Effects of herd size and bedding surfaces on milk yield and some health problems in dairy cow farms

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SUMMARY

Dairy farms around the world have undergone some changes over the years. One of these changes was the size of the herd, although its scale varied from country to country. Various factors such as cost, profitability and ease of solving possible problems are taken into consideration while deciding on the size of the herd in the planning phase of the investment. This study was carried out to determine the effect of herd size and use of different bedding materials on health and milk yield in Turkish dairy herds. A total of 44 dairy farms were used in the study, and all of them were free stall. Farms were grouped into three herd size categories; small (with less than 30 cows), medium (30 to 50 cows) and large (with more than 50 cows). 305-day milk yield data were collected at the end of lactation period from the database of Cattle Breeders' Association of Bursa/Turkey. While health data (about dystocia, retained placenta, clinical mastitis and repeat breeding) were collected from the herd records, locomotion scoring was done by the researchers. The effects of herd size on repeat breeding, locomotion score, mastitis and milk yield were found significant. Bedding materials were examined in three different types (rubber, sand or without bedding-concrete surface) and their effects on repeat breeding, locomotion score, mastitis and 305-day milk yield were also found significant. The large size herds had higher milk yield (6993.24 ± 72.52 L) and better herd health than small and medium-size herds except for the repeat breeding and also, milk yield (7235.60 ± 110.94 L) and herd health were better in herds that used rubber bedding than concrete and sand except for the repeat breeding and dystocia. Consequently, herd health and milk yield were significantly affected by herd size and the bedding material that was used.

KEY WORDS

Dairy herd, herd size, bedding type, milk yield, cow health.

INTRODUCTION

The dairy industry in the developing world has undergone some changes over the recent decades like herd size. Herd sizes have increased, and large herds have started to adopt new technologies to improve both efficiency and profits. As a result of this, these herds have tended to increase production and reduce the cost per unit of milk[1], but herd size has had and will probably continue to have some effects on the health of dairy cows[2]. To the best of our knowledge, there are just a few studies that have assessed the effects of herd size on animal health and milk yield[3-6], and existing studies have provided conflicting results. While Wolf et al.[6] reported that infectious disease incidence increased with increasing herd size, on the other hand, Chapinal et al.[3] reported that larger dairy farms had a lower prevalence of lameness.

Differently from the aforementioned researchers, Barkema et al.[2] stated that herd size did not have a consistent, predictable association with health. Considering different studies about this topic and their different results, further research is needed to determine the effects of herd size on animal health.

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This is why the objective of this study was to investigate the effects of herd size on health and milk yield in dairy herds. Although there are no studies in the literature on this particular topic, dystocia, clinical mastitis, retained placenta, lameness and repeat breeding were evaluated as the health parameters in this study, because they are the most common health problems in the region where the study was conducted. Besides, the effects of bedding materials used for dairy herds on health and milk yield were also investigated as it was seen that the biggest difference among herds was bedding material in the course of the study. This study aims to guide breeders who want to improve their herds, to provide data for practice and to serve as a reference.

MATERIALS AND METHODS

Selection of cows

A total of 44 Holstein dairy herds located in west central Bursa/Turkey, including 1215 cows that had completed their first lactation period, were visited during the Spring season (March through May) of 2019. The records of 110 cows that had lactation lengths (LG) of 220<LG<550 days and 72 cows that had a 305-day milk yield (MY_{305}) of 2,000<MY_{305}<12,000 L were not included, because these records were not considered within normal managerial limits. 1033 cows that had completed their first lactation were included in the study.

Selection of herds

44 different sized free stall herds were selected from among the herds of the members of the Cattle Breeder's Association of Bursa. The herds were classified in 3 groups as small, medium and large according to the number of animals (NA) in each hear. Small referred to NA<30, medium referred to 30≤NA≤50, and large referred to NA>50.

Collection of disease and milk yield records

For each cow, the following data were collected from the herd records: dystocia (yes, no), retained placenta (yes, no), clinical mastitis (yes, no), and repeat breeding (yes, no). Data on lactation length (day) and 305-day milk yield (L) were collected at the end of the lactation period from the database of the Cattle Breeder's Association of Bursa. Since there were no locomotion score records in the herds or in the Bursa Cattle Breeders' Association records, the cows were evaluated for their locomotion score status by the researchers using a 4-point locomotion scoring method modified from the method reported by Sprecher et al.[7], the rates of lameness with reference to the locomotion score were investigated in relation to 3 different bedding materials (sand, rubber or without bedding-concrete surface), and the assessments were made by the same trained professional.

Table 1 - Effects of herd size and bedding material on milk yield.

Herd Size	n	Mean±SE	Min	Max
Small	457	5990.86±47.95[a]	2621	9066
Medium	348	6484.85±72.98[b]	3569	11164
Large	228	6993.24±72.52[c]	4208	11464
Bedding				
Concrete surface	715	6174.82±39.84[a]	2926	9596
Sand	159	6437.44±106.81[b]	2621	11464
Rubber	159	7235.60±110.94[c]	4208	11164
	1033	6378.52±38.17	2621	11464

[abc] Means in a column with no common superscript differed significantly **(P<0.01).

Statistical analyses

The herds included in the study were divided into 3 groups according to their sizes (small: <30 cows, medium: 30-50 cows, large: >50 cows). Similarly, it was seen that 3 different bedding materials as rubber, sand and concrete were being used in the farms. SPSS[8] was used for the statistical analyses. Chi-squared tests were performed to investigate the association between herd size and bedding materials with some herd health features (locomotion score, mastitis, dystocia, retained placenta and repeat breeding). Analysis of variance (ANOVA) was used to investigate the effects of herd size and bedding material on milk yield after checking the normal distribution of the data.

The statistical model that was used in the study is given below:

$$Y_{ijk} = \mu + HS_i + BM_j + e_{ijk}$$

where: Y = Milk yield; μ = overall mean; HS = Herd size; BM = Bedding material and e = Error

Table 2 - Effects of herd size and bedding material on herd health.

		Herd Size			Bedding			
		Small	Medium	Large	Concrete surface	Sand	Rubber	Total
Locomotion Score	0	226	165	161	343	101	108	552
	1	175	131	52	275	46	37	358
	2	45	40	10	75	9	11	95
	3	11	12	5	22	3	3	28
			**			**		
Mastitis	No	379	305	212	598	148	150	896
	Yes	78	43	16	117	11	9	137
	Prevalence (%)	17.07	12.36	7.02	16.36	6.92	5.66	13.26
			**			**		
Dystocia	No	419	323	213	654	154	147	955
	Yes	38	25	15	61	5	12	78
	Prevalence (%)	8.32	7.18	6.58	8.53	3.14	7.55	7.55
			NS			*NS*		
Retained Placenta	No	423	334	219	672	150	154	976
	Yes	34	14	9	43	9	5	57
	Prevalence (%)	7.44	4.02	3.95	6.01	5.66	3.14	5.52
			NS			*NS*		
Repeat Breeding	No	174	132	63	258	70	41	369
	Yes	283	216	165	457	89	118	664
	Prevalence (%)	61.93	62.07	72.37	63.92	55.97	74.21	64.28
			*			**		

**,* denote statistical significance on the levels of P<0.01, P<0.05 respectively; *NS*, not significant.

RESULTS

According to the study results, the effects of different herd sizes and bedding materials on milk yield were found significant (P<0.01). The results as shown in Table 1.When the results were assessed in terms of health problems, while effects of herd size on locomotion score, mastitis and repeat breeding was found significant (P<0.01, P<0.01 and P<0.05, respectively), its effects on dystocia and retained placenta was not. There were also found similar results in terms of the effects of bedding materials on health problems. While effects of bedding material on locomotion score, mastitis and repeat breeding was found significant (P<0.01), its effects on dystocia and retained placenta was not. The results are shown in Table 2.

DISCUSSION

According to the herd size and bedding material effect on milk yield, the current study results were similar to Krpalkova et al.[9] and Singh et al.[10] for effects of herd size and similar to van Gastelen et al.[11] and Astiz et al.[12] for effects of bedding material. As seen in Table 1, milk yield increased when the herd size increased. There was a difference of approximately 1,000 liters between the mean milk yield in different herd size (small and large) and bedding (rubber and others) groups. The best explanation of these results may be that larger herds use more intensive management strategies than smaller herds, and a better understanding of how bedding management in these farms influences productivity and milk quality is needed as reported by Rowbotham and Ruegg[13].

When the effects of herd size and bedding material on health problems assessed, as seen in Table 2, the locomotion score was 0 in approximately half of the cows housed in the small and medium-sized herds (49.45% and 47.41%, respectively), whereas in the large herds, this rate was quite high (70.61%). In other words, the problem of lameness was encountered less frequently in the large herds as in the results reported by Chapinal et al.[14]. Also it was seen that the number of lame cows was higher in the herds that used no bedding material (concrete surface). Possible reasons for our result may be the time spent standing and its effects on the locomotion score. This is because lying time is shorter, and standing time is longer when dairy cows are forced to use hard surfaces, especially concrete[15], and the prevalence of clinical lameness in cows kept in freestall barns using less soft bedding compared to sand or rubber bedding is higher and associated with more time spent standing[16]. While 78 of the 457 cows in the small herds had mastitis (17.07%), this rate was 12.36% for the medium-sized herds and only 7.02% for the large herds. The biggest possible reason for this result may be that the management practices - regular inspection of milking machine, use of milking parlor, central transport of milk, teat disinfection and dry cow treatment- performed for the herds became more reliable as the herd size increased. This finding was in a similar with the trend of better udder health and milk quality observed in larger herds in previous studies[17; 18]. Another reason could be the bedding material because sand or rubber bedding was used in most of the large herds (75%) within the scope of this study. According to the results of the comparison of different bedding materials, the herds with concrete bedding had disadvantages in terms of mastitis. In other words, mastitis cases were encountered in 6-7% of the cows in the herds using sand or rubber as the bedding material, while in the herds that with concrete surface, it was seen that this ratio more than doubled. The effects of different bedding materials on mastitis have been proven in many other studies. Such comparative studies have reported a low mastitis incidence in herds that used sand or rubber bedding material[19; 20].

The problem of repeat breeding was observed in almost 2/3 of the cows included in this study. In the large herds, 72.37% of the cows had repeat breeding, whereas small ratios of approximately 10% were encountered for the small and medium-sized herds. When the results were assessed in terms of bedding material, the herds that used sand bedding were more advantaged in terms of conception. While the prevalence for repeat breeding was 55.97% in the herds that used sand bedding, this rate was 63.92% and 74.21% for the herds that used no bedding (concrete surface) and used rubber bedding, respectively.

This result is noteworthy because a high prevalence for lameness and mastitis was seen in the herds for which concrete bedding was used, but the prevalence of repeat breeding in this group was low in comparison to the group of herds that used rubber bedding. One of the underlying reasons for this result may be differences in milk yield and changes in bedding options depending on the herd size. Accordingly, in this study, while most of the large herds (with higher milk yield and repeat breeding rates) were using rubber bedding, the rates of using this bedding material were low in most of the small and medium-sized herds (with lower milk yield and repeat breeding rates). The second reason may be the numbers of herds that were included in this study according to their size, because the number of small herds was higher than the others in this study. The third reason may be the selection of bedding materials for the cows because cows could prefer a softer area for lying or standing. Indeed there were observed all herds involved in this study have soil walkways. As a matter of fact, previous research has shown that cows tended to spend more time lying on softer surfaces, and adequate lying times led to an increase in cow health[21].

CONCLUSIONS

In conclusion, this study revealed that increased herd size or using rubber bedding resulted in increased milk production. This result suggested that there was paying more attention to maintenance and feeding had a big role in the health of the large herds. In terms of the health problems identified in the herds in this study, having large herds (except for repeat breeding) and rubber bedding provided an advantage. This result strengthened the interpretation given above. The most common health problem in the region is repeat breeding, which follows a contrary trend to the increase in the herd size and milk yield. Considering these issues together, it was concluded that it is necessary to be more careful about reproductive health and foot health in herd management especially in small and medium-sized herds, since these issues are in the shadow of milk yield in developing countries.

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