Hygienic and technological conditions favouring lameness in dairy cows: a review

T. PENEV1*, J. MITEV1, A. ILIEV1, I. BORISOV2, T. MITEVA1, Z. GEROVSKA3, K. UZUNOVA4

1Department of Applied ecology and animal hygiene, Faculty of Agriculture, Trakia University, 6000 Stara Zagora, BULGARIA.
2Department of Veterinary Surgery, Faculty of Veterinary Medicine, Trakia University, 6000 Stara Zagora, BULGARIA.
3Department of Animal Science – Ruminants and Dairy Science, Faculty of Agriculture, Trakia University, 6000 Stara Zagora, BULGARIA.
4Department of Animal Husbandry, Faculty of Veterinary Medicine, Trakia University, 6000 Stara Zagora, BULGARIA.

*Corresponding author: penevtoncho@yahoo.com

SUMMARY

The lameness is a complex problem and its development depends on many factors such as technologies of rearing of young animals and dairy cows, the proper design and construction of animal buildings as well as the built-in equipment; the main microclimatic and hygienic conditions of surrounding environment. The social hierarchy, genetic predisposition, age, body condition and lactation stage are aggravating factors for higher rates of lameness in some farms, depending on the applied technology of farming. Farmers around the world spend thousands of Euros in the construction of their farms, but above all, they should be familiar with the animal hygiene and technological characteristics of each system otherwise any deviation or failure from established norms may induce high sensitivity and risk of lameness in dairy cows.

Keywords: Dairy cows, lameness, favouring conditions, animal hygiene, technology.

Introduction

The lameness in contemporary cattle husbandry is polyetiological. A number of factors, rearing technologies for young and productive cattle, properly designed and built premises for dairy cows and adequate equipment are essential for lameness occurrence. The environmental hygienic parameters for animals are additional preconditions with this respect in herds. Social hierarchy, the genetic predisposition, age [8, 24, 27, 40], body condition [24, 27, 42, 56, 89] and lactation stage [37] result in higher prevalence of lameness in some farms, depending on the applied production system.

Influence of the dairy production systems

Two principal dairy production systems are known: tie stall and free stall housing. Ordinance 44/20.04.2006 (amended in Official Gazette 90/17.10.2008) “Veterinary medical requirements for the stock-breeding objects” [57] regulates the environmental parameters for dairy cows. The available area (including the place for lying and movement) to a cow in either tie stall or free stall housing is 6 m². Optimal dimensions of bed are: length : minimum 1.70 m and width : 1.10-1.20 m, and those of cubicles: 2.20 m and 1.10-1.20 m, respectively. According to EFSA (2009) this area is necessary to ensure an adequate space for moving, to reduce social interactions and fights, to maintain good body hygiene, to ensure access to feed for all cows and a stable social hierarchy in the herd [25].

The tie stall production system has provoked more injuries of legs compared to the free stall housing and resulted in higher predisposition of cows to lameness [2, 71]. The transition from tie stall to free stall housing of dairy cows is related to a markedly higher predisposition to hoof diseases and a higher degree of clinical lameness [1, 43]. In the view of authors, this is due to the stress resulting from gathering of numerous animals, the longer time spent standing, the concrete floor, high flooring humidity, the continuous contact of hooves and masure, the worse immune status of cattle etc.

Grazing dairy cattle system is widely practiced on a global scale. Numerous researchers have provided evidence that this technology ensured a softer and more comfortable flooring and prevented traumas and diseases in animals [19, 20, 23, 35, 41, 47, 67, 75, 79]. Grazing production system could cause lameness if cows step on stones or other sharp objects traumatizing the hooves at the pasture or on pathways leading to it [13, 15, 74].

The attitude of animal careers and farmers to cows could significantly influence the prevalence of lameness [6]. Forcing
cows to move quickly on pathways instead of letting them determine the speed of movement could markedly increase the lameness within the herd [13, 14, 38, 81-83]. MILL and WARD [53] consider that the ability of the farmer to recognize signs of lameness should be an integral part of his attitude towards animals. The failure to identify early signs of lameness from the part of careers and farmers is considered to be a manifestation of negligence towards dairy cows. WEBSTER [85] judges that most careers commit serious flaws with respect to signs of pain due to lameness. In agreement with MILL and WARD [53], BOIVIN et al. [11] considered that it is particularly important for farmers to be more aware about lameness and its signs. The knowledge of signs and mechanisms of lameness would help farmers to recognize it early and to undertake proper measures for prevention [55].

Influence of the technical equipments and surrounding environment

The appearance of hoof and finger diseases is also influenced by flooring of technological alleys in facilities and of beds for rest. A large assortment of bedding materials is available for both free stall and tie stall production systems: solid rubber bedding, rubber crumb-filled mats, foam-, air- or water pillow mats, as well as beds with deep sand, soil or wood shavings [24]. Some technological parameters of the premises could be also important in the appearance of lameness. It was found out that the dimensions of cubicles such as width, length, the position of the neck-rail and brisket board were essential with regard to the comfort of cows and the box utilization index [24, 26, 60]. Having investigating the milking parlour types, ESPEJO and ENDRES [26] observed significant differences in movements necessary for cows to assume a proper position. These movements, as well as sudden changes in body position pose a considerable mechanical stress on hooves that is entirely dependent on the milk parlour type. The authors, however, did not observe a statistically significant relationship between milk parlour type, the time spent in the waiting room and lameness, but trends confirming the studies on cows' behaviour in different milk parlour types [23] should be interpreted carefully due to previous experience of cows, the type of cubicle floor or the adaptation during the experiment. It is proved that bedding is important for development of microorganisms which could provoke a number of diseases of hooves and interdigital skin [7, 17, 18]. The bedding should also conform to some other requirements: cheap, dry, it should not promote bacterial growth, should not contain bacterial pathogens and to be compliant with the farm cleansing systems [7]. The authors established that wood shavings from pine and cedar wood contain acid-proof substances, fats, terpenes and phenols with adverse effect on bacterial growth compared to shaving from oak and other broad leaved trees that support the growth of many microbial species. It was also reported that barley and wheat straw, oak shavings and sunflower residues were a good medium for bacterial growth. They absorb better the water, which persists inside beddings with the surface remaining dry – a dangerous source for hoof and systemic infections.

The presence of manure and dirtier than usual alleys in premises, may increase hoof disorders induced by pathogenic bacteria [21, 22, 64]. According to GRIFFIN et al. [39] faeces on the floor could protect cows from development of some traumatic diseases as faecal masses represent soft flooring. These assumptions are supported with the observed sudden lameness among cows after cleaning this "pad". Several investigations have shown that the high ambient temperature results in heat stress of cows, forcing them to spent more time standing on the manure-polluted alleys to seek cooling from fans or colder places in the stall [21, 77]. It was also shown that very low temperature in the farm could cause the manure to freeze and therefore, could also have an adverse effect on cows' health. Frozen manure causes slip incidents, and sharp edges of manure and of frozen mud on pastures injure the hooves and interdigital skin and create an entry door for pathogenic microorganisms [39, 44, 64].

Ordinance 44/20.04.2006 (amended in Official Gazette 90/17.10.2008) stipulates an optimal air temperature in the living area of animals of 10-15°C, with allowed limits between 5 and 28°C [57]. When the stall floor is dry and soft, there is a minimal risk for slipping and trauma on movement [70]. In their research, TELEZHENKO and BERGSTEN [69] showed that cows moved more confidently on soft surfaces with longer steps. Thus, it contributes to proper distribution of the weight among four legs and reduces the risk of hoof lesions. The coefficient of friction of the floor has also an effect on the locomotion of cows [61]. The low friction coefficient (μ < 0.4) makes cows to move with frequent and short steps. With increase in friction coefficient (μ = 0.5) the step length also increases, their number decreases and the locomotion speed was preserved.
Cows felt more confident on floors with friction coefficient between 0.4 and 0.5. On the basis of the natural behaviour of cows on pastures, the attention of several manufacturers of rubber mats for dairy cows was directed to "bring the meadow in the farm". These products were designed on the basis of natural physiology of the growth and hoof horn abrasion.

**Influence of biological factors and hoof care**

Age, the number and the stage of lactation, the body condition are especially important for the occurrence of lameness. It was found out that as age advances, the risk of hoof disorder and lameness development in cows also increases [9, 24, 27, 40]. In the view of GREEN et al. [37] the high milk production during the first lactation months has also an impact on lameness development [46, 66, 84]. In another study, no relationship between the lactation month and the incidence of lameness in cows was found out [27].

The relationship between the body condition score (BCS) and lameness showed that cows with low BCS (<2.5) were more prone to lameness [24, 27, 42, 54, 89]. The low BCS according to MÜLLING and GREENOUGH [56] reduces the function of the digital cushion and facilitates the corium injury. These conclusions are supported by ultrasonography of the digital cushion thickness in decreased BCS at the beginning of lactation [8]. It was not completely understood whether the low BCS (<2.5) is a factor or a consequence of lameness [24, 27]. There are reports stating that very high BCS (>3.75) could pose a higher risk for lameness [33, 54, 87]. The higher live body weight overloads the hooves and the corium in such cows and significantly increases the risk for lameness.

Another important factor for occurrence of lameness in dairy cows is the feeding regimen and ration's composition. The nutrition of cows is among the main factors predisposing to laminitis and the subsequent high sensitivity of the hoof to infections and traumas. To ensure high productivity of cows, high-concentrate feeding systems with large amounts of concentrate and protein feeds are used at a global scale [36]. This ration type may cause subacute rumen acidosis that is prevented by feeding with a complete ration. Apart data about roughage size, detailed information is provided by the components of diets that contribute to proper fermentation in forestomachs of ruminants [12]. The role of dietary supplements as zinc, copper, molybdenum and magnesium for preventing acidosis is emphasized, as the role of vitamins and buffers that a diet should contain. Apart dietary ingredients, the feeding schedule is also believed to be important, how many times a day the feed is offered, how dry cows are prepared for the feeding during lactation etc. All these factors are very important for the proper digestion and for achievement of maximum productivity without risk for laminitis [12].

Along many other health status parameters, lameness in cattle is thought to have a genetic predisposition. The daughters of some bulls were found to be more prone to lameness [58]. Another genetic trait with impact on lameness is the relatively higher live body weight of sires that is inherited by their female progeny [5, 10]. A selection for live body weight of cows should be therefore performed. This statement is confirmed by researchers which found out a positive relationship between lameness and body condition score [33, 54, 87].

Social factors in a given group of cattle predetermine the duration of the rest. Cows with low hierarchy rank lie for much shorter periods and stand longer, while the beds near to the feeding alley are occupied by herd leader cows [23, 29, 30, 32, 59, 65, 73]. The long time spent standing by low-rank cows pose a considerable risk for lameness and hoof lesions [23, 29, 31, 33]. GALINDO et al. [31] established that low-rank cows develop hoof lesions and clinical lameness for a very short time as compared to leaders. This fact confirmed the role of the social hierarchy in the herd for lameness prevalence. Lame cows, as stated by GALINDO and BROOM [30] are more often defeated by healthy ones and this had an impact on the rest and lying times, so that lame cows spent more time lying outside the cubicles. The physical fight between healthy and sick cows could play important role for lameness development and discomfort in cows.

The disinfection of hooves is also essential for infectious diseases of the digit and the hoof. The disinfection bath should be located after the milk parlour thus preventing the worsening of microclimate (formalin vapours) in the parlour itself and thus, the quality of milk [12]. Each foot bath should ensure at least two steps with each hoof in a solution with depth not less than 10 cm. This requires a bath length of 3 m minimum [12, 13]. Schedules for hoof disinfections were developed [12] and those designed on rotation of disinfectants are thought to be the most effective. In authors' view, this schedule prevented the risk for onset of microbial resistance of agents causing diseases of the digit and the hoof, to one or another substance.

An essential part of hoof care is the regular trimming. This contributes to proper distribution of the body weight among both hooves of a leg and protects the corium from injury [49, 51, 52]. The hooves of cows should be trimmed at least 2 times per year (autumn and spring). This opinion is shared by others [63], confirming that hooves should be trimmed by a qualified specialist. The improper hoof horn trimming changes the posture, the body weight is distributed unevenly and joint, ligament and tendon damage could occur. The abnormal loading of hooves is related to a great risk for white line disease [13, 14]. A positive aspect of hoof trimming is the lower risk for slip accidents [62]. The changes in floor friction...
coefficient is attributed to the altered, better quality of the new horn. The lack of adequate hoof care in heifers posed a three times higher risk for lameness during the next lactation [52]. It was recommended to trim hooves between the 3rd and the 4th lactation months in order to reduce significantly the risk for hoof disorders.

As a conclusion, lameness is a multifaceted problem and its occurrence is dependent on numerous factors. Thousands of Euros are spent by farmers for farm construction, but they should be familiar with hygienic and technological characteristics of each system. The production system type and implemented technological solutions are essential for the optimal health of cows and for prevention of lameness. Every deviation and failure to observe the norms provokes one way or another, higher susceptibility and risk of lameness in dairy cows.

References


