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## THE INFLUENCE OF THE HOUSING SYSTEM ON WELL-BEING DAIRY CATTLE

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### ABSTRACT

The results are presented for black and white dairy cows with dominant participation of the Holstein genes on two commercial farms of Al Dahra Corporation (former PKB) with different husbandry systems. The method of description was used as a method in this research. This method shows the number of dairy cattle on Al Dahra's farms in 2021/22/23. years, different housing systems, certain characteristics of milk yield and reproduction. The results are presented in the form of mean values of the observed parameters for each examined year. In the free housing system, during the three years of observation, a significantly higher number of dairy cows were raised compared to the bounded housing system (+2420; +1900 and +1825, respectively). The production and reproduction results were significantly better in dairy cows in the freestall system compared to the bounded housing system. A higher daily milk yield per head (29.0) was achieved compared to the bounded system (27.2), which resulted in a higher annual milk production - 6,889 l compared to 5,278 l, but the quality of the milk (3.6% milk fat and 3.25% protein) was the same for both presented housing systems. The duration of the service period of 127 days in the free system is significantly shorter than the duration of the service period in the bounded system (171 days). The free housing system also led to a lower insemination index for both cows (2.7) and heifers (1.9) compared to the other way of housing (3.8 for cows and 2.4 for heifers). In both Al Dahras farms, the age of dairy cow at the moment of excluding from production herd is on average 5 years for both husbandry systems, which significantly reduces the profitability of production. Housing system is a factor that strongly affects the welfare quality of dairy cows. In the management system of Al Dahra there is no monitoring, but it could be pointed out that the available investigations of housing system did not bring complete answer on all questions. However, based on this research we can recommend a free housing system with positive influence on the welfare of the animals.

**Key words:** animal welfare, housing systems, Holstein Friesian race, milk yield, reproduction.

## INTRODUCTION

The most important breeding goal in milk production is to achieve high genetic productivity per head, but also to reduce the variability of the most economically important traits, which include milk yield and fertility. Milk yield traits, yields of milk, milk fat and protein are traits whose phenotypic variability is influenced by a large number of factors, both genetic and non-genetic. Accordingly, different models of genotype-environment interaction were experimented with, because productivity traits are quantitative traits with polygenic nature, but they are also the result of the interaction of genes and environment, with the environment affecting their variability in different degrees.

Since heritability of milk yield traits is low (about 0.25%), and genetic correlation between reproductive traits and milk yield varies from negative (-0.25) to low positive (0.5), desired phenotypic expression of milk yield traits and fertility is greatly influenced by non-genetic factors. It is precisely because of nutrition, care, accommodation, health care, and populations with a similar hereditary basis exhibit large variations in production. In addition to milk production, these factors affect the health and other, general well-being of domestic animals.

There is worldwide increasing scientific research, consumer activity, and political response towards housing condition, animal health and welfare issues (Hristov et al., 2008). There are several definitions of animal welfare. Broom (1996) defines animal welfare as follows: "welfare is the state of an animal resulting from its attempts to cope with environmental influences", which is the most widely accepted definition of welfare today. The welfare assessment methods can be broadly divided into the so-called input methods that are based on information about environmental conditions-resources and output methods that use information about the animals themselves (Erbez and Trkulja, 2020). The best method of welfare assessment should include both types of mentioned indicators (input and output) (Ostojić Andrić, 2013). The issue of well-being mostly concerns those who are directly or indirectly involved in food production - producers and consumers of animal products. In addition, the protection of the welfare of dairy cows is also related to issues of environmental protection, sustainable development and a whole range of health, hygiene, economic and social problems of a society.

Modern applied measures for increasing the productivity of cows have had a negative impact on the well-being and health of cows, which has reduced profits in the dairy industry. Endemic disease, such as lameness and mastitis, as well as different metabolic disorders, infertility and shorter life time, are some of the consequences of disturbed welfare on dairy farms (FAWC, 2009). In an attempt to determine the reasons, it was taken into account that the industrialization of dairy cattle significantly reduced the living space for cows, insufficient or completely denied movement (bound system), which led to the impossibility of manifesting natural forms of behavior and social interactions. This kind of farm management, but also due to some other applied technologies aimed at increasing productivity, there was a negative impact on animal health, as well as on certain economically important characteristics of cattle.

In spite of many different variations of existing housing systems, they can be broadly classified into two major groups: the loose (LHS) and the tie-stall system (THS). The main difference between them is reflected in the freedom of movement, which is by default better in LHS and thus support more natural cow housing. Still, the results of several studies show that both systems are characterized by advantages and disadvantages (Ostojić Andrić et al., 2022).

In Serbia, tie system is predominant, since it enables individual treatment of every animal, but at the same time is strong contrast to natural habitat of cattle. Ostojić-Andrić et al. (2013) found a significant influence of the housing system on the welfare quality of dairy cows in Serbia. The test was carried out on six farms, with a capacity of 30 to 900 cows, with a free and bounded housing system. The research results prove that the welfare quality of dairy cows is significantly influenced by the holding system and that the free system has an advantage when comfort, ease of movement and the health condition of the cows are emphasized. The same authors pointed out the inadequacy of accommodation and the lack of comfort by determining the value of the indicator.

Black and white, low land atle has important place in Serbia's cattle production. Especially because of high share in total milk production, in spite of relatively low share in total number of heads of cattle. However, it should be noted that management failures are possible in both housing systems, which can seriously compromise the quality of cow welfare (Novaković et al., 2009). All this points to the importance of examining milk yield traits in high-milking herds such as black and white dairy cows with dominant participation of the Holstein gene in different housing systems. Ostojić-Andrić et al. (2011) pointed this by analyzing indicators related to cow hygiene (dirty feet and udders) and diseases (dystocia). Presentation of the currently available capacities, milk yield parameters and some reproduction parameters of Holstein-Friesian cows on the farms of the Al Dahra Corporation shows the impact of two systems of keeping both on the well-being of cows and on the profitability of production.

## **MATERIAL AND METHODS**

The influence of the holding system was examined on two commercial farms of Al Dahra Corporation (former PKB). On one farm there is a bound system of keeping, while on another farm there is a free system of keeping dairy cows. The results are presented for black and white dairy cows with dominant participation of the Holstein gene. Investigated sample of cows were under different conditions of housing, nutrition and care. Farms were of various capacities.

The method of description was used as a method in this research. This method shows the number of dairy cows on Al Dahre farms in 2021/22/23. year, housing systems, certain characteristics of milk yield and reproduction, as well as various causes of death of freshly calved cows. The results are presented in the form of mean values of the observed parameters for each examined year.

## **RESULTS AND DISCUSSION**

Formerly a European conglomerate PKB, today part of the international corporation Al Dahra, conducts cattle production on two farms.

The number of black and white dairy cows with a dominant part of Holstein genes on Al Dahra farms in Serbia in 2023 is 4065. Table 1 shows the number of dairy cows in the last three years (2021/22/23) on farms with two housing systems.

Table 1. Number of dairy cows on Al Dahra farms in 2021/22/23.

Years	Number of dairy cows			
	Free housing system	Bound housing system	Differ.	Total
2021	3600	1180	+2420	4540
2022	3100	1200	+1900	4300
2023	2945	1120	+1825	4065

In breeding and selection programs, economically important ones have a special importance milk yield traits such as duration of lactation, milk yield, yield and milk content fat and protein. Fertility traits are gaining more and more importance in genetics

improvement of dairy cattle, considering that they significantly affect the economic efficiency of milk production (Lazarević, 2019).

According to Ostojić Andrić et al. (2011) housing system is a factor that strongly affects the welfare quality of dairy cows, especially in regard to health condition and expression of behaviour. In Serbia, like in most countries, bound housing system is predominant, since it enables individual treatment of every animal, but at the same time is strong contrast to natural habitat of cattle. In the free housing system, during the three years of observation, a significantly higher number of dairy cows were raised compared to the bounded housing system (+2420; +1900 and +1825, respectively). The total number of dairy cows (4,540, 4,300 and 4,065, respectively) is devastating considering that in 2010, 21,568 head of cattle were raised, of which 8,721 were dairy cows (Stojić et al., 2010).

Examining the keeping of the Holstein-Friesian breed during 2011 in the Belgrade region, Stojić et al. (2012) determined that their average milk production per day in the milk was 21.96 kg, per day of life 10.63 kg and per productive day 19.75 kg. In this research, in the free system a higher daily milk yield per head (29.0 kg) was achieved compared to the bounded system (27.2 kg). The amount of milk was higher for 1,8 kg which resulted in a higher annual milk production (6,889 kg compared to 5,278 kg). The results are consistent with the research of Popović et al. (2015) who found a highly significant influence of non-genetic factors (farm, year, calving season) on the variability of milk yield and production characteristics of black and white cattle ( $P < 0.01$ ).

Table 2. The relationship between some characteristics of milk yield on Al Dahra farms in relation to the housing system

Year	Housing system*	Cows number	Daily milk yield, kg	Annual milk yield, kg
2021	A	3600	28,8	6.480
	B	1180	26,2	4.585
	Differ.	+2420	+2,6	+1895
2022	A	3100	28,6	6.893
	B	1200	27,6	5.382
	Differ.	+1900	+1,0	+1513
2023	A	2945	29,5	7287
	B	1120	27,8	5867
	Differ.	+1825	+1,7	+1420
Average	A	2135	29,0	6889
	B	1666	27,2	5278
	Differ.	+469	+1,8	+1611

\* A – Free housing system; B – Bounded housing system

Examining the milk and reproductive characteristics of the cows of the Holstein-Friesian breed, Lazarevic (2019) determined that in lactation, with average duration of 373.89 days, the average milk yield was 9,452.52 kg with 3.48% milk fat and 3.23%



protein. Comparison of the above mentioned results with milk yield of the tested dairy cows of the same breed at Al Dahre farms indicates significantly lower values (-1611 kg) (table 2), but the milk quality is competitive with 3.6% milk fat and 3.25% protein (table 4).

Table 3. The relationship between some characteristics of reproduction on Al Dahra farms in relation to the housing system

Year	Housing system*	Service period	Insemination index for cows	Insemination index for heifers
2021	A	140	3,6	2,0
	B	190	4,2	2,6
	Differ.	-50	-0,6	-0,6
2022	A	124	3,2	1,9
	B	170	3,8	2,3
	Differ.	-46	-0,6	-0,4
2023	A	118	3,0	1,9
	B	154	3,3	2,2
	Differ.	-36	-0,3	-0,3
Average	A	127	2,7	1,9
	B	171	3,8	2,4
	Differ.	-44	-0,9	-0,5

\* A – Free housing system; B – Bounded housing system

Đedović et al. (2020) stated that in the population of black and white cows, the duration of the service period was 98.78 days, which is significantly shorter than the service period of cows on observed farms, although the duration of the service period of 127 days in the free system is shorter 44 days than duration of the service period in the bounded system (171 days). However, the duration of the service period on the surveyed farms is significantly shorter compared to the research by Trifunović et al. (2005) and Gouda et al. (2017) (141.35 days and 165.8 days, respectively). The free housing system also led to a lower insemination index for both cows (2.7) and heifers (1.9) compared to the other way of housing (3.8 for cows and 2.4 for heifers) (table 3). Trifunović et al. (2005) established in the population of black and white cattle the mean values of the general average for the insemination index of 2.44.

Table 4. Important indicators of milk production during 2021-22-23 at Al Dahra farms

Milk fat content, %	3,6
Protein content, %	3,25
Average number of lactation	2,6
Age at excretion	5 година
Remount herd	35%

This confirms that fertility traits in Holstein-Friesian populations expressed significant variability. Conclusion can be made that long-term unilateral selection aimed at improving milk yield traits had a negative impact on fertility traits, but management also has a decisive role.

Novaković et al. (2009) examined 331 cows that originally belong to the European type of black and white cattle and they are in the final phase of intensive breeding with the Holstein-Friesian breed. They determined that the average age of cows at the time of exclusion was  $2,265 \pm 463.26$  days or  $6.21 \pm 1.27$  years. In Al Dahra, the age at exclusion is significantly lower, i.e. around 5 years on average, which significantly reduces the profitability of production.

Also, Novaković et al. (2009) claim that prolonging of production life of animal reduces the percentage of remount in the herd, which enables more strict selection in regard to other traits and additional income from sale of breeding material.

Stojić et al. (2012) examined the causes of exclusion of cows from the herd in Holstein-Friesian breed. The research was conducted on a sample of 3,060 excluded cows during 2011 on seven big dairy farms in the Belgrade region. The mentioned authors determined that at the time of exclusion the cows were on average 5.18 years old, and they spent an average 1,112 days in production, of which 978 days were in dairying.

In addition to the improvement of housing conditions of highly milking cows, the dairy profile (genetics), regular control of the genital apparatus, artificial insemination technique, nutrition, drying and body condition have a great influence on the fertility and should not be ignored (Lyubimov et al., 2020). Novaković et al. (2009) recommend, beside the effort invested into increase of the level of production, it is necessary to consolidate certain physical qualities of cows using selection, in order to contribute to increase of production and prolonging of the lifetime period of cows in the herd. The mentioned authors claim this is especially important if stress effects of intensive rearing system are taken into consideration, as well as housing conditions and exploitation conditions. Study of the body development and type should be more in focus of the attention through defining of certain breed type of animal which would be most suited for the breeding purpose. Body development/condition and type should be considered in relation to rearing conditions and realized production.

Holding systems are part of the management of milking cow farming technology and the results obtained in the research are expected. In their research, Lyubimov et al. (2020) confirmed the high impact of cultivation technology on milk yield traits and fertility traits.

Ostojić Andrić et al. (2022) conclude that the initial hypothesis of the better welfare quality in the loose system can be accepted if taking into account that the majority of the farms with loose system were classified into a better category compared to the tie-stall system. However, by perceiving values and relations of welfare parameters between housing systems in more detail, it can be concluded that the welfare quality parameters were not exceptional in any of them.

Although the Al Dahra farm adopted a free system of keeping cows, there is no monitoring that would emphasized all the advantages of this system.

## **CONLUSIONSS**

Housing system is a factor that strongly affects the welfare quality of dairy cows. The milk yield of cows on a farm with a free system is significantly higher in each year, which indicates the great influence of the housing system as a non-genetic factor on milk properties. The examined reproductive traits were also better in cows and heifers in the free housing system. Certain reproductive traits were better compared to previous research.

Given that the content of fat and protein, as well as the year of excluding and the remount of the herd did not different between the herds, it could be pointed out that the available investigations of housing system did not bring complete answer on all questions. However, based on this research we can recommend a free housing system with positive influence on the welfare of the animals.



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