



*Review*

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**EFFECT OF LAMENESS ON SOME PRODUCTIVE TRAITS AND HEALTH STATUS OF COWS IN DAIRY CATTLE FARMS**

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**ABSTRACT**

The intensification of modern cattle husbandry has achieved high milk productivity standards. The discussion performed herein makes clear that high milk yields predispose cows to lameness and as a result, to considerable milk losses. This productivity of cows necessitates adequate feed intake to respond to the enhanced metabolic rates. This type of feeding often results in metabolic disorders and presents a risk for lameness occurrence. Hoof and foot diseases in cattle reflect on their reproductive potential, udder health, body hygiene, body condition and therefore, on the economic results of dairy cattle industry.

**Key words:** lameness, dairy cattle, productivity, health

The modern standards of dairy cattle farming have increased the demands for high productivity and profitability. In response to new conditions and trends, cattle husbandry has undergone numerous changes in both production and management systems, and in selection of contemporary dairy cattle breeds (1). The selection in intensive dairy cattle is performed for higher production rates (2). With this respect, it is often ignored that genes responsible for high production of milk are not always predetermining the health of feet and hooves in cows. The stimuli existing so far in dairy cattle husbandry result in a certain underestimation of the good physiological and health status of cows and encourage the efforts aimed at selection for a high milk production (3, 4).

Despite the aroused scientific interest, the opinion about lameness-related milk loss is not yet unanimous. The investigations on the subject had shown that lameness was mostly prevalent in high production cows (5). Besides lameness, the period of lactation, during which cows manifest clinical lameness, the season, and the uniformity among animals may also significantly influence milk yield (Archer et al., 2010) (6). In months with highest rainfall (March, April, October, November), the incidence of lameness is increasing. Lameness is more frequent in stall barns where the humidity is high and when areas with continuous collection of water in unacceptable amounts – around the watering troughs and the low positioned areas (7). The calving season may significantly influence proliferation of lameness when humidity coincides with the peak of lactation around the 4<sup>th</sup> post parturient month (8, 9). The dry climate leads to dehydration, hardening, fragility and cracking of the hoof horn. The lameness affects cows at all ages, but the incidence is higher between the first and the sixth parity (10). Single cases

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of lameness in heifers before calving are due to injuries or infections (11). In a number of studies, cows with clinical sign of lameness decreased their productivity even before the appearance of clinical symptoms. Warnick et al. (12) provided evidence for reduced milk yield about 2 weeks before and 3 weeks after detection of hoof disorder, whereas according to Green et al. (13) the milk yield in clinically ill cattle could decrease 4 months before evident symptoms of leg and hoof diseases. Other cases of reduced milk production due to lameness, as well as lower fat and protein percentage in milk are reported (14). These reports allowed assuming that the lower production due to hoof diseases is considerably higher than the directly estimated losses. The reported daily milk losses in a cow with hoof disease could be summarized as follows: 1.5-2.8 kg (15); 0.8-1.5 kg (16); 2.4 kg (17). Data showed a substantial decreased milk yield, which vary between 300 and 400 kg per cow over 305-day lactation. Studies performed by Warnick et al. (16) and Hernandez et al. (18) established that the development of lameness during the first 100 days of lactation had an extremely adverse effect on current lactation milk yield. The higher the lameness grade, the more adverse the effect on milk yield during the lifetime of animals is. Archer et al. (6) established that cows with long-term lameness - 4, 6 and 8 months, yielded 0.51 kg/day, 0.66 kg/day and 1.55 kg/day less milk, respectively. The authors pointed out that the losses could be even greater if lameness persisted for a longer period or recurred on a periodical basis. It is proved that lameness-induced milk yield losses over 305-day lactation were considerable, with similar values in the different reports: 360 kg (13); 314-424 kg (19); 350 kg (6). Apart the direct losses, lameness caused also indirect losses from costs related to treatment, labour, reduced fertility which has a special effect on the lifetime milk production of cows. Both direct and indirect losses reflect on the farm's income. According to, Bicalho et al. (19) the milk production of cows decreased by 3.1 kg daily after a hoof disease. It could be therefore assumes that hoof diseases are of particular significance for the profitability when rearing dairy cattle, but the proper and timely treatment could preserved the productivity of animals (20) or even slightly increase the daily milk yield nu 1.5 to 1.64 L per cow (21).

In an investigation on the relationship between hoof lesions and milk yield, Amory et al. (22) demonstrates that cows with the highest milk yield were most commonly affected by specific traumatic sole ulcer and white line disease. The authors found out that when these pathological states are present, the productivity declines considerably (under the farm average) and remain low even after the treatment. The effect of digital dermatitis on cows' milk production was insignificant, while sole ulcer and white line disease resulted in higher milk losses of 570 kg and 370 kg respectively for 305-day lactation (22). It could be then concluded that not all hoof lesions and diseases were detrimental for the health, productivity and reproductive traits in cows. In the view of Hernandez et al. (17) the interdigital phlegmon resulted in reduced milk yield by 10% in diseased animals. The authors did not observe statistically significant difference in the milk yield in other hoof diseases, but reported lower milk yield. In fact, the secondary diseases occurring after the initial hoof damage are the cause for the substantial milk losses (20, 23).

It is acknowledged that lameness has also an impact on reproductive traits of dairy cows. Melendez et al. (24) established that cows with lameness and hoof problems showed lower first-service conception rate (17.5% vs 42.6% in healthy cows) and higher incidence of ovarian cysts. According to this research, lame cows exhibited higher percentage of ovarian cysts during the first 30 days after calving compared to healthy cattle, resulting in lower conception rates and high percentage of infertility in them. The effect of lameness during the different stages of lactation upon reproductive disorders in cows remains unclear. In the view of Lucey et al. (25), hoof diseases and lameness appearing between the 36<sup>th</sup> and the 70<sup>th</sup> days after calving had the most important impact on cows' reproduction and on the calving to first service interval, in particular. Having investigated the type of lameness and the time of its occurrence after calving, Collick et al. (26) observed a certain relationship between the stage of lactation and the extent of lameness, as well as prolonged calving to first service period. It was proved that the development of hoof diseases within post calving days 36-70 prolonged that period by 8 days; within post calving days 71-120: by 11 days and after the 120<sup>th</sup> day by even more days. Cobo-Abreu et al. (27) as well as Dohoo and Martin (28) did not observe any

relationship between the time of hoof disease development and the gynaecological service periods. Similar to what was reported by Amory et al. (22) about the effect of hoof lesions on milk yield, Collick et al. (26) demonstrated that sole ulcer had the most serious consequences on cattle reproduction. The severity of lameness was also essential for conception rates. Bicalho et al. (29) provided evidence that the higher grade of lameness resulted in lower conception rate and higher culling percentage due to infertility. Substantial differences in the reproduction traits of cows with lameness from grades 3 and 4 (as assessed on a five-point score system) were shown. Garbarino et al. (30) reported that lame cows suffered 3.5 times more frequently from ovarian problems. They affirmed that ovarian diseases could decrease by 71% if cows were protected from lameness and hoof disorders that supported the close relationship between lameness and reproduction. In support of this hypothesis comes the fact that cows with good locomotion score and without hoof disease were bred much faster than diseased cows (31). The authors proved differences in the time needed to fertilize cows with different grade of lameness, underlining the importance of the lameness grade on gynaecological indices. The early detection and treatment of cows with hoof diseases could reduce and restrict the influence of lameness and significantly improve the reproductive status of animals (31).

The breed composition of the farm could also influence lameness and other traits of cattle reared. In a comparative investigation of four cattle breeds (Montbeliard, Normande cattle, Holstein-Friesian and a local breed from the Castlelyons region, Ireland), 55-67% of hoof disease cases occurred in the Normande breed (32). It was interesting to note that during the three years of the study, this breed exhibited the shortest service period (85.6 day) together with the highest prevalence of lameness, whereas the first insemination index and the number of inseminations per conception (50% and 1,90 respectively) came second after Montberliard cows. According to Barker et al. (33), the Holstein-Friesian breed was the most susceptible to lameness. It is thought that this was due to the breed's genetic potential for high milk yield. Alban (34) reported for lower risk for lameness in Jersey as compared to Danish Black and White, Danish Red and White and Danish Red cattle. Baranski et al.

(35) also reported lower risk of lameness in Jersey than in Holstein-Friesian cows. Dippel et al. (36) believes that the low body condition score (BCS) is an important risk factor for occurrence of lameness in some breeds. It was shown that BCS of 1.25-2.50 for Holstein-Friesian cows and BCS of 2.50-3.50 (on a 5-point score system) in Simmental cows posed a risk for lameness in the respective breeds.

Laminitis plays an important role for development of lameness and hoof disorders. A number of factors involved in the intensive metabolism of high-productive cows are involved in the etiology of laminitis. Apart from feeding mode, flooring types, the humidity, the approach of care also play a considerable role for appearance of laminitis, as they predispose to trauma of the corium with subsequent pathological growth of the hoof horn (37). Concentrate feeding is related to both laminitis and high milk production, hence the diseases of the toe are mainly encountered in highly productive animals. Pregnancy causes an additional load of hooves, tendons and joints, and predisposes to disease. The temperature comfort of cows is also important for the high production of milk, as heat stress predisposes to appearance of laminitis (37). The increased proportion of concentrate in the summer ration of cows which is commonly practiced to maintain the high milk yields at the farms is another aggravating factor. In the opinion of Fleischer et al. (38) and Vatandoost et al. (39), high milk yields are maintained over the entire year by feeding concentrate type rations. An incontestable fact is that this feeding type and the respective rations could provoke a subacute rumen acidosis. Stone (40) observed that acidosis damaged the rumen epithelium and the permeability to histamine and endotoxins from the rumen content. These substances, in the view of the author, influence the normal blood circulation in the hoof and make it susceptible to external influences. Lame cows often decrease their body weight and BCS, especially at lactation's beginning (41). Thus, cows with leg and diseases could spend much more time in the cubicles than feeding. The continuous lying down could be among the major reasons for incomplete nutrition resulting in weight loss, lower rank in the hierarchy and on the manger path, that further influenced the amount of feed intake (41). According to our research data, cows with simultaneous lameness and ketosis during lactation were with the highest precalving BCS

(3.95 on a 5-point score system). Later, these cows exhibited the highest body reserve losses and the average BCS (2.03 points) remained the lowest over the lactation compared to all other cows. The sharp drop in BCS, occurring probably because of the high milk yield and disproportionate feed intake is a considerable risk factor for occurrence of lameness (36). Such animals are usually highly productive that further influences their body condition (42). Dairy cows, in the view of authors, tend to maintain an energy balance fit for high milk yields even by body reserve utilization that reflects upon their body condition. This way they establish that when lameness occurs it has an effect on body condition, live body weight and milk yield of affected cows and for sick animals this has a negative effect on lifetime productivity and fertility.

The studies on the relationship between lameness and metabolic diseases in cows, ketosis in particular, are relatively few. The data about their effect on milk production rates are contradictory. Dohoo and Martin (28) reported that clinical ketosis and hoof problems had a positive effect on milk productivity whereas only subclinical ketosis had an adverse effect. According to Detilleux et al. (43) cows with ketosis exhibited reduced milk yields but nevertheless, the productivity of diseased cows was higher than that of healthy ones. The high milk yields after a disease episode was probably due to the fact that these cows had a genetic potential for higher milk yields compared to others (15). The high milk production at lactation's beginning predisposed cows to a number of metabolic disorders (ketosis) which decreased the production of milk, but according to Green et al. (13) posed a strong risk of lameness in later stages of lactation. It was shown that not only the high milk yields, but also the composition of milk was important for the occurrence of diseases in cows. The ratio between milk fat and milk protein could be used as an indicator for dietary energy deficiency in cows (44). In the view of authors, when this ratio was over 1.5, these cows were at significant risk to become lame (OR=1.5;  $P<0.05$ ). In such a ratio, there was an indirect negative effect on reproductive traits, ketosis and milk yields during the first 100 days of lactation (44). Our research data have shown that the combination of lameness and ketosis had the most adverse effect on milk yields. The daily milk losses when these two diseases

occur simultaneously were 4.6 kg/day, and at lactation peak -6.15 kg. Despite the relationships between lameness and ketosis (OR=1.8 (45); OR=6.3 (44)) this problem is not enough investigated and requires further studies that be beneficial for dairy cattle breeding.

The effect of lameness on milk yields could be discussed from another aspect – the connection of lameness and behaviour of dairy cows. Cook and Nordlund (46) outlined that there was a close relationship between lameness and occurrence of mastitis and hence, on productivity of cows. The poor hygiene in stall barns and the inappropriate maintenance of cubicles predispose to infectious hoof and udder diseases. According to Singh et al. (47), the prolonged lying down results in a long exposure to pathogenic microorganisms from the environment and development of mastitis. It is proved that lame cows lie down for a longer time in cubicles (48) than healthy ones, affirming the possible relationship between lameness and mastitis. Whay et al. (49) observed a positive correlation between certain physical hoof and joint defects (tarsal joint bruising, swelling and wounds) with lameness. The authors observed a negative correlation between the influence zone (when a man is approaching) and lameness prevalence. The bedding is also important for the development of bacterial pathogens that could lead to mastitis or hoof diseases in cows (50). Vasilev et al. (51) affirms that the extent of body dirtiness (third and fourth grade on a four-point score system) predisposes to subclinical mastitis. Mitev (45) established that 5.5% of cows with subclinical mastitis had also hoof diseases. According to some studies (52) all factors predisposing to mastitis occurrence such as: increased herd size, lower number of calving boxes and increased time for stall rearing, especially rearing in stall barns on concrete floors, are factors for development of lameness. For detection and prevention of lameness, the authors recommend the development of the so called subclinical markers, such as somatic cell counts for mastitis. Nevertheless, it is affirmed that no relationship existed between mastitis and lameness in cattle – in support of it, Heuer et al. (44) reported a lower percentage of mastitis in cows with lameness.

**CONCLUSION**

The intensification of modern cattle husbandry has achieved high milk productivity standards. The discussion of the topic makes it clear that high milk yields predispose cows to lameness and as a result, to considerable milk losses. The high productivity of cows necessitates adequate feed intake to respond to the enhanced metabolic rates. This type of feeding with highly concentrated forage often results in metabolic disorders and presents a risk for lameness occurrence. Hoof and foot diseases in cattle reflect on their reproductive potential, udder health, body hygiene, body condition and therefore, on the economic results of dairy cattle industry.

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