RESEARCH ON MILK PRODUCTION POTENTIAL IN COWS FROM A DAIRY FARM: ANALYSIS AND PERSPECTIVES

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Abstract

This paper presents an analysis of milk production and quality at the Moara Domnească farm between 2020 and 2023, with a focus on key parameters such as total bacterial count (TBC) and somatic cell count (SCC). The data reveals a significant increase in milk production in 2023, after a slight decline from 2021 to 2022. The highest production occurred in May 2021, while November 2023 recorded the lowest. In terms of quality, the milk generally met safety standards, with TBC and SCC values staying below legal limits. However, occasional spikes in SCC were noted in early and mid-2023 due to health issues in some cows, whose milk was excluded from the market. The study suggests stricter veterinary controls, careful feed management based on lactation stages, and enhanced milking hygiene to ensure consistent production and maintain milk quality. These measures are crucial for reducing bacterial contamination and preventing diseases like mastitis, ensuring high standards in dairy production.

Key words: *cow, milk, production. quality, quantity*

INTRODUCTION

The importance of animal husbandry, especially dairy cattle farming, and milk production is essential from several perspectives: economic, social, nutritional, and ecological. A worldwide transformation is underway, driven by new global challenges with long-term effects, necessitating the development of a strategic vision in animal breeding and the food industry [1].

The dairy cattle sector plays a central role in agriculture, providing basic food, economic income for farmers, and essential dairy products for human health. It is anticipated that future milk production will embody sustainable intensification, benefiting animals, agro-ecosystems, and humanity by supplying essential nutrients for human consumption [2].

Romania's milk production falls for the second year in a row in 2022, also under pressure from rising costs (especially fuel and energy) of the drought that has affected the quantity and quality of feed and the pressure of large processors to impose prices. However, the quantities of milk collected by milk processing factories had an increasing trend. This also led to the manifestation of a general tendency of increasing in the production of dairy products [3].

Technologies used in livestock management, including feeding, milking, and facility hygiene, along with environmental factors such as season and

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high temperatures, have an impact on milk quality [4].

The microbiological quality of raw milk is one of the quality standards that need to be considered. While still in the udder milk, the milk is still sterile, contamination can occur after coming out of the udder due to several sources of pollutants [5].

Total bacterial count and somatic cells count are the most widely accepted indicators to evaluate raw milk quality [6]. The quantitative and qualitative parameters of milk production are essential in evaluating economic performance and ensuring a quality product for consumers.

These parameters directly influence farm profitability, animal health, and the fulfilment of market demands.

This paper aims to present the partial results of a study on the quantitative and some qualitative parameters of milk from dairy cows at the Moara Domnească farm, located in the milk supply area of Bucharest. The study seeks to evaluate milk production performance and quality, focusing on aspects such as microbiological parameters. These preliminary data will contribute to a better understanding of the performance of farms in the analysed area, providing useful information for optimizing production processes and ensuring high-quality milk that meets the demands of the Bucharest market.

MATERIAL AND METHOD

The biological material studied in this research consists of Montbéliarde dairy cows raised at the Moara Domnească didactic cattle farm from 2020 to 2023.

The Montbéliarde breed is a dairy cattle breed originating from France, known for its excellent milk production capabilities and adaptability to various environmental conditions. Montbéliarde belongs to the group of dual-purpose milk-beef breeds and is considered the most refined breed for milk production within the Simmental family [7].

The dairy cows are housed in a shelter that is 79.5 meters long, 9.6 meters wide, and 2.7 meters high up to the roof (5.5 m height of the roof). The shelter features three sections: a resting area, a feeding front for stationary positioning, movement, and waste removal, as well as an access aisle for feed management. Additionally, the cows have access to an outdoor pen, which includes a feeding and watering area located in the shade of a protective canopy.

The cows are milked twice a day, in the morning (between 5:00 and 6:30) and in the evening (between 17:00 and 18:30).

Milk samples were collected to assess both the quantity and quality of the milk produced by each animal and by the herd as a whole. The study focused on the herd size, milk quantity, as well as milk quality in terms of total number of bacteria (TBC), and somatic cell count (SCC)

Data on the quantitative and qualitative parameters of milk production were obtained both through automatic recording, using the herringbone milking system, equipped with a GEA digital evaluator for measuring milk quantity, and through chemical and microbiological analyses. These analyses were conducted at the Laboratory of the Milk Quality Control Foundation—accredited by RENAR—and at the Veterinary and Food Safety Laboratory in Bucharest, using specific equipment and analysis methods (SR EN ISO 13366-2:2007, SR EN ISO 4833-1/2014).

The results of the quantitative and qualitative parameters of the farm's milk production, obtained during the research period, were processed through numerical techniques: simple frequency analysis and graph and statistically analysed, using summative numerical indicators of central tendency (mean - $\overline{X}$) and dispersion (standard error of the mean - $s_{\overline{X}}$, standard deviation - SD and coefficient of variation - CV%).

RESULTS

After the centralization and statistical processing of the data, the results regarding the quantitative production of milk are presented in the following tables and figures.

Table 1 and 2 and Figure 1 and 2 present the monthly milk production (total and average), the number of cows milked each month, the total production for each year, the average and total milk production per year and per cow and the dynamics of annual averages for milk production and the milking herd size during the period 2020–2023. TBC and SCC situation are presented in Table 3 and Figure 3 and 4.

Table 1. Total monthly milk production during the period 2020-2023 (Kg)

Month	Year											
	2020			2021			2022			2023*		
	N	Kg	$\bar{X}$	N	Kg	$\bar{X}$	N	Kg	$\bar{X}$	N	Kg	$\bar{X}$
January	26	9991	384.27	18	7481	415.61	23	7642	332.26	23	7688	334.26
February	26	8360	321.54	16	6545	409.06	24	7121	296.71	28	8428	301.00
March	23	8370	363.91	18	6700	372.22	24	7728	322.00	31	12402	400.06
April	23	8856	385.04	18	5625	312.50	23	7046	306.35	31	11147	359.58
May	22	9063	411.95	17	8030	472.35	25	8530	341.20	31	11157	359.90
June	22	8166	371.18	24	9720	405.00	25	7325	293.00	31	11264	363.35
July	19	7504	394.95	24	9743	405.96	23	6688	290.78	30	10931	364.37
August	19	6343	333.84	25	8560	342.40	22	7195	327.05	28	10981	392.18
September	16	5150	321.88	26	8754	336.69	22	6848	311.27	29	10942	377.31
October	18	5743	319.06	27	9662	357.85	23	7014	304.96	27	7797	288.78
November	18	5350	297.22	24	7060	294.17	24	7370	307.08	28	7779	277.82
December	18	7483	415.72	16	4542	283.88	25	7934	317.36	27	8673	321.22
Total		**90379**	**360.05**		**92422**	**367.31**		**88441**	**312.50**		**119189**	**344.99**

Table 2. Average and total milk production per year and per cow during the period 2020-2023

Year	Specification	Total	$\bar{X} \pm S_{\bar{X}}$	SD	CV%	Minim	Maxim
2020	Milk production per year	90379.00	7531.58±452.15	1566	20.80	5150	9991
	Milk production per cow	4320.57	360.05±11.55	40.02	11.11	297.22	415.72
2021	Milk production per year	92422.00	7701.83±485.65	1682.35	21.84	4542	9743
	Milk production per cow	4407.69	367.31±18.62	64.50	17.56	283.88	472.35
2022	Milk production per year	88441.00	7370.08±148.98	516.09	7.00	6688	8530
	Milk production per cow	3750.02	312.50±4.58	15.86	5.07	290.78	341.20
2023	Milk production per year	119189.00	9932.42±492.73	1706.85	17.18	7688	12402
	Milk production per cow	4139.84	344.99±11.59	40.16	11.64	277.82	400.06

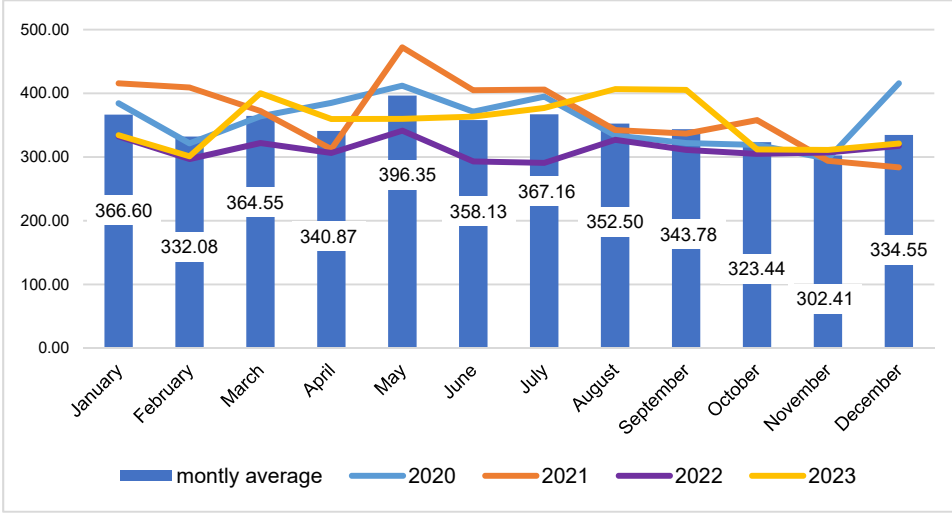

Figure 1. The dynamics of monthly milk production during 2020-2023 period

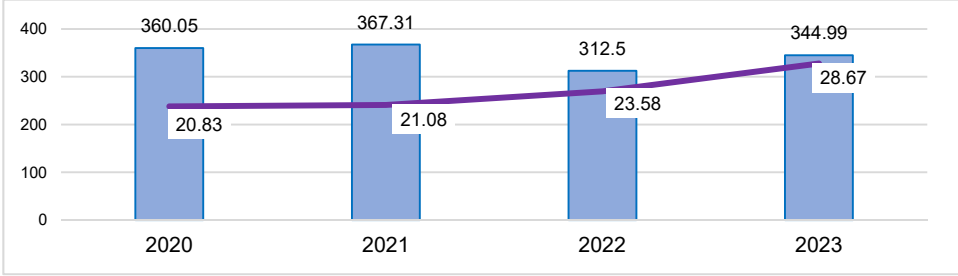

Figure 2. The dynamics of annual averages for milk production and the milking herd size during the period 2020–2023

Table 3. The annual average values for total number of bacteria (TBC) and somatic cell count (SCC) of the milk production during the period from 2020 to 2023

Year	TBC x 10000 CFU/ml				SCC / ml			
	N	$\bar{X} \pm S_{\bar{X}}$	**S**	**CV %**	N	$\bar{X} \pm S_{\bar{X}}$	**S**	**CV %**
2020	23	5.25±0.48	2.34	44.61	13	129840.38±12074.26	43534.36	33.52
2021	25	7.49±0.18	0.93	12.43	12	134180.42±1594.31	5522.87	4.11
2022	13	4.77±0.65	2.35	49.40	12	208622.08±40479.69	140225.78	67.22
2023	14	6.43±0.39	1.48	22.99	11	127745.36±11985.87	39752.64	31.12

CFU - colony-forming units.

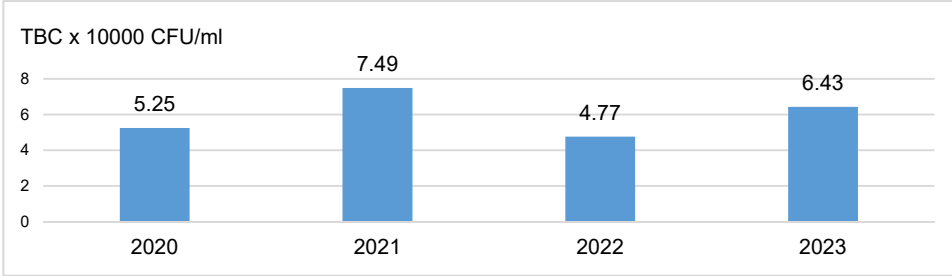

Figure 3. The annual average values for total number of bacteria (TBC x 10000 CFU/ml) of milk production during the period from 2020 to 2023

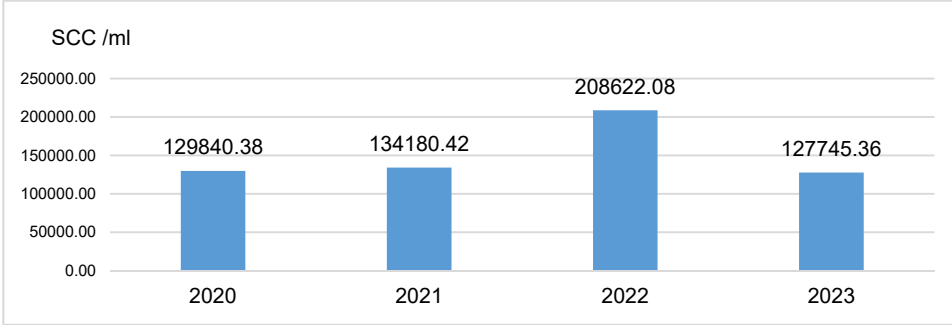

Figure 4. The annual average values for somatic cell count (SCC) of milk production during the period from 2020 to 2023

DISCUSSIONS

During the monitored period, there were days when some cows were either not milked or milked separately, leading to their exclusion from the daily milk production, even though they were nominally included as milking cows for that month.

The highest annual milk production was achieved in 2023, followed by production in 2021. In 2023, compared to 2020, there was an increase of 28,810 kg of milk, and compared to 2022, an increase of 30,748 kg of milk. In the first five months of 2023, approximately 67% of the production obtained in 2021 was achieved, due to the increase in the number of milking cows, and by the end of 2023, this percentage reached 128%, exceeding the 2021 production by 26,767 kg. The lowest milk production in the analysed period was recorded in September 2020, when 5,150 kg of milk were obtained from only 16 cows. In contrast, the highest production, 12,402 kg, was reached in March 2023, when 31 cows were milked (Table 1 and Figure 1)

Milk production followed a slightly downward trend between 2021 (92,422 kg) and 2022 (88,441 kg), but in 2023, there was a significant increase, reaching 119,189 kg. The analysis of monthly production reveals that the best performance was in May 2021, with 472.35 kg of milk per cow, and the lowest was in November 2023, with 277.82 kg of milk per cow. Regarding annual production, 2022 recorded the lowest average, with 312.5 kg per cow, while 2021 had the highest, at 367.31 kg per cow (Table 2)

The increase in milk production in 2023, compared to the other years studied, is also attributed to the month-to-month growth in the number of milking cows, compared to the same months in previous years. The herd reached 31 lactating cows in March,

April, May, and June 2023, then slightly decreased to 27 lactating cows by December 2023.

The highest monthly average milk production for the period 2020-2023 was recorded in May for all years (411.95 kg, 472.35 kg and 341.20 kg), except for 2023, when the highest average production occurred in March (400.06 kg). The lowest monthly average milk production varied from year to year: in 2020 and 2023, it was in November (297.22 kg and 277.82 Kg), while in 2021 and 2022, it occurred in December (283.88 kg) and July, respectively (290.78 kg).

The highest annual average milk production was recorded in 2021 (367.31 kg), when the average number of milking cows was 21.08. The lowest annual average milk production was in 2022, with 312.50 kg, at an average of 23.58 milking cows. (Table 1 and 2 and Figure 2).

Milk quality is a crucial aspect, both in terms of animal health and food safety for human consumers, as milk from the Moara Domnească farm is sold and processed into dairy products.

The sanitary and hygienic properties of milk include indicators such as total bacterial contamination and the quantitative content of somatic cells (SCC).

The number of somatic cells per 1 ml of milk is one of the most important and informative indicators regarding milk quality. A certain amount of these cells is always present in milk, even from healthy cows; however, in cases of udder diseases, the number of somatic cells increases.

Milk samples were individually collected from each cow and sent for analysis. Cows with (udder) health issues were removed from the herd, and their milk was not used for consumption or mixed with the rest of the collected milk, from which samples were taken for analysis.

In the four years studied, the results for total number of bacteria (TBC) and somatic cells count (SCC) remained below the maximum limits set by current legislation, not exceeding 100,000 TBC / ml and 400,000 SCC / ml, indicating that, in general, milking hygiene, animal health, and milk processing conditions are adequate. The high coefficient of variation (over 30%) in 2020 and 2022 indicates significant fluctuations among the analysed samples, even though the average values are within normal parameters. This suggests that there may be inconsistencies in herd management or hygiene practices.

CONCLUSIONS

Milk production varied from year to year. These fluctuations were observed both throughout each month in the analysed years and in the same month across different years. The changes were mainly influenced by the variable monthly and annual size of the milking herd, as well as factors such as microclimate conditions in the shelters, and the cows' physiological and health status

Each month recorded a specific average milk production per cow, influenced by the number of cows being milked, the cows entering or exiting lactation, and the individual production of each cow

The milk quality met the required standards. Sanitary and hygienic parameters, such as the total germ count (TBC) and somatic cell count (SCC), were below the maximum permissible limit of 400,000 SCC/ml. However, there were a few months in 2023 (January, February, and August) where these values were exceeded, reaching 472,280 SCC/ml, 450,140 SCC/ml, and 563,080 SCC/ml, respectively. These spikes were attributed to isolated cases of poor health in certain cows, whose milk was not processed or sold until the health issues were resolved. Therefore, the milk produced can be considered safe for consumption and suitable for processing.

It is recommended to implement stricter zootechnical and veterinary controls, along with closer monitoring of the animals'

health and reproductive parameters, to reduce large fluctuations in herd composition by age and physiological state, and to ensure a more consistent milk production. Additionally, careful feed planning, focusing on the nutritional needs during different lactation stages, can help prevent production declines and improve milk quality. Consistent administration of feed that provides a balanced supply of energy and nutrients is also advised. Implementing strict hygiene measures during milking and conducting regular udder health checks is essential to reduce bacterial contamination levels and prevent the occurrence of mastitis and other diseases that affect udder health. These actions contribute to lowering somatic cell counts and maintaining milk quality

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