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Role of Calcium in Dairy Cattle during Transition Period and its Management

Surajit Das[1*], Dipti Nain[1], Arsha Shaji[1], Shubham Singha[1]

[1]Ph.D Scholar, Dept. of Animal Reproduction, Gynaecology and Obstetrics, ICAR-National Dairy Research Institute, Karnal-132001, Haryana

[*]Corresponding author: Surajit Das, Ph.D Scholar, Dept. of Animal Reproduction, Gynaecology and Obstetrics, ICAR-National Dairy Research Institute, Karnal-132001,Haryana

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Abstract

The transition period in dairy animal, which is the period considered from three weeks prior and after parturition, is crucial for their health and productivity. Most of the animals' nutritional needs were met by feed, consisting in energy, protein, minerals and vitamins. For maintenance of production performance at an adequate level, the minerals play an important role, which we often overlook. In terms of production, including reproductive performance and disease prevention, such as milk fever or retention of the placenta during the postpartum period, calcium plays an important role in all major minerals, i.e. calcium, magnesium, phosphorus, and potassium. Clinical or subclinical hypocalcemia around calving is the most common disorder due to massive calcium secretion into colostrum. As a consequence of subclinical hypocalcemia, there is decreased milk production, immune function, increased risk of ketosis, and decreased reproductive performance. So it's pivotal to maintain calcium levels during the dry period so that later consequences do not occur and the fertility of the animal is maintained.

Keywords: Calcium, dairy cow, diseases, productivity, transition period

Introduction

Our nation is very much concerned with increasing animal productivity, which may be governed by several factors, and balanced nutrition is one of them. Various studies indicated that minerals are a significant part of maintaining optimal production performance, which is often not taken into account in the course of dairy feed intake. Out of all the minerals, four macro-minerals play major role with respect to production or reproduction performance during the postpartum period. Those four macro-minerals are calcium (Ca), magnesium (Mg), phosphorus (P), and potassium (K). Reduced feed intake,

poor rumen or gut motility, low productivity, and greater vulnerability to other metabolic and infectious diseases can all result from inadequate blood concentrations of these minerals (Goff, 2004). Out of these four minerals, calcium has a major impact on the transition period of cattle. The transition period in dairy cattle, considered three weeks prior and after parturition, is crucial for their health and productivity. During late pregnancy and early lactation, it is challenging for high-yielding dairy cows. Early lactation requires a 2.5 percent increase in energy requirements (Reynolds *et al*., 2003) and a 65 percent increase in mineral requirements (primarily calcium), to support lactogenesis (DeGaris and Lean, 2008).

Effects of low calcium level in dairy cattle:

In the early stages of lactation, dairy cow produces milk (contains 1.1 g Ca/kg) or colostrum (contains 1.7-2.3 g Ca/kg) drains 20-30 g Ca/day from reserve pools such as plasma pool, extracellular fluids, and bones (Goff, 2004). A high amount of calcium loss from the blood occurs through milk which leads to parturient paresis (also known as milk fever) and other life-threatening conditions, so the cow must replace calcium lost through milk by withdrawing calcium from the dietary calcium absorption or mobilization from bones. The parathyroid hormone (PTH) helps in the mobilization of calcium from bones. In addition to that hormone, 1, 25-dihydroxyvitamin D is the hormone which secreted from the kidney in reaction to a rise in blood PTH, from vitamin D (active form is 1, 25-dihydroxycolecalciferol) helps in absorption of calcium from the intestine (Figure 1). Hypocalcemia affects the muscular tone or function as a result of uterine prolapes or dystocia. The biological processes dramatically change during the transition period; the demand for calcium virtually doubles as lactation begins. Since, it has been established that milk production increases from the third lactation onward, and demand for calcium in the body also rises from that point on. Low calcium levels without the emergence of clinical symptoms such as recumbency, lethargy, hypothermia, and rumen atony are referred to as subclinical hypocalcemia. Subclinical hypocalcemia initiates when the blood calcium level is 8.0 mg/dL to 8.8 mg/dL (Goff, 2008). Negative energy balance is made worse by subclinical hypocalcemia, which also affects lipid metabolism. Reduced energy availability worsens immune cell dysfunction and increases uterine disease incidence. Some farmers have been feeding pregnant cows a lot of calcium during the last month before pregnancy, believing that it will control their hypocalcaemia; which is very dangerous for the postpartum cow. High availability of blood calcium during the last month of pregnancy, the parathyroid gland becomes inactive after calving, resulting in less calcium absorption by the body of the lactating cow. So, during the last month of pregnancy, single source of calcium should be avoided, but mineral mixtures containing calcium can be continued.

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How do you determine whether your cow needs calcium or not?

1. For that in a cattle farm 10 lactating cows' blood calcium levels were measured,
2. The potassium content of the diet,
3. Take a history of any metabolic disorder, particularly when the level of blood potassium is adequate in the body,
4. Any unsatisfactory performance in terms of milk production, reproduction, or growth rate.

Managemental strategies to maintain calcium levels in dairy cattle:

On the basis of those facts, it has been shown that calcium plays an important role in dairy cattle and differing requirements for calcium at various stages of life are observed. Moreover, it is most important to start feeding calcium to the dairy cattle during the dry period so that later consequences prevent and the fertility of the cattle is maintained. There are several sources of dietary calcium that can be given to the cattle, like legume seeds, legume roughages, and animal by-products like tankages, fish meal, etc. Besides, different calcium supplements like limestone (34% Ca), oyster shell (34% Ca), dicalcium phosphate (26% Ca), etc. can be given. The efficiency of intestinal calcium absorption was enhanced by feeding dietary zeolites (sodium aluminium silicate) throughout the final two weeks before delivery, leading to higher circulating calcium concentrations during calving (Khachlouf *et al*., 2019). Requirements for calcium at different stages of life in dairy cows are mentioned in Table 1, 2 and 3.

Conclusion

To prevent the common postpartum disorders (ketosis, displaced abomasum, milk fever, dystocia, retained placenta, metritis, etc.) that have been associated with hypocalcaemia precautionary measure has to be taken to maintain fertility and production of the dairy cattle, especially during the transition period. Although several single calcium supplements are present, it is better to go with a mineral mixture supplement where along with calcium, other minor and major trace elements are well balanced.

Table 1: Requirements for calcium during growth of dairy cattle (adapted from NRC ,2001)

	Body weight of animals (Kg)	Ca Requirement (g/ Kg wt. gain)
For Growth	<200	17
	200-300	13
	>400	8

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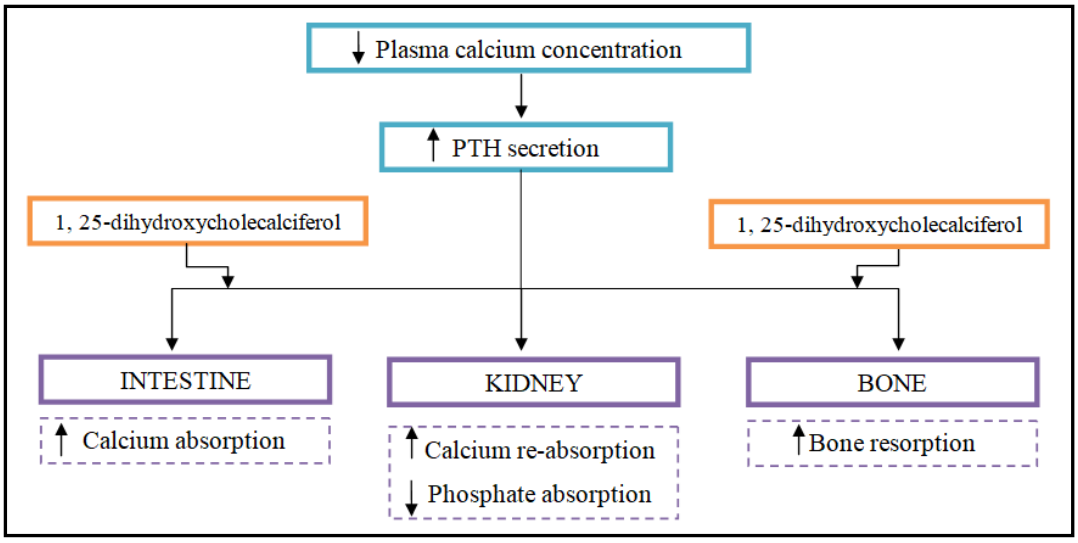
Table 2: Requirements for calcium during pregnancy and lactation of dairy cattle (adapted from NRC, 2001)

During Pregnancy		**For Milk production**
Requirement upto 190 days (g/day)	Requirement 190 days onwards (g/day)	Requirement (g/Kg milk production)
1	10.0	3.2

Table 3: Calcium requirements (g/day) for maintenance of cattle (adapted from NRC, 2001)

BW (Kg)	**Calcium requirements(g/day)**	
	Dry	**Lactating**
200	8	9
250	10	11
300	12	14
350	14	16
400	16	18
450	18	20
500	20	23
550	22	25

Figure 1: Calcium homeostasis



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