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# RESEARCH ON THE INFLUENCE OF TECHNOLOGICAL FACTORS ON PRODUCTIVE PERFORMANCE IN A BROWN CATTLE HERD

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***Abstract***

*This paper aims to highlight the influence of exploiting technology on productive performance in a dairy herd belonging to the Brown breed. The herd for which the study was carried out consisted of 48 head of cows in different lactations and which are exploited for semi-intensive milk production on a farm in NV Moldova, Romania. The data on milk production and quality for 2024 were obtained from records drawn up during the official control of the productions and those existing on the farm and were statistically processed using the software SAVC and SPSS 16.00 for WINDOWS. The average daily production was 20.03 kg of milk/head with 4.13% fat and 3.59% protein. The highest average production of 5,699.26 kg was achieved in the second lactation, when milk contained 3.83% fat and 3.42% protein. Analyzing the results obtained and comparing them with those characteristics of maternal ascendancy, we can conclude that, in the herd studied, milk is of good quality, but the animals do not externalize their genetic potential.*

***Key words:*** *Brown breed, milk, Romania.*

## INTRODUCTION

Milk is a biological product synthesized by the mammary gland of mammals. In the case of taurines, its organoleptic properties are a white-yellowish color, a sweet taste, and a characteristic smell (Bosch et al., 2025). Of all foods of animal origin, milk is considered the most complete, easily assimilated by the body, and can be constituted as a basic food for human nutrition, especially during the period of growth and development of the body (Guzun, 2001).

Milk is a complete product and has a high biological value because its composition includes all essential amino acids and more, enzymes, over 10 fatty acids, lactose, 25 vitamins, and more than 45 mineral elements. (Mihai et al., 2020). Milk consumption benefits the body by increasing its resistance to infections and intoxications and by directly contributing to the improvement of the population's health status (Wirth & Duda, 2021).

The energy value of milk is 680 calories/kg and it is equivalent to the caloric energy contained in 600 g of beef, 500 g of fish, 400 g of pork, 7-8 eggs, 2.6 kg of cabbage, or 1.4 kg of apples. Due to its dietary properties, cow's milk is recommended for consumption by all age groups, especially children and the elderly (Maciuc et al., 2006; Fadhil & Zülkadir, 2020).

In Romania, several cattle breeds are raised under different production systems, including the Brown of Maramures (Brown Swiss strain), which represents an important genetic population in the country. The formation of the Brown of Maramures breed was not a random phenomenon, but the result of a breeding strategy initiated at the end of the 19th century, aimed at improving the productive performance of local rustic breeds from the country's mountainous areas, such as Mocanita and Grey steppe cattle. As a breed, it was developed through a directed process of grading-up crossbreeding using foreign genetic material, followed by intensive selection and adaptation to the specific environmental conditions of mountain regions (Maciuc et al., 2003).

The systematic importation of Schwyz-type (Brown Swiss) bovine genetic material was not restricted to a single source, but encompassed genetic lines originating from several regions of Central Europe. The continuous process of crossbreeding ("browning") led to the production of animals that progressively converged phenotypically toward the Brown breed standard (Roșu et al., 2024).

The final outcome was the development of a breed with superior combined productive traits, while maintaining high resilience and adaptation to mountainous environments - characteristics inherited from the local Mocanita and the Grey steppe cattle variety.

The resulting cattle populations were officially recognized in 1959 as a distinct population, being homologated as a breed and designated "Brown of Maramures" (Brown Association, 2024), the name refers to the region and to the area of origin and initial dissemination at the national level. Regarding population dynamics, the highest proportion of Brown of Maramures cows was recorded in 1980, when they accounted for more than 30% of the total national cow population, ranking as the second most important cattle breed; however, after 1990, the breed entered a period of continuous numerical decline (Maciuc et al., 2015).

Animals respond markedly to management and feeding conditions, and when nutritional and husbandry requirements are optimized, milk yields may reach up to 6,000 kg per lactation, with an average fat content exceeding 3.91% and a protein content of approximately 3.25% (ANARZ, 2024). Moreover, the milk is characterized by a high casein content, which makes it particularly suitable for cheese production.

The aim of the present study is to compare the productive performance of Brown of Maramures cattle under different physiological states, across successive lactations, and within varying age categories.

## MATERIALS AND METHODS

The study was conducted on a herd of 48 dairy cows belonging to the breed Brown of Maramureș, exploited for milk production under the conditions of the SCDB Secuieni farm, located in Neamț County, in northeastern Romania. Research station was established on January 1, 1962, with the primary objective of improving the Brown of Maramures cattle population and developing modern technological solutions for their management.

The herd included in the present study comprises animals originating from the initial nucleus of 10 Brown of Maramures cows maintained at the time of the research station's establishment. The herd has been reared as a closed population and currently constitutes a conservation nucleus aimed at preserving the genetic resources of the Brown of Maramures breed. Productive performance data were collected and analyzed exclusively from animals belonging to this conservation herd.

The cows are maintained in permanent free-stall housing and are fed with stock fodder using a single-type ration, nutritionally balanced to meet the animals' requirements for basal metabolism and production, according to their age and physiological status. The animals are milked twice daily. Milking is performed using a pipeline system, and the milk is stored in cooling tanks until delivery.

The quantitative and qualitative parameters of milk production were obtained from analysis reports conducted during official production control and from farm records. Statistical processing focused on data from three normal lactations (LH1, LN2, LN3), including lactation length (DLN), milk yield (MY), fat yield (GY), protein yield (PY), and the percentage content of fat (G%) and protein (P%). Data from other lactations were excluded due to the very low number of animals with more than three lactations in the herd.

Statistical analyses were performed using the software packages SAVC (Statistical Analysis of Variance and Covariance) and SPSS 16.0 for Windows. The following statistical parameters were calculated: arithmetic mean ($\bar{X}$), standard error of the mean ($\pm s_{\bar{X}}$), standard deviation (s), and coefficient of variation (V%). Graphical representations included the regression line, Pearson correlation, Chi-Square test, ANOVA, significance test (p-value), and confidence intervals (C.I.).

## RESULTS AND DISCUSSIONS

The aim of this study is to highlight the influence of external environmental factors, such as management and production technology, on the productive performance of Brown of Maramures dairy cows. Productive and qualitative performances are determined by the cumulative effect of internal factors, such as the genetic base, and external factors that are determined by the applied exploitation technology (Popovac, 2020; Yıldırır, 2024; Ma

et al., 2025; Mulianda et al., 2025; Rodriguez et al., 2025).

The statistical dynamics of the main parameters characterizing milk production, both quantitative and qualitative, were analyzed for the progeny across three normal lactations (LN1, LN2, LN3). Additionally, the study examines the productive performance of the dams (M) and maternal granddams (MM) of the cows, focusing on production traits and comparing the statistical values. All results of the statistical analyses were summarized in the following tables, with the statistics for the ancestors presented in Table 1 and those for the progeny in Table 2.

Table 1. Milk production statistics by ancestry of the studied cattle herd

| Ascendence | Traits | n | $\bar{X}$ | $\pm s_{\bar{x}}$ | s | V% | Minim | Maxim |
|---|---|---|---|---|---|---|---|---|
| M | MY - kg | 34 | 6,258.38 | 122.933 | 716.816 | 11.454 | 5,308.00 | 8,286.00 |
| | G - % | 34 | 3.99 | 0.046 | 0.271 | 6.773 | 3.56 | 4.63 |
| | GY - kg | 34 | 250.00 | 5.679 | 33.112 | 13.245 | 204.00 | 308.00 |
| | P - % | 33 | 3.49 | 0.026 | 0.150 | 4.289 | 3.21 | 3.91 |
| | PY - kg | 34 | 218.74 | 4.558 | 26.577 | 12.150 | 170.00 | 270.00 |
| MM | MY - kg | 9 | 6,471.00 | 178.614 | 535.843 | 8.281 | 5,704.00 | 6,993.00 |
| | G - % | 9 | 4.28 | 0.139 | 0.416 | 9.700 | 3.57 | 5.01 |
| | GY - kg | 9 | 277.67 | 12.301 | 36.902 | 13.290 | 204.00 | 324.00 |
| | P - % | 9 | 3.58 | 0.057 | 0.170 | 4.765 | 3.27 | 3.92 |
| | PY - kg | 9 | 231.67 | 7.853 | 23.558 | 10.169 | 198.00 | 254.00 |

M - mother; MM - mother's mother

For the herd of cows representing the progeny, the statistical values of milk production for the first three normal lactations are presented in Table 2.

Table 2. Milk production statistics for the normal lactations in the case of descendance from the studied herd

| Parity (Lactation) | Traits | n | $\bar{X}$ | $\pm s_{\bar{x}}$ | s | V% | Minimum | Maximum |
|---|---|---|---|---|---|---|---|---|
| LN1 | DLN | 38 | 303.71 | 1.237 | 7.623 | 2.510 | 258.00 | 305.00 |
| | MY - kg | 38 | 5,683.26 | 90.244 | 556.304 | 9.788 | 4,797.00 | 6722.00 |
| | G - % | 38 | 4.04 | 0.049 | 0.304 | 7.519 | 3.21 | 4.44 |
| | GY - kg | 38 | 227.95 | 3.924 | 24.188 | 10.611 | 172.00 | 270.00 |
| | P - % | 38 | 3.47 | 0.022 | 0.138 | 3.959 | 3.28 | 3.77 |
| | PY - kg | 38 | 200.16 | 3.018 | 18.602 | 9.294 | 168.00 | 245.00 |
| LN2 | DLN | 38 | 295.92 | 4.572 | 28.184 | 9.524 | 169.00 | 305.00 |
| | MY - kg | 38 | 5,699.26 | 128.728 | 793.531 | 13.923 | 3,642.00 | 8091.00 |
| | G - % | 38 | 3.83 | 0.066 | 0.409 | 10.680 | 3.14 | 4.50 |
| | GY - kg | 38 | 217.37 | 4.546 | 28.024 | 12.892 | 160.00 | 289.00 |
| | P - % | 37 | 3.42 | 0.021 | 0.130 | 3.819 | 3.20 | 3.75 |
| | PY - kg | 38 | 195.58 | 4.212 | 25.963 | 13.275 | 120.00 | 265.00 |
| LN3 | DLN | 13 | 296.15 | 6.828 | 24.620 | 8.313 | 216.00 | 305.00 |
| | MY - kg | 13 | 5,089.92 | 186.791 | 673.486 | 13.232 | 3,193.00 | 5924.00 |
| | G - % | 13 | 3.88 | 0.091 | 0.329 | 8.475 | 3.40 | 4.40 |
| | GY - kg | 13 | 197.00 | 7.353 | 26.511 | 13.457 | 132.00 | 230.00 |
| | P - % | 13 | 3.48 | 0.025 | 0.088 | 2.546 | 3.31 | 3.64 |
| | PY - kg | 13 | 176.85 | 6.741 | 24.307 | 13.744 | 110.00 | 213.00 |

As shown in Table 2, for the studied herd of descendants, the highest milk yield (MY) of 5,699.26 kg was recorded in the second lactation, with milk containing 3.83% fat and

3.42% protein. The range of milk production varied between a minimum of 3,642 kg and a maximum of 8,091 kg, which represents the highest production record in the herd across all lactations.

In the first lactation, cows produced over 4,797 kg of milk, with an average of 5,683.26 kg, which is close to the maximum yield. The milk contained 4.04% fat and 3.47% protein. The coefficient of variation for the normal lactation length was 2.51%, and for milk yield it was 9.788%, the lowest values observed in the first lactation. Consequently, fat and protein yields were the highest, at 227.95 kg and 200.16 kg, respectively.

The variability of fat content was low in the first and third lactations, at 7.52% and 8.475% in the third lactation, respectively, and showed medium homogeneity in the second lactation. In LN3, although milk yield would be expected to increase, the average production of 5,089.92 kg was the lowest, with a minimum of 3,193 kg and a maximum of 5,924 kg, representing the lowest range. Although the variability of the trait was lower than in LN2, the production levels were still reduced, indicating that the animals did not fully express their genetic potential due to external environmental factors related to management and production technology.

Fat and protein yields were also the lowest; however, compared to LN2, the average lactation length of 296.15 days was similar, and the percentage content of fat (3.88%) and protein (3.48%) was higher.

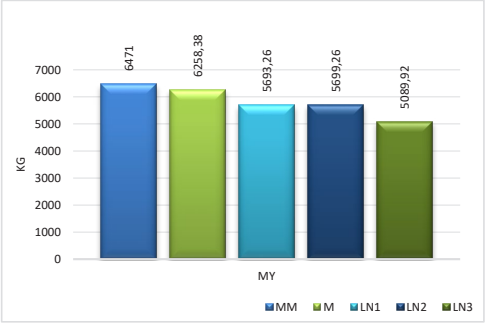


Figure1. Milk yield in the studied herd and its ancestry

Figure 1 provides a comparative graphical representation of milk production values between maternal ancestors and descendants. Maternal granddams (MM) had an average milk yield of 6,471 kg per lactation, while the dams (M) had an average milk yield of 6,258.38 kg, higher than the maximum mean of 5,699.26 kg recorded in LN2 among the ancestors. Compared to the maternal granddams (MM), the variability of the trait in the dams was higher, at 11.454%, with a production range from a minimum of 5,308 kg to a maximum of 8,286 kg of milk. While milk production in the dams was 3.28% lower than that of the MM, the highest mean production in LN2 of the progeny was 8.93% lower than that of the dams. Compared to the maternal granddams (MM), the variability of milk yield in the dams (M) was higher at 11.454%, with a production range from a minimum of 5,308 kg to a maximum of 8,286 kg of milk. While the average milk yield of the dams was 3.28% lower than that of the MM, the highest mean production in LN2 of the progeny was 8.93% lower than that of the dams.

Analyzing the values from Tables 1 and 2, it can be observed that the milk of maternal granddams (MM) contained 4.28% fat and 3.58% protein. In the case of the dams (M), the milk had comparatively lower percentages, with 3.99% fat and 3.49% protein. The average values for the dams were comparable to those of the progeny, where in LN1 the milk contained 4.04% fat and 3.47% protein, and in LN3 the averages were 3.88% fat and 3.48% protein.

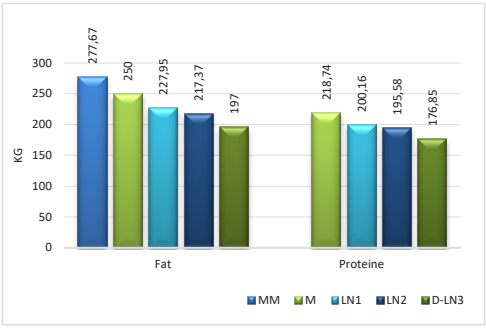


Figure 2. Fat and protein yield in the study herd and its ancestry

Figure 2 illustrates the average fat and protein yields in both the maternal ancestors and the progeny; these traits exhibited medium homogeneity in all cases.

In the case of the maternal granddams (MM), the highest average yields were recorded, with 277.67 kg of fat and 231.67 kg of protein per

lactation, reflecting the correlations between production traits. The dams of the progeny produced on average 250 kg of fat and 218.74 kg of protein, representing 9.96% less than the average performance of the granddams.
In the descendancy, these yields decreased from one lactation to the next, with the highest values recorded in LN1, where 227.95 kg of fat and 200.16 kg of protein were produced. From an analytical perspective, compared with the averages of the dams, these values were 8.82% lower for fat yield and 8.49% lower for protein yield.
Although the cows in the studied herd possess genetic potential, their performance does not fully reflect it. The average milk production in LN1 represents 99.72% of LN2 and is 10.44% higher than the average production in LN3. The standard deviations for the analyzed productive traits were also higher in LN2 and LN3 compared with LN1.
The high variability in milk, fat, and protein yields in LN2 and LN3 compared with LN1, along with the other observations, highlights that external environmental factors strongly influence the phenotypic expression of these traits in the studied herd, with animal nutrition being the most important factor.

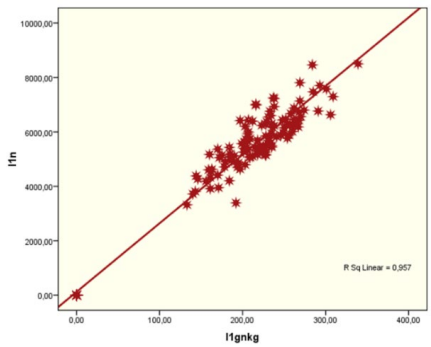


Figure 3. Regression line for milk yield (kg) and fat yield (kg)

Figure 3 presents the regression line for fat yield as a function of milk yield. The orientation of the line and the clustering of points close to it indicate the existence of a strong positive correlation (0,957) between milk yield (kg) and fat yield (kg). Any increase in milk production is accompanied by a corresponding increase in fat yield.

## CONCLUSIONS

The study conducted on a herd of 48 cows belonging to Brown of Maramures breed, reared under a semi-intensive system, highlights that management practices and feeding conditions significantly influence productive performance and milk quality.
Although the average milk yields and qualitative parameters fall within the breed-specific range, they are lower than those of the ascendants, indicating that the animals' genetic potential is not fully expressed. The dams and maternal granddams exhibited higher production than the descendants, with differences of approximately 8-10% in favor of the ancestors for the main productive traits.
The analysis of the three normal lactations shows that maximum production was achieved in the second lactation, with an average of 5,699.26 kg; however, this remains lower than the values reported for the ancestors, confirming the unfavorable influence of environmental factors. In contrast, the first lactation exhibited the highest data homogeneity, the lowest variability, and the highest fat and protein yields relative to lactation length.
The third lactation most clearly reflects the negative impact of environmental conditions, with lower production levels despite lactation length and milk component percentages that would allow higher yields. This decline suggests limitations in management technology, particularly regarding nutrition, milking management, and animal comfort.
The very strong correlation (r = 0.957) between milk yield and fat yield confirms the direct relationship between total milk production and the output of its components. Overall, the results demonstrate that the herd's performance does not fully reflect the cows' genetic potential of the cows, with technological and environmental factors being the main limitations to its expression.
In these conditions, it can be made the following recommendations:
1. Optimize feeding rations by adapting nutritional intake to the physiological stage and production level of each cow.
2. Improve housing conditions (space, microclimate, bedding) to reduce stress and enhance productive efficiency.

3. Evaluate the milking technology and protocol to reduce losses and stimulate milk production.
4. Apply genetic selection focused on productive traits and milk quality, considering the performance of ascendants.
5. Continuously monitor performance through regular official controls and annual comparative analyses.

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