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For Vet Professionals only

Face2Vet
A Clinical Update

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Calf Anemia - Prevalence, Diagnosis, Management and Control

Calf, the young one of bovine is the life and future of a dairy animal and economics of a dairy farmer. Healthy calves are the first step towards thriving replacements and growing animals. Calf health depends greatly on the quality and management of the calf in early life, particularly in the first six weeks. Proper management of young calf is prerequisite to the success of any dairy farm. An optimal level of nutrition in early life favours faster growth and early maturity. Calves should be reared carefully to obtain optimum gain in body weight, so that they attain about 70-75 per cent of mature body weight at puberty. Poor feeding of young calves leads to delayed puberty, higher age at first calving and overall loss of productivity in it's life span.

Facts about healthy calves rearing

- Young calves are the backbone of dairy industry.
- The ideal birth weight of a calf ranges between 15 -35 kg depending on the breed and sex.
- A new born calf ideally should receive 10 percent of their body weight of fresh and creamy colostrum during its first 24 hours of life.
- The consumption of at least 2 litres of colostrum by suckling or bucket feeding within the first six hours of life and a further 2 litres within 12 hours is critical.

Calf age	Colostrum to be Fed
15-30 minutes of life	5-8 % of body weight
10-12 hours of life	5-8 % of body weight
2nd day	10 % of body weight
3rd day	10 % of body weight

Table 1: Colostrum Requirement for Newborn Calves

- The potential for attaining optimum body weight is an important factor that affects the economy and success of a dairy farm.
- Calves gain 400-500 grams of live weight per day, which is adequate for attaining satisfactory body weight at the end of six months.
- Feeding of colostrum provides passive immunity to calves, ensures more immunity, disease resistance and reduced mortality.
- Colostrum is a rich feed, a good source of the fat-soluble Vitamins A, D and E and immunoglobulins.
- Milk replacers is given after 7 days of the calf age and continue upto 3 months.
- Calf Starter is then fed to calves after three months of age till one year.
- Deworming dose within 10 days of birth and then after up to 6 months of age at regular interval.

Anemia in calves

As well-known fact, milk is poor source of iron for all species, so for calves also. Exclusive feeding of whole milk to calves without the additional administration of dietary supplements leads to iron deficiency anaemia. There is low iron content in cow's milk, which is approximately 0.5 mg/kg in raw milk. There are number of aetiologies behind occurrence of anemia in calves.

A. The calves susceptible to chronic blood loss due to bleeding gastrointestinal ulcers, infestation with blood sucking parasites, hemorrhagic diseases, or malnutrition. Calves health compromises due to **Parasitic infestation** are:

1. They have not yet acquired any resistance against parasites commonly found in their environment. Adult animals grown up in a certain area have normally developed some kind of resistance (immune response) against the parasites in the surroundings which they are constantly exposed to.

2. Calves show much stronger disease symptoms from heavy parasite infections as they have yet to build up an immune defense.

3. Calves need all the nutrients required for growth. If they are fed normal rations but heavily infected by internal parasites, they cannot utilize the feed given to them. Their growth is reduced dramatically and they easily become victims of pneumonia or diarrhoea that may cause their death.

4. Incidence of blood parasites is found majorly in exotic and crossbred cattle than indigenous breed. *Theileria annulata, Babesia bigemina* and *Anaplasma marginale* are blood sucking parasites in bovine calves.

5. In calves, heavy infestation of parasites like *Toxocara vitulorm*, sucking lice such as *Hematopinus eurysternus* and *Linognathus vituli* causes greater haemorrhage and blood loss leading to anemic conditions.

6. Gastrointestinal infections in calves are also caused by protozoa viz *Eimeria alabamensis*, *Giardia duodenalis* and *Cryptosporidium parvum*. Predominantly they cause acute gastrointestinal disturbances, mucoid or haemorrhagic watery diarrhea which is responsible for huge amount of blood loss making them more susceptible to anemic condition.

B. At time of birth, there is a transition from the hypoxic intrauterine life to extra-uterine environment making the new born calves more susceptible to **Oxidative stress**. Due to abundance of polyunsaturated fatty acids within their membranes, erythrocytes are particularly sensitive to oxidative stress, their membranes becoming less deformable and more sensitive to damage, eventually decreasing their life span and worsening the anaemic condition.

C. In a study, healthy normal calves were given 35 mg Iron, a decline in the volume of the erythrocytes took place during the first 7 weeks. This slow fall presumably reflects the death rate of large erythrocytes present in the calf at birth and their replacement by erythrocytes of normal size. This is a **physiological change in calves.**

D. Anemia results when the body does not produce enough red blood cells. Many nutrients are needed for red blood cell production. The most critical are iron, Vitamin B_{12} and folate (folic acid), but the body also needs trace amounts of copper, as well as a proper balance of hormones, especially erythropoietin (a hormone that stimulates red blood cell production). Without these nutrients and hormones, production of red blood cells is slow and inadequate or red blood cells may be deformed and unable to carry oxygen adequately. Chronic inflammatory disease also suppress red blood cell production. In other circumstances, the bone marrow space may be invaded and replaced (for example, by leukemia), resulting in decreased production of red blood cells.

E. Iron deficiency anemia should also be considered to be a predictor of **neonatal calf diarrhoea**. There is a role of iron in the maintenance of intestinal homeostasis. The inadequate morphological and functional adaptation of the gastrointestinal tract is considered to have a central role in the etiology of gut diseases during the neonatal period. The declining levels of IGF-1 status associated with iron deficiency might be one of the predisposing factors for the increased incidence of diarrhea in anemic calves. The major findings indicate that IGF-1 could influence the growth and development of intestine.

The mal-absorptive changes and incidence of diarrhea in anemic calves resulted from changes in IGF-1 induced nutrient uptake or from a lack of iron dependent enzymes.

Iron – An Essential Mineral

Iron is an important trace element in mammals and performs several vital functions, such as binding and transporting oxygen as a key component of hemoglobin and myoglobin proteins, mediating electron transport within the cells in the form of cytochromes and facilitating oxygen enzyme reactions in various tissues. The adequate level of iron in newborn calves is essential not only for the achievement of good health but also for the achievement of adequate weight gain of young calves due to the involvement of the insulin-like growth factor (IGF) system in proper utilization of consumed nutrients.

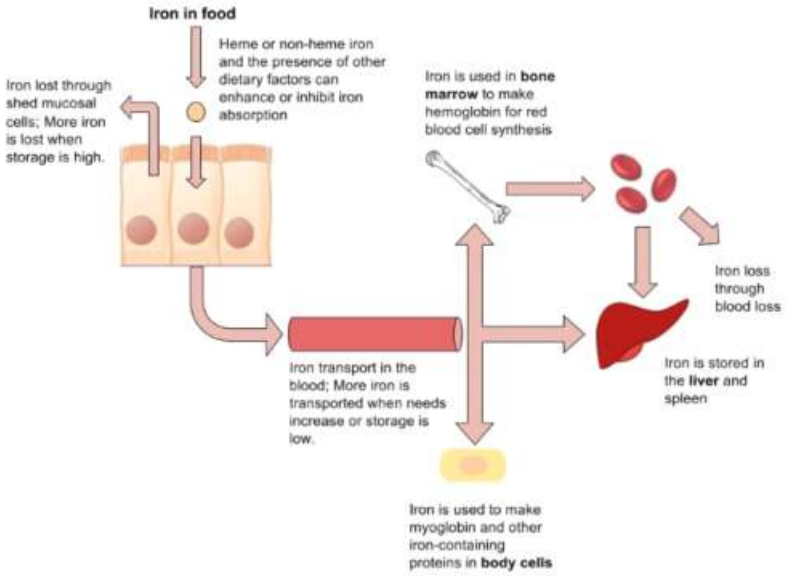

Fig – 1 Iron Absorption, Distribution and Metabolism in Body

The calf has only sufficient iron for about three weeks after birth. Over half the iron in the body is in form of hemoglobin with small amounts present in myoglobin and in enzymes used for oxygen utilization. Iron deficiency occurs in calves because iron requirement is greater due to rapid growth of calves. The normal blood hemoglobin values for adult cattle are 8.0- 15.0gms/100ml. However, the value in calf at birth is 12.9gms/100ml, dropping to 10.4gms/100ml on a diet of milk and solid feed. The calf's daily iron requirement is 50gms and it receives only about 2–4gms from the mother milk.

Iron depletion occurs in three stages:

a) First, the iron storage in the liver, spleen and bone marrow decreases parallel to serum ferritin, while the serum iron remains constant.

b) Second, subsequent time-shifted lowering of the serum iron level occurs.

c) The third stage is eventually characterized by development of hypochromic and microcytic anemia.

d) With slow depletion of iron levels in body, the fall of hemoglobin content occur in two stages:

- The initial fall in haemoglobin content of the blood appears to be due to an increase in the proportion of microcytes.
- After 11-12 weeks the total number of erythrocytes per mm^3 blood begins to decline.
- At third stage does there appear to be a reduction of haemoglobin concentration in the erythrocytes.

Iron deficiency signs leads to numerous health conditions

Young animals in the early stages of life are most susceptible to iron deficiency; however neonates do have some iron reserves in their body. In the case of feeding calves with cow's milk, which has low iron concentration, rapid growth rates can lead to the development of temporary iron deficiency. This condition exacerbated by the immaturity of molecular mechanisms of iron absorption as in other animal species. Transient iron deficiency in new born calves most commonly manifests as anemia. The deficiency is characterized by

- Reduction in appetite followed by reduced weight gain.
- The mucous membranes become pale.
- Increased susceptibility to various infections.
- Lethargy

- Major symptoms are due to a deficiency of hemoglobin with low hematocrit, PCV and Oxyhemoglobin values etc.

Diagnosis of Iron deficiency anemia

Differentiation of iron deficiency anemia from similar afflictions, due to deficiency of other trace minerals, such as selenium or copper should be taken into consideration.

- Copper is an essential element in hematopoiesis, but before anemia is detectable, reduced growth rates and depigmented fur can be observed.
- Selenium deficiency leads to muscular dystrophy while a shortage of copper impairs the intestinal absorption of iron.

Ferritin has capability of retaining iron in a non-toxic form, represent a biomarker protein to monitor dietary supplementation of iron. Ferritin level in circulation is directly proportional to the iron storage of the organism. It has been shown that ferritin is more sensitive parameter to detect the onset of iron deficiency in dairy bulls, compared to other blood parameters, such as hemoglobin, hematocrit, or quantity of red blood cells (RBC).

In calves with Fe values < 18 µmol/l at or shortly after birth are at greater risk for development of gut disorders (i.e. severe diarrhea). In anemic calves, increase in the fecal pH values related to their impaired iron status. Fecal pH is higher in anemic calves than in healthy calves. The most likely scenario points to the necessity of iron for normal gastric secretion. In the other words, the incidence of neonatal diarrhea in anemic calves is a reflection of the alteration in gastric function and consequently imbalance in the gastrointestinal tract microbiota.

Iron for Anemia Management and Development of Healthy Calves

- Iron is an essential element in living cells.
- Iron requirements of young calves are higher than those of adults and thought to be about 100 parts per million. Cow milk contains low concentrations of iron; therefore, neonatal calves can easily become iron deficient as they grow.
- Iron deficiency causes a decrease in the antioxidant enzymes of erythrocytes and plasma total antioxidant capacity. The erythrocytes with iron deficiency are lysed faster than normal erythrocytes following exposure to hydrogen peroxide (H_2O_2), which indicate defects in the protective mechanism of red blood cell (RBCs) with iron deficiency against oxidative damage which further leads to decrease in the lifespan of erythrocytes in circulation.
- 75 percent of body's iron is associated with hemoglobin, iron deficiency limits the synthesis of hemoglobin, resulting in reduced production of red blood cells (RBCs).
- Iron is also a key component of myoglobin proteins, mediating electron transport within the cells in the form of cytochromes and facilitating oxygen enzyme reactions in various tissues.
- Iron has a role in many redox reactions. This redox cycling is useful for many metabolic pathways essential to life, such as cell cycle progression and division, oxygen transport, mitochondrial activity and immune system function.

Prevention of Iron Deficiency Anemia in Calves

- Calves fed with milk as major source of diet during first four weeks of life.
- The calves raised on kuccha floor get more iron because of their direct access to soil. Calves reared on pucca (concrete) floor have higher chances to develop iron deficiency anemia.
- Iron deficiency does not appear during first few weeks of life, as there is enough iron stores in body, however discrepancy occur after three months in the level of iron absorption from dry matter or other roughages nearly at the time of weaning.
- That's why most case of iron anemic calves occur around four months of age.
- Rapid growth rate and expansion of blood volume in young animals resulting in immediate utilization of iron than storage in body.
- Milk replacers diet of calves contain up to 40 mg/kg DM of iron for the first months, but commonly only 10-15 mg/kg DM for the finishing period.
- For adequate iron levels in body, stimulate the production of Red blood cells or increase the amount of

haemoglobin in blood, by supporting, initiation, Hb incorporation and maturation phases of erythropoiesis.

- Erythropoiesis involves Initiation, Haemoglobin (Hb) incorporation and RBC maturation.
- In anaemia, there is low RBC or haemoglobin concentration which leads to low oxygen supply.
- The low oxygen supply in kidney leads to release of erythropoietin which stimulates bone marrow for erythropoiesis.
- For initiation of erythropoiesis, animal requires Niacinamide, Pyridoxine and Biotin which enhance synthesis of Erythropoietin and ensure optimum energy for erythropoiesis.
- Iron gets absorbed in intestine of animals and from there iron transported to cell through blood vessels.
- Iron converts into heme in mitochondria of cells.
- Incorporation of Hb requires Iron which forms heme of haemoglobin.
- Copper helps in iron transport and Pyridoxine have role in conversion of iron to heme.
- After synthesis of globin, haemoglobin got accumulated in early erythroblast and after ejection of nucleus it changes in to late erythroblast.
- Reticulocyte is final stage of RBC's after maturation which changes into mature RBC and ready for systemic circulation.
- Maturation of RBC requires Folic acid and Vitamin B_{12} which help in globin protein synthesis.
- **3-D Red**, is an ideal hematinic for calves preventing them from iron deficiency and ensuring better weight gain and good health.
- Depletion of iron stores can delay growth rate which causes economic losses to dairy farmers.
- **3-D Red** contains elemental iron equivalent to 54 mg/10ml, sufficing the requirements for calves even if the diet is deficient of the same.

Treatment of Anemia due to Iron Deficiency in Calves

- The best indicator of the onset of anemia in calves is loss of appetite, which is a more sensitive indicator than biochemical measurement.
- Number of parasites *viz Toxocara vitulorm*, *Hematopinus eurysternus, Eimeria alabamensis* and blood parasites like *Theileria annulata, Babesia bigemina* and *Anaplasma marginale* are common causatives for anemia in calves.
- **Feritas bolus** can be used in such conditions along with dewormers to replenish lost iron and restore normalcy.
- Feritas bolus containing ferrous fumerate, folic acid and Vit B_{12} which provides uninterrupted RBC formation and highly bioavailable form of iron for better absorption.
- It effectively improves hemoglobin level.
- **Feritas bolus** can be used during pregnancy, post parturition and in young ones on exclusive milk diet.
- **Feritas bolus** can be used in anemia, as a follow up after injection for upto 1-2 weeks, following anti-parasitic treatment and in debilitated and weak animals.
- Single dose of **Feritas Inj** can be recommended for acute or emergency cases in iron deficient calves.
- Use as adjunct treatment of blood parasites, surgeries or accidents involving excess bleeding, prolapse of uterus, and haemoglobinuria etc.
- Feritas injection is superior formulation of Iron Sorbitol Citric Acid complex, Hydroxocobalamin (Vit B_{12}) and Folic Acid.

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For suggestions and comments, please write to us

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