Review Article

OPTIMIZING HOOF HEALTH IN DAIRY CATTLE : A SCIENTIFIC PERSPECTIVE

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ABSTRACT

Hoof health is one of the key factors in maintaining proper animal health, longevity and productivity. Hoof health influences the overall well-being of animals, so it is a concern for the dairy farmers. It is a serious welfare issue also. In this article common hoof disorders of cattle and various risk factors associated with hoof health and the common management practices suggested to improve the hoof health of the cattle and thus to improve overall health and productivity are discussed.

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INTRODUCTION

Indian dairy farming is strongly aligned with agriculture and contributes significantly to the improvement of the rural economy. India ranks first in world cattle population. According to 19th Livestock Census, the total bovine population in India is 299.99 million out of which cattle population is 190.90 million. India is the leading producer of milk contributing around 23% of the global milk production. But high milk producing ability of country is mainly because of higher population of cattle and per animal productivity is still less. Following infertility and mastitis, hoof disorders/lameness are the third most economic disease of dairy cows (Enting *et al.*, 1997). Shearer *et al.* (2017) reported that lameness is the third most common cause of culling or premature removal from the herd. Hoof disorders are primarily responsible for the development of lameness in dairy cattle. (Somers and O'Grady, 2015; Solano *et al.*, 2016). 87.5% of lame animals suffer from hoof lesions (Sadiq *et al.,* 2017). Cattle suffering from hoof problem have reduced milk yield, lower reproductive performance, decreased life span, severe pain and distress. Hoof problem is a major animal welfare issue also. Financial losses occur as the result of reduced milk production, loss of body condition, reduced fertility, culling, veterinary costs and medication, as well as time devoted to nursing an animal

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(Greenough, 1997). For all these reasons, early detection and treatment of cows with hoof problem is important. This article focuses on several aspects of hoof health, such as potential risk factors and the essential management techniques to overcome them.

COMMON HOOF DISORDERS

Common hoof abnormalities include overgrown hooves, scissors claw, cracked hoof, sole ulcer, sole abscess, corkscrew hooves, white line disease, inter digital dermatitis etc.

INCIDENCE

Worldwide approximately 20% of intensively managed cows are lame at any one time. (Wells *et al.,* 1993; Clarkson *et al.,* 1996; Whay, 2002; Cook, 2003; Espejo *et al.,* 2006). In India, the prevalence of lameness in cows is around 8 to 30.5%. (Chawla *et al.,* 1991; Randhawa, 2006; Sood and Nanda, 2013). Average prevalence of lameness in Crossbred and Tharparker cattle was 13.67% and 11.05% respectively. Difference in management practices is important factor for the difference in prevalence of diseases like lameness. Hoof disorders may exist at a subclinical level for a while before cows are seen to be clinically lame. Many researchers, like Das *et al.* (1992) in West Bengal, Saikia *et al.* (1992) in Assam, Chakrabarti (1996) in Tripura, Nandi SK *et al.* (2008) in West Bengal, Bagate *et al.* (2012) in Gujarat, Bhatt *et al.* (2016) in Gujarat, Chakrabarti and Kumar (2016) in Bihar, Pooja (2018) in Kerala, Kumar *et al.* (2019) in Karnataka, have reported on the incidences of bovine foot diseases or various risk factors of lameness in India.

RISK FACTORS

Lameness is caused by a combination of managemental, nutritional, and genetic factors that affect the structural and functional integrity of hoof (Buragohain, 2012). Aetiology of hoof disorders is not entirely understood, although there are several risk factors that impact their development, and their prevalence varies region to region and according to different environmental conditions. Different localized and systemic diseases like foot and mouth disease, foot rot, wounds, arthritis, laminitis, bed sore, abscess, milk fever, downer's cow syndrome and physical trauma predispose cows towards abnormalities of hooves leading to lameness and recumbency (Cook *et al.,* 2004).

The possible risk factors can be classified under three headings i) Animal related: breed, age/parity, body weight, production stage, hoof colour/symmetry, behaviour; ii) Management related: farm hygiene, housing, nutrition, trimming, stocking density and iii) Environment related: season.

Breed

Overall Holstein Friesian crossbreds have a higher incidence of hoof diseases than Jersey crossbreds or other indigenous breeds and the percentage of incidence varied because of different management practices followed in different regions.

(Kumar et al., 2019; Lohith *et al.,* 2016; Chakrabarti and Kumar, 2016; Bhatt *et al.,* 2016; Bagate *et al.,* 2012). Exotic and crossbreds are predisposed to such condition due to their high milk yielding potential and soft nature of hoof. Hoof problems are observed commonly in heavy breeds and breeds with less pigmented hooves like that of Holstein Friesian (Chesterton *et al.,* 1989). One of the reasons for an increased incidence of lameness is that the genetic selection of traits focuses mainly on quantity and quality of the milk, reproductive traits and ignores the other important traits such as body conformation, leg conformation, etc. to reduce the susceptibility to foot diseases and hence these selection traits must also be included.

Age/Parity

Dembele *et al.* (2006) stated that the incidence of lameness increased with advancement in age, following an inverted 'U' shaped relationship with age. Cows over ten years old were four times more likely to develop lameness (Rowlands *et al.,* 1983). Older cows have more hoof damage, low body condition score and low digital cushion thickness (Hoedemaker *et al.,* 2008).

As parity increases, animals experience more transitional phases throughout their lives, which affects hoof health and the keratinization process. For each increased lactation number, the chance of being lame increases by 30% (Groehn *et al.,* 1992).

Body weight and confirmation

Cattle rely on functional hoof and limb conformation for their normal locomotion and behaviour. The weight distribution and loading direction of the entire hoof, between and within each claw, are determined by hoof shape, posture, and biomechanics. Although the conformation of the hoof and leg is primarily hereditary, aging, disease, and environmental exposure all have a significant influence. The cause-effect link between hoof shape and posture (acquired conformation) is not well known. Overloading the hoof or an inferior environment can have a serious effect on the underlying tissue and cause disease. Horn growth is also triggered by higher relative pressure of the sole. Cows selected for larger body size were more likely to be culled due to leg and foot problems than cows selected for smaller body size (Hansen *et al.,* 1999). In a study conducted by Das *et al.,* (1992) in cattle and buffalo, hoof disorders were high in front feet (65.8%) in comparison to the hind feet (28%) and all four feet (5.2%). Movement of fore feet is more frequent in cattle. When an animal sits, walks, or runs away, the movement of the fore feet occurs first. This could be one of the causes of the increased prevalence of foot disorders in the fore feet. But in high yielding dairy cattle hind feet involvement may be owing to bearing more weight than fore feet.

Hoof colour

Animals with light-coloured hooves are more likely to suffer from certain hoof lesions, such as sole haemorrhages and white line disease, than those with darker

hooves (Sogstad *et al.,* 2011). Similarly, animals with mixed-coloured hooves were more likely to have sole haemorrhages and corkscrew hooves than those with dark-coloured hooves. Less pigmented hooves (more common in Friesian cattle) are more susceptible to lameness than darker colored hooves (Chesterton *et al.,* 1989).

Production

As the severity of hoof lesions and pain increases, milk production decreases. Reproductive performance was the poorest in the group with the highest number of hoof disorder observations (frequency) within a single lactation. The higher the number of hoof problems per lactation, the greater the negative association with production and reproductive performance (Krpalkova *et al.,* 2019). Hoof disorders lead to milk loss up to 31.66 per cent during the entire lactation (Bagate *et al.,* 2012).

Season

Comparable data for seasonal variable in foot diseases in cattle is very scanty. Incidence of foot diseases is highest during the rainy season and lowest during the winter (Maoivor and Horor ,1987; Singh *et al.,* 1993). Out of total cases of lameness recorded in crossbred cattle, occurrence was maximum in rainy season (43.7%) followed by winter (30.17%) and summer (26.13%). Possible causes include poor housing conditions, increased humidity, soil softening, and increased mud and water contact (Chakrabarti *et al.,* 1996). Risks are greater in winter than in summer (Cook, 2003; Rowlands *et al.*, 1983), most likely reflecting the fact that most cows are housed during the winter. DeFrain *et al.* (2013) reported that the infectious foot lesions such as digital dermatitis and foot rot are most common during the first lactation and in the winter season. The non-infectious disease condition like whiteline disease, toe ulcer, sole ulcer, etc., occur within three months of summer due to heat stress.

Housing

Housing cannot be considered as a single factor. There are several co-active environmental and management factors that contribute, such as the type of floor surface, the space and design of the resting area, etc,. The hoof disorders were predominantly identified in cows raised commercially under intensive housing systems (Rahman *et al.,* 2014). The type of floor and flooring materials used in different places might have variable effects on creating hoof disorders. Housing cows on concrete is thought to adversely affect the health of the legs and feet because of its unyielding nature. The use of a softer layer of rubber over the concrete surface of alleyways or on flooring appears to minimize leg and claw lesions compared to concrete or wood flooring alone (Vokey *et al.,* 2001). Zero-grazing farms had higher levels of lameness and knee swellings in compared to farms with grazing facility (Haskell *et al.,* 2006). The increase in lameness may be due to the concussive effects of concrete, or to continual exposure of the feet to slurry (Cook *et al.,* 2004).

Nutrition

Nutrition is a significant factor for healthy hooves. Nutritional disorders, such as acidosis, can lead to excessive lactic acid generation, histamine production, and the release of endotoxins, all of which are negatively associated with hoof health in cattle. Keratinization requires amino acids (cysteine and methionine), fatty acids (linoleic and arachidonic acid), minerals (particularly calcium), trace elements (zinc), and vitamins (biotin). Imbalances in minerals (zinc, copper, selenium, and manganese) and vitamins (particularly A, D, and biotin), as well as other nutritional deficiencies can lead to the growth of a fragile hoof, which may be more prone to cracks and infections. Zinc, sulphur and some trace elements have positive impact on hardness of the hoof horn (Langova *et al.,* 2020).

Behaviour

Galindo and Broom (2000) found out that when total standing time was increased, the incidence of lameness also increased because lesions in the soft tissue increased. Lame cows had a shorter period of standing and walking because of a longer time of lying down, and they exhibit reduced sexual behaviour, estrus behaviour. The social ranking in cows affects the incidence of lameness as the total lying period in the cubicle of low ranking cows is less, they spend more time standing still than middle and high ranking cows.

General management practices recommended

The foot diseases are one of the most neglected conditions in farms. Farmers' inexperience and practical difficulties associated with the examination and treatment of lame cows resulted in the neglect of bovine hoof health (Bagate, 2012). Prevention, early detection, and treatment can minimize losses, improve recovery, and reduce animal pain. Lameness scoring can be done on regular basis and cow comfort indices should be considered. There are several lameness scoring methods available in the public domain. Many of the lameness scoring systems use a 5-point ordinal scale. The available number of lameness scoring systems is relatively large and many of the systems are modifications of each other and therefore very much alike (Thomsen *et al.,* 2008).

Foot bathing: Prevention of infectious lameness is far better, cheaper, and more successful than treatment. Hence, footbath is recommended for the control and prevention of infectious hoof diseases. It is mostly used to prevent and control interdigital dermatitis. Most used formulations include formalin solution (5-10%), zinc (or) copper sulphate and quaternary ammonium compounds and other commercial products in various strengths. The best location for a footbath is at the exit lane of milking parlour and at the entrance of the farm. A footbath can be used for approximately 2-3 days, depending on the number of animals.

Flooring: Floor surfaces should not be excessively slippery nor too rough. Concrete surfaces must be cleaned on a regular basis, as both silage effluent and slurry causes erosion. Cow tracks are also critical, especially when cows are required to walk long distances to and from milking. Ensure that cows are not hurried while walking to and from pastures. Soft and less slippery rubber floor can reduce various gait abnormalities with low hoof wear. It has a lower thermal conductivity than concrete. The soft ground acts as a shock absorber and thus maintains the integrity of the animal's hooves. Dermatitis, heel horn erosion, white line haemorrhage, sole ulcer, and white line separation cases were seen less on the hoof of tied dairy cows on rubber slatted floor than in hard floor (Hultgren & Bergsten, 2001).

Nutrition: Maintain proper concentrate to forage ratio to avoid SARA (sub-acute ruminal acidosis). Feeding a well-balanced mineral mixture with additional trace minerals especially zinc, manganese, copper, cobalt and biotin is a key component of the nutrition to minimize lameness. Feeding monensin can reduce the lactic acid concentration through inhibition of the lactic acid producer *Streptococcus bovis* (Nagaraja *et al.,* 1981). Acclimate the cow to the post-calving/milking ration well before calving. Cows must be switched to a transition diet around two weeks before calving. Unnecessarily high levels of protein and starch/sugar should always be avoided in the diet. Abrupt changes in the ration should be avoided during lactation. Wet, highly acidic silages must be avoided.

Hoof trimming

Hoof trimming is the removal of overgrown appendages or portion of the hoof materials covering the feet of an animal for better balance, posture, and healthy living. (Ovnicek *et al.*, 2003; Kummer *et al.,* 2006). There are two types of hoof trimming: preventive and curative. Preventive hoof trimming, also known as functional or routine trimming, is carried out to avoid the occurrence of lameness and hoof disease. Curative hoof trimming is carried out to address hoof injuries and control infectious diseases in the foot in cows. It is advisable to trim feet at least twice a year. The ideal times would be once at dry-off and again around 100 days in milk. Association between hoof trimming and production variables should be considered. A minimum of two to three times a year is needed for almost all animals, regardless of diet or environment. (Leach *et al.,* 2005).

CONCLUSION

More than 90% of cases of lameness can be attributed to hoof lesions, in which the most common causative factors are infectious agents, laminitis, or traumatic injuries. Hoof disorders are most common in cows raised in intensive housing systems, with breed, age/parity, body weight, production stage, hoof colour/symmetry, behaviour, farm hygiene, and diet being the most likely risk factors. Hoof shape and posture adapts to physiological and environmental changes. A correct foot trimming and soft foundation can even out the weight distribution between the hooves.

Lameness and conformation are influenced by genetics, so breeding programmes for healthy feet should be promoted. Good foot health is highly dependent on a healthy environment. Any compromise with the animals' natural needs raises the possibility of foot and leg disorders and lameness. Well-designed housing systems, foot-relief areas, and good management with a long pre-calving adaptation period can reduce the negative effects of confined dairy systems.

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