

Preferences of Freestall Housed Dairy Cows to Different Bedding Materials

*Jurii MITEV¹, Ivan VARLYAKOV¹, Tchonka MITEVA¹, Nasko VASILEV²,
Jivka GERGOVSKA¹, Krassimira UZUNOVA^{2*}, Vania DIMOVA¹*

¹Trakia University Faculty of Agriculture, Student's Campus 6000, Stara Zagora, Bulgaria

²Trakia University Faculty of Veterinary Medicine, Department of Animal Husbandry,
Student's Campus 6000, Stara Zagora, Bulgaria

*Corresponding Author: Krassimira UZUNOVA Trakia University, Faculty of Veterinary Medicine, Department of Animal
Husbandry, Student's Campus 6000, Stara Zagora, Bulgaria
e-mail: mira60bg@yahoo.com

Geliş Tarihi / Received: 10.06.2011

ABSTRACT

The purpose of this study was to examine the behaviour of dairy cows during the rest periods and their preferences to different bedding materials with limited amount of straw as well as the hygienic score of dairy cows. Thirty-six Holstein dairy cows at the first to fourth lactation with live weight 610 ± 58 kg and milk yield of 7364 ± 1202 liter for 305 days of lactation were used for the experiment. Three types of bedding materials were used for the preference test – rubber mats, manure-straw bedding and sand. The hygienic score of the animal's body was made by 4 point system. The average values of the studied functional activity (FA) were determined by using a mathematical model adapted for this purpose. The installed soft rubber mats on concrete floor mitigated the adverse effects on animal behaviour at rest. The lying time (iFA-0.4133) on the rubber mats and the number of lying down (21.2) during the day showed that rubber mats are more comfortable for cows than manure-straw bedding and sand. When using a small amount of straw bedding, the cows preferred to lie longer on soft rubber mats. The hygienic score of the body of dairy cows was between 1.40 and 2.94, and depended on floor bedding and the regular cleaning of the stall.

Key Words: Cow comfort, freestall, dairy cows, behavior, bedding materials

ÖZET

SERBEST GEZİNME Lİ SİSTEMDE BARINDIRILAN SÜTÇÜ İNEKLERİN ALTLIK MATERYALİ TERCİHLERİ

Bu araştırma sütçü ineklerin dinlenme dönemindeki davranışlarının incelenmesi, sınırlı miktarda saman kullanıldığında altlık tercihlerinin ortaya konulması ve hijyenik skorlarının belirlenmesi amacı ile yürütülmüştür. Araştırmanın hayvan materyalini 610 ± 58 kg canlı ağırlık ortalamasına, 7364 ± 1202 litre süt verimine sahip, 1-4. laktasyondaki 36 baş Siyah Alaca inek oluşturmuştur. Araştırmada tercih testi için üç farklı altlık materyali kullanılmıştır: a) kauçuk, b) gübre-saman karışımı ve c) kum. Hayvan vücudunun hijyenik skorlaması 4 puanlı sistem ile yapılmıştır. İncelenen fonksiyonel aktivite (FA) için ortalama değerler, bu amaç için adapte edilen bir matematik model yardımı ile belirlenmiştir. Beton zemine serilen yumuşak kauçuk, dinlenme sırasındaki hayvan davranışları üzerine olumsuz etkileri azaltmıştır. Kauçuk zemindeki yatma süresi (iFa=0,4133) ve günlük yatma sayısı (21,2)

sonuçları, kauçuk zeminin gübre saman karışımı ve kum altlığa kıyasla inekler için daha konforlu olduğunu göstermektedir. Altlık materyali olarak az miktarda saman kullanıldığında, inekler kauçuk zeminde daha uzun süre yatmayı tercih etmişlerdir. Araştırmada, sütçü ineklerin hijyenik skorlarının 1,40 ile 2,94 arasında değiştiği ve zemin altlık tipi ve ahırın olağan temizlik faaliyetlerinden etkilendiği sonucuna ulaşılmıştır.

Anahtar Kelimeler: İnek konforu, serbest gezinmeli sistem, sütçü inekler, davranış, altlık materyali

Introduction

The flooring of stalls where dairy cows lie down should be comfortable enough in order to ensure an adequate rest and welfare according to concepts for humane attitude to animals. Resting describes the state of lying down or standing, doing nothing but ruminating. During resting, all movements controlled by the central nervous system are strongly limited, the reactivity of external receptors is reduced and animals assume a posture that limits the effect of external irritants. Before lying down, cows usually stand for several minutes on the site chosen for rest. The preference of cows to the lying side is not accidental. When lying for the second time, more than 80% of cows change the lying side. If lying period lasts more than 2 hours, the cow stands up, stretches and after several minutes lies down again on the contralateral side (Petkov et al., 1999). In tie-stall barns, cows spent 664-774 min lying, while in free-stall barns – only 624-682 min lying over 24 hours. The building of pens for rest allows reducing the costs for bedding creates conditions for isolation of the animals and prolongs the lying period by 30-90 min (Tossev et al., 1989).

Of all production system elements, the bedding has the greatest influence on lying behaviour. The longest lying period are observed on wood shavings bedding. When pens are dirty, the lying time is reduced. On dry beddings, 54% of cows were observed to lie down compared to only 17-20% when the beddings were dirty. The differences were most pronounced during the night when 82% of cows were lying down on the dry and only 23-50% on the dirty bedding (Varlyakov, 1989). The soft, dry bedding of permanent quality and quantity is similar to best known places for lying, such as pastures or meadows (Fregonesi et al., 2007).

Cows prefer to lie down in soft beds (Benz, 2009; Herlin, 1997; Tucker et al., 2003), with softness of bed depending on the amount and quality of used bedding. The straw bedding improves the insulation of the floor (Tuytens, 2005; Zdanowicz et al., 2004), ensures the necessary level of comfort and maintains cows to be dry and clean. This is particularly important when cows are kept in non-heated premises and when farmers reduce the amount of straw bedding so as to decrease costs. The increase of bed softness could compensate for the lower amount of bedding (O'Connell and Meany, 1997). Sand is becoming increasingly popular as bedding material because it is of inorganic origin, increases the cleanliness of animals and has several advantages related to cows' health (Cook, 2003; Espejo et al., 2006; Norring et al., 2008). Compost materials, and packed straw mixed with manure are promising bedding materials that are used in many dairy cattle farms worldwide (Endres and Barberg, 2007; Tims, 2010).

In free-stall reared dairy cows, dirtiness of various parts of their bodies is observed as a result of irregularly cleaned beds, adding and replacement of beddings (Vasilev et al., 2007). Decreased cleanliness of cows assessed with a score of 3 and 4 is a prerequisite for development of subclinical mastitis, and high somatic cell counts in milk. The purpose of the present study was to investigate the resting behaviour of cows in order to evaluate their preference to bedding material in cubicles and the body cleanliness score.

Materials and Methods

Thirty six Holstein dairy cows at the first to fourth lactation with live weight of 610±58 kg and milk yield of 7364±1202 liter for 305 days of lactation were used in this experiment. Cows calved 4 to 6 months prior to the experiment

and were fed a ration for high production dairy cow distributed by a mixer on a feed alley. Throughout the experiment, cows received 36.8 ± 1.30 kg feed on the average. A constant access to drinking water was provided. Cows were milked twice a day (5:00 AM and 5:00 PM) in a milking room situated in a separate premise. The average daily milk production of the group during the experiment was 23.4 ± 0.5 liter.

Prior to the experiment, cows were reared freely in a non-heated (non-insulated) premise in individual boxes in order to adapt to environmental conditions. The experiment was carried out in winter for 21 days at ambient temperature between -6 to $+2^\circ\text{C}$. The behaviour of cows using 36 cubicles for rest (3 rows of 12 cubicles each), with 3 bedding types was recorded: variant 1 – concrete floor with rubber mat; variant 2 – concrete floor with manure-straw bedding; variant 3 – concrete floor with sand.

Rubber mats KEW Plus (Kraiburg) were used in this experiment. Sand bedding consisted of a sand layer 20 cm in depth. The manure-straw bedding – by packing also had the same depth. In the beginning of the experiment, the floor of every cubicle was covered with 2 kg cut barley straw. During the experimental period, the straw contaminated with urine and faeces was removed from cubicles on a daily basis. After cleaning, sand beds were filled with clean sand to achieve the initial depth. Again, 2 kg cut straw was spread - an amount that barely covered the beds. The experiment was carried out in a manner that did not create additional discomfort to cows and did not alter their habitat.

The behaviour of animals was observed by direct individual continuous monitoring over 24-hour periods in three different days (days 7, 14 and 21). Observations were made at maximum intervals of 10 min in order to achieve consistent results (<5% error). The main functional activity recorded was the rest and its behaviour elements: lying down and idle standing in the cubicle, including perching. The

total duration of the rest and its distribution over the 24-hour observation period were calculated, accepting the time from 7:00 AM to 7:00 PM as day and from 7:00 PM to 7:00 AM as night.

The evaluation of body cleanliness was performed during the same periods after the morning milking using a 4-point score system (Hughes, 2001).

The average level of functional activity (FA) was determined by a mathematical model adapted for the specific purpose. Its application was justified in previous studies of ours (Varlyakov, 1989; Varlyakov et al., 1995). In order to compare our data with those from similar researches, the index of the respective functional activity was calculated by the equation:

$$iFA = \Delta t / t,$$

where

iFA : functional activity index,

Δt : sum of time intervals when the respective FA was exhibited (min),

t : total duration of the study (min).

All data were processed with SAS, SPSS Statistics 17.0 and Excel statistical software products.

Results and Discussion

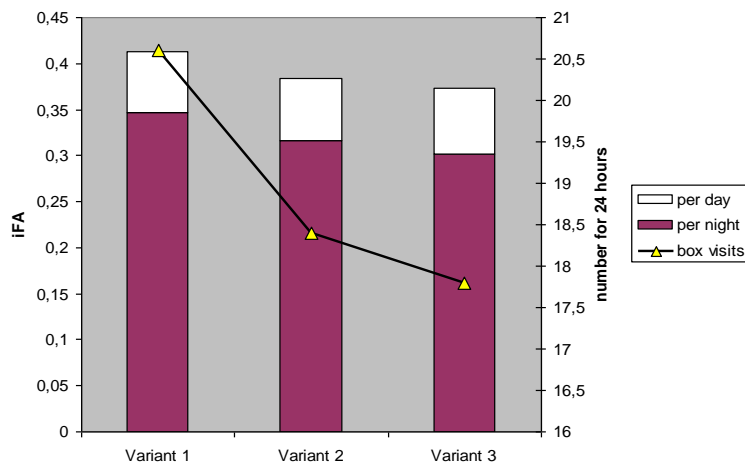
The results showed that the duration of rest was from 538 min (variant 3) to 595 min (variant 1). It was exhibited mainly during the night – 60-69% of the total rest time (Figure 1). Statistical significant differences were found out between variants 1-2 and 1-3 with regard to the total time spent resting and night-time rest (Table 1).

Comparing the three types of bedding, we established that although statistically insignificantly, cows showed a preference to cubicles with rubber mats (20.6 visits to cubicle per 24 hours) than those with manure and straw bedding (18.4 and 17.8 visits to cubicle per 24 hours).

Table 1. Average values of the investigated parameters.**Tablo 1.** İncelenen özelliklere ait ortalama değerler.

Parameters	Rubber mat	Manure-straw bedding	Sand
Rest -Total (iFA)	0.41330 ^a	0.38444 ^a	0.37389 ^a
Rest -per night	0.34720 ^a	0.31601 ^b	0.30210 ^b
Rest -per day	0.06613	0.06843	0.07179
Number of visits in the boxes (cubicles) per 24 h	20.60000	18.40000	17.80000

^{a,b} : Differences between values at same row are statistically significant at $P < 0.05$.

**Figure 1.** Indexes for functional activity for rest and number of visits in the boxes (cubicles)**Şekil 1.** Bölme ziyaret sayısı ve dinlenme fonksiyonel aktivitesi için indeksler

The total time spent resting per 24 hours was longer on floors with rubber mats. These data are similar to what was reported by Rushen et al. (2007) stating that cows tended to lie down for a longer time in cubicles with rubber mats than on concrete floors with 0.5 kg straw bedding. The total time spent lying and resting could be used as a parameter of comfort in cows (Haley et al., 2001). It is believed that rubber mats improve the insulation of cubicles and preserve the body thermal comfort of the

lying animal for a longer period of time. Therefore, the utilization of rubber mats on cubicle floor with a limited amount of straw on them is a good management practice for maintenance of the comfort of cows in non-heated premises during the winter. The longer time spent resting during the night in cubicles with rubber mats as compared to those with manure-straw bedding using a limited amount of straw bedding agreed with the findings of Sonck et al. (1999) that cows preferred to lie in

cubicles with soft rubber mat floors (Kraiburg mat, Supercomfort cow mattress, Pasture mat, Blister Mattress, Kraiburg Soft Bed System, etc.) instead of cubicles with packed manure flooring covered with wood shavings.

The anticipated advantage of sand floors with regard to cows' comfort was not confirmed. Cows did neither show a preference to cubicles with sand floors, nor the average time spend by one cow resting on sand floors per 24 hours was longer. Furthermore, the major part of straw used for bedding was mixed with sand and the need to supply additional straw occurred more frequently. The amounts added occasionally to the different floor bedding variants were as followed: in cubicles with sand – 640 ± 12 g, in cubicles with manure-straw bedding: 470 ± 8 g and in cubicles with rubber mats: 466 ± 12 g. Regardless of the greater amount of straw needed for sand bedding, a substantial part of cubicle's area remained without bedding and thus contributed to the shorter time spent resting by cows. The achieved favourable results of 103.38 min daytime rest per cow when using variant 3 bedding was probably due to the fact that the necessary amount of sand and straw was compensated in the morning before cows' return from the milking room.

In support of data reported by Tucker et al. (2003), cows avoided cubicles with sand and without straw bedding, especially during the night, compared to cubicles with rubber mats (Manninen et al., 2002; Norring et al., 2008). The adaptation of cows to sand flooring should be carried out, in the view of Tucker et al. (2003) over at least 2 lactation periods or at least 21 weeks (Norrning et al., 2008), which improves the acceptance of sand as a bedding material, but areas without straw were never preferred as a place for lying down. In this type of cubicles, cows often remove sand outside the cubicles exposing the rough, irregular and injuring ground beneath that is not appropriate for lying down and resting. If the sand layer was not restored on a daily basis, cows could remove more than 10% of all amount of sand outside the cubicles in 2-3 days (Tims, 2010).

Cubicle floors covered with sand improved hoof health and decreased the incidence of foot lesions (Espejo et al., 2006; Norring et al., 2008). This conclusion most probably aims to find an agreement between hoof health improvement and the reduced comfort of cows when lying down on sand bedding. In concordance with the data of Benz (2010), in which the used rubber mats were similar to those used in our experiment, it was found out that cows preferred boxes with softer bedding that could be achieved with using suitable rubber mats. The addition of straw on the sand increased the utilization of cubicles up to the same level as of boxes with rubber mats, whereas the reduction of the amount of straw on manure-straw bedding decreased their utilization, most probably because the surface of this type of bedding was rapidly altered, dried out and become rough and hard.

The body cleanliness score of cows included in this experiment varied between 1.40 and 2.94, which in the latter case presented a hazard for increase in milk somatic cell counts as pointed out by Vasilev et al. (2007). According to our results, 62.2% of cows with dirtier bodies visited more often cubicles with manure-straw bedding.

Conclusion

Consequently to the present research, the following conclusions could be made:

1. The covering of concrete floors with soft rubber mats reduced the adverse effect on cows' resting behaviour.
2. The time spent resting in cubicles with rubber mats and the average number of visits per 24 hours confirmed that they were more comfortable for cows compared to manure-straw or sand beddings.
3. A beneficial factor increasing the time spent resting on soft rubber mats was the addition of a small amount of straw as bedding.
4. The body cleanliness of cows depended mostly on bedding type of cubicles.

REFERENCES

- Benz, B., 2009.** Im liegen durch den Tag. Bundesamt für Landwirtschaft 40, 25-27.
- Benz, B., 2010.** Kuhe sollen lang liegen, wenig stehen. Bundesamt für Landwirtschaft 4, 10-11.
- Cook, N.B., 2003.** Prevalence of lameness among dairy cattle in Wisconsin as a function of housing type and stall surface. *Journal of American Veterinary Medicine Association* 223, 1324-1328.
- Endres, M.I., Barberg, A.E., 2007.** Behavior of dairy Cows in an alternative bedded-pack housing system. *Journal of Dairy Science* 90, 4192-4200.
- Espejo, L.A., Endres, M.I., Salfer, J.A., 2006.** Prevalence of lameness in high-producing Holstein cows housed in freestall barns in Minnesota. *Journal of Dairy Science* 89, 3052-3058.
- Fregonesi, J.A., Veira, D.M., von Keyserlingk, M.A.G., Weary, D.M., 2007.** Effects of bedding quality on laying behaviour of dairy cows. *Journal of Dairy Science* 90, 5468-5472.
- Haley, D.B., de Passillé, A.M., Rushen, J., 2001.** Assessing cow comfort: Effects of two flooring types and two tie stall designs on the behaviour of lactating dairy cows. *Applied Animal Behaviour Science* 71, 105-117.
- Herlin, A.H., 1997.** Comparison of lying area surfaces for dairy cows by preference, hygiene and lying down behaviour. *Swedish Journal of Agricultural Research* 27, 189-196.
- Hughes, J., 2001.** A system for assessing cow cleanliness. In *Practice* 23 (9), 517-524.
- Manninen, E., de Passillé, A.M., Rushen, J., Norring, M., Saloniemi, H., 2002.** Preferences of dairy cows kept in unheated buildings for different kind of cubicle flooring. *Applied Animal Behaviour Science* 75, 281-292.
- Norring, M., Manninen, E., de Passillé, A.M., Rushen, J., Munksgaard, L., Saloniemi, H., 2008.** Effects of sand and straw bedding on the lying behavior, cleanliness, and hoof and hock injuries of dairy cows. *Journal Dairy Science* 91, 570-576.
- O'Connell J.M., Meany W.J. 1997.** Comparison of shredded news paper and sawdust as bedding for dairy cows: behavioural, clinical and economic parameters. *Irish Veterinary Journal* 50, 167-170.
- Petkov, A., Enev, E., Sivkova, K., Varlyakov, I., Oblakov, N., 1999.** *Animal Behaviour. Textbook of Ethology.* ISBN 954-9574-14-3, KOTA Publishing House, Stara Zagora.
- Rushen, J., Haley, D., de Passillé, A.M., 2007.** Effect of softer flooring in tie stalls on resting behavior and leg injuries of lactating cows. *Journal of Dairy Science* 90, 3647-3651.
- Sonck, B., Darlemans, J., Langenakens, J., 1999.** Preference test for free stall surface material for dairy cows. In: *ASAE/CSAE-SCGR Annual International Meeting, Toronto, Ontario, Canada, Paper No: 994011.*
- Tims, L., 2010.** Personal information – Training courses for dairy farmers in Bulgaria, Liaskovez, Lesopark, 22-23 May, 2010.
- Tossev A., Varlyakov, I., Sivkova, K., 1989.** Behaviour of Cows under an Intensive Production System. *AA-CSIT Sofia*, pp. 56.
- Tucker, C.B., Weary, D.M., Fraser, D., 2003.** Effects of three types of free-stall surfaces on preferences and stall usage by dairy cows. *Journal of Dairy Science* 86, 521-529.
- Tuytens, F.A.M. 2005.** The importance of straw for pig and cattle welfare: A review. *Applied Animal Behaviour Science* 92, 261-282.
- Varlyakov, I., 1989.** Ethological evaluation of two production systems for dairy cattle rearing. PhD Thesis. Higher Institute for Zootechnics and Veterinary Medicine, Stara Zagora.
- Varlyakov, I., Tossev, A., Sivkova, K., Dragneva, R., 1995.** Studies on the range of behaviour reactions of dairy cows. In: *Proceedings of the 29th International Congress of the International Society for Applied Ethology*, 3-5 August, Exeter, UK, 247-249.
- Vasilev, N., Dinev, D., Mitev, Y., Koleva, M., Miteva, C., 2007.** Hygiene status of dairy cows, reared in a spacious building and resulting quality of produced milk. *Trakia Journal of Sciences* 5 (1), 47-51.
- Zdanowicz, M., Shelford, J.A., Tucker, C.B., Weary, D.M., von Keyserlingk, M.A.G., 2004.** Bacterial populations on teat ends of dairy cows housed in free-stalls and bedded with either sand or sawdust. *Journal of Dairy Science* 88, 1694-1701.