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Prevention of Milk fever: Nutritional Approach

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Abstract

The use of negatively balanced cation-anion rations during the late dry or prepartum period requires excellent monitoring and management. The cows must be separated from the remaining herd and fed a total mixed ration as a group. Lower plasma calcium (Ca) will stimulate the Parathyroid hormone (PTH) and 1-hydroxylase system to increase intestinal absorption of Ca and bone resorption –reduce incidence of milk fever. The incidence of milk fever was increased simply by increasing the potassium (K) concentration in pasture Diet high in K or sodium (Na) -alkalinize the blood - decreased bone Ca resorption and renal production of 1, 25-(OH)2 vitamin D, increase incidence of milk fever. Inadequate supply of magnesium (Mg) in dry period - reduce the ability of a cow to mobilize Ca at parturition. Anionic salts (-ve DCAD) prevents milk fever by acidifying the blood to restore tissue responsiveness to the PTH.
Keywords: Milk fever, cation-anion ration, total mixed ration, Parathyroid hormone, DCAD

Introduction

The art of feeding dairy cattle is rapidly becoming the basic and applied science of dairy cattle nutrition. Milk fever, a metabolic disease, affects high producing dairy animals usually within one or two days after calving, resulting in a huge reduction in milk production and thus becomes economically most important. It is also known as periparturient paresis.

It is estimated that this disease affects 3 to 8% of cows with some herds having prevalence as high as 25 to 30%. Symptoms appear when blood calcium levels are low; hence the synonym of milk fever is hypocalcaemia. Incidence of milk fever is estimated to be between 4-5% of 2nd plus lactation cows and increases with cow age. Economic losses due to medicines, veterinary services and reduced production exceed Rs.400 per cow (Mandali, 1999). Losses are also associated with increased incidence of secondary diseases, such as ketosis, mastitis, retained placenta, displacement of abomasum, uterine prolapse, limb injuries, and pneumonia can further inflate losses.

Milk fever occurs in dairy cattle after calving because of low blood calcium levels as a result of calcium moving into milk. There are about 23 grams of calcium in 10 liters of colostrums, and when this is added to the normal amount of calcium needed for maintenance, the needs of the cow can be more than 10 times the supply of calcium in her bloodstream. When the demand for calcium is greater than the supply in the blood, it causes the problem of milk fever, unless the cow can rapidly mobilize stored calcium in her body (e.g. in bones) to offset the situation.

Calcium Regulation Mechanism

Cattle can absorb Ca from gut according to their needs. They are able to alter the absorption efficiency to meet changes in Ca requirement. When cattle consume more Ca than needed, the proportion of Ca absorbed is decreased (Horst, 1986). Ca is regulated by Parathyroid hormone and Calcitonin, which are secreted from Parathyroid gland. The decrease in Ca intake stimulates the secretion of parathyroid hormone (PTH) from the parathyroid gland. PTH enhances renal reabsorption of Ca (Capon and Rosol, 1989) and promotes the synthesis of 1,25-dihydroxycho-lelalciferol (1,25-(OH)2D) from 25-hydroxycho-lecalciferol in the kidney (Allen and Sansom, 1985). As result of stimulated 1, 25-(OH) 2D and PTH secretion, bone Ca resorption and intestinal Ca absorption increase (Horst et al., 1994). The action of PTH hormone is counteracted by calcitonin (CT), which is secreted by thyroid C cells. CT decreases the concentration of Ca in blood plasma by reducing the rate of bone resorption (Allen and Sansom, 1985).

Interrelationships between minerals can also influence the absorption and utilization of each other. Ca has an interrelationship with phosphorus, Table-1: Nutritional factors responsible for milk fever

No.	Factor	Effect
1	General Nutritional status at Prepartum period	Increase K – pasture, Over fat cow and very thin cows
2	Reduce feed intake on day of calving	Reduce Ca intake and absorption
3	Increase Ca intake prepartum	Increase passive absorption and quiescence of Parathyroid gland
4	Increase P intake prepartum (>80 g P/d)	Inhibits Vit-D metabolism
5	Reduce Mg concentration at prepartum	Reduce production and secretion of PTH
6	Dietary Cation Anion Differences	Increase DCAD balance

magnesium, manganese and zinc (Underwood and Suttle, 1999). Recommended optimal Ca:P ratio to reduce the incidence of parturient paresis were approximately 2.3:1. When the Ca: P ratio decreased from 2.3:1 to 1.1:1 the incidence of parturient paresis increases.

A nutritional approach to managing milk fever involves monitoring specific elements in the diet. The common strategies to prevent milk fever can be divided into three, which are summarized below:

1) Low calcium strategy (often with relatively high phosphorus):

This is the strategy that's most commonly used in the UK and is still effective on many farms. It works by ensuring that the dry cow is mobilising calcium, so that when it switches to milk production it is better able to cope. A useful analogy is to think of the lactating cow as an athlete, it's much more likely to do better if it has a bit of training before it needs to compete. Low calcium in the dry period provides that training.

2) DCAD strategy

This strategy was developed in the US in order to combat the high potassium in their forages, which prevents the low calcium strategy from being effective. Altering the balance of the diet by feeding an excess of strong anions (primarily chloride and sulphide) would change the pH of the blood, if the body's mechanisms didn't prevent it. One of the mechanisms that prevents this is the calcium metabolism, thus feeding an 'anionic diet' is another way of training the cow before it starts milking. This can be very effective, but it is more difficult to undertake than the low calcium strategy (with which it mustn't be combined). Potential problems include low palatability of some anionic salts and the requirement for regular urine pH testing. If the DCAD strategy is not done correctly it can lead to significantly increased milk fever levels.

3) Drenching or pasting

Several commercial products are available for boosting blood calcium. Best results are obtained if the first dose is given just before calving (usually around 8 hours before) with a second dose 24 hours later. This obviously requires calving to be accurately predicted. This method is used more commonly in Europe than in the UK, and is more time consuming and has less economic benefit than good dry cow nutrition. It is probably used in herds suffering from a high level of metabolic disease around calving.

Whichever technique is used, good dry cow management is essential. The transition between dry and milking needs to be as seamless as possible. Also, whichever prevention route you choose make sure that all cows receives plenty of magnesium, as low magnesium intake is one of the most important causes of milk fever.

In recent years, dairymen have been able to reduce the incidence of milk fever and subclinical hypocalcemia during the early postpartum period by feeding adequate amounts of calcium, phosphorus, and magnesium. Earlier studies suggested that a lack of available phosphorus in the diet of lactating dairy cows is the predisposing factor in milk fever. More recently, it has been shown that dairy cows on high alkaline diets during the dry period are more prone to milk fever while an acidogenic diet tends to prevent hypocalcemia and milk fever. Dietary cations (positively charged) such as sodium (Na), and potassium (K) are alkalogenic; dietary anions (negatively charged) such as chlorine (Cl), sulfur (S), and phosphorus (P) are acidogenic.

Dietary Cation-Anion Balancing

Dietary cation-anion balancing is a new concept that has received much attention recently as a nutritional tool for reducing milk fever in early lactation as well as improving health and production. The dietary electrolytes are balanced according to the charges they contain. Because cations are positively charged and anions are negatively charged, the ration is balanced to be either negative or positive. A negatively balanced ration favors prepartum dry cows and reduced incidence of milk fever, whereas a positively balanced ration favors lactating cows and increased levels of milk production. That is, lactating cows do better with a positively balanced ration and prepartum cows with a negatively balanced ration. Mineral elements considered in cation-anion balancing are sodium, potassium, chlorine and sulfur. To create a well-balanced ration using the cation-anion approach, about 150 to 250 total grams of a combination of compounds such as ammonium chloride, ammonium sulfate, calcium chloride, calcium sulfate and magnesium sulfate are needed daily per cow. The amount needed will vary with the concentration of potassium and sodium in the ration. Because anionic diets stimulate greater mobilization of calcium from bone, they should not be fed the entire dry period. The anionic salts used in the prevention of milk fever are quite unpalatable to dairy cows. As a result, they should be used with caution and mixed thoroughly in the dry cow ration.

A cation-anion balance is calculated by subtracting anion milliequivalents from cation milliequivalents (meq.). While several formulas have been used, the following equation (Equation 1) is suggested for dry cows.

Equation 1: Cation-anion balance = meq [(Na + K) – (Cl + S)] / 100 gms DM

Dietary K plays a significant role in predisposing cows to milk fever. An effective means of offsetting the detrimental effects of K is to increase the anions content of diets. It has the distinct disadvantage of being unpalatable. The current understanding of the Cation Anion Difference concept suggests that milk fever could be managed more effectively if dietary K was reduced (Horst *et al.*, 1997). High concentrations of potassium in rations may lead to a greater incidence of hypocalcemia and possibly milk fever in a dairy herd.

A mineral mixture should be purchased or formulated to provide the extra minerals and vitamins needed in the dry cow ration. The special anionic salt mix should be formulated to provide the desired negative cation-anion balance for feeding prepartum dairy cows.

A number of studies show less milk fever when cows are fed a ration with a negative cation-anion balance during the late dry period. The reduction in incidence of milk fever appears to be due primarily to the greater mobilization of calcium from bone stores. Research has shown that cows fed anionic diets have higher blood calcium levels at calving.

The cation-anion balance may have potential for improving milk yield in the subsequent lactation, and reducing the incidence of both retained placenta and of milk fever. Most of the available research indicates that diets which are acidogenic (negative cation-anion balance) are beneficial to calcium absorption and in the reduction of the incidence of milk fever. The feeding of such rations should be during the last 2 to 3 weeks of the dry period.

Nonlactating cows should be properly managed during the dry period to assure top production in the subsequent lactation. Properly balanced rations designed to avoid metabolic problems and fed during the prepartum period will assist the dairyman in reaching his objectives.

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