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ANALYSIS OF THE POSSIBILITY OF VARIOUS LITTER BEDDINGS APPLICATION WITH SPECIAL CONSIDERATION OF CATTLE MANURE SEPARATE

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Abstract. The aim of the work was to analyse an utilisation of various litter beddings by dairy cows during rest. Cows cleanness and hygiene level in cowsheds determine yield and quality of milk, however is still an up-to-date issue. For the experiment purposes, the sites with straw, sand, sawdust and cattle manure separate (12 site with each bedding) were allocated in free-stalls cowshed. The cattle manure separate is a solid fraction of slurry formed as a result of its separation from liquid part. Such a separation allows to utilize a liquid manure as a fertilizer, while solid fraction may be applied as litter material in a closed cycle. Twelve animals were selected among the dairy cattle herd and let to the separated part of the cowshed where they had a free access to all the sites. The analyses conducted demonstrated that the cows observed preferred the separate as litter material more than other kinds of beddings. A few-months observations of mastitis frequency in cows did not confirm the threats concerning hygienic state of such a litter, and also hooves were dry that increased their hygienic status.

Keywords: cattle, litter bedding, separator, welfare

INTRODUCTION

The recognition of animals behaviour standards and their constant observation allow to assess health status and predict future performance of animals, and may also be a criterion for proper modification of breeding environment and husbandry technology improvement. Also the constant analysis of cattle condition level, their living conditions and nutrition are significant issues [Adamski and Kupczyński 2005]. The level of cows cleanness which is an index of hygiene and maintenance quality in a cowshed is also one of performance influencing factors [Szulc 2005]. It is a determinant not only of health status of dairy cows, but also an overall insight of their welfare [Kołacz and Bodak 1999].

Bedding materials of different origin are used in cowsheds and they include: straw, sawdust, peat, sand or separated manure. Straw is used the most often, and it is characterised by an ability of water and gases absorbing, and also by high content of dry mass (about 85%).

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These two factors for many years determined the popularity of its application. An application of sawdust as bedding material is to a high degree dependent on farm localization, since their long-distance transport in not economical. Moreover, the sawdust is a material which must be isolated from a moisture during storage. There is also a problem with used material management, since it causes soil acidification. Before sand is applied in turn, it should be characterised by suitably low humidity. There is also the problem with its further utilisation like in the case of used sawdust. The best bedding material seems to be peat, since is characterised by very high hygroscopicity [Jeppsson 1999]. The problem is however its high price and difficulties in material purchase. The temperature of a bedding has a high influence on ammonia emission from bedding materials [Anderson et al. 2003].

The quality of bedding materials affects emission of organic compounds and odours (olfactory methods) to air environment [Rumburg et al. 2004, Roggea et al. 2006]. Cattle bedding quality is assessed, among others, on the basis on behaviour standards, which is an important welfare determinant.

From the economic point of view it is significant to use the cheapest technical solutions connected to bedding obtaining [Jeppsson 1999]. Such a possibilities are observed in the case of cattle manure separate application. The cattle manure separate is a solid fraction of slurry formed as a result of its separation from liquid part. Such a separation allows to utilize a liquid slurry as a fertilizer, while solid fraction may be applied as bedding material. The formation of precipitates and surface scum in main decanters is eliminated by separation, and the time of possible storage of liquid slurry is elongated.

The aim of the study was to compare an acceptance by cows of various litter bedding with a special consideration paid to cattle manure separate.

MATERIAL AND METHODS

The study was conducted on dairy cattle farm of a mean yield of 7000 kg of milk in a lactation. TMR type feeding is used on a farm. The cows are maintained in litter freestalls cowshed. The separate from cattle manure was assessed as bedding material.

Within the experiment, the analysis of an acceptance by dairy cows during their rest of various litter beddings with a maintenance of free access to them (choice) was conducted. The observations of cattle behaviour in such conditions were conducted. The composition of cattle manure separate was subjected to a detailed analysis in laboratory of Department of Animal Nutrition and Feed Management, Wroclaw University of Environmental and Life Sciences according to AOAC 1990. The material was analysed in terms of bacteriology in the laboratory of Department of Veterinary Hygiene, Wroclaw University of Environmental and Life Sciences.

The part containing 48 resting sites was separated in a cowshed. Various bedding material i.e. straw, sand, sawdust and cattle manure separate, was used on each 12 sites. Twelve animals were randomly selected and let to the separated part of the cowshed where they had a free access to all the sites. Two different periods of observation were assigned: summer and autumn.

The observations of preferences of selection of sites with different kind of bedding were conducted for a period of 7 days in July and November in morning and evening hours. At this time, the number of cows staying on particular sites was noted. The temperature of air inside the building was measure everyday in the morning and at the evening. In order to conduct bacteriological analysis and determine separate composition, 5 representative samples were collected on each site. The results were subjected to statistical analysis using Statistica®7.2. software. Non-linear correlations were calculated in order to verify if there is a statistical relationship between number of cows on a given site and ambient temperature.

The selected function which in the best manner, when regards least squares method, reflects the relationship between number of cows and ambient temperature is cubic polynomial in a form:

$$Y = a_1 + a_2x + a_3x^2 + a_4x^3.$$

Based on (x_i, y_i) sample the values of a_1, a_2, a_3, a_4 parameters should be determined. To do this, the least squares method was used, where parameters should be selected so that the function

$$F(a_1,\dots,a_4) = \sum_{i=1}^{4} [y_i - Y(x_i, a_1,\dots,a_4)]^2$$

reached the minimum. The values of the parameters fulfilling that condition are determined from so called normal set of equations

$$\frac{\partial F}{\partial a_m} = 0 \text{ for } m = 1,\dots,4.$$

In our case the adjusted polynomial is of a form

$$Y = 8.3473 - 0.42665x + 0.03632x^2 - 0.00111x.$$

RESULTS AND DISCUSSION

The analysis included some quantitative relationships connected to used and selected by animals various bedding material [Jeppsson 1999]. There are sparse information in the literature concerning an application of cattle manure as bedding material [Dolezal and Cerna 2003]. High cleanness of cows was observed in the present study and also in an analysis of production herd maintenance. One of the most significant factors determining selection of bedding for rest by cows was ambient temperature. In July the temperature was within the range from 16 to 22°C, and an average value of the temperature was 19.3°C (Fig. 1). In November the values of ambient temperature ranged from 1 to 5°C, and an average value for that period of observation was on a level of 2.7°C (Fig. 1).

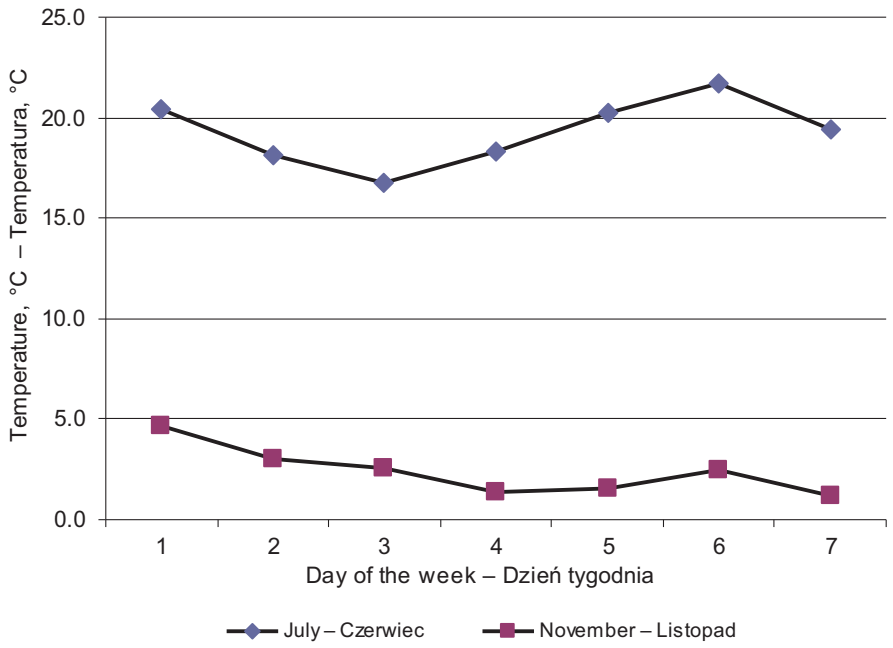

Fig. 1. Air temperature changes during one week of observations in June and November
Rys. 1. Przebieg zmian temperatury otoczenia w ciągu jednego tygodnia obserwacji w lipcu i listopadzie

The distribution of bedding boxes use by cows is presented on Figs 3 and 4. Based on the study conducted it was noted, that both in July and November the highest number of cows selected the sited with separate bedding. Similar relationships were observed by Dolezal and Cerna [2004]. Analysing percentage relationship of cows depending on selected bedding material (Fig. 2) it was noted, that in July over 52% of cows rested on a sites with separate bedding. The second most willingly selected site for the rest was sand (25%). The most seldom the animals rested on sawdust and straw, i.e. 13.6 and 9.3% of cows, respectively.

In November when ambient temperatures were much lower than in summer months, higher percentage of cows, over 75%, selected boxes with separate bedding as their resting place (Fig. 2). Also the number of cows using sites with straw bedding increased (14.3%). Lower percentage of cows used the sites with sawdust bedding (8.6%), and also small percentage of cows occupied sites with sand bedding.

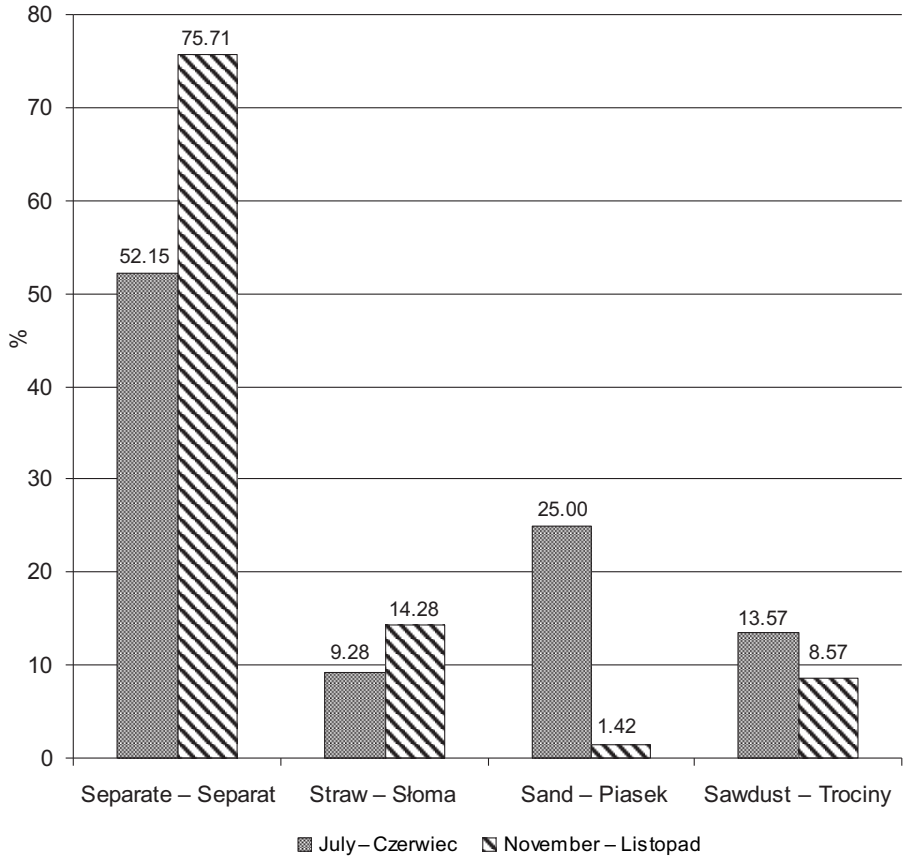

Fig. 2. Percentage of resting cows depending on chosen litter bedding in June and November
Rys. 2. Procentowy rozkład odpoczywających krów w zależności od wybieranego podłoża ściołowego w lipcu i listopadzie

One of factors determining the choice of resting place by the animals is an ambient temperature [Grzegorzak 1989]. Thus, it was checked if there is a statistical relationship between number of cows on a site with separate bedding and ambient temperature. An application of non-linear correlation in this case is justifiable due to complexity of the problem analysed and its two-dimensional character. It appears, that calculated coefficient of non-linear correlation is highly significant ($P \leq 0.01$) and it amounts to 0.781. This means, that in that case the temperature is a factor determining animals choice in 78%, and in the rest 22% other factors determine bedding choice.

Black points represent observations, while the red line presents adjusted cubic polynomial, which analytical form was placed above the diagram (Fig. 3).

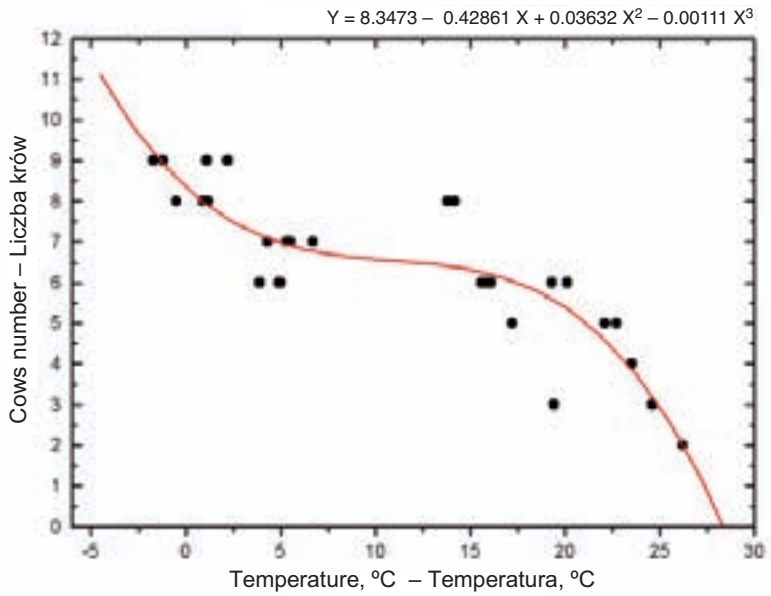

Fig. 3. The diagram of relationship between the number of cows resting on separate and ambient temperature

Rys. 3. Wykres zależności pomiędzy liczbą krów odpoczywających na separacie a temperaturą otoczenia

The results obtained suggest that an application of separator as a device enabling obtaining of litter bedding is fully justifiable, what was confirmed in Czech studies [Dolezal and Cerna 2003]. In most of cases observed the cows selected sites with separate bedding both in summer and autumn. That means, that physical parameters of that kind of bedding are proper for cattle, especially the level of heat conduction is optimal [Grzegorzak 1989]. Due to porous structure, heat conduction coefficient for separate is characterised by relatively low value. In winter, the separate is a substance of well isolation properties, while in summer it does not accumulate large quantities of heat. The cows were not discouraged to using it during resting both in summer and winter period. Specificity of smell, structure, heat conduction are certainly one of the most important factors determining selection by cows of sites with separate bedding.

The analysis of a composition of fresh cattle manure separate was conducted in a laboratory of Wroclaw University of Environmental and Life Sciences. It contains about: 24% dry matter, 8% crude fibre, 2.4% protein, 0.2% fat and 2.5% ash. Also quantitative and qualitative analyses were conducted within the study. In bacteriological examinations of fresh material no increase in amount of Salmonella spp. was noted. No numerous colonies of *Escherichia Coli* were observed in bacteriological inoculations made. A few-months observations of mastitis frequency in cows did not confirm the threats concerning hygienic state of such a litter, what was also noted by Dolezal et al. [2004]. Additionally, the hooves were dry what confirms that hygiene level was improved. After 2–3 month period of com-

posting, the liquid fraction may be used as a natural fertilizer [Romański and Mulka 1983]. The economic effectiveness of that material when purchasing a new separator and storage only for that purpose is however still a questionable issue [Dolezal and Cerna 2003].

CONCLUSIONS

The comparison in the range of acceptance by cows of various bedding during resting demonstrated the validity of an application of cattle manure separate as litter bedding material. The ambient temperature to a high degree determined the choice of bedding sites by the animals (r = 78%). Separate does not pose any bacteriological risk, however it needs to be replaced after use on fresh material.

Separator is characterised by simple installation, easy operation, and labour costs are small. The level of device noise is low, and similar energy consumption (maximum 5.5 kW). The technology applied allows to obtain bedding material without undesirable smell.

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ANALIZA MOŻLIWOŚCI WYKORZYSTANIA RÓŻNYCH PODŁOŻY ŚCIOŁOWYCH ZE SZCZEGÓLNYM UWZGLĘDNIENIEM SEPARATU

Streszczenie. Celem pracy było przeprowadzenie analizy wykorzystania przez krowy mleczne w czasie ich odpoczynku różnych podłoży ścielących. Czystość krów i poziom higieny w oborach decyduje o wydajności i jakości mleka i jest nadal problemem aktualnym. Dla celów eksperymentu w oborze wolnostanowiskowej wydzielono i wyścielono po 12 stanowisk: słomą, piaskiem, trocinami, separatem z odchodów bydlęcych. Separat z odchodów bydlęcych jest to frakcja stała gnojowicy, powstała na skutek oddzielenia jej od części płynnej. Taki rozdział odchodów pozwala na wykorzystanie płynnej gnojowicy jako nawozu, natomiast frakcja stała może być wykorzystana jako materiał ścielący w cyklu zamkniętym. Ze stada krów mlecznych wybrano12 zwierząt i wpuszczono je do wydzielonej części obory, gdzie miały swobodny dostęp do wszystkich stanowisk. Przeprowadzone analizy wykazały, że obserwowane krowy preferowały separat jako materiał ścielący bardziej niż inne podłoża. Kilkumiesięczne obserwacje częstości występowania u krów mastitis nie potwierdziły obaw o stan higieniczny takiej ściółki, również racice były suche, przez co poprawił się poziom ich higieny.

Słowa kluczowe: bydło, dobrostan, podłoże ściołowe, separator

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