Colostrum Management for Calves

Sudipta Ghosh[1], Biswajit Roy[1], K.K.S. Baghel[2], Giridhari Das[3], Malay Kr Mandal[4] and S. Koley[5]

College of Veterinary Science and Animal Husbandry,
Kuthulia, Rewa, Madhya Pradesh-486001

The article Colostrum is the secretion from the mammary gland of cow in the first 24 hours after parturition. It differs markedly from normal (whole) milk in composition, physical properties, and function. Transition milk is the secretion from the mammary gland from 24 to 72 hours after calving and it differs from colostrum in composition. The composition of transition milk changes to milk by 72 hours after calving. Colostrum is important for providing passive immunity and survivability of the calves. The consumption of colostrum in the first 24 hours results in an increased concentration of immunoglobulins particularly immunoglobulin G (IgG) in blood stream. This will protect the calf against pathogens in the environment. This transfer of immunoglobulins to the calf by way of colostrum is termed as passive transfer. The concentrations of immunoglobulins decline over time. At the same time the calf's own immune system will be activated on being challenged by pathogens in the environment. This will result in the production of its own complement immunoglobulins. This production of immunoglobulins is termed as active immunity and is critical to the long term health of calf.

i. **Composition and physical properties of colostrum:** Colostrum contains two times more dry matter, three times more minerals, and five times more protein than whole milk (Table 1). It is also higher in energy and vitamins like A, D, and E. In addition, relatively low lactose content of colostrum reduces the occurrence of diarrhoea. Colostrum is also rich in immunoglobulins (antibodies) which provide passive immunity to the calves. Colostrum is thick and creamy.

Table-1 : Composition of colostrum, transitional and whole milk of Holstein cow

Item	1st day milk (colostrum)	2nd day milk (transition milk)	3rd day milk (transition milk)	4th day onwards (Whole milk)
Solids (%)	**23.9**	**17.9**	**14.1**	**12.9**
Protein (%)	**14.0**	**8.4**	**5.1**	**3.1**
Solids (%)	**23.9**	**17.9**	**14.1**	**12.9**
Protein (%)	**14.0**	**8.4**	**5.1**	**3.1**
IgG (mg/ml)	**48.0**	**2.05**	**15.0**	**0.6**
Fat (%)	**6.7**	**5.4**	**3.9**	**4.0**
Lactose (%)	**2.7**	**3.9**	**4.4**	**5.0**
Minerals (%)	**1.1**	**1.0**	**0.8**	**0.7**
Vitamin A (μg/dl)	**295.0**	**190.0**	**113.0**	**34.0**

(Source: Journal of Dairy Science, 1978, 61:1033-1060)

ii. **Colostral immunoglobulins:** There are three types of immunoglobulins present in the colostrum of cattle viz., IgG (with two isotypes IgG_1 and IgG_2), IgM and IgA in the amount (%) of 70-80, 10-15 and 10-15, respectively. Most of the IgG is IgG_1. IgG_1 and IgG_2 are transported from the blood of the cow into colostrum by a highly specific transport mechanism. This mechanism moves large amounts of IgG (particularly IgG_1) from blood into the udder. Consequently, serum IgG concentrations of the dam decline precipitously, beginning about 2 to 3 weeks prior to calving. Cows require several weeks to resynthesize the lost IgG. IgM and IgA are synthesized by the plasmacytes in the mammary gland. The primary role of IgG is to identify and help to destroy the invading pathogen. Because of the smaller size of IgG, it can move out of the blood stream into other body pools where it helps to identify the pathogens. IgM is larger molecule and remains in the blood and serves as the first line of defense in cases of septicemia. IgA protects mucosal surfaces such as it attaches to the intestinal lining and prevents pathogen from attaching and causing disease.

[1] Assistant Professor (LPM), College of Veterinary Science and A.H., Kuthulia, Rewa, Madhya Pradesh-486001
[2] Dean, College of Veterinary Science and A.H., Kuthulia, Rewa, Madhya Pradesh-486001
[3] Associate Professor (Vety. Parasitology), College of Veterinary Science and A.H., Kuthulia, Rewa, Madhya Pradesh-486001
[4] Associate Professor (Veterinary Extension), College of Veterinary Science and A.H., Kuthulia, Rewa, Madhya Pradesh-486001
[5] Assistant Professor (Animal Nutrition), College of Veterinary Science and A.H., Kuthulia, Rewa, Madhya Pradesh-486001

iii. Importance of colostrum feeding:

a) Passive immunity: The newborn calves are born without immunoglobulins (antibodies) in blood which are critical for defense against pathogen in their early life because the immunoglobulins are unable to pass from the maternal blood to the foetus through placenta. Also the immune system of the calf not starts functioning at birth. Therefore, feeding of colostrum rich in immunoglobulins is essential to provide passive immunity to the calves to fight against pathogens until its own immune system starts functioning at about 3 weeks of age (Figure 1).

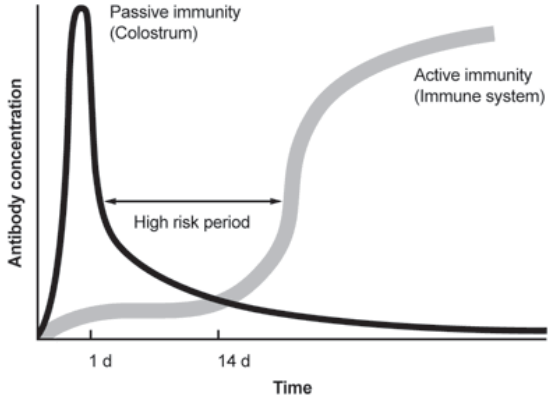

Figure 1. Antibodies from colostrum protect calves until their own immune systems are fully functional.
(**Source:** Journal of Dairy Science, 1981, 64:1727-1730)

b) Rich in nutrients: Colostrum is rich in dry matter (DM), energy, protein, minerals and vitamins than the whole milk. High fat and vitamins in colostrum provides instant energy to the calves and protein is important for body growth.

c) Low lactose content: Low lactose content of colostrum reduces the incidence of diarrhoea.

d) Laxative property: Colostrum has laxative property and helps in the removal of the meconium (first faeces of calf)

e) Hormones and growth factors: Colostrum also contains various hormones and growth factors that are necessary for the growth and development of digestive tract of calf. Colostrum is the only natural source of two major growth factors namely, transforming growth factors alpha and beta, and insulin-like growth factors 1 and 2. These growth factors have significant muscle and cartilage repair characteristics. Colostral growth factors have multiple regenerative effects that extend to all structural body cells, such as the gut.

f) Lysoenzyme protein: It attacks bacteria.

g) Oligosaccharides: They block attachment of bacteria especially *S. pheumponococci* to mucous membranes, thereby aiding in the prevention of respiratory inflammation

iv. Time and reason of early colostrum feeding

The new born calves must get first dose of colostrum within 15-30 minutes of birth to get maximum antibodies, followed by a second dose in approximately 10-12 hours later. The amount of antibody absorption depends on the time of colostrum feeding after birth. The antibody absorption through gut decreases to about 30% within 6 hours and about 10% within 24 hours after birth (Figure 2). There is a decline in serum IgG concentration of 2 g/litre if colostrum was fed 30 minutes after birth.

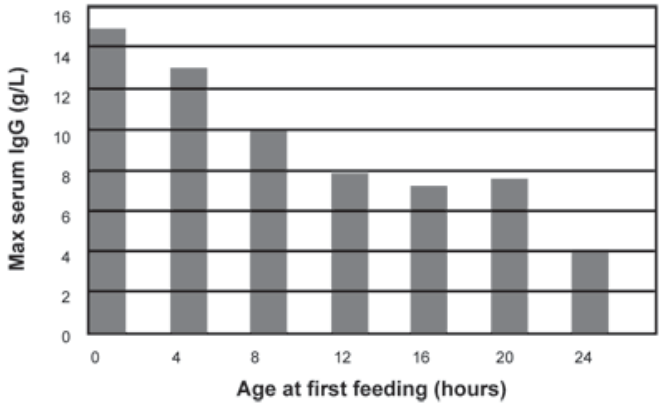

Figure 2. The calf's ability to absorb antibodies declines rapidly over the first 24 hours

(Source: Journal of Dairy Science, 1979, 62:1766-1773)

The reasons behind the early feeding of colostrum are as follows

a) Loss of absorptive sites in the intestine: At the time of birth the intestinal cells are immature and they can absorb the antibodies present in the colostrum as intact macromolecule. The maturation of intestine begins shortly after birth and within 24 hours of birth the intestinal cells become mature enough and lose their ability to absorb intact macromolecules.

b) Secretion of digestive enzymes: Just after birth the normal digestive enzymes in the abomasums and small intestine do not function or function with limited activity, allowing antibodies to reach small intestine without being digested. The secretion of digestive enzymes in the abomasum and intestine becomes marked by about 12 hours after birth. This causes breakdown of the antibodies (protein in nature) into amino acids, which have no antibody function.

c) Bacterial colonisation in intestine: The intestinal tract of new born is sterile at birth. The bacteria from environment begin to colonise in the intestine within a few hours of birth and this will hamper the colostum absorption. Further, if the intestinal cells are not saturated by colostral proteins this may favour colonization of pathogenic bacteria in this site.

d) Enzyme inhibitors: Colostrum contains enzyme inhibitor (trypsin inhibitor) that allows antibodies to escape intestinal digestion and absorb intact. The concentration and activity of trypsin inhibitor is closely related to the concentration of IgG in the colostrum and it decreases with gradual drop of IgG concentration.

v. Amount of colostrum feeding

The total amount of colostrum fed to the calves should be @ 10 percent of the body weight per day in 12 hours interval.

vi. Methods of feeding colostrum

a) Allowing the calf to suckle colostrum from the dam if weaning is not done just after birth

b) Teaching the calf to drink if weaning is done just after birth

1) Hand feeding: Colostrum is poured into a clean pail. The calf is brought to the pail and its nose in contact with the colostrum. The husbandry person should insert two fingers of right hand (after cleaning) into the mouth of the calf, while holding the colostrum at left hand at a convenient height for the calf. As the calf starts suckling the fingers, the muzzle is gradually dipped into the pail and the fingers are gradually removed when the calf starts suckling colostrum. This procedure may be repeated whenever the calf stops drinking and lifts its head.

2) Nipple feeding: The calf can be fed from rubber nipples attached to the pails or bottles, placed at a convenient height from which the calf suckles colostrum. This stimulates the natural suckling process of the calf keeping mouth and neck stretch upward. The nipples should be removed, washed thoroughly and sterililsed once a day.

vii. Factors affecting the quality of colostrum

The quality of colostrum depends upon the following factors:

a) Age of cow: Colostrum of older cows contains more amount and greater variety of immunoglobulins than younger cows because older cows are comparatively more exposed to pathogens.

b) Pathogen exposure of dam: If the dam is exposed to many pathogens she will have high level of antibodies.

c) Vaccination of the dam: A good dry cow vaccination programme can improve colostrum quality as vaccines stimulate increased maternal antibody production.

d) Calving number: As calving number increases the level of immunoglobulins also increases in the colostrum (Table 2).

Table 2. Antibody content of milk, according to calving number

Calving number	**Antibody (%)**
First	5.9
Second	6.3
Third	8.2
Fourth and later	7.5

(Source: **Journal of Dairy Science, 1981, 64:1727-1730**)

e) Length of dry period: A 3-4 weeks dry period is needed to allow antibodies from the blood to be concentrated in colostrum.

f) Dry cow nutrition: Providing adequate nutrition (like protein, energy) to the dry cow produce good quality colostrum than the cows not fed adequately.

g) Prenating: Milking before calving or leaking milk pre-partum reduces antibody levels in the colostrum.

h) Breed: Jersey has the highest level and Holstein has the lowest level of antibodies in colostrum.

i) Season: The quality of the colostrum is reduced due to stress during severe summer in tropical regions and severe winter in temperate regions, associated with variation in the quality of feed and fodder.

viii. Storage of colostrum

Excess colostrum can efficiently be stored and used later when necessity arises in conditions like i) death of the dam just after parturition, ii) non-availability of colostrum, iii) pathogen contaminated colostrum, and iv) poor quality colostrum.

1. Freezing of colostrum

Excess colostrum can be stored by freezing in 2 litres double bagged freezer bags or 2 litres plastic containers. These can be kept on a flat surface in non-frost-free freezer for upto one year. The freezer temperature should be -20°C.

Thawing colostrum: At the time of necessity, the frozen colostrum can be thawed in warm water (not hot water) or in a microwave on low power for shorter periods and immediately fed to the calves.

2. Fermented /soured colostrum

Colostrum ferments when it is stored at a temperature between 60°F and 80°F (in absence of direct sunlight) by the action of fermenting microorganisms present in the colostrum. It is to be stirred daily to prevent separation. The colostrum takes approximately 10-14 days to ferment and can be stored for an additional 14-30 days. The production of lactic acids lower pH of colostrum (4.5 or less) favouring its preservation. The addition of small amount of acid preservatives can extend the life of the fermented colostrum and decrease undesirable fermentation.

Milk from antibiotic treated cows can not be used for preparation of fermenting colostrum, since the antibiotics will kill the fermenting organisms. Milk from such cows can be used two weeks after antibiotic withdrawal.

Fermented colostrum should be diluted with warm water (not hot water) @ 1 part warm water to 2 parts fermented colostrum and the reconstituted mixture can be fed to the calves approximately 10 percent of their body weight at 4 days of age instead of whole milk or milk replacer. It can be not be used as substitute of colostrum in the first 3 days of calf's life.

ix. Colostrum substitute

Substitute of colostrum may be required when colostrum is not available from any source. It can be prepared with the use of following ingredients

Ingredients	Amount
Whipped up fresh egg	1 piece
Cod liver oil	5 ml
Castor oil	15 ml
Warm water	300 ml

The total amount constitutes single meal and it should be prepared freshly just before feeding. Castor oil in the mixture is used as laxative. Therefore, after defaecation of meconium castor oil should be omitted from the mixture. The rest ingredients should be mixed and fed thrice daily for 3-4 days.

Other colostrum supplements are available commercially for use such as bovine serum, cheese whey etc.

--o0o--