Lecture 5

GENERAL MANAGEMENT PRACTICES OF DAIRY ANIMALS

(1) Sanitation and General Cleanliness

Sanitation and General Cleanliness are important to prevent digestive upsets and diarrhoea. The pens and stores as well as management equipments must be thoroughly clean and disinfect pen after one calf is removed and before another calf enters. Calves should be housed in warm environment to prevent pneumonia. Stalls usually 1.5x2m with solid partitions between them are suitable to prevent calves from sucking each other after milk feeding and minimise spread of disease. Group housing saves labour but provisions must be made for individual milk feeding and tying up of the calf for a short period after milking to prevent them from sucking one another. Diseases of one calf are easily spread to other calves.

(2) Dehorning

Horns are objectionable on animals in the commercial herd because of possibility of inflicting injuries of one another. The presence of horns also necessitates the provision of extra shed and feeding space and makes the animal more difficult to handle. It is therefore desirable that calves should be dehorned at 2-4 weeks old. Several methods are in use:

- **Use of chemicals eg KOH or NaOH**

  They come in the form of sticks, pastes or liquids. The hair around the horn buds clipped closely. A ring of heavy grease or petroleum jelly is smeared on surrounding skin to prevent skin burn and keeps the liquid caustic from running into the calf's eyes. If a stick is used, then slightly moisten one end of the stick with water and rub it firmly over the horn buds with a rotator motion until blood appears. The effect is to deaden the horn root, in a few days a scab appears over each horn bud which soon drops off leaving a smooth spot of skin devoid of hair. Calves treated should be protected from rain for a day following the application since the chemical may wash down and injure the side face and the eyes of the calf. It is also best not to turn calves back to their dam for a few hours after the application of the caustic.
- **Use of saws, shears and clippers**

Saws of various forms, shears and clippers are used for dehorning. This is, however, less desirable method which applies only to older calves. Whatever the instrument used, it is necessary to remove the horn 0.50 to 1.00cm of the skin around its base to be certain that horn forming cells are destroyed

- **The electric dehorner or hot iron dehorner**

  This method consists of the application of a specially designed electrically heated hot iron to the horn buds of young calves. The cup-like end of the hot iron is firmly pressed on the horn bud for a few seconds to destroy horn forming cells. While the method is bloodless, it is much painful than the use of chemicals. It can only be used for calves under 5 months of age.

- **The elastrator**

  It is an instrument used in stretching a specially made rubber over the horn well down into the hair- line. This is aimed at cutting off the blood circulation to the bud. This system may be used on cattle with horns from 6-15cm long. Small horns drop off in 3-6weeks. Large horns stay up to 2 months.

Treatment after dehorning

It is essential that a good fly repellant be applied to the wound to remove the danger of flies. The danger of infection is generally reduced if there is extreme care and cleanliness. Instruments should always be disinfected

(3) Castration of bull calves

This results in a more symmetrical development and balancing of body between the fore and hind quarters. It makes animal more quiet and easier to handle. The bull is not prone to excitation, i.e. decreased libido. Bull calves can be castrated from few weeks to 8 months but best done at 4 months old. The older the animal, the greater the shock and risk

Methods of castration

(i) The bloodless castrator (Burdizzo Pincers)

It is used in animals with pendulous testis. The spermatic cords and associated blood vessels are crushed or severe so completely that the testicles waste away from lack of blood circulation.

Young calves can be castrated while standing but those over 3 months are best castrated while lying down. The operator's assistant should sit on the calf's head and keep the upper most hind leg of the calf pulled well forward. Two independent closure about1/4 inch apart should be made for each cord. If done properly, it is a satisfactory means of castration as there is no external bleeding and the chances of infection are reduced.

(ii) Open incision

An incision is made on the scrotal sac. The testes are removed by pulling them away from the spermatic cord. It is not advisable to cut spermatic cord since excessive bleeding may result. The cord is gradually scrapped with a sharp knife until it snaps off.

(iii) The rubber ring elastrator

This involves stretching a specially made rubber ring over the scrotum. It is a useful method for castrating young calves under 2 months old. The ring cuts off the scrotal and testicular blood circulation so that they finally drop off. As a rule the hands of the operator and instrument should be kept clean and as nearly sterile as possible by dipping in disinfectant solution between operations. The wounds should also be disinfected

(4) Branding and Marking

It is highly desirable that all animals in the herd bear some mark or tag whereby each can be positively identified. This is necessary for the establishment of pedigree or ancestry as in case of purebred herd. The method of marking employed will depend primarily on the objective. When the objective is to establish ownership as in the case on open range and in poorly fenced pastures, branding with a hot iron is probably the best method. Although, much has been said against branding because of the pain inflicted and the damage to the hide, the hot iron is still the common method. In advanced countries, before cattle can be legally branded, the brand being used must be properly registered with the Livestock Identification Office to avoid duplication especially at state boundaries. Other methods include Ear marking, Ear tags, Neck chains or strap and tattoo.

PHYSIOLOGY OF MILK PRODUCTION

Milk is synthesized in the mammary gland. Within the mammary gland is the milk producing unit, the alveolus. It contains a single layer of epithelial secretory cells surrounding a central storage area called the lumen, which is connected to a duct system. The secretory cells are, in turn, surrounded by a layer of myoepithelial cells and blood capillaries.

The raw materials for milk production are transported via the bloodstream to the secretory cells. It takes 400-800 L of blood to deliver components for 1 L of milk.

- **Proteins**: building blocks are amino acids in the blood. Casein micelles, or small aggregates thereof, may begin aggregation in Golgi vesicles within the secretory cell.
- **Lipids**: C4-C14 fatty acids are synthesized in the cells. C16 and greater fatty acids are preformed as a result of rumen hydrogenation and are transported directly in the blood.
- **Lactose**: milk is in osmotic equilibrium with the blood and is controlled by lactose, K, Na, Cl; lactose synthesis regulates the volume of milk secreted.

The milk components are synthesized within the cells, mainly by the endoplasmic reticulum (ER) and its attached ribosomes. The energy for the ER is supplied by the mitochondria. The components are then passed along to the Golgi apparatus, which is responsible for their eventual movement out of the cell in the form of vesicles. Both vesicles containing aqueous non-fat components, as well as liquid droplets (synthesized by the ER) must pass through the cytoplasm and the apical plasma membrane to be deposited in the lumen. It is thought that the milk fat globule membrane is comprised of the apical plasma membrane of the secretory cell.

Milking stimuli, such as a sucking calf, a warm wash cloth, the regime of parlour etc., causes the release of a hormone called oxytocin. Oxytocin is released from the pituitary gland, below the brain, to begin the process of milk let-down. As a result of this hormone stimulation, the muscles begin to compress the alveoli, causing a pressure in the udder known as letdown reflex, and the milk components stored in the lumen are released into the duct system. The milk is forced down into the teat cistern from which it is milked. The let-down reflex fades as the oxytocin is degraded, within 4-7 minutes. It is very difficult to milk after this time.

DAIRY CHEMISTRY

The role of milk in nature is to nourish and provide immunological protection for the mammalian young. There are many factors that can affect milk composition such as breed variations (cow to cow variations, herd to herd variations - including management and feed considerations, seasonal variations, and geographic variations. With all this in mind, only an approximate composition of milk can be given:

- 87.3% water (range of 85.5% - 88.7%)
- 3.9 % milkfat (range of 2.4% - 5.5%)
- 8.8% solids-not-fat (range of 7.9 - 10.0%):
    - protein 3.25% (3/4 casein)
    - lactose 4.6%
    - minerals 0.65% - Ca, P, citrate, Mg, K, Na, Zn, Cl, Fe, Cu, sulfate, bicarbonate, many others
    - acids 0.18% - citrate, formate, acetate, lactate, oxalate
    - enzymes - peroxidase, catalase, phosphatase, lipase
    - gases - oxygen, nitrogen
    - vitamins - A, C, D, thiamine, riboflavin, others

The following terms are used to describe milk fractions:

- Plasma = milk - fat (skim milk)
- Serum = plasma - casein micelles (whey)
- solids-not-fat (SNF) = proteins, lactose, minerals, acids, enzymes, vitamins
- Total Milk Solids = fat + SNF

Looking at milk under a microscope, at low magnification (5X) a uniform but turbid liquid is observed. At 500X magnification, spherical droplets of fat, known as fat globules, can be seen. At even higher magnification (50,000X), the casein micelles can be observed.

Milk Lipids

The fat content of milk is of economic importance because milk is sold on the basis of fat. Milk fatty acids originate either from microbial activity in the rumen, and transported to the secretory cells via the blood and lymph, or from synthesis in the secretory cells. The main milk lipids are a class called triglycerides which are comprised of a glycerol backbone binding up to three different fatty acids. The fatty acids are composed of a hydrocarbon chain and a carboxyl group. The major fatty acids found in milk are: Long chain (C14 - myristic 11%, C16 - palmitic 26%, C18 - stearic 10% and C18:1 - oleic 20%) and short chain (C4 – butyric, C6 – caproic, C8 - caprylic and C10 – capric)

Butyric fatty acid is specific for milk fat of ruminant animals and is responsible for the rancid flavour when it is cleaved from glycerol by lipase action. Saturated fatty acids (no double bonds), such as myristic, palmitic, and stearic make up two thirds of milk fatty acids. Oleic acid is the most abundant unsaturated fatty acid in milk with one double bond. Triglycerides account for 98.3% of milk fat. The small amounts of mono- , diglycerides, and free fatty acids in fresh milk may be a product of early lipolysis or simply incomplete synthesis. Other classes of lipids include phospholipids (0.8%) which are mainly associated with the fat globule membrane, and cholesterol (0.3%) which is mostly located in the fat globule core.

Fat Destabilization

While homogenization is the principal method for achieving stabilization of the fat emulsion in milk, fat destabilization is necessary for structure formation in butter, whipping cream and ice cream. Fat destabilization or agglomeration refers to the process of clustering and clumping of the fat globules which leads to the development of a continuous internal fat network or matrix structure in the product.

Coalescence: an irreversible increase in the size of fat globules and a loss of identity of the coalescing globules;

Flocculation: a reversible (with minor energy input) agglomeration/clustering of fat globules with no loss of identity of the globules

Functional Properties

Like all fats, milk fat provides lubrication. They impart a creamy mouth feel as opposed to a dry texture. Butter flavour is unique and is derived from low levels of short chain fatty acids. If too many short chain fatty acids are hydrolyzed (separated) from the triglycerides, however, the product will taste rancid. Butter fat also acts as a reservoir for other flavours, especially in aged cheese. Fat globules produce a 'shortening' effect in cheese by keeping the protein matrix extended to give a soft texture. Fat substitutes are designed to mimic the globular property of milk fat. The spreadable range of butter fat is 16-24° C. Unfortunately butter is not spreadable at refrigeration temperatures. Milk fat provides energy (1g = 9 cal.), and nutrients (essential fatty acids, fat soluble vitamins).

Milk Proteins

The nitrogen content of milk is distributed among caseins (76%), whey proteins (18%), and non-protein nitrogen (NPN) (6%). This does not include the minor proteins that are associated with the fat globule membrane (FGM). The concentration of proteins in milk is as follows:

	grams/ litre	% of total protein
Total Protein	33	100
Total Caseins	26	79.5
alpha s1	10	30.6
alpha s2	2.6	8.0
beta	9.3	28.4
kappa	3.3	10.1
Total Whey Proteins	6.3	19.3
alpha lactalbumin	1.2	3.7
beta lactoglobulin	3.2	9.8
BSA	0.4	1.2
Immunoglobulins	0.7	2.1
Proteose peptone	0.8	2.4

Caseins

The casein content of milk represents about 80% of milk proteins. The principal casein fractions are alpha(s1)- and alpha(s2)-caseins, ß -casein, and kappa-casein. The distinguishing property of all caseins is their low solubility at pH 4.6. The common compositional factor is that caseins are conjugated proteins, most with phosphate group(s) esterified to serine residues. Within the group of caseins, there are several distinguishing features based on their charge distribution and sensitivity to calcium precipitation:

alpha(s1)-casein: It can be precipitated at very low levels of calcium.

alpha(s2)-casein: It can also be precipitated at very low levels of calcium.

ß -casein: Less sensitive to calcium precipitation.

kappa-casein: Very resistant to calcium precipitation and stabilizes other caseins.

Caseins are able to aggregate and there are four major ways in which aggregation can be induced:

1. chymosin - rennet or other proteolytic enzymes as in Cheese manufacturing
2. acid
3. heat
4. age gelation

Whey Proteins

The proteins appearing in the supernatant of milk after precipitation at pH 4.6 are collectively called whey proteins. These globular proteins are more water soluble than caseins and are subject to heat denaturation. The principle fractions are ß -lactoglobulin, alpha-lactalbumin, bovine serum albumin (BSA), and immunoglobulins (Ig).