to friction. It should be applied before and after milking
- **Milking bucket /pail:** used forcollection of milk during milking. It should be made up of materials which are free from copper /iron traces on their surfaces
- **Milk can:** Is used to hold milk during storage and transportation of milk to the market. It should be made of materials free from copper or iron on their surfaces
- **Warm water**: Is necessary for washing of the udder to remove dirt and for stimulation of milk let down in a cow by massaging.
- **Soap:** For washing of the udder and milker's hands with water to kill germs.
- **Milking rope:** Is used for restraining the animal with poor dairy temperament during milking.
- **Strip cup**: Is used for detecting mastitis in animals. The first drop of

milk from each teat is directed into it to check whether there are clots, flakes or stains of blood in milk.

Reasons for using a strip cup

- To detect signs of mastitis in milk of a cow.
- To remove the milk that is low in butter fat before actual milking.
- To remove the milk that is high in microorganisms usually found in the teat cistern.
- To ensure safe milk for human consumption.

Milking

This is the removal of milk from the teats after successful milk let down. This involves 3 stages i.e.

(a) Preparation before milking.
(b) Actual milking.
(c) Stripping.

(a) Preparation for milking

- The milking parlour should be cleaned free of dust and odours. The milker should put on the milking attire i.e. clean overall and gumboots.
- The cows should be gathered into the collecting yard at least half an hour before milking starts to allow the animals to calm down.
- The equipment e.g. buckets, milk cans, ropes, strainers, towels etc. are assembled.
- A certain amount of dairy meal should into the feed trough.
- The cow to be milked should be brought into the milking compartment and allowed to eat dairy meal and its hind legs tied.
- The udder and teats should be washed with warm water and wiped with a towel. One towel for each cow.
- Remove one or two streams of milk from each teat into the strip cup to detect mastitis and get rid of bacteria which could have gathered into the teat canal.

(b) Actual milking

This should begin immediately after washing and drying the udder.

Methods of milking

- **Hand milking:** the teat is held between the index finger and the thumb so that it is closed to prevent milk from flowing upwards. Milk is obtained by compressing the fingers against the teat. Next the index fingers are released to allow the teat canal to open for the teat cistern to refill.
- **Suckling by the calf:** the suckling of the calf creates a partial pressure outside the teat and inside the buccal cavity of the calf. Milk flows out of the udder into the calf's mouth.
- **Machine milking:** this involves use of a power driven machine. The machine has a milking unit which holds the teats, a pulsation unit which creates the vacuum and a storing unit that holds and stores the milk. The vacuum in the milking unit causes milk to flow from the teat into the milking unit. Absence of the vacuum

brought about by temporally removal of the vacuum by the pulsation unit enables the teat to fill again. The rhythmic presence and absence of the vacuum milks the cow.

Stripping

This is the removal of the last milk from the udder of the cow during milking.

Udder quarters are massaged and squeezed to ensure that it's completely empty and this also increases milk let down.

It also controls mastitis since it denies the bacteria a chance which would have attacked the udder.

After the milking process is completed, the following activities are carried out;

- Weighing and recording the amount of milk from the cow, this done immediately when the milk is still in the bucket.
- Sieving the milk to remove any foreign matter.
- Covering and carrying away the milk into the storage room.
- Cleaning the milking place and utensils properly.

Sources of milk contamination

- If the cow being milked is dirty or diseased.
- The milker and the persons handling the milk.
- Flies and other insects.
- Water used to clean the equipment and udders.
- Dirty equipment.
- The milking environment could be dirty.
- Chemicals e.g. insecticides.
- Feeds supplied during milking e.g. silage.

Rules for good milking

- Avoid exciting the animal before and during milking.
- Ensure that the milking period is not interrupted.
- Prepare and assemble the milking equipment before time.
- Prepare the cow for milk let down by washing the teats and udder with warm water and a towel.
- Always milk the cow at the same time every day.
- Use the strip cup to detect mastitis for clean milk production.
- Begin milking soon after preparing the cow so as to utilize the effect of the oxytocin hormone.
- Strip the udder completely in order to get the last milk out in case the machine is used for milking.

Calf suckling

This involves direct suckling of the milk by its mouth from the teats.

Machine milking

This involves the use of a machine that is operated by electric power to milk the animals on a farm.

It is used on large dairy farms where hand milking may be impossible.

Advantages of machine milking

- It is quick and saves time for milking.
- It reduces the labour requirement on the farm.
- Very clean milk is produced since it doesn't come into contact with the air (atmosphere).
- It leads to more milk output i.e. large amount of milk is produced than hand milking.
- There are fewer chances of damages (injuries) to the udder if properly used.

Disadvantages of machine milking

- It is expensive to buy, install and maintain the equipment.
- It needs some technical skills in its operation.
- There is a risk of power failure i.e. it cannot work in case of power failure.
- The teat cups can injure the teats leading to high incidence of mastitis disease.
- A faulty machine may result into injury to the cow due to high vacuum pressure.

Note

The milking machine is composed of the vacuum supply units, pulsator, vacuum controller, teat cups, teat cups line and milk receiving unit.

Hand milking

This involves the use of hands by the milker to remove (draw) milk from the udder of the cow.

Procedure of hand milking a cow

- Before milking a cow, wash the udder with warm water, dry it with a towel and provide the cow with the dairy meal (meal).
- Tie the hind legs of the cow with a rope if the cow is of poor temperament.
- Wash the hands with water and soap and dry them with a clean towel.
- Squat or sit on a milking stool on the sides of a cow near the teats.
- Apply milking salve on the teat and do not use water /milk or saliva to lubricate the teats.
- Clean your hands with clean water again.
- Draw a few streams of milk into a strip cup to test for mastitis.
- Place the thumb fingers along the teat and the index finger above the teat to enclose it and exert pressure by squeezing the teat rhythmically downwards into the container /bucket.
- Milk quickly but gently within 5-8 minutes to utilize the effect of oxytocin hormone.
- Strip the udder to get the last milk by massaging the udder quarters as far as possible.

Note

Avoid pulling the teats during milking as this may lead to milk hold up and cracking of the teats and always never excite the animal during milking.

Factors that affect the quality of milk

- **Nutritive quality**: milk must have most of the nutrients it is supposed to have.

- **Cleanliness**: milk must be free from dust, bacteria, blood or puss that may arise from the udder.
- **Flavor**: milk must be free from any taint or bad flavours.
  Such flavours may arise from;
  - The environment around the milking barn.
  - The animal's barn.
  - Feeds consumed by the animal.
  - Diseases e.g. mastitis causes a salty taste.
  - Accidental addition of medicants, insecticides, paraffin etc.
  - Oxidation due to exposure to sunlight, bare copper or iron. Since milk is rich in fats, these undergo auto-oxidation and develop strange odours.
- **Keeping quality**: milk in storage is spoilt due to contamination by bacteria, high temperatures etc.
- **Safety**: freedom from bacteria likely to cause disease in man or animals.

Factors that affect milk yield and composition

(a) Genetic or inheritance factors

- **Breed of the animal:** dairy breeds give more milk than beef breeds. Also milk yield and composition in dairy breeds varies e.g. Friesians give more milk than jersey cows but with lower butter-fat content.
- **Temperament of the animal:** cows that are calm during milking give more milk than those that are nervous.

(b) Physiological factors

- **Health:** healthy animals produce more milk than sick ones because diseases make the body systems fail to function optimally.
- **Age of the animal:** cows that are lactating for the first time yield less milk and the yield increases with successive lactations until it reaches the maximum at the 5^{th}-6^{th} lactation and gradually declines with age. Also the butter-fat content declines with successive lactations.
- **Stage of lactation:** within a single lactation period, milk yield increases gradually up to the maximum in the 6^{th}-7^{th} week after calving and then declines as lactation period advances till drying off. As the milk yield declines towards end of lactation, the butter-fat content and protein content increases.
- **Heat period:** during heat, the changes in sex hormones concentrations cause loss of appetite reduced feed intake which also affects milk yield.
- **Stage of pregnancy:** as pregnancy advances from the 5^{th}-7^{th} month, milk yield declines rapidly due to increased foetal nutrient demand and hormonal imbalances. However the effect is low if the cow is well fed.

(c) Nutritional factors

- **Level and quality of feeding:** when the cow is underfed, it does not produce as much milk as it should since the cow uses the surplus energy

after satisfying its body requirements to produce milk. The quality of feeds also affects quality of milk produced. However overfeeding should be avoided as it leads to fattening and reduced net income.

- **Water supply to the animal:** water forms the biggest proportion of milk therefore inadequate water supply to the cow leads reduced milk yield.

(d) Environmental factors;

- **Season of the year:** e.g. during dry periods, milk yield is low due to shortage of forage and water supply but with higher butter-fat content.

(e) Management factors;

- **Frequency of milking:** the more the number of times a cow is milked daily, the higher the quantity of milk produced.
- **Competence of the milker:** milking should be completed within seven (7) minutes when oxytocin hormone is still active. The style of milking also matters.
- **Handling of the cow at the time of milking:** rough handling results in milk hold up.
- **Conditioning of the cows to the milking routine:** milking animals at irregular time affects milk yield because cows are unable to get used to such kind of routine and therefore do not respond as expected when milking time approaches.

(f) Animal handling during milking

- Gentle treatment and care given to animals during milking leads to high milk yields than rough animal handling e.g. beating.
- Exercise: the more exercise that the animal does, the less the butter fat content of the milk.
- Excitement: nervous animals produce milk with varying conditions (composition) in terms of quality of the milk.
- Use of drugs: some traces (types) of drugs given to the animals may change the composition of milk.

Milk off flavours

This refers to bad taste and bad odour (smell) in milk.

Causes of off flavours in milk

- Ingestion (taking of) poisonous plants or feeds by animals like onions, oranges, tick berry, Sodom apple, thorn apple etc.
- Physical contact of the animal with foreign materials like paraffin, perfumes, insecticides.
- Inhalation or breathing in of bad odour from unclean conditions or areas like garbage.
- Vaccination or treatment of the animal with highly resistant drugs e.g Arsenic drugs.
- Use of dirty containers for milk storage.
- Storing of milk in unhygienic places such that it absorbs taints.

- Exposure of milk to direct sunlight causing the fats to become rancid.

4.9.2 Milk products

These are produced through processing of milk, They include the following;

- **Skimmed milk**: This is the milk where fats have been removed from it and used for the manufacture of fat free milk powder.
- **Dried/ powdered milk:** This is the milk from which water is evaporated on a roller and then dried to produce a brown or cream powder.
- **Condensed and sweetened milk**: This is the milk from which water is removed under controlled temperatures and sugar is added into it.
- **Cultured milk**: This is the milk in which some bacteria have been added to give a desired flavor or taste.
- **Cream milk**: This is the milk in which fats have been added or left to be in the milk, it is made when raw milk is allowed to stand for some time and the fat layer settles on top. This layer is called cream and the liquid that remains is called skim milk.
- **Fortified milk**: This is milk in which minerals like vitamins and lactose sugars have been added into it to increase its nutritive quality. E.g. yoghurt.
- **UHT (Ultra heat treated) milk**: This is milk that has been treated at temperatures between 130^0C- 135^0C for 2-3 seconds to sterilize it and then cooled and immediately packed.
- **Yoghurt**: This is treated and coagulated milk processed in a factory.

  Procedure of making yoghurt
  - Skim milk is boiled up to 150C
  - Cool it up to 450C at room temperatures.
  - Inoculate or administer a culture of streptococcus bacteria.
  - Incubate the milk and allow it to coagulate for 5-10minutes until complete fermentation occurs.
  - Stir it vigorously and add in the flavours like sugars, salt, fruit juice.
  - Put a preservative in it and store it under a refrigerator.

- **Butter**: is a solid fat made from milk cream.

Procedure of making butter
- Milk is placed in a bowel/ container for 24hours.
- Cream collects on top and it is skimmed off or through a separator and then churned and inoculated with streptococcus bacteria.
- The cream is then churned and then fat globules collect in the middle
- Water is added into it and churning is done again.
- Drain off the butter milk using a cloth so as to leave only the butter granules.
- Butter is then salted and cut it into pieces.

- **Ghee**: This is produced by heating butter in an open pan to evaporate the water. The non-fat solids settle at the bottom and it is skimmed off.
- **Cheese:** This is produced by heating of milk up to 78^0C for 20seconds and cooled to 35^0C. Streptococcus bacteria are added as an active acid starter followed by enough rennin solution to make it coagulate/curdle. Salting is done then, the liquid is drained off and cheese is allowed to ripen.

4.9.3 Milk quality and conservation

Clean milk is the milk which is produced so as to improve on its appearance, palatability and keeping quality.

Ways in which quality of milk may be reduced;

- Milking of the animal in dirty areas like parlours or barns with foreign materials e.g. onions, oranges etc.
- Use of dirty milking equipment which are not sterilized and contains fats e.g buckets, milk cans etc.
- Poor storage facilities of milk with limited refrigeration that leads to accumulation of microbes.
- Adulteration of milk due to dilution of milk with water and other solid materials.
- Poor milking habits e.g. use of unwashed hands, long finger nails, long hair on the milker's head etc.
- Ill health of the milker who may be infected with flu, TB etc.
- Poor feeding of the animals with unbalanced feed rations lacking minerals.
- Poor handling of milk during and after milking e.g. living the milk in open air.
- Ill health of the animal due to disease infection like mastitis, TB.
- Poor transportation of milk to the marketing centers due to exposure of milk to atmospheric conditions.

Preservation of milk

The milk can be preserved using the following processes;

- **Pasteurization.** This is the process of heating milk at a controlled temperature below its boiling point and cooling it immediately. It is important because; it kills and reduces microorganism like bacteria that contaminate milk without destroying the nutrients in the milk. It increases the keeping quality of milk by destroying or sufficiently reducing number of those organisms which shorten milk lifespan.
- **Sterilization.** This is the process of heating the milk to destroy the microbes completely. However, this also results in the reduction in the quality of vitamins and proteins in the milk.
- **Homogenization.** This is the process of passing milk at a high pressure through a homogenizer in order to break fat globules in the milk so that they mix properly in milk to obtain a

uniform texture and white colour in milk.

Determination of the quality of milk

When the milk arrives at the dairy collection point, it undergoes some tests or examinations that include:

- Test for odour (smell).
- Test for flavor.
- Specific gravity or density of milk.

Milk testing using a lactometer

Lactometer is a veterinary tool used for determining specific gravity or density of milk by immersing or dipping it into the measuring cylinder containing the milk sample.

The normal specific gravity of milk is 1.025 -1.032 but sometimes milk may be diluted with water and this causes the lactometer to sink hence giving a reading below 1.032 or the farmer may decide to add solids like maize flour, ripe bananas etc. into the milk and this causes the lactometer to float hence giving a reading above 1.032 and such milk is called adulterated milk.

Simple experiments to determine whether milk is good and suitable for human consumption

(i) Clot on boiling

Milk sample is put in a beaker /test tube then heated over a flame.

If it clots then it's unfit for human consumption and vice versa

(ii) Acidification test /litmus test

Fresh milk is put in a beaker overnight without heating or boiling for observation the following day.

- **Smell**: It will have a bad smell suggesting it is unfit for human consumption.
- **Litmus test**: i.e. when blue litmus is used, it turns red suggesting that the milk has an acid so it has fermented and not fit for human consumption.
- **Separation**: The milk is found to have separated into 2 Layers i.e. the top thick white layer and the bottom watery layer.

Note

The separation is brought by a process called fermentation. If an orange or juice containing citric acid is added to good fresh milk, milk clots leaving the watery parts .this is brought about by acidification process

(iii) Dye production test:this test depends on the changing of colours as a result of microorganisms growing in the milk e.g. methyl blue is added to a sample of milk in a test tube.

Observation

The blue colour changes to pink then to white i.e. it indicates that the milk is bad and contains microorganisms and should be rejected, if the colour remains blue then the milk is good.

(iv) Ruzaline test:Ruzaline tablets which are purple in colour are put in a sample of milk in a test tube.

Observation

The colour changes from purple to pink or red, it means that the milk contains a lot

of microorganisms. If the milk is not containing a reasonable number of microorganisms, the colour does not change.

Revision questions

(a) Explain the process of milk production.
(b) Describe how mastitis can be controlled.
(c) Describe the hormonal control of milk letdown in a cow.
(d) Explain the causes of off-flavours in milk.

4.10 Beef Production

This is the rearing of animals for beef or meat production.

Objectives of beef cattle production

- To produce animals for slaughter at regular intervals either annually or more frequently.
- To produce young healthy stock, fatten them and sell them for slaughter as meat.
- To maintain healthy breeding herd for the major purpose to produce replacement heifers.
- To ensure efficient conversion of feeds into high quality beef or meat.

Factors limiting beef production in East Africa

- Climate: The dry season with high temperatures causes scarcity of pastures and water for animals.
- **Poorbreeds of animals**: The farmers keep animals of poor quality hence poor and low beef production.
- **Poor soils**: The presence of infertile soils doesn't support the growth of quality pastures for beef cattle grazing.
- **Parasites and diseases**: The different parasites like ticks and diseases like brucellosis limit the production of high quality beef.
- **Poor vegetation:** The scrub and thorny bush vegetation associated with drier areas leads to low beef production.
- **Inadequate capital**: It is limited among farmers due to poverty. Capital is required to purchase of animal drugs, equipment etc.
- **Ignorance**: Most farmers are illiterate due to the low level of education and hence adopt modern beef production practices.
- **Poor extension services**: Services like veterinary care, AI, cattle dipping etc are poor due to poor facilitation.
- **Poor management**: Most farmers lack knowledge or measures that are available for improvement of beef cattle
- **Insecurity/political instability:** The frequent cattle rustling and raiding in most areas leads to reduction in the number and death of beef animals.
- **Urban development**: Most of the areas which receive adequate rainfall are used for crop growing and hence beef is forced into less and drier unproductive areas.

Strategies for improving beef production

- Change in land tenure system from communal to individual ownership.
- Provision of adequate clean water for the animals.
- Introduction of improved forage species in the natural grasslands.
- Provision of education and extension services to farmers.
- Improving infrastructure like developing roads and storage rooms.
- Disease and parasite control to improve quality of meat animals.
- Provision of loan facilities to the farmers to invest in beef production projects.
- Practicing controlled breeding to improve quality of livestock.
- Setting up well organized livestock marketing facilities.
- Encouraging the establishment of **feedlot cattle finishing system** (involves buying immature stock from pastoralists and fattening them in yards/feedlots).

Factors to consider when selecting animals for establishing a beef herd (factors to consider before establishing a beef herd)

- **Age of the animals**: too old animals should not be selected as they would have passed their reproductive age.
- **Adaptability to local conditions** e.g. temperatures, feed scarcity, water supply etc.
- **Reproductive capacity**: i.e. select animals with good fertility.
- **Type of animals**: i.e. whether to stock indigenous, exotic or crosses.
- **Size of the herd**: the size of herd to start with depends on amount of capital and grazing land available.
- **Health of the animals**: i.e. select animals that are free from dangerous diseases.
- **Uniformity**: i.e. the breed chosen should show uniformity of characteristics e.g. growth rate.
- **Size of cattle**: always select animals which grow fast and reach slaughter weight early.

Factors that influence the productivity of beef animals

- **Inheritance factors**: superior animals (those with good genetic potential) have higher productivity than genetically inferior animals.
- **Management**: proper care of animals determines their level of productivity. Proper management involves aspects like proper feeding, good health care, routine management practices etc.
- **Proper feeding**: poorly fed animals have low productivity and are susceptible to disease attack.
- **Health**: poor health like disease and parasite attacks lower productivity of beef animals.
- **Climatic factors**: e.g. temperature, rainfall, humidity and wind affect animal production. High temperatures cause stress to animals, strong winds expose animals to risks of diseases such as pneumonia etc.

5.10.1 Management of beef cattle

Proper management is essential to high productivity and profitability. The profitability of a beef cattle enterprise depends on;

- Number of animals sold for slaughter.
- Prices of animals sold.
- Percentage of cows calving and weaning calves.
- Cost of maintaining the herd.

Management practices in beef cattle rearing

- Selection and preparation of breeding stock: heifers are selected and mated at the right body weight (250kg) and age (2-2½) years. Young bulls below 1½ years are not allowed to start servicing. Mating should be planned such that animals calve just before the rainy season when there is abundant supply of pastures.
- Proper management of pastures to ensure supply of good quality forage to the animals through optimum stocking, rotational grazing, resting pastures etc.
- Proper housing: the animal houses should be spacious, well ventilated and provided with concrete floors, easy to clean with adequate beddings.
- Watering of animals by provision of adequate and clean water in troughs daily.
- Proper health care: provision of drugs and necessary veterinary equipment on the farm.

Systems of beef cattle rearing

(i) Pastoral (traditional) system: is the most common system in Uganda. Farmers don't keep records, animal are grazed on low quality pastures and usually local breeds are kept. There is low productivity and low calving percentage in the system due to;

- Poor nutrition of breeding animals.
- Indiscriminate mating.
- Poor fertility of bulls and a too high bull: female ratio.
- Poor quality breeds.

(ii) Ranching: cattle are kept on ranches. Ranches are large privately owned farms where commercial cattle production is done.

Establishing of a new ranch

- The area should be surveyed to determine the fertility of the soil, topography, and rainfall reliability and to locate where to construct permanent structures e.g. 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.
- Construct animal handling structures such as dip tanks, crushes etc.
- Construct buildings like stores, farm houses etc.
- Construct roads for easy accessibility and movement in the ranch.

Objectives of ranch management

- To maintain and improve breeding efficiency.

- To minimize calf mortality and losses due to disease.
- To reduce seasonal fluctuations in live weights of stock.
- To maximize reproductive performance towards the ideal of one calf per cow per year.
- To maintain and improve feeding efficiency e.g. by preserving excess forage.

Management activities on a ranch

- Rehabilitating pastures.
- Controlling distribution of animals by evenly distributing watering points and fencing.
- Controlling breeding and calving times such that many animals mature and are sold off at the same time.
- Supplementary feeding of lactating cows and calves.
- Rounding up of animals.
- Keeping of records.

Factors that determine the size of the herd

- Types of pasture species available.
- Type of stock: hardy animals that can survive under pasture scarcity can be kept in large number.
- Economic factors e.g. cost of keeping many animals.
- Topography: overstocking is not good in hilly areas as it increases risks of erosion.
- Availability of reserve feeds for use during scarcity.
- Availability of sufficient water.

Products of beef animals

1. Meat

This refers to all skeletal muscles (flesh) and tissues that can be used as food from cattle, goat, sheep and poultry etc.

Types of livestock meat

- Mutton: This is meat from sheep.
- Bacon: Meat from goats and young pigs.
- Pork: Meat from pigs.
- Real: Meat from young animals like rabbits, calves etc.
- Chicken: Meat from poultry/ birds.
- Beef: Meat from cattle.
- Lean: Meat without tissues like bones and fats.

Nutrients contained in meat

- Proteins (myosin).
- Fats.
- Vitamins B, B1 and B3.
- Mineral ions like Fe, P, and Ca etc.

Meat by-products

- **Bone**: These are burnt and crushed to produce bone meal containing Ca and P for feeding poultry and cattle.
- **Blood:** This collected from the animal when fresh, boiled and dried under the sun, then crushed or broken into small bits. It can also be mixed with feeds as a source of iron and protein.
- **Condemned meat**: This is sterilized and converted into meat for dogs and pigs as long as it is free from diseases like anthrax. It is boiled, dried and (milled) crushed into meat powder.

- **Horns and hooves**: These are collected and used in the industries for manufacture of buttons, combs, handles, glue etc.
- **Ruminant content**: This is undigested food stored temporarily in the rumen, recticulum and omasum. They are dried and fed to other animals after mixing with other feed ingredients.

Note

Meat is a perishable product and needs to be processed and sold immediately.

Procedure of beef slaughter / butchering

- **Pre-slaughter handling**: The animals for slaughter should be starved for 16-24 hours and given water for drinking. Starving reduces the amount of undigested food and feaces in the digestive tract which would contaminate meat leading to spoilage. During this time, animals should be rested to conserve glycogen in the body which at slaughter is converted into lactic acid that has a preserving effect on meat.
- **Ante mortem inspection**: The animal is examined before slaughter to find out whether it has any deformities or serious injuries.
- **Stunning**: This involves rendering the animal senseless just before slaughter to reduce pain. It is done by use of a hummer gun or electric shock.
- **Actual slaughter:** The neck is cut and the animal immediately suspended using ropes with the head down and hind legs up to ensure complete bleeding which is essential to producing meat of good keeping quality. The blood can be collected and processed into blood meal.
- **Skinning and evisceration**: Skinning (flaying) is the removal of the hide from the carcass. It is done carefully to avoid damage to the hide and to avoid leaving a lot of meat that can lead to deterioration. Evisceration 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 the meat. The remaining weight of the carcass after removing the weight of the internal organs, head, hide, feet and blood is known as **dressed weight.**

$$\frac{dressedweight}{liveweight} \times 100 = \frac{killingout}{percentage}$$

$$\frac{liveweight(LW)}{inpounds} = \frac{L \times G^2}{300}$$

Where

- L =the length of the animal from the point of shoulder to pin bone in inches.
- G =chest girth in inches.

Note

$$1\,pound = 0.454kg$$

Post-mortem inspection: The meat is examined after slaughter to check for dangerous diseases such as tuberculosis and cysts of internal worms. If the meat is found contaminated, it is then declared unfit for human consumption (condemned) and hence disposed off by burying or incineration. Condemned meat

is not supposed to be fed to animals as they are likely to become infected and act as a source of infection to man.

Grading: Meat is graded according to amount of fats and degree of marbling (distribution of fats within the muscles), texture and colour of the meat.

Cooling: After grading, meat is quickly stored in a cold room to reduce multiplication of decomposer microbes. Keeping of meat at 2^0C for about six weeks makes it palatable and tender (tenderization). The enzymes in the meat break down some of the tissues making the meat soft. Tenderization can also be achieved by pounding meat in machines or by using protein splitting enzymes e.g. papain and trypsin to soften the meat by applying them on the surface of meat or injecting them into the animal before slaughter.

Sanitation of the slaughter place

Care has to be taken ensure that the slaughter place is clean and dry before and after slaughter to reduce chances of meat contamination. Control of rodents and insects e.g. cockroaches is important.

Preserving/curing of meat

Meat has to be preserved to avoid it from losing quality.

Meat preservation methods

- **Dry salting**: Raw fresh meat is sliced into slabs of 1.5-2.2cm and not more than 2.5cm thick. The slices are immersed in a saturated salt solution for about one hour; the slices are then drained and cured on a sloping grooved slab under a roof. They are piled to a maximum height of 0.9m and kept being turned and pressed to squeeze out surplus moisture. Dry salted meat has good keeping quality and is resistant to attack by beetles and moulds. It should be soaked in water to remove some of the salt before it's prepared for eating.
- **Curing**: Curing involves use of salt, sugar and sodium nitrite solutions as under dry salting for about 12 hours after which meat is then rinsed in clean water to prevent a crust forming on the surface of meat during smoking. Curing preserves the red colour of meat, increases palatability and adds flavour.
- **Smoking**: Meat is cut into small slices; saw dust plus wood are burnt to produce smoke. The meat is smoked as well as partially cooked. The meat is allowed to slowly cool and then stored in a cool dry place.

Qualities of good meat

- It should be free from contaminants e.g. soil and dung.
- It should have a pleasant smell.
- It should not be too bony.
- It should have a moist and fresh appearance.
- It should be well marbled.
- It should have normal red color.
- Should not be dripping even when moist.

Factors that lower the quality of meat

- Poor feeding of the animal.
- Poor storage of meat.
- Infections by internal parasites.
- Age of the animal e.g. too old or very young.
- Poor breed of animal.
- Treatment of animals with drugs before slaughter
- Chemical poisoning of the animals.
- Unhygienic handling of meat i.e. dirty houses
- Incomplete bleeding of the animal

How to determine quality of meat

- Observing its appearance, colour and texture.
- Considering the odour/ smell of the meat.
- Determining tenderness of the meat.
- Determining juiciness of the meat.

Factors that make meat unfit for human consumption.

- Animal diseases e.g. TB, Anthrax, Brucellosis which attack man.
- Poor bleeding which leaves a lot of blood causing rotting and poor taste of meat.
- Drugs: animals treated with certain drugs do not have to be slaughtered for some time (withdrawal period) to allow drugs to break down.
- Bad flavors: due to rotting and disease infections.
- Rotting due to poor preservation.
- Infections by parasites like liver flukes and tape worms.
- Contamination of meat during transportation when dirty or unhygienic facilities are used.

Factors that influence the rate of meat spoilage

- Diseases: Meat of diseased animals usually gets spoilt faster than that of healthy animals.
- Environmental temperature: high temperature encourages rapid multiplication of putrefying bacteria that causes rotting of meat.
- Moisture content of meat: High moisture content favors growth of microbes hence increasing rate of meat spoilage.
- Level of bleeding after slaughter; poor bleeding of slaughtered animals leaving much blood in meat increasing rate spoilage.
- Handling conditions; Transportation of meat in unhygienic containers allows bacteria attack hence increasing rate of spoilage.
- Rumen contents at slaughter: if the rumen is full, its contents will contaminate the meat hence encouraging bacterial growth on meat.
- Slaughter conditions; Unhygienic slaughter house leading to meat contamination.
- Preservatives used; Application of preservatives like salt reduces the rate of meat spoilage significantly.

4.11 Hides and skins production

Hides are coats of big animals e.g. cattle, buffaloes etc. while skins are coats of small animals e.g. goats and sheep.

Hides and skins are made into leather by a process of tanning. The quality of leather produced depends on the care and handling given to the animal and the hide before, during and after slaughter.

Causes of damage to hides and skins.

The causes are classified according to the stage at which they occur as below;

Damage during the animal life time

- Injuries caused by sticks when beating animals.
- Scratches by barbed wire.
- Wounds due to horning by other animals during fights.
- Sharp objects like sticks in animal handling structures e.g. crushes.
- Diseases and parasites attack e.g. ring worm, cow pox, ticks etc.
- Fallen hides i.e. hide from dead animals particularly animals that have died from anthrax which attacks human as well.
- Bad branding on valuable parts of the skin.

Damage during slaughter and flaying

- Throwing down the animal on sharp objects.
- Dragging the carcass on a rough floor causing damages to skins.
- Incomplete bleeding causing blood to remain in the hide and encourage bacterial growth.
- Delayed flaying causing difficulty to remove the skin.
- Ripping the skin so fast causing a poor pattern.
- Flay cuts due to using sharp knives.

Damages during curing/ drying

- Delaying to wash the hide after flaying causing dung and blood to stick on it.
- Drying hides directly on the ground making them to absorb moisture from the soil.
- Taking long to hang hides for drying resulting into hair flip.
- Uneven stretching of hides leading to damage of the pattern.

Damage during storage

- Attack by vermin or insect pests e.g. the larvae of the hide beetle.
- Wetting by rain water due to storage in leaking store.
- Placing hides on the ground instead of racks.
- Poor folding causing hair flip.
- Use of steel wire when baling which can cut the hides.

Damage during transportation

- Wetting of hides and skins by rain water.
- Contamination by oil or grease.
- Rubbing due to poor handling during loading and off-loading.

Uses of hides and skins

- Source of income after selling.

- Source of foreign exchange for the country.
- Source of leather for making shoes, bags etc.
- Provide employment for the people in tanneries.
- Used for making musical instruments such as drums.
- Used as clothing by some people.
- Used as bedding materials.
- Provide food for some animals.
- Used for construction of huts and shades.

Procedure followed when preparing hides and skins

- **Flaying** to remove hides and skins from the body of the slaughtered animal.
- **Washing:** to remove dung, dirt and blood.
- **Draining**: hides and skins are hanged to remove water and some blood after washing.
- **Fleshing**: removal of fat and meat from the hide or skin.
- **Trimming**: removal of odd flaps to give the hide/skin an even shape.
- **Preserving**: by use of chemicals to prevent hides and skins from rotting and attack by pests.
- **Curing:** drying to remove excess moisture.
- **Grading:** according to quality and size/ weight.
- **Weighing:** is done before selling to determine value of hides and skins.
- **Proper storage** to avoid damage by rodents, moisture and insects.
- **Tanning:** soaking hides and skins in chemicals such as tannic acid to soften and turn them into leather.

How to prevent/ reduce damage to hides and skins

- Avoid using barbed wires and sharp objects in collecting areas of animals.
- Brand marks should be placed on less valuable parts of the skin e.g. hocks.
- Controlling diseases like ring worms that lower quality of skins.
- Controlling parasites like ticks that destroy hides and skins.
- Applying good techniques of slaughtering and ensuring that there are no sharp objects in the slaughter place.
- Flaying immediately after slaughter when carcasses are still warm.
- Using knives with curved edges and blunt points to avoid piercing hides and skins during flaying.
- Avoid contaminating the hide with contents of the digestive tract.
- Washing and scrubbing the hide after flaying to remove dung and blood.
- Storing hides in well ventilated, dry, leak proof and vermin free shelters to avoid loss of quality.
- Apply pesticides in stores to eliminate pests e.g. hide beetles.
- Hides should be kept on stack and raised off the ground to avoid dampness.
- Proper handling during loading and off-loading to avoid rubbing.

- Transportation in covered trucks to avoid wetting of hides and skins by rain.

Preservation of hides and skins

- **Wet salting:** alternate layers of salt and hides are piled to form a stack about 1.5M high. The salt in between the hides absorbs moisture from the hides such that putrefaction cannot start. This takes about 3 weeks.
- **Dry salting:** the hides are salted for a short period and then the rest of the moisture is removed by air drying.
- **Suspension drying:** hides are suspended in frames so that all hides receive free circulation of air and they get uniform heating from the sun's rays.

When ground drying is done, poor quality hides and skins are produced due to;

- The 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 on ground dried hides because of over drying and the temperatures from the soil.
- There is a tendency of fat melting, spreading into the hide which leads to low quality product.

Questions

(a) Outline the factors that should be considered when establishing a beef herd.
(b) Explain the measures government should take to improve beef production in the country.
(c) Explain the factors that may lower the quality of hides and skins.
(d) Describe the procedure of preparing hides and skins for sale.