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Review

Effect of cubicle technological parameters on welfare and comfort of dairy cows

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Abstract. *The welfare and comfort of dairy cows is of particular importance and therefore, would become an issue of increasing interest for dairy farmers. A number of studies established that better comfort of cows results in higher milk yields. The impact of technological parameters of cubicles on cows' comfort and welfare is considerable. The mechanism of influence of cubicle's parameters on the comfort and welfare of cows is still disputable. This requires more detailed studies in order to provide the necessary level of comfort and hence, better economic parameters of farms.*

Keywords: dairy cows, free stall, cubicle technological parameters, cow comfort, comfort index

Abbreviations: CCI – cow comfort index or quotient, SSI – stall standing index

Introduction

Cubicles are an important element of the technology for housing, and they have to be as clean and comfortable as possible, in order to provide easy access, leaving, lying down and standing up of the cows, ensuring their wholesome rest (Ito et al., 2009; Anderson, 2003; Carlsson, 1999). Poorly designed and maintained cubicles force the cows to lie down improperly, to defecate within the cubicle, or to refuse to use it altogether. The complications are largely related not only with the cubicle type but also with their maintenance, whose flaws could become significant risk factors for the occurrence of mastitis, bruises on the metacarpal/metatarsal joints, the udder, the teats and laminitis in dairy cows (Cook and Nordlund, 2003; McFarland, 2003; Penev et al., 2013). Over the last few years, various cubicle models for resting cows have been introduced. Many of them are decommissioned shortly afterwards, yet many others are well-accepted in practice. In many cases the farmers prefer cubicle models, which are traditional for the country. Still, cubicle producers, together with the farmers, are looking for the suitable design, which would provide maximum comfort and rest for the animals with the minimum production expenses (Carlsson, 1999). Leonard et al. (1994) have conducted a study, which established that the percentage of cubicle usage depended most of all on its design.

The design, size and bedding of the cubicles, in the case of tie stall as well as free stall housing of dairy cows, must comply with certain requirements and provide cows the necessary comfort, freedom of lying down, standing up, and duration of the daily rest within 12–14 hours a day.

Height of the cubicle rear curb

The cubicle's rear curb determines the cubicle space, starting from the manure alley. It must be sufficiently high to prevent the entry of manure while the alley is cleaned, yet it should also be low enough to allow the cow easy entry and leaving from the cubicle (Graves et al., 2009). Palmer (2005) recommends a height of the cubicle rear curb of 25 cm, whereas Cook and Nordlund (2004b) believed that the height of 20 cm was not sufficient. The height of the cubicle rear curb varies depending on the used bedding. In cases when sand or straw bedding is used, the height of the cubicle rear curb is 10–15 cm and serves to keep the bedding within the cubicle. It is recommended that the cubicle rear curb should be bevelled towards the cubicle, since the cubicle changes its content due to being spilled by the animals and could cause discomfort to the cows when the amount of bedding is reduced (Miteva, 2012). According to Graves et al. (2009), when using rubber mats and mattresses, the maximum height of the cubicle rear curb has to be 30 cm. Leach and Whay (2009) considered that the ideal cubicle rear curb height was between 12 and 20 cm (Figure 1).

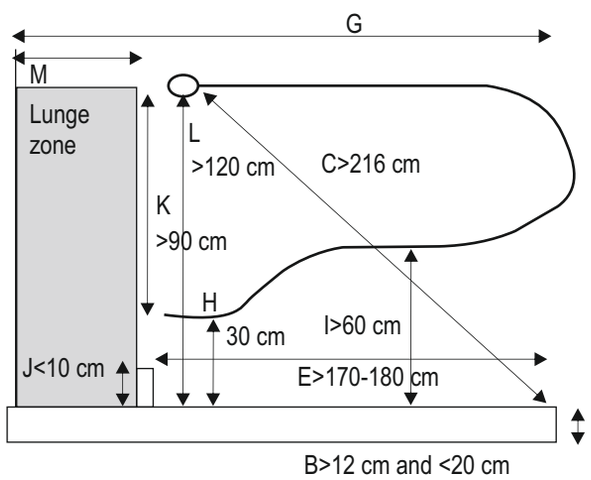

Figure 1. Recommended cubicle dimensions for holstein-friesian cows over 600 kg (Leach and Whay, 2009): B – cubicle rear curb height; C – Diagonal neck rail to rear; E – brisket to rear of cubicle; G – total length; H – height of lowest rail at head end; I – height of lowest rail at rear; J – brisket board's height; K – side lunge; L – neck rail height; M – lunge zone

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Cubicle bed slope

Dinev and Delchev (2005) recommended a slope towards the manure alley, ranging from 1 to 2%. The cubicle slope is necessary for the normally excreted faeces and urine to drain towards the manure alley. Cows enjoy lying down in such a way that the front part of their body is higher than the rear part. In order to achieve this effect, more bedding is put within the front end of the cubicle than in the rear end. The animals themselves also stir up the bedding as to make a more comfortable area for lying down (Anderson, 2007). An inadequately executed slope would cause the animals to assume improper positions within the cubicle, with their limbs protruding outside the cubicle (Graves et al., 2009).

Space for movement within the cubicle

According to a number of authors (Owen et al., 1994; McFarland, 2003; Graves et al., 2009) there are three zones within the cubicle: the body zone, the head zone and the lunge zone. The authors had different views with regard to the dimensions of these spaces, yet they all agree that their size depends mostly on the size of the animal itself. McFarland (2003) recommends body zone dimensions for an animal weighing 550 kg of 158 to 164 cm; for 650 kg – 169–174 cm; for 750 kg – 179–184 cm. The dimensions of the head zone for the same weights are, respectively, 44, 46, 48 cm, and the respective dimensions of the lunge zone – 36, 38 and 40 cm.

Neck rail position

Neck rails are placed perpendicularly to the partitions between the cubicles, forcing the cows to stand at the cubicle curb and to venture inside only as much as to defecate and urinate outside of it, on the manure alley. The positioning of the neck rail, as well as its height from the floor of the cubicle, can have a considerable impact on the time that the cows spend resting (Tucker et al., 2005; Weary and Tucker, 2003; Veissier et al., 2004). Dinev et al (1997) recommend that the neck rail should be fixed at 60 – 70 cm from the front end of the cubicle. For Holstein cows weighing 600 kg, Leach and Whay (2009) recommend a neck rail height of 120 cm from the cubicle floor (Figure 1), whereas Anderson (2008) specified the neck rail position at 122 cm from the floor for Holstein cows with a body weight of 700 kg. According to Tucker et al. (2005), the cows remain standing within their cubicles because they don't have more comfortable spots within the barn. Therefore, the neck rail's effect on the welfare of the cows depends on the condition of the flooring outside the rest cubicles as well. Thus, according to Tucker et al. (2006), despite the poor quality (wet concrete) of the barn floor (outside the cubicles), the placement of the neck rail could force the cows to spend more time outside the cubicle than inside it. Hörning (2003) proved that multiple hits of the cow's body while lying down inside the narrow cubicles, and standing up and sitting down in a manner similar to that of horses, with bending of the hind limbs, could possibly have negative consequences, leading to injuries, pain and fear.

The studies of Miteva et al. (2012b) established that the distance between the neck rail and the cubicle's rear board, and its height from the floor, have a considerable effect on the values of the cows' comfort index and for using the cubicles, but not on the index of standing inside the cubicle. Tucker et al. (2006) proved that the mobility of the neck rail could reduce injuries, pain and fear in the animals. According to Palmer (2005), the position of the neck rail when sand is used as bedding, could be moved further backward, so that the cows would stand upright within the cubicle with its hind legs on the manure alley. Otherwise, the cows stand exactly at the rear curb of the cubicle, which is uncomfortable and provokes them to go further inside the cubicle, likely increasing the contamination of the bedding and the animals themselves.

Cubicle length to the brisket board

The brisket board's purpose is to position the cow while lying down. According to Leach and Whay (2009), it is normal for the brisket board to be mounted at 170 – 180 cm distance from the rear curb of the cubicle, whereas Miteva (2012) recommends a distance of 170 – 186 cm. Anderson (2008) believes that the height of the brisket board should be less than 20 cm, which matches to an extent the recommendation of Leach and Whay (2009) for a brisket board's height of more than 10 cm (Figure 1). The author did not recommend the usage of brackets for the fixation of the brisket board on the lower dividing pipe of the cubicle because these brackets obstruct the stretching of the cows' fore limbs. Such boards are easily applicable when rubber mats or mattresses are used in the cubicles. The position of the brisket board also affects the ratio of cubicle usage by the cows (Tucker et al., 2006).

Total cubicle length

The total cubicle length should include the length of the three zones – for the head, the body and the lunge zone for lying down and standing up. Cubicles that are opened at the front allow the cow to position its head in the opposite cubicle when the cubicles are positioned “head against head,” thus expanding the usable space. For a cubicle opened in the front McFarland (2003) offered a total length of 238 cm for animals weighing 550 kg, for 650 kg – 248 cm, and for 750 kg – 267 cm. Cook and Nordlung (2004b) proposed larger dimensions for 635 kg – 260 cm, for 725 kg – 275 cm and for 815 kg – 275 cm. Cubicles that are closed at the front do not allow the cow to expand its space outside the parameters of the cubicle. According to McFarland (2003), the total length for a cubicle closed in the front for cows with a weight of 550 kg is 244 cm, for 650 kg – 258 cm, for 750 kg – 272 cm. Cook and Nordlung (2004b) propose for cubicles closed in the front a total cubicle length 275 cm for cows weighing 635 kg, and for weights from 725 to 815 kg – 300 cm. Leach and Whay (2009) recommend for Holstein cows weighing 600 kg, with cubicles opened in the front, a lunge zone larger than 60 cm, a total cubicle length above 240 cm, whereas for cubicles closed in the front, the lunge space should be larger than 90 cm and the total cubicle length – above 270 cm (Figure 1). For boxes that are closed in the front or shorter, the cows lie down sideways diagonally across the cubicle's length, which often causes considerable contamination of the rear part of the cubicle, adding to severe deterioration of the animals' hygiene (Miteva, 2012). Cermak (1987) recommends a cubicle length of 220 cm for cows weighing 625 kg, and 228 cm for a weight of 725 kg. For cows weighing 635 kg, Irish and Martin (1983) recommend a length of 220 cm, and for a weight of 725 kg – 228 cm. Owen et al. (1994) propose, for weight of 650 kg, cubicle length of 210 cm for 750 kg – 221 cm. According to the Swedish Animal Welfare Ordinance (L100, 1993) for animals weighing 650 kg, the cubicle length should be 220 cm for weights > 650 kg – 230 cm. Schoonmaker (1999) proposes a cubicle length of 255 – 270 cm for adult Holstein cows, whereas Leonard et al. (1997) suggest a cubicle length of 222 cm for cows of the same weight. According to Dimova et al. (2012) cubicle length should be 250 cm, and it is anticipated to improve the comfort of dairy cows. The current

Bulgarian legislation recommends a minimum cubicle length of 220 cm, and that it should correspond to the size of the housed cattle breed (Ordinance 44/20.04 2006).

Anderson (2003b) established that at farms with cubicles opened in the front (lunge zone length of 40 cm) with "head against head" positioning, 34% of the cows lay diagonally when the opposing cubicle was empty vs 81% when there was an animal in the opposing cubicle. At a farm with cubicles opened in the front, 60% of the cows lay diagonally. When the cubicles were replaced with the frontally opened type, this percentage was reduced to 44%. According to the author, if cubicles closed in the front are used, their length should be above 250 cm. The studies by Wagner-Storch et al. (2003) and Fulwider and Palmer (2004c) contradict the findings of Anderson (2003b). According to them, the share of the cows that lie down diagonally within the cubicles that are closed or opened in the front, with a length of 250 cm, is almost the same and no cubicle preference can be inferred for this length.

It is more likely for the cows to defecate on the cubicle surface and get soiled by manure when they are accommodated in cubicles, which are larger than necessary (Tucker et al., 2005; Bernardi et al., 2009; Fregonesi et al., 2009).

Cubicle width

The cubicle width should allow the animals to lie down and get up freely. If the cubicles are wider, the cows would assume unusual positions within them, they would turn around and rotate freely, which could lead to cubicle contamination with manure, thus deteriorating the animals' hygiene. Cermak (1987) recommends, for cows weighing 625 kg in free stalls, a width of 120 cm; with weight 725 kg – 120 cm. Irish and Martin (1983) recommend for cows weighing 635 and 725 kg, a cubicle width of 122 cm. Owen et al. (1994) propose a width of 115 cm for a weight of 650 kg; 118 cm for 750 kg, and according to the Swedish Animal Welfare Ordinance (L100, 1993) the width for 650 kg animals should be 120 cm; for weight >650 kg – 130 cm. Schoonmaker (1999) suggests that the cubicles for adult Holstein cows had to be between 120–130 cm in width, whereas Leonard et al. (1997) recommend a width of 111 cm for the same cows. According to Palmer (2005), the width of the cubicles for lactating Holstein-Friesian cows should be between 118-123 cm, and for pregnant heifers – 125 cm. Dinev and Delchev (2005) recommend a cubicle width for lactating cows between 110 – 120 cm, which is in agreement with the current national legislation (Ordinance 44/ 20.04 2006). The cubicle width can affect the comfort of using the cubicle, especially with regard to the cows' lying within them, yet the study by Miteva et al. (2012b) did not establish a significant influence of cubicle width on the three indexes of comfort.

Cubicle partitions

The partitions between the cubicles have to guide the cows while entering and leaving the cubicle, to help them assume the proper position while lying down, and to provide the cows with "protection" from the animals in the neighbouring cubicles. The material from which they are made, their dimensions, their means of mounting must be implemented in such a way that they would not create any risk of the animals getting stuck or injured (Graves, 2009). According to Bickert et al. (2000) the distance from the end of the partition to the rear curb of the cubicle should be 35 cm. When this distance is grater, the cows manage move within the rear part of the cubicle, which could allow them to contaminate it. When the distance is less than 35 cm, the cows have difficulty entering the cubicle, the injuries caused by the partitions are frequent. The distance from the lowest part of the partitions to the surface of the cubicle bedding, according to Palmer (2005), has to be 28 to 30 cm, which coincides with the position of Leach and Whay (2009) (Figure 1). According to the authors, the height of lowest rail at rear should be at least 60 cm, and the side lunge – over 90 cm (Figure 1). This is important for the trouble-free lying down and rising of animals and the free movement of the head aside.

Cubicle bedding

The presence of soiled or moist bedding within the cubicle could lead to high mastitis occurrence, due to pathogens in the environment (Gergovska et al., 2012; Miteva et al., 2012a), as well as expenses for additional labour during milking, along with deterioration of the milk quality (Carlsson, 1999).

The type and quantity the used bedding affects the cubicles' usage for lying down (Drissler et al., 2005). Miteva et al. (2012b) established that the type of the used bedding had a significant influence on the values of the three indexes, with lowest cow comfort index in cubicles with a bedding of straw on a concrete surface (CCI 59.03%), whereas the index for cubicles with rubber mats was the highest (CCI 83.14%). Their results indicated that using straw as bedding on the concrete, especially when its quantity was small, made the cubicle uncomfortable for lying down. The most preferred cubicles were the ones with rubber mats bedding, followed by those with manure mass and straw (CCI 68.04%). Based on the results of Overton et al. (2003), Cook et al. (2004) also examined the connection between the different indexes of cow comfort, registered during different times of the day, and their dependence on the used bedding. They reached the conclusion that the cow comfort index was 76% when mattresses were used, and 86% – when sand was used. According to Hippen et al. (2007) SSI varied from 18.1% to 20.4%, depending on the type of bedding in the box, whereas Cook et al. (2005) reported a variation of 6% to 36%. The index's low values are indicative of cubicles, which are comfortable for lying down and getting up, and partially for the presence of good bedding (Miteva et al., 2012b).

A study by Cook et al. (2005) pointed out that comfort indexes for dairy cows are widely used by consultants in dairy cattle breeding because they are representative for the assessment of dairy cows' behaviour while lying down. The authors examined the influence of the cubicle bedding type (sand or geotextile mattress with filling) and the record times on four comfort indices.

According to Fregonesi et al. (2007b), bedding which is hard, dry and consistent in terms of quality and quantity imitates most closely the conditions of the ground that the animals have at the pasture. According to the authors, the bedding should be able to provide thermal comfort, convenience for optimal rest of the cows, to bear the weight of the animals and allow for lying down and getting up without risk of slipping. Moreover, the bedding should help keep the animals clean and in good health, with the minimum care (Chaplin et al., 2000).

Various materials are used as bedding for cows in practice: straw, sand, wood shavings, etc. Composted materials show promise as bedding material (Endres and Barberg, 2007). The thick straw bedding, according to Zdanowicz et al. (2004), is the best bedding for cows with regard to provided comfort, and it keeps the cows clean and dry. On the other hand, straw is a favourable environment for the replication of various bacterial pathogens, which cause mastitis. Miteva et al. (2012a) reported that, in the process of using straw as bedding, there was an increase in coliform

microorganisms and staphylococci, while the number of streptococci remained unchanged. The authors also examined bacterial growth in bedding of rice flakes, establishing a considerable increase in the number of coliforms and staphylococci, whereas the number of streptococci increased only slowly.

Softer beddings significantly reduce the percentage of carpal joints swelling, which is explainable, considering the fact that cows shift their centre of gravity towards this part of the body while standing up or lying down (Rushen et al., 2007a). Using rubber mats and mattresses is widely spread in the central and northern regions of Europe, and their usage is increasing in the Mediterranean region, which has a completely different climate. It was determined that microbial contamination of the synthetic materials and organic materials are different within the same ecologic conditions (Hogan et al., 1999; Reneau et al., 2003), because the microbial contamination of lying surfaces is directly related to the bacterial count of the udder, to the materials used as bedding, and it plays a key role in the prevention of mastitis from the environment (Zdanowicz et al., 2004; Miteva et al., 2012a).

In order to improve the overall condition and hygiene of the cows, according to De Palo et al. (2006), the qualities of the materials used for the floors of the resting cubicles have to be evaluated, along with the climate peculiarities (of the microhabitat), where the cows are accommodated. The materials used as bedding in the cubicles cannot be used as absolute standards with regard to dairy cows' comfort because they change their qualities in accordance with the microclimatic conditions that they are used in. Lombard et al. (2010) proved better hygiene and fewer injuries when using sand in free cubicle breeding of dairy cows. Wagner-Storch et al. (2003) established that the percentage of standing cows in the cubicles was higher with the usage of rubber mats, as opposed to mattresses. The results showed that cubicles with sand or mattress bedding were preferred, whereas rubber mats and concrete were less attractive.

In a comparative study on the resting preferences and duration of cows for two types of bedding, Norring et al. (2008) established that the cows' previous “experience” had a major impact on their choice. The issue of cow preferences is still under dispute because, according to some authors, the cows preferred sand to other beddings (Cook, 2003; Cook et al., 2004). Norring et al. (2008) proved that cows chose the bedding that they were “used to.” During their studies, the authors found out that sand helped for the maintenance of better body hygiene despite the reduced lying time. Studies related to the behaviour of cows depending on the amount of bedding, on the other hand, proved that cows are capable of choosing softer surfaces (Tucker and Weary, 2004; Tucker et al., 2009; Mitev et al., 2012). Providing better comfort and more time for lying down, according to the authors, has a considerable effect on improving the animals' health status. Water beds are used in practice as well, their big advantage being the maintenance of a constant temperature. In a hot climate, water beds maintain a cooler surface, and in colder weather they maintain a warmer surface without freezing. A water mattress provides better hygiene for the udder, with the need for bedding being minimal, and the case of mastitis dropping significantly (Panayotova, 2005).

Conclusion

On the grounds of the conducted analysis, it becomes evident that there are still some unclear issues with regard to the influence of various technological parameters of the cubicle on the animals' behaviour and comfort. This influence and its effect should be taken into account, especially with intensive technologies for dairy cows rearing, in order to maximise their productivity, since their effects can be very unfavourable and reflect upon dairy cows' health condition, productivity and, finally, on the financial income of dairy farms. The cubicles must be compatible with the size of the cows, in order to provide optimal comfort and maintain satisfactory hygiene. The materials, which are used as bedding, must be chosen in accordance with the conditions in the region where the animals are being housed, should be cheap and accessible, compliant with the implemented technology for manure cleaning, and providing the comfort required by the cows.

References

Anderson N, 2003. Observations on dairy cow comfort: Diagonal lunging, resting, standing and perching in free stalls. Proceeding ASAE Dairy Housing Conference, Fort Worth, 26-34.

Anderson N, 2003b. Freestall Dimensions, Ontario Ministry of Agriculture and Food web site (www.gov.on.ca), 1-14.

Anderson N, 2007. Free Stall Dimensions, Livestock Technology, 2, 1-15.

Anderson N, 2008. Dairy Cow Comfort. Cow Behaviour to Judge Free-stall and Tie-stall Barns. MAFRA. Infosheet

Bernardi F, Fregonesi J, Winckler C, Veira DM, Von Keyserlingk MAG and Weary DM, 2009. The stall-design paradox: Neck rails increase lameness but improve udder and stall hygiene. Journal of Dairy Science. 92, 3074-3080.

Bickert WG, 2000. Freestall Design. In: Dairy Housing and Equipment systems: managing and planning for profitability. NRAES, Ithaca, New York, 205-213.

Carlsson H, 1999. Cubicles for dairy cows in loose housing-Dimensions and partition design for more comfort and cleaner cows, Report 236 ISSN 00283-0086.

Cermak J, 1987. The design of cubicles for British Friesian dairy cows with reference to body weight and dimensions, spatial behavior and upper leg lameness. In Cattle housing systems, lameness and behavior, 119-129. (ed. Wirenga, H. K. & Peterse D. J.) Martinus Nijhoff Publishers.

Chaplin SJ, Tierney G, Stockwell C, Logue DN and Kelly M, 2000. An evaluation of mattresses and mats in two dairy units. Applied Animal behaviour Science, 66, 263-272.

Cook N and Nordlund K, 2003. Interrelationships between Housing and Herd Health. Advances in Dairy Technology, 15, 85-92.

Cook NB and Nordlund KV, 2004b. Behavioral needs of the transition cow and consideration for special needs facility design. Veterinary Clinic Food Animal 20, 495-520.

Cook NB, 2003. Prevalence of lameness among dairy cattle in Wisconsin as a function of housing type and stall surface. Journal of the American Veterinary Medical Association, 223, 1324-1328.

Cook NB, Bennett TB and Nordlund KV, 2004. Effect of free stall surface on daily activity patterns in dairy cows with relevance to lameness prevalence. Journal of Dairy Science 87, 2912-2922.

Cook NB, Bennett TB and Nordlund KV, 2005. Monitoring indices of cow comfort in a free-stall-housed dairy herds. Journal of Dairy Science 88, 3876-3885.

De Palo P, Tateo A, Zezza F and Corrente M, 2006. Influence of free-stall flooring on comfort and hygiene of dairy cows during warm climatic conditions. Journal of Dairy Science, 89, 4583-4595

Dimova V, Mitev J, Miteva Tch, Popova Y and Vasilev N, 2012. Evaluation of some zoohygienic parameters in a semi-open free-stall dairy barn. Trakia Journal of Sciences, 10, 102-108.
Dinev D and Delchev N, 2005. Technological Design of Agricultural Facilities. BG Stara Zagora ISBN 954-9887-02-0 (Bg).
Dinev D, Stanev S and Delchev N, 1997. Cattle Production Systems. BG Manual of Livestock husbandry, part III. Dairy cattle farming. pp. 242-260 (Bg).
Drissler M, Gaworski M, Tucker C and Weary D, 2005. Freestall maintenance: Effects on lying behavior of dairy cattle. Journal of Dairy Science, 88, 11, 2381-2387.
Endres MI and Barberg AE, 2007. Behavior of dairy cows in an alternative bedded-pack housing system. Journal of Dairy Science, 90, 4192–4200.
Fregonesi JA, Tucker CB and Weary DM, 2007b. Overstocking reduces lying time in dairy cows. Journal of Dairy Science, 90, 3349-3354.
Fregonesi JA, Von Keyserlingk MAG, Tucker CB, Veira DM and Weary DM, 2009. Neck-rail position in the free stall affects standing behavior and udder and stall cleanliness. Journal of Dairy Science, 92, 1979–1985.
Fulwider WK and Palmer RW, 2004c. The Effect of Stall Design and Rubber Alley Mats on Cow Behavior in Freestall Barns. The Professional Animal Scientist. Accepted for publication, May.
Gergovska Zh, Miteva Ch, Penev T, Dimova V and Mitev Y, 2012. Evaluation of cows' comfort in freestalls. I. Functional activities of lactating cows depending on cubicle design. Ecology and Future, 4, 64-68 (Bg).
Graves RE, McFarland DF and Tyson JT, 2009. Designing and Building Dairy Cattle Freestalls, College of Agricultural Sciences, U.S. Department of Agriculture, and Pennsylvania Counties Cooperating, pp. 8.
Hippen A, Garcia A, Hammink W and Smith L, 2007. Comfort and hygiene of dairy cows housed in freestalls bedded with processed limestone compared with separated manure solids. Sixth International Dairy Housing Conference Proceedings, 16-18 June 2007, Minneapolis, Minnesota. Annual International Meeting of the ASABE, Minneapolis: 27-34.
Hogan JS, Bogacz VL, Thompson LM, Romig S, Schoenberger PS, Weiss WP and Smith KL, 1999. Bacterial counts associated with sawdust and recycled manure bedding treated with commercial conditioners. Journal of Dairy Science, 82, 1690-1695.
Hörning B, 2003. Attempts to integrate different parameters into an overall picture of animal welfare using investigations in dairy loose houses as an example. Animal Welfare, 12, 557-563.
Irish WW and Martin RO, 1983. Design considerations for free stalls. Dairy housing II 108-121. Proceedings of second National Dairy Housing Conference. Madison, Wisconsin. ASAE SP, 4-83.
Ito K, Weary DM and Von Keyserlingk MAG, 2009. Lying behavior: Assessing within- and between-herd variation in free-stallhoused dairy cows. Journal of Dairy Science, 92, 4412-4420.
L100, 1993. Djurskyddsförordningen (Swedish Animal Welfare Regulation) Swensk Författningssamling SFS, 1988:354.
Leach KA and Whay HR, 2009. The Welfare Quality Lameness Control Programme for Dairy Cattle. Resources to Help Farmers and Advisors Tackle Lameness Problems in Dairy Herds. Welfare Quality Reports No. 14.
Leonard FC, O'Connell J and O'Farell K, 1994. Effect of different housing condition on behavior and food lesion in Friesian heifers. Veterinary Record, 134, 490-494.
Leonard FC, O'Connell JM and O'Farrell KJ, 1997. Cubicle housing conditions and cow comfort. Irish Veterinary Journal, 50, 675-682.
Lombard J, Tucker C, von Keyserlingk M, Kopral C and Weary D, 2010. Associations between cow hygiene, hock injuries, and free stall usage on US dairy farms. Journal of Dairy Science, 93, 4668-4676.
McFarland DF, 2003. Freestall Design: Cow Recommended Refinements. Proceedings of the Fifth International Dairy Housing Conference, Fort Worth, Texas. ASAE. St. Joseph, MI.
Mitev J, Varlyakov I, Miteva Tch, Vasilev N, Gergovska Zh, Uzunova K and Dimova V, 2012. Preference of free stall housed dairy cows to different bedding materials. Journal of the Faculty of Veterinary Medicine İstanbul Üniversity, 38, 135-140.
Miteva Ch, 2012. Hygienic aspects of production in dairy cows in freestall barns. Trakia University Publishing House, Stara Zagora; ISBN 978-954-338-048-0 (Bg).
Miteva Ch, Gergovska Zh, Penev T, Mitev Y and Dimova V, 2012b. Evaluation of cows' comfort in freestalls. II. Comfort indices of cubicles for lactating cows. Ecology and Future, 11, 69-77 (Bg).
Miteva Ch, Penev T, Rusenova N, Vasilev N, Koleva M and Kostadinova G, 2012a. Effect of bedding in dairy farms on the occurrence of some mastitis pathogens. Ecology and Future, 11, 46-50 (Bg).
Norring M, Manninen E, de Passille AM, Rushen J, Munksgaard L and Saloniemi H, 2008. Effects of sand and straw bedding on the lying behavior, cleanliness, and hoof and hock injuries of dairy cows. Journal of Dairy Science, 91, 570-576.
Ordinance № 44 from 20.04.2006 for veterinary medical requirements to animal rearing facilities, Ministry of Agriculture and Food (Bg).
Overton MW, Moore DA and Sischo WM, 2003. Comparison of commonly used indices to evaluate dairy cattle lying behavior. Proceedings 5th International Dairy Housing Conference, Fort Worth, TX. ASAE, St. Joseph, MI.125-130.
Owen J, Cermak J, Bartussek H, Biskert WG, Bure RG, Chiappini U, Flaba J, Michanek P and Tillie M, 1994. The design of dairy cow housing-Report of the CIGR section II, Working group no. 14. Cattle Housing. ADAS Bridgets Dairy Research Centre, Farm Buildings Research Team. Winchester, U.K. 56 pp.
Palmer RW, 2005. Cow comfort issues in freestall barns. Proceedings of the 7th Western Dairy Management Conference, March 9-11, Reno, NV, 141-156.
Panayotova M, 2005. The comfort is important for cows – happy cows yield more milk, disease incidence is lower and profits are higher. Animal Husbandry Plus, 2, 13-15 (Bg).
Penev T, Miteva Ch, Dimova V, Roydev R, Mitev J and Manolov Z, 2013. Assessing frictional properties of rubber floors in free housing systems for dairy cows. Trakia Journal of Sciences, 11, 2, 197-204.
Reneau JK, Seykora AJ, Heins BH, Bey RF and Farnsworth RJ, 2003. Relationship of cow hygiene scores and SCC. National Mastitis Council Annual Meeting Proceedings, Madison, 362-363.
Rushen J, Haley D and de Passillé AM, 2007a. Effect of softer flooring in tie stalls on resting behavior and leg injuries of lactating cows. Journal of Dairy Science, 90, 3647-3651.
Schoonmaker K, 1999. Maximize the comfort of sand. Dairy Herd Management, 24-25.
Tucker CB and Weary DM, 2004. Bedding on geotextile mattresses: How much is needed to improve cow comfort. Journal of Dairy Science, 87, 2889-2895.
Tucker CB, Weary DM and Fraser D, 2005. Influence of neck-rail

placement on free-stall preference, use, and cleanliness. Journal of Dairy Science, 88, 2730-2737.

Tucker CB, Weary DM, Von Keyserlingk MAG and Beauchemin KA, 2009. Cow comfort in tie-stalls: Increased depth of shavings or straw bedding increases lying time. Journal of Dairy Science, 92, 2684-2690.

Tucker CB, Zdanowicz G and Weary DM, 2006. Brisket boards reduce freestall use. Journal of Dairy Science, 89, 2603-2607.

Veissier I, Capdeville J and Delval E, 2004. Cubicle housing systems for cattle: Comfort of dairy cows depends on cubicle adjustment. Journal of Animal Science, 82, 3321-3337.

Wagner-Storch AM, Palmer RW and Kammel DW, 2003. Factors affecting stall use for different freestall bases. Journal of Dairy Science, 86, 2253-2266.

Weary DM and Tucker C, 2003. The Science of cow comfort. Proceedings of the Joint Meeting ofthe Ontario Agri Business Association and the Ontario Association of Bovine Practitioners, Guelph, Ontario, April, 1-15, 2003.

Zdanowicz M, Shelford JA, Tucker CB, Weary DM and von Keyserlingk MAG, 2004. Bacterial populations on teat ends of dairy cows housed in free stalls and bedded with either sand or sawdust. Journal of Dairy Science, 87, 1694-1701.

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The manuscript should be structured as follows: Title, Names of authors and affiliation address, Abstract, List of keywords, Introduction, Material and methods,Results, Discussion, Conclusion, Acknowledgements (if any), References, Tables, Figures.

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Todorov N and Mitev J, 1995. Effect of level of feeding during dry period, and body condition score on reproductive performance in dairy cows,IXth International Conference on Production Diseases in Farm Animals, September 11–14, Berlin, Germany.

Thesis:

Hristova D, 2013. Investigation on genetic diversity in local sheep breeds using DNA markers. Thesis for PhD, Trakia University, Stara Zagora, Bulgaria, (Bg).

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