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ANALYSIS OF MILK PRODUCTION AND MILK QUALITY IN MONTBELIARD COWS FROM A FARM IN SOUTHEASTERN ROMANIA

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Abstract

Milk has had a fundamental importance in nutrition over the centuries, mainly due to its high nutritional value, which results from a diversified chemical composition, including fat, protein, lactose, and mineral content. This study aims to monitor milk production and the evolution of the main milk quality parameters such as fat, protein, lactose, dry matter, and somatic cell count. The study was carried out on a farm in southeastern Romania, on Montbeliard cows raised in an intensive system. The study was conducted over 12 months, covering both the warm and cold seasons. The results highlighted the importance of monitoring milk production and that a well-balanced nutrition, which includes high-quality feed, is essential for maximizing milk yield, but also for its chemical composition.

Key words*: cow farm, dairy cows, fat content, milk quality, protein content.*

INTRODUCTION

Milk is generally defined as a whitish liquid secreted by the mammary glands of female mammals (Ben Franj et al., 2023). Milk has played a fundamental role in nutrition over the centuries, mainly due to its high nutritional value, which results from a diversified chemical composition, including fat, protein, lactose, and mineral content (Dror & Allen, 2014; Mihai et al., 2019; Kapaj & Kapaj, 2021). Notably, approximately 87.7% of milk is water, with the remaining constituents distributed in various forms, and the proportion of each component differs between breeds (Tyasi et al., 2015). Feeding management practices on dairy farms significantly influence the levels of fat and protein concentration in milk. Consequently, all factors affecting milk composition including nutrition, and feeding management have the potential to compromise milk quality (Tyasi et al., 2015). The quality and composition of milk can vary significantly depending on a number of factors such as breed, diet, season, stage of lactation, husbandry system, environmental conditions, etc. (Ben Franj et al., 2023; Kostovoska et al.,2024).

In Romania, the milk and dairy sector constitutes one of the most significant segments of national agriculture, representing more than 25% of total agricultural production and approximately 10% of animal production. The main source of milk comes from the exploitation of animals in the private sector, which contributes over 95% to total milk production (Porosnicu et al., 2020). Milk quality is one of the major challenges in Romanian cow farms, especially regarding parameters influenced by hygiene (Răducu C. et al., 2016).

Among the most widespread breeds of cows in Romania are Holstein, Montbeliard, Romanian Spotted (in Romanian: Bălțată Românească), Brown (in Romanian: Brună) and Jersey (Grăsinaru et al., 2018). The Montbéliarde cattle breed became known in Romania in 2009, after importing several animals from France. Today, Montbéliarde cattle are raised in several countries on five continents, and they are known globally for their dual purpose of milk and meat production (Mirulugovna, 2020; Soatov et al., 2021). Although primarily raised for milk production, Montbéliarde also demonstrates significant potential in the production of quality meat. The breed does not require very special care, for this reason, it has successfully adapted to the environmental conditions of the area, Romania having a temperate continental climate (Mihai et al., 2019).

The main purpose of this paper is to analyze milk production from Montbeliard cows, and the evolution of the main milk quality parameters such as fat, protein, lactose, dry matter, and somatic cell count.

MATERIALS AND METHODS

The study was conducted over 12 months between January and December 2024, at a Montbeliard cow farm in southeastern Romania to monitor milk production and determine chemical composition and somatic cells. The research included a total of 350 Montbeliard cows raised on an intensive farm. All animals included in the study were selected with great care, taking into account similarity criteria in terms of weight, age, and health status. The methods for assessing milk quality consisted of physicochemical and microbiological analyses. Milk samples were taken daily for laboratory analyses, such as determining the percentage of fat, protein, and lactose, using an automatic milk analyzer according to ISO 9622:2013. Each sample was obtained through standardized procedures, using sterile containers to avoid contamination and, if necessary, a preservative such as bronopol. The samples were collected in sterile containers, labeled and placed in an ice box, and transported immediately to the laboratory. The samples were collected in the morning at the first milking and their analysis was performed within two to three hours after sampling.

Located in southeastern Romania, Călărași County is characterized by a dominant relief of plains and meadows, with an average altitude of 46 meters, with maximums of up to 83 meters and minimums of 8 meters. The climate is temperate-continental, influenced by the uniformity of the plain relief, manifested by very hot summers and cold winters. Located on the course of the Danube and the Borcea branch, the region occupies a significant portion of the Muntenia Plain.

For statistical analysis, the data obtained were analyzed using the ANOVA and FISHER tests.

For statistical analysis, the following intervals of the variables were considered: fat ≥ 3 and $\leq 4\%$; protein ≥ 3 and $\leq 4\%$; lactose ≥ 4.5 and $\leq 5.5\%$. All parameters were evaluated using an analysis of variance (ANOVA), analyzing the variations in the chemical composition of milk and milk production over the 12 months. For all statistical analyses, $p < 0.05$ had a significant effect, and at $0.05 < p \leq 0.1$ there was a trend.

RESULTS AND DISCUSSIONS

Farm description

The farm studied is divided according to Table 1. The stables are made of metal structures with large openings (large air volume), with a height of 5 m at the eaves and 11 m at the ridge. The livestock farm is composed of 4 stables (3 for lactating cows and a stable for calves between 0 and 6 months - maternity). For raising dairy cows, the farm's activity is focused on ensuring the comfort and welfare conditions of the animals in the 4 shelters in order to obtain better results regarding the quantity and quality of the finished product.

Table 1. Shelter size and farm capacity in Călărași County

Cowshed	Area (m^2)	Number max
Cowshed 1	3200	150 lactating cows
Cowshed 2	3200	150 lactating cows
Cowshed 3	2820	120 cows in maternity
Cowshed 4	2800	120 lactating cows
Total	12.020	

Description of the technological flow

The interior of a stable was divided into three distinct areas: a) the feeding area consists of two perimeter alleys (Figure 1) where the animals receive food. The alleys are sufficiently wide for the machines that administer the feed to access them. Access to the feed is through a specially arranged, self-capturing fence, with feeding possible for each animal; b) the animal rest area is provided with individual boxes separated by a metal bar. These boxes offer increased comfort to the animals, who are on chopped straw bedding provided with dividing bars. Each animal has its own resting place and an adjustable tube depending on its size, but it is not possible for the animal to defecate on the resting bed; c) the free area where the animals move and have access to the feeding, watering, and resting areas. The animals are watered using tilting stainless steel drinkers with a constant level and water flow depending on the number of animals in the respective batch. Access to water is

permanent, allowing the animal to be watered as often as needed.
The animal circulation alley is made of rolled concrete with a slight slope with an inclination towards the scraper bridge gutter that pushes the manure at the end of the stable into a concrete collector channel and a concrete collection pit, respectively, allowing the manure to be stored. The evacuation of manure from the movement alley is done using the scraper plow.

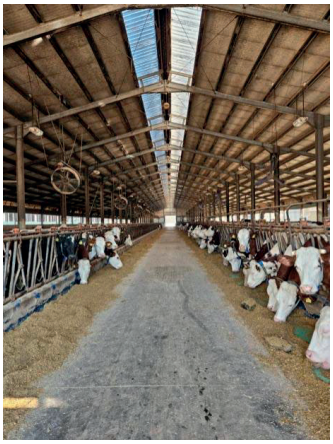

Figure 1. Feeding area consisting of two alleys, in a dairy farm (original)

The milking process

The animals are directed to the milking parlor (area 200 m^2) (Figure 2) in production batches, avoiding crowding and animal stress.

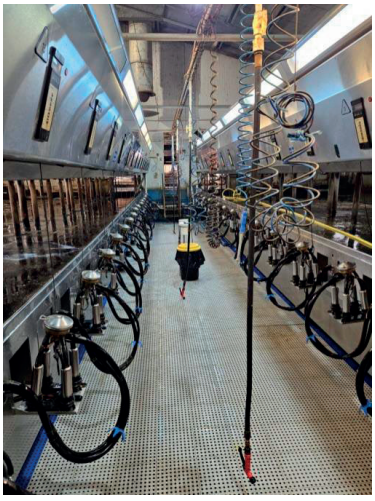

Figure 2. Cow milking area automatic milking system (original)

The duration of milking for an animal is 12 minutes, after which the animals return to the shelter through specially arranged corridors, equipped with gates (closing-opening), so that they reach the stable area to be fed. The milk milked from the animals is pushed with a pump on a stainless steel pipe to the cooling and storage tank, which keeps the milk at a temperature of 4°C, from where the milk is delivered.

Microclimate

The cattle shelter ensures an appropriate microclimate in terms of the construction itself, which is made of thermally insulating materials with access routes for feed administration and manure evacuation, drainage channels and a paved resting area. The brightness of the shelters is ensured by spaces with vertical openings with an area of 1/20 of the total area of the shelter. The bedding is changed daily, keeping it dry to prevent manure from depositing, especially on the back of the cow (udder and other nearby portions) and to avoid infections.

Feeding

Other spaces within the zootechnical complex are used to store fibrous feed and silage corn. The animals are fed with feed from their own production (Figure 3).

Figure 3. Feeding dairy cows with stock feed (original)

For the preparation of concentrated feed, there is a mill on the farm premises for grinding and mixing appropriate feeding recipes. Throughout the 12 months of the study, the cows' nutrition

was not modified; they were fed with stock feed.The cows' ration consists of fully ground corn on the cob, corn silage, wheat bran, barley, oats, soybean meal, alfalfa hay, semi-hay and sphagnum.

Milk composition

Table 2 presents a summary of three components of cow's milk: fat, protein and lactose, evaluating them by means of the mean, standard deviation, and minimum and maximum values. The mean fat content is 3.62%, which indicates a relatively constant concentration in most of the samples analyzed.

Table 2. Milk composition: Mean, Standard Deviation, Minimum and Maximum for fat, protein and lactose

	Fat content	Protein content	Lactose content
Mean	3.62	3.57	4.83
Std. Deviation	0.1	0.08	0.05
Minimum	3.51	3.46	4.73
Maximum	3.8	3.67	4.92

The standard deviation of 0.1 suggests a low variability around this mean. The minimum and maximum values, of 3.51% and 3.8%, respectively, show that fat levels are well controlled and do not undergo significant variations over the 12 months. For protein, the mean is 3.57%. The standard deviation of 0.08 also indicates a low variability. The minimum and maximum values, of 3.46% and 3.67%, respectively, reflect the lack of significant differences over the 12 months, the total difference being 0.21%. As for lactose, the mean is 4.83%. The standard deviation of 0.05 suggests an extremely low variability, indicating a pronounced uniformity of this component in the analyzed samples. The minimum and maximum values, of 4.73% and 4.92%, denote a similar consistency inlactose content, without significant differences. The data in Table 2 suggest that the investigated samples have a stable content, with minimal variations in fat, protein and lactose levels.

Figure 4 provides information on the fat, protein and lactose content of cow's milk, analyzed during each month of 2024. Regarding fat, a slight variation is observed, with the highest values in October (3.80%) and the lowest in April (3.51%). This suggests a general trend of increasing fat content in the autumn season, which could be influenced by the microclimate or the health of the cows. It is worth noting that the nutrition of the cows was not changed throughout the analysis. The protein content remains relatively constant throughout the year, with minimum values observed in June (3.46%) and maximum values in October, November and December (3.67%). This stability suggests uniformity in the nutrition and health of the animals, with no significant fluctuations affecting the quality of the milk proteins. Regarding lactose, the content fluctuates insignificantly throughout the year, with the lowest values in January (4.73%) and the highest in April (4.92%). These minimal variations indicate possible seasonal influences, suggesting that the composition of milk is affected by environmental conditions, especially during winter and summer.

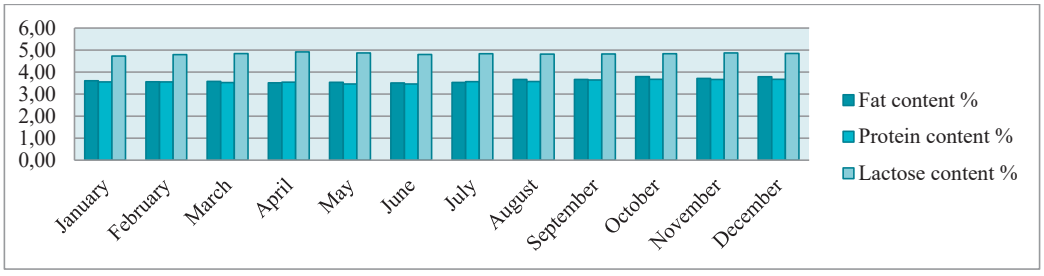

Figure 4. Variation in protein, fat and lactose content over 12 months

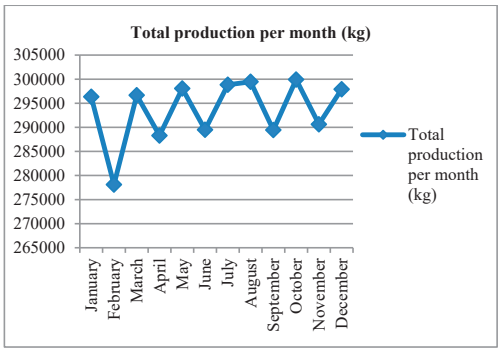

Figure 5. Total milk production per month for 12 calendar months

The analysis of total milk production throughout the year highlights significant variations throughout the period, with a peak recorded in October when production reached 299,925 kg (Figure 5). This is possibly influenced by favorable climatic conditions and maintenance technology. In contrast, February recorded the lowest production, with 278,110 kg, which may indicate possible challenges encountered during the winter period, such as animal welfare, but also the fact that February has fewer days than the others. Most months in the analyzed interval show a relatively constant production, with values fluctuating around the average. For example, milk production in January (296,360 kg) and March (296,670 kg) is similar, which suggests stability in feed management and cow health. August saw a notable increase in production (299,460 kg), indicating increased efficiency in animal care and feeding practices. Overall, the data suggests a positive trend in total milk production.

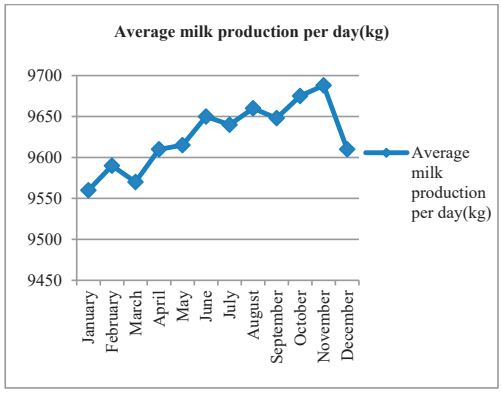

Figure 6. Average milk production per day (kg)

Analysis of the average daily milk production, as shown in Figure 6 with the data presented, highlights a general trend of slight increase throughout the year, with minimal variation between months. Starting with January, daily production was 9,560 kg, and in December a value of 9,610 kg was recorded, suggesting stability on the farms throughout the year. This analysis suggests that farmers had to continue to optimize their care practices to maintain these production levels. Overall, the data reflects a good performance of the dairy herd with minimal variations.

CONCLUSIONS

The analysis of the chemical composition of the milk showed a slight variation in fat content, with maximum values in October (3.80%) and minimum values in April (3.51%). The protein content remained relatively constant throughout the year, with minimum values in June (3.46%) and maximum values in October, November and December (3.67%). The lactose content showed insignificant fluctuations, with the lowest values in January (4.73%) and the highest in April (4.92%). The results obtained emphasize that although the nutrition of the cows was not modified during the analysis, the health of the cows, environmental conditions and maintenance technology can influence the chemical composition of the milk.

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REFERENCES

Ben Franj, S., Enea, D.N., Marin, M., Marginean, G.E., & Vidu, L. (2023). Research on different types on protein in cow's and sheep's milk according to different influencing factors (season, feed ration, breed, physiological condittion), *Scientific Papers. Series D. Animal Science*, *LXVI*(1), 259-267.

Dror, D.K, & Allen, L.H. (2014). Dairy product intake in children and adolescents in developed countries: trends, nutritional contribution, and a review of association with health outcomes. *Nutrition Reviews.,* 72, 68–81.

Grădinaru, A. C., Petrescu-Mag, I. V., Oroian, F. C., Balint, C., & Oltean, I. (2018). Milk Protein Polymorphism Characterization: a Modern Tool for Sustainable Conservation of Endangered Romanian Cattle Breeds in the Context of Traditional Breeding. *Sustainability*, *10*(2), 534.

Kapaj, I., & Kapaj, A. M. (2021). An Analysis of Household Consumption of Dairy Products. *Archives of Business Research*, 9(1), 148–153.

Kostovska, R., Horan, B., Drouin, G., Tobin, J. T., O'Callaghan, T. F., Kelly, A. L., & Gómez-Mascaraque, L. G. (2024). Effects of multispecies pasture diet and cow breed on milk composition and quality in a seasonal spring-calving dairy production system. *Journal of dairy science*, *107*(12), 10256–10267.

Mihai, R., Hassan, A. A. M., Marin, I., Fîntîneru, G., & Vidu, L. (2020). Impact of Precision Livestock Farming on Welfare and Milk Production in Montbeliarde Dairy Cows**.** *Sci. Papers. Ser. D. Anim. Sci., 63*(2), 165–169.

Mihai, R., Mihalascu, C., Marginean, G.E., Marin, M.P., Caratus, M.A., & Vidu, L. (2019). The dynamics of milk production in Montbeliarde breed on a farm in southern Romania. *Sci. Papers. Ser. D. Anim. Sci.*, *62*, 165–169.

Mirulugovna, E.G. (2020). Characteristics of Montbeliard cows, recommendations for feeding. *The American Journal of Interdisciplinary Innovations and Research*, *2*(07), 114–119.

Porosnicu, I., Ratu, R.N., Davidescu, M.A., Madescu, B.M., Matei, A.C., Creanga, S., & Usturoi M.G. (2020). Researches on the quality assessment of mozzarella cheese for the safety of use. *Scientific Papers. Series D. Animal Science*, *LXIII*(2), 370-376.

Răducu, C., Vioara, M., Coroian, A., Pop, C., Coroian, C., Cocan, D., & Andronie, L. (2016). Study on the milk quality parameters in three farms from Sălaj County. *Bulletin of University of Agricultural Sciences and Veterinary Medicine* Cluj-Napoca, Animal Science and Biotechnologies, 73.

Soatov, U., Ashirov, M., Eranova, G., Ulmasov, B., & Kasimova, M. (2021). Productivity characteristics of Montbeliard breed cows in the conditions of Uzbekistan. *E3S Web of Conferences,* 258, 04045.

Tyasi, T., Gxasheka, M., & Tlabela, C. (2015). Assessing the effect of nutrition on milk composition of dairy cows: A review. *International Journal of Current Science*, 56–63.