LAMINITIS IN DAIRY CATTLE - WITH SPECIAL REFERENCE TO NUTRITION AND MANAGEMENTAL FACTORS - A REVIEW

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ABSTRACT

This review paper presents information on the nutritional and management factors that can predispose dairy animals to laminitis. The suggestions regarding various feeding and management practices that may help in preventing laminitis are also discussed.

Lameness in dairy animal is a serious problem as it causes significant economic loss to dairy farmers. The outbreak of laminitis can occur at any time of the year, but it is strongly related to the time of calving. Acute lameness can turn a healthy animal into a physical wreck over a matter of days. The laminitic animals may refuse to move or have difficulty in moving. Many workers have indicated that laminitis in cattle is brought about by several factors including bacterial infection (Maclean, 1971a; Leaver, 1983; Castle and Watkins, 1984 and MDC, 1997) rough concrete (Leaver, 1983; Castle and Watkins, 1984; Bazeley and Pinsent, 1984; Colam-Ainsworth et al., 1989; Bergsten, 1994 and Bargai, 1998) inherited weakness (Vermunt and Greenough, 1994; MDC, 1997; Nocek, 1997) and changes in feeding practices (Leaver, 1983; Vermunt and Greenough, 1984 and Nocek, 1997). Other factors like metabolic and digestive disorders, infectious diseases such as mastitis/metritis, acetoneemia and foot rot can predispose the cows to lameness (Maclean, 1965 and 1971b). Environmental factors such as lack or little use of bedding (Colam-Anisworth et al., 1989 and Bergsten, 1994), lack of exercise or hard surfaces can also cause mechanical damage to the feet of dairy animals (Bergsten, 1994).

The present review paper consolidates information on the major nutritional factors such as carbohydrates, roughages, proteins etc. that can predispose laminitis in dairy animals. The additional knowledge on the associated factors such as housing, bedding, exercise etc. on lameness have also been given. The article also includes literature on various feeding and management practices that can be adopted to prevent laminitis.

Nutrition

The increase in the occurrence of laminitis has been primarily ascribed to the erratic feeding or sudden change in feeding regimes. Feeding with rations high in carbohydrates and low in fibre are the most commonly implicated factors in the initiation of laminitis syndrome (Vermunt and Greenough, 1994). A disturbed digestion in the rumen or a toxic agent like oxalate or nitrate in forages are also considered to be the causative factors (Ahuja et al., 1998 and Singh et al., 2000).

Carbohydrates: Most investigators (Telley and Preston, 1971; Theurer, 1986; Nocek and Tamminga; 1991; Nocek, 1992) agree that excessive carbohydrate intake is the principal nutrition related factor in the development of laminitis. Nocek (1987) reported that feeding of rations high in fermentable carbohydrates to ruminants can lead to a lactic acid accumulation in the rumen. As a result, the pH of the rumen decreases below 5.0 and this condition is known as lactic acidosis (Cricklow and Chaplin, 1985). The symptoms include inconsistent appetite, body weight loss, diarrhoea and lameness (Gentile et al., 1986 and Norlund, 1995).
Livesey and Fleming (1984) studied the effect of feeding low fibre (16.5% DM basis) and high starch diet in early lactation on the incidence of laminitis and sole ulcers in Friesian dairy cows. The animals fed on low fibre and high starch rations had 68% incidence of clinical laminitis and 64% sole ulcers. Cows given high fibre (19% DM basis) diet had only 8% clinical laminitis and 8% sole ulcers. They concluded that feeding of low fibre and high starch diet in early lactation increased the incidence of clinical laminitis and the severity of corium lesions.

Dirksen (1989) reported that rumen acidosis can occur in ruminants which are given large amount of feed containing high level of readily available and digestible carbohydrates. The low fibre and high starch diet affects rumen fermentation, which results in unfavourable proportion of crude fibre to readily available carbohydrates in the diet and causes loss of appetite or irregular appetite among animals.

The experiment of Kelly and Leaver (1990) indicated that fibrous type of concentrates cause less lameness than starch concentrate. They compared a concentrate containing ground barley (starch rich source of energy) with dried mollysed sugarbeet pulp (fibrous source) to see its influence on lameness in stall fed dairy cattle. Rations were offered in 60:40 ratio (DM basis) of concentrate/grass silage, during 3 to 26 weeks of lactation. The barley based concentrate resulted more cases of clinical lameness as compared to sugarbeet concentrate diet.

In another study, Manson and Leaver (1988a) showed that increasing the level of concentrate from 7 to 11 kg per cow per day during 7 to 22 weeks of lactation increased the incidence of lameness and sole lesions were the major problem.

Peterse and Van Vuuren (1984) indicated that the critical factor is not the length of period during which the cow is allowed to adapt to a new diet, but rather the high quantity of concentrate in the ration. Manson and Leaver (1988b, 1989) also arrived at similar conclusion. In their studies, they found a higher incidence of laminitis in cows fed with high levels of concentrate than those with low levels of concentrate.

Nocek and Tamminga (1991) showed that rate and extent of ruminal digestion of various feed stuffs such as barley, wheat flour, oats and steam flaked corn all have starch availabilities of more than 85%. MDC (1997) and Orskov (1999) reported that feeding of large quantities of starch rich ingredients in powder/ground form can suppress the growth of cellulolytic bacteria in the rumen and this causes ruminal acidosis. However, Theurer (1986) and Nocek and Tamminga (1991) showed that processing (grinding, steam flaking or chemical treatment) of such feeds can have a major influence on availability and utilization in gastrointestinal tract. Therefore, the incorporation of processed feeds should be taken into consideration while formulating rations for dairy animals.

Several workers, (Bazeley and Pinset, 1984; Livesey and Fleming, 1984; Peterse and Vuuren, 1984; Peterse et al., 1986; Moser and Drivers, 1987) reported that the practice of feeding large amount of concentrate in absence of roughage in the milking parlour, could disturb rumen pH, which is believed to predispose the animal to laminitis. Mgasa et al. (1994) showed that feeding bulls on adlibitum concentrate but with limited roughage causes severe laminitis in these animals.

From the above such studies, it has been observed that high energy/low fibre ration together with rapid increase in the amount of concentrate feed after calving are the major nutritional factors which could be implicated in the occurrence of subclinical laminitis.

Roughage/Fibre in the diet: The fibre...
fraction of the feed stimulates chewing and cudding and has great influence on the digestibility of food. Greenough (1985) reported that at least one third of the total dry matter to be consumed by cow should come from roughages and rest from concentrates to guarantee good function of the rumen. Vermunt (1990) suggested that 2.5 cm or greater length of roughage particle is required to ensure proper rumination and saliva flow. Feeding of long stem roughage is incompatible with the modern concept of complete or total mixed diet but not with a semi mixed ration. The provision of some long stem hay may improve the animals capacity to maintain rumen pH. MDC (1997) also reported that free access to straw is beneficial in problem situations, while some type of wet, high energy finely chopped grass silage with low fibre contents are thought to promote lameness. Alkali forages such as urea-treated whole crop can help to maintain normal ruminal function. Therefore, increasing the level of fibre type ‘scratch factor’ in the ration is important to control the conditions which lead to lameness.

Level of protein in the ration: Another factor commonly suspected as a cause of lameness is the use of excess protein (oil seed cakes) in the diet. Manson and Leaver (1988b) reported that increasing the concentration of dietary protein in the ration from 161 to 198 g/kg DM significantly influenced locomotion scores and the severity and duration of clinical lameness during 3 to 26 weeks of lactation. The duration of lameness was mainly associated with solar problems in hind claws. They also observed that trimming of hooves before calving reduced prevalence of lameness. Bargai et al. (1992) compared the effect of feeding rations containing 15.3% and 18% dietary protein in healthy calves. They reported outbreaks of laminitis in calves fed with rations containing 18% digestible crude protein.

Feeding of barley grain: Ahrens (1967) and Weaver (1971) reported high incidence of laminitis on incorporation of barley in the ration of dairy cows. They suggested that continuous feeding of barley grain should be avoided in dairy animals immediately after calving.

Research carried out so far has not fully established all the possible links between nutritional regime and occurrence of laminitis, but major changes in ration of cows at calving, heavy feeding of concentrate and/or protein with little roughage after calving and high proportion of cereals viz., wheat, barley in the diet are all thought to be the predisposing factors of laminitis.

Other nutritional factors: Vermunt (1992) and Sidhu et al. (1996) reported that feeding ad libitum forage containing high levels of nitrate or oxalate produces toxic symptoms like dullness, decrease in rumen motality, constipation, straining and lameness in ruminants.

Age of the animal
Laminitis in young dairy and beef calves has been reported by several workers (Maclean, 1966; Braldy et al., 1989; Greenough, 1990; Vermunt, 1990, Bargai et al., 1992). Nilsson (1963) observed high incidence of laminitis in first heifer calves of high yielding herds. Moser and Divers (1987) also made a similar observation. Edwards (1982) and Bradley et al. (1989) stated that heifers and young cows are more prone to laminitis. Singh et al. (1998) studied the incidence of lameness in 2216 dairy cows and buffaloes in Punjab state. They reported that out of 2216 cows and buffaloes examined the incidence of lameness was found to be 8.10 and 3.89 per cent in cows and buffaloes, respectively. The hind feet (54.7%) was more prone to foot lesions than the fore feet (28.9%). Cows in the age group of 3-5 years were more liable to become lame. In buffaloes, lameness
was more prevalent in the age group of five years (40%). They also reported that the incidence of lameness was more in Holstein-Friesian (63.8%) than in Jersey (10.6%) cows. Brochart (1987) noticed a greater susceptibility of Friesian cattle than those of Holstein-Friesian cows to laminitis. Swedish Friesians are more often affected by lesions associated with laminitis than Swedish and White cattle (Nilsson, 1963; Anderson and Lundstrom, 1981). The results of the above studies indicated the breed differences in susceptibility to laminitis.

Management

Management factors that are considered important in the aetiology of laminitis are housing, flooring, bedding and exercise.

Housing and flooring: Many research workers have stressed the importance of housing and flooring in the initiation of claw lesions. Bazeley and Pinset (1984) observed laminitis in heifers introduced into a herd housed on concrete floor. Similar observations were made by Greenough and Vermunt (1991). They found that sudden introduction of pregnant heifers into dry group, confrontation by dominant cows and housing on a rough concrete in cubicle housing system played a vital role in the occurrence of haemorrhage of claws of heifers. Bargai (1998) reported deep antisilding grooves in concrete floors as high risk factor in predisposing animals to subclinical laminitis. Dewes (1978), Harris et al. (1988), Chesterton et al. (1989), Tranter et al. (1991) and Vermunt (1992) speculated that laminitis in dairy cattle is associated with the length, quality and design of the farm track and the movement of animals on abrasive surfaces and the length of time spent on concrete yards.

Mgasa et al. (1994) concluded that confinement and restricted movement of beef bulls on concrete floors was the predisposing factor for laminitis. The results of the aforesaid studies suggested that animals should be housed in a clean and vast place having smooth flooring to minimize the risk of subclinical laminitis.

Bedding: Brochart, (1987) reported that the incidence of laminitis is normally less in animals kept on straw yards. Sand is optimal stall bedding material providing comfort to cows and lack of organic matter for bacterial growth that may predispose cows to mastitis. Colam-Ainsworth et al. (1989) observed that soft bedding results in longer resting time and fewer cases of lameness associated with laminitis. Several workers (Cermak, 1983; Bazeley and Pinset, 1984; David, 1986; Franken et al. (1992) have recognized the importance of soft resting area in relation to claw lesion.

Exercise: Nocek (1997) reported that mobility of the animal influences peripheral circulation of blood, therefore, little or no exercise can cause sluggish blood flow, edema and swelling of feet. Weaver (1979) suggested that physical confinement may lead to inadequate exercise and is a predisposing factor for laminitis. Greenough (1990) also reported that long standing or reduction in exercise will decrease the blood flow through the corium of the claw making it more susceptible to injury. Bergsten, (1994) observed that too much exercise and concussion on concrete floors, especially for heifers that have been accustomed to pasture can cause trauma and mechanical damage and greater incidence of sole ulceration.

CONCLUSION

Studies undertaken so far indicated that laminitis is multifactorial in etiology. Therefore, to isolate one possible predisposing factor is difficult, if not impossible. However, the total effect of all interrelated factors on the occurrence of laminitis is important. Since nutritional and management factors have been identified as key components in the
development of laminitis, good feeding practices and proper management methods as suggested in this review should be followed to minimize its risk. Although feeding of high energy ration to dairy cows is essential for high milk production, this practice may lead to a disturbed rumen pH - a predisposing factor for laminitis. To overcome this problem group feeding of cows according to their milk yield may be practiced with some advantage.

REFERENCES