

THE EFFECT OF HERD SIZE ON DAIRY COWS' WELFARE QUALITY – PROVISION OF GOOD FEEDING AND HOUSING

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Abstract: In the last decades, there has been a trend present in the world to increase the size of dairy herds while increasing the yield of milk per head. In addition to environmental and economic benefits, this trend carries certain risks for the welfare of cows because in conditions of increased agglomeration of cattle the possibility of spreading of pathogens is also increased, there are less opportunities for adequate control and cows are exposed to greater selection and production stress. Research of the relationship between herd size and welfare quality parameters is still not sufficient to make relevant conclusions. Starting from that, the aim of this study, conducted in Serbia, is to examine the influence of herd size on parameters related to providing good feeding and housing conditions as important segments of the overall welfare of dairy cows. The assessment of given welfare parameters was done by *Welfare Quality® Assessment Protocol for Cattle (2009)* on 16 dairy farms of different herd sizes (large, medium and small) and housing management. The results indicate that there are significant variations in welfare indicators in each of the observed groups, which is why the size of the herd cannot be taken as a parameter that explicitly determines the quality of welfare. However, individual observation and comparison of welfare parameters between groups indicate that small herds in our production conditions could be identified as the greatest risks to the welfare of cows. In small herds, the highest share of cows of poor (4.62%) and fattened condition (8.76%) was found, as well as the lowest freedom of movement because cows on small farms are mostly reared in a tied system. Average values of indicators: lying down time (6.24s), frequency of collisions with equipment (13.25%) and high dirt contamination of cows (65.6-89.8%) further emphasize the issue of providing comfort in small herds.

Key words: dairy cows, welfare, herd size, feeding, housing, comfort

Introduction

The relationship between herd size and welfare quality has not been extensively investigated in the past. Based on a review of the available literature, it is evident that this topic was considered mainly from the perspective of the impact of herd size on the incidence of various disorders and diseases of dairy cows (USDA, 1996; Wells et al., 1999; Waage et al., 1998). Although some studies indicate significant variation in welfare parameters under the influence of herd size (Gieseke et al., 2018; Beggs et al., 2019), there is currently no reliable scientifically based confirmation of this relationship. However, it is widely believed that the quality of welfare of cows in large herds is generally worse compared to smaller herds. There are several reasons for this. In conditions of higher concentration of animals, the possibility of spreading infectious agents increases, and thus the frequency of the disease, while the identification of health and other problems is difficult. In herds of large size, production usually takes place with higher intensity, which implies greater pressure on the physiological functions of farmed animals and their welfare (Rauw et al., 1998; Royal et al., 2000). Intensive production is often accompanied by infrastructural solutions that support higher economy of production (fewer beds and feeding places, higher population density, etc.) but adversely affect the welfare of cows (Leonard et al., 1996; Tucker et al., 2005; Popescu et al., 2007).

The mentioned influences should be taken seriously, especially since in the developed countries of the world, there has been a significant increase in the size of farms in the past decades. In the past 30 years, the average herd size in New Zealand and Australia has almost tripled (*Dairi New Zealand, 2014; Dairi Australia, 2015*), while in the United States the size of dairy herds has increased sixfold (*MacDonald et al., 2007*). In many countries, the increase in the herd was accompanied by changes in the way of housing of animals, because the development and application of the lying boxes resulted in a reduced stay of cows on pasture and free ranges. Consequently, only 20% of lactating cows and 34% of dry cows accessed pasture in 2013 (USDA, 2014).

A similar development of herd size has been observed on the European continent. In the EU-10 Member States (Belgium, Denmark, Germany, Ireland, Greece, France, Italy, Luxembourg, the Netherlands and the United Kingdom), herd size has been increased from 17 to 54 dairy cows per farm (*Eurostat, 2015*). It is indicative, however, that in these EU countries, milk production is relatively stable (100 million tons) despite a significant reduction in number of farms of about 80% and a reduction in dairy cattle populations by about 30% (*Eurostat, 2015*). This indicates a significant improvement in milk yield per cow as well as increased stress to which cows are exposed in production, which could affect the

welfare of dairy cows, especially due to the increased frequency of productive diseases (Coignard *et al.*, 2014).

At the same time, public awareness of farm animal welfare issues is growing in the EU (European Commission, 2016), and many consumers are concerned about the industrialization of livestock production. Observed from the consumer point of view, natural housing conditions are the main precondition for animal welfare (Spooner *et al.*, 2014), while the industrial farms induce serious animal health and welfare problems (Vanhonacker and Verbeke, 2014).

Starting from the need to contribute to a more thorough understanding of the relationship between the quality of welfare and the size of dairy herds, as well as the main challenges arising from it, this study examined the impact of herd size on parameters related to providing good nutrition and housing, as important segments of overall welfare of dairy cows on farms in Serbia.

Material and Methods

The farms

The study was conducted on 16 selected conventional dairy farms of different herd sizes and housing management (free-stall housing-FSH; tie-stall housing-TSH). Therefore, farms were classified by the number of cows into three herd size groups: large (>301 cows), medium (101–300 cows), and small (30 - 100 cows). FSH was implemented in 60% of large, 75% of medium, and 15% of small size herds. Presences of the races were 80% and 20% for Domestic Simmental and Holstein Friesian cattle, respectively. Due to discretion and simpler presentation, the analyzed farms were assigned codes (1 - 16).

Welfare assessment

Welfare assessment of cows was done according to the *Welfare Quality® Assessment Protocol for Cattle -WQP (2009)*. This is a standardized indicator system for on-farm animal welfare assessment. It focuses mainly on animal-based measures, which directly reflect the actual welfare state of the animals. Three trained assessors (experienced in cows' welfare assessment) evaluated the cows on each farm. To avoid seasonal effects on the animal welfare assessment, each farm was visited twice a year, in the winter and summer season, and the average value of each welfare measure was calculated.

Processing of data collected on the farms was carried out using the *Welfare Quality® Scoring System Software Program (2012)*. More than 30 animal welfare indicators covering aspects of feeding, housing, health, and behavior are measured and aggregated to 12 welfare criteria and 4 welfare principles (Good feeding; Good

housing; Good health and appropriate behavior). Finally, farms are assigned to 1 of 4 overall welfare categories, representing an “excellent” (81-100 points), “enhanced” (56-80 points), or “acceptable” (21-55 points) animal welfare state. In cases where minimum requirements could not be achieved, the farms are rated as “not classified” (under 20 points). Since this research focuses on the effect of herd size on the provision of good feeding and housing, only the parameters included in the assessment of these principles (principles of “Good feeding” and “Good housing”) are shown in Table 1. A detailed description of the assessment of each measure can be found in the WQP.

Table 1. Criteria and measures used in the assessment of “Good feeding” and “Good housing” principles (*Welfare Quality® Assessment Protocol, 2009*)

Principles	Criteria	Measures
Good feeding	Absence of prolonged hunger	Body condition score
	Absence of prolonged thirst	Water provision; cleanliness of water points; water flow; functioning of water points
Good housing	Comfort around resting	Time needed to lay down; animals colliding with housing equipment during lying down; animals lying partly or completely outside the lying area; cleanliness of udders, flank/upper legs, lower legs
	Ease of movement	Presence of tethering; access to outdoor loafing area or pasture

Statistical analysis

All statistical analyses were performed using Statistica v.10 commercial software (*StatSoft, Inc., USA, 2010*). Descriptive statistical parameters were determined (mean, standard deviation, minimal and maximal values) for the assessed measures, and for the scores of the criteria and principles. The statistical significance of the herd size effect on the welfare in the studied farms was determined by the t-test or the Mann-Whitney test, depending on the normality of data distribution, established with the Kolmogorov-Smirnov test. P values less than 0.05 were considered as significant.

Results and Discussion

Welfare measures and categorizations of studied farms

Table 2 provides an overview of welfare parameters on the studied farms (1-16). For a more complete presentation, the categories of welfare quality for each of the farms are given, determined on the basis of the overall assessment, i.e. values for all four principles. The results show that one half of the surveyed farms are classified in the category of acceptable and the other half in the category of appropriate quality of welfare. None of the studied farms' quality of welfare was evaluated as unacceptable or excellent, based on which it can be argued that the observed farms provided cows with conditions that meet more than the basic needs of animals in terms of nutrition, health, comfort and behavior.

In relation to herd size, category of enhanced welfare quality was established in all farms of medium herd size, about 60% of small herd size and 20% of large herd size. Lower, acceptable welfare quality was determined predominantly in large herds (80%) whereas about 40% of small herds were assessed by this category.

The principle of "Good feeding" was evaluated as twice as good as the principle of "Good housing" and generally indicates that the welfare of dairy cows on the surveyed farms is not endangered by prolonged starvation and thirst. However, within this principle, great variability has been determined, so there are evident deficiencies on some farms (score ≤ 20) that have a threatening effect on the nutritional status of farmed animals.

Conditions of housing were assessed on average as acceptable, with a rather low score for the "Comfort around resting" criterion, which indicates a more pronounced problem of providing appropriate rearing conditions (space, hygiene and collision). In contrast, freedom of movement was assessed more favourably, but with pronounced variability on the surveyed farms.

Table 2. Welfare measures and categorizations of farms

Farm code (1 - 16)	1	2	3	5	6	4	7	8	9	10	11	12	13	14	15	16	Average score	Standard deviation
Herd size (L; M; S)	L	L	L	L	L	M	M	M	M	S	S	S	S	S	S	S		
Housing (FSH; TSH)	FSH	TSH	TSH	FSH	FSH	FSH	FSH	TSH	FSH	TSH	TSH	TSH	FSH	TSH	TSH	TSH		
Principle Good feeding	94.40	89.10	80.30	13.95	94.80	67.40	95.85	49.10	61.60	100.00	59.40	86.00	69.65	95.65	100.00	58.30	75.97	25.31
Absence of prolonged hunger	92.30	85.05	73.00	94.50	92.85	55.35	94.30	80.35	73.15	100.00	44.40	80.80	58.45	94.05	100.00	42.90	78.84	19.51
Absence of prolonged thirst	100.00	100.00	100.00	3.00	100.00	100.00	100.00	51.50	60.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	88.41	29.58
Principle Good housing	47.30	13.15	13.80	56.50	53.90	62.25	56.35	19.00	53.90	27.90	30.35	30.35	62.90	13.60	15.50	28.65	36.59	19.37
Comfort around resting	16.40	14.70	14.20	30.90	26.70	40.10	30.75	26.70	26.70	26.85	30.75	30.75	41.10	13.55	16.40	25.75	25.77	12.50
Ease of movement	100.00	15.00	15.00	100.00	100.00	100.00	100.00	15.00	100.00	34.00	34.00	34.00	100.00	15.00	15.00	34.00	56.94	39.25
Welfare category of farm	Acceptable	Acceptable	Acceptable	Acceptable	Enhanced	Enhanced	Enhanced	Enhanced	Enhanced	Enhanced	Acceptable	Acceptable	Enhanced	Acceptable	Enhanced	Acceptable		

The effect of herd size on provision of “Good feeding”

Although small farms were, in summary, rated for the principle of "good nutrition" with the best score, the results presented in Table 3 show that the criterion "absence of hunger" was rated as the worst, while the criterion "absence of thirst" was given the maximum number of points. On large and medium-sized farms, this relationship is exactly the opposite, based on which it can be assumed that when calculating the score of the main principle based on the score of the

corresponding criteria, there is some compensation. However, this outcome is actually the result of the application of a specific mathematical operation (Choquet integral) in computational processing, which gives one criterion greater importance (weight) than another. In this particular case, "absence of thirst" is more important for welfare than "absence of hunger", which is reflected in the score for the main principle "good feeding". However, due to the high variability within the groups, statistical analysis showed no significant impact ($p \geq 0.05$) of herd size on the provision of good feeding, i.e. analyzed principle and criteria.

Table 3. Effect of herd size on provision of good feeding

Herd size	Large (>301 cows)				Medium (101-300 cows)				Small (30 - 100 cows)				F	LSD test		
	\bar{x}	SD	Min	Max	\bar{x}	SD	Min	Max	\bar{x}	SD	Min	Max		L/M	L/S	M/S
Principle Good feeding, points	74.51	32.71	13.30	100.00	68.49	27.03	12.20	100.00	81.29	18.07	56.40	100.00	ns	ns	ns	ns
Criterion Absence of prolonged hunger, points	87.54	10.75	70.90	100.00	75.79	15.55	52.40	100.00	74.37	24.74	40.30	100.00	ns	ns	ns	ns
Very lean, %	1.68	1.51	0.00	4.17	3.65	2.71	0.00	8.20	4.62	4.88	0.00	12.50	ns	ns	ns	ns
Regular body condition, % ^N	97.00	2.26	94.00	100.00	96.26	2.63	91.80	100.00	86.35	6.73	75.87	97.26	**	ns	**	**
Very fat, % ^N	1.32	1.68	0.00	4.17	0.09	0.25	0.00	0.72	8.76	5.21	1.22	18.00	**	ns	**	**
Criterion Absence of prolonged thirst, points	80.60	40.90	3.00	100.00	77.88	35.24	3.00	100.00	100.00	0.00	100.00	100.00	ns	ns	ns	ns

^N=not included in software analysis, P = significance of differences between the means calculated by t-test, ns = not significant ($P > 0.05$),

* = significant statistical differences at $P < 0.05$, ** = significant statistical differences at $P < 0.01$

The criterion "absence of prolonged hunger" was assessed on the basis of the cows' body condition (BCS), which represents the nutritional history of the animal, rather than the current nutritional status. Including BCS within welfare assessment has the aim to identify the proportion of animals that are under nutrition or over nutrition. Both of these conditions can lead to serious health problems and thus can be regarded as a potential welfare risk. BCS is determined regard to breed (dairy or dual purpose) and four body region condition (cavity around tail head;

vertebrae; tail head, hipbones, spine and ribs) according to descriptive scale (0-regular; 1-very lean or 2-very fat). On herd level, the calculated percentage of very lean cows served as indicator for food provision on farm. The highest share of cows with regular body condition was determined on large and medium farms (Table 3). On the other hand, cows were nutritionally provided the worst on small farms, where the highest share of cows of poor body condition (4.62%) and fattened cows (8.76%) was found. Similar results were obtained in a study by *Adams et al. (2017)* where the highest share of lean cows (BCS ≤ 2.5) was also found on small farms (9.1%) compared to medium (3.0%) and large herds (2.0%). The association of lower percentages of lean cows with increasing herd size was also found in studies by *de Vries et al. (2016)* and *Gieseke et al. (2018)*.

The high share of cows of undesirable body condition (lean and fat) on small farms may be due to inadequate diets as a result of insufficient education and poor financial capabilities of farmers, while on medium and especially large farms, due to more demanding production conditions, balancing the diet is responsibility of permanently employed experts or consultants. However, it should be noted that the determined share of cows of poor body condition on farms of different herd sizes, from 1.68% to 4.62%, does not endanger the quality of animal welfare as it corresponds to the range 0-11% stated by *Webster (2005)* for farms of best welfare quality. Contrary to that, the share of fattened cows of 8.76% in small herds corresponds to the range established by *Webster (2005)* on farms of lower welfare categories and may pose a risk to the welfare of cows in terms of disposition to dystocia and fatty liver degeneration (*Reid et al., 1986*).

Animal health, welfare and productivity are significantly affected by adequate water intake (*Beede, 2012*). Limited access and/or poor water quality inevitably lead to reduced production performance and endanger animal health. It is therefore very important to provide cows with unrestricted access to drinking water of appropriate quality (*Häbich and Kamphues, 2009*). Water provision (availability of at least two power supplies per head), cleanliness and functionality of drinkers, as well as water flow are indicators on the basis of which the criterion "absence of prolonged thirst" was assessed. The average value of this criterion indicates that in our conditions cows were not exposed to prolonged thirst (Table 2), but unexpectedly, the best water provision for cows was determined on farms with small herd size. The average score for this criterion was 88.41 points with 6.25% of farms with a value of less than 10 points. In the EU, the average value is 64.6 points with a significant share of farms (20%) on which the value is less than 10 points (*Welfare Quality Network, 2012*). The range of minimum and maximum values of the criteria is the same in Serbia and the EU (3 - 100 points). This indicates a significant variation in the assessment of this criterion between farms, which in our conditions is mainly due to insufficient number of drinkers per head, while other indicators (functionality and cleanliness of drinkers) are satisfactory on all surveyed farms.

The effect of herd size on provision of “Good housing”

Based on the results of the research presented in Table 4, it is evident that the size of the herd had no significant influence ($p \geq 0.05$) on the principle of “Good housing”. However, the best score of this principle was achieved on farms of medium herd size (47.88 points) and the worst (29.89 points) on small farms, up to 100 heads, with significant differences at the level of $p \leq 0.05$

Housing comfort was rated very low in herds of all sizes and worst in large herds. Some indicators within this criterion were significantly influenced by herd size. Thus, the longest duration of cows’ lying down of 6.65 seconds on average was observed in large herds and the shortest 5.78 seconds in medium-sized herds ($p \leq 0.05$). The laying down duration determined in the present study (Table 4), according to *Forkman and Keeling (2009)*, on large-capacity farms is a serious and on small and medium farms a moderate problem from the aspect of dairy cow welfare. Differences in the values of the mentioned indicator can be explained by different housing conditions (*Pleisch et al., 2010; Ostojić Andrić et al., 2011*). Namely, studies have shown that a deep mat, more often used in medium-sized herds, provides better comfort to animals, which can result in reduced lying down time (*Wechler et al., 2000*). Also, inadequate dimensions of accommodation, typical of small farms with tied animals, reduce comfort and may increase collisions with equipment (*Veissier et al., 2004*). Finally, some painful conditions such as laminitis and mastitis, which are more common in intensive production conditions, can cause prolonged lying down, as found in study of *Popescu et al. (2013)*. Considering that the longest duration of lying down was determined on large and small farms, which at the same time had a higher share of collisions with equipment and lying out of lying area, it can be concluded that their interaction resulted in a worse score for comfort and adequate principle.

Cleanliness of cows is defined as the degree of dirt on the lower hind legs, hind quarters and the udder considered splashing (e.g. faeces, mud) and plaques (three-dimensional layers of dirt). Firstly it is estimated on individual level (scale: 0-no dirt/minor splashing or 2-separate or continuous plaques of dirt) and then on herd level by calculating percentage of animals with clean (score 0) and dirty body parts (score 2). Most of the recent studies including ours (Table 4) showed that alarm thresholds set by WQP for the dirtiness of lower hind legs (50%) and dirtiness of flank and udder (20%) were widely exceeded (*Heath et al., 2014; Zuliani et al., 2017*). The results of *Gieseke et al. (2018)* confirmed the significant effect of herd size on the proportion of cows with dirty lower legs ($p \leq 0.05$), unexpectedly with the lowest dirtiness in large herds.

Table 4. Effect of herd size on provision of “Good housing”

Herd size	Large (>301 cows)				Medium (101-300 cows)				Small (30 - 100 cows)				F	LSD test			
	\bar{x}	SD	Min	Max	\bar{x}	SD	Min	Max	\bar{x}	SD	Min	Max		L/M	L/S	M/S	
Welfare measures																	
Principle Good housing, points	36.93	20.70	7.30	59.10	47.88	18.83	19.00	65.40	29.89	16.75	11.00	65.40	ns	ns	ns	*	
Criterion Comfort around resting, points	20.58	9.77	2.70	35.10	31.06	10.01	16.40	45.10	26.45	14.64	8.60	45.10	ns	ns	ns	ns	
Time needed to lie down, s	6.65	0.73	5.33	7.58	5.78	0.65	4.50	6.70	6.24	0.62	5.40	7.10	*	**	ns	ns	
Colliding with equipment during lying down, %	12.39	14.11	0.00	37.00	1.03	1.90	0.00	4.35	13.25	10.71	0.00	28.60	*	*	*	ns	
Lying outside the lying area, %	39.05	29.49	0.00	83.78	17.29	16.39	0.00	41.90	45.74	40.72	0.00	100.00	ns	ns	ns	ns	
Cows with dirty lower legs, %	72.57	28.07	14.81	95.80	90.65	10.68	72.60	100.00	89.83	14.88	61.30	100.00	ns	ns	*	ns	
Cows with dirty udder, %	49.17	29.00	9.26	91.70	63.95	13.14	42.70	87.75	65.64	23.73	20.00	100.00	ns	ns	ns	ns	
Cows with dirty flank and upper legs, %	58.33	26.07	3.70	92.10	82.50	8.05	68.30	95.92	74.27	16.53	39.70	100.00	*	**	*	ns	
Criterion Ease of movement, points	66.00	43.89	15.00	100.00	78.75	39.35	15.00	100.00	38.00	27.64	15.00	100.00	*	ns	ns	*	
No. of days with access to outdoor loafing area, per year	72.00	92.95	0.00	180.00	128.75	159.84	0.00	365.00	121.07	115.91	0.00	300.00	ns	ns	ns	ns	
No. of days with access to outdoor loafing area, daily	7.20	10.12	0.00	24.00	12.00	12.83	0.00	24.00	8.57	8.72	0.00	24.00	ns	ns	ns	ns	
No. of days with access to pasture, per year	0.00	0.00	0.00	0.00	15.00	27.77	0.00	60.00	30.00	76.26	0.00	210.00	ns	ns	ns	ns	
No. of hours with access to pasture, daily	0.00	0.00	0.00	0.00	6.00	11.11	0.00	24.00	1.71	4.36	0.00	12.00	ns	ns	ns	ns	

P = significance of differences between the means calculated by t-test, ns = not significant ($P > 0.05$), * = significant statistical differences at $P < 0.05$, ** = significant statistical differences at $P < 0.01$

In our research (Table 4), the cleanliness of cows as an indicator of housing comfort was the biggest problem in medium-sized herds where the highest share of cows with dirty legs and flank was observed, as opposed to large herds where cow hygiene was scored as the best. In the interpretation of obtained results, significant influence could also be attributed to the housing system. Namely, in our study, most (3 out of 4) medium-sized herds were reared in free housing conditions for which studies (Regula *et al.*, 2004; Ostojić Andrić *et al.*, 2011) have found to have a worse effect on cow hygiene compared to the tied system. Nevertheless, it is certain that the type of lying area (Cook *et al.*, 2016; Cramer *et al.*, 2009) as well as the regularity of cleaning the facility (Gieseke *et al.*, 2018), i.e. the organization of farm business management, play an important role in ensuring hygiene.

In small herds, where the tied system was mostly used, the highest number of cows lying partially out of lying area (45.74%) and the highest frequency of collisions when lying down (13.25%) were found in contrast to the herd size of 100 to 300 head where these phenomena were least represented. The fact is that in our conditions, small farms are located within family farms, and their construction is often unplanned and does not follow the appropriate technical - technological standards and norms.

Freedom of movement, a welfare criterion assessed on the basis of the applied housing system and the time spent in the free range and on the pasture, was significantly influenced by the size of the farm ($p \leq 0.05$). This criterion of welfare was scored the best on medium-sized farms and worst on small-capacity farms with significant differences at the level of $p \leq 0.05$. The results of the research presented in Table 3 show that freedom of movement was most endangered on large-capacity farms where cows were allowed an average of 21.6 days in the free range per year, without access to pasture, while on medium-capacity farms the average annual stay of cows in the free ranges was 64 days, with 3.75 days on pasture.

Conclusion

This study showed no statistically significant effect of herd size on the provision of good feeding and housing as significant preconditions for ensuring the overall welfare of farmed animals. Given that large variations in welfare indicators were found in each of the observed groups, herd size could not be used, on its own, as a valid indicator of animal welfare. On the contrary, housing and management conditions appear to have a greater impact on welfare than the number of dairy cows per farm. Based on that, overcoming the identified risks in herds of different

sizes can be achieved by investing in continuous education of breeders, optimization and innovation of technical characteristics of facilities and technological processes in a way to adequately adapt to the needs of livestock and production conditions.

Uticaj veličine stada na kvalitet dobrobiti mlečnih krava - obezbeđenost adekvatne ishrane i uslova držanja

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Rezime

U svetu je poslednjih decenija prisutan trend povećanja veličine mlečnih stada uz istovremeno povećanje prinosa mleka po grlu. Pored ekoloških i ekonomskih benefita, ova tendencija nosi i određene rizike po dobrobit krava sa obzirom da se u uslovima povećane aglomeracije grla povećava mogućnost širenja patogena, manje su mogućnosti adekvatnog nadzora dok su istovremeno krave izložene većem selekcijskom i proizvodnom pritisku. Istraživanja odnosa veličine stada i parametara kvaliteta dobrobiti još uvek nisu zastupljena u dovoljnom obimu kako bi se izveli relevantni zaključci. Polazeći od toga, cilj ove studije izvedene u Srbiji, bio je da se ispita uticaj veličine stada na parametre koji se odnose na obezbeđivanje dobrih uslova ishrane i držanja kao važnih segmenata celokupne dobrobiti mlečnih krava. Ocena datih parametara dobrobiti obavljena je prema *Welfare Quality® Assessment Protocol for Cattle (2009)*, na 16 mlečnih farmi različitih veličina stada (velike, srednje, male) i načina držanja. Rezultati ukazuju da postoje značajne varijacije indikatora dobrobiti u svakoj od posmatranih grupa, zbog čega se veličina stada ne može uzimati kao parametar koji eksplicitno determiniše kvalitet dobrobiti. Ipak, pojedinačno sagledavanje i upoređivanje parametara dobrobiti između grupa ukazuje da bi se stada male veličine u našim uslovima proizvodnje mogla označiti kao nosioci najvećih rizika po dobrobit krava. U malim stadima utvrđen je najveći udeo krava slabe (4,62%) i utovljene kondicije (8,76%), kao i najmanja sloboda kretanja jer se krave na malim farmama uglavnom gaje u vezanom sistemu. Prosečne vrednosti indikatora: vreme leganja (6,24s), učestalost kolizija sa opremom (13,25%) i visoka zaprljanost krava (65,6-89,8%) dodatno naglašavaju problematiku obezbeđenja komfora u malim stadima.

Ključne reči: mlečne krave, dobrobit, veličina stada, ishrana, uslovi držanja, komfor

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