RESEARCH INTO THE INFLUENCE OF MOUNTAIN AREA AND FARMING SYSTEMS ON THE PRODUCTIVE PERFORMANCE OF THE BROWN CATTLE BREED

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Abstract

The research was carried out on a herd of Brown Swiss cattle, comprising a total of 223 head, namely 114 dairy cows, of which 23 were reared under extensive farming conditions and 91 under semi-intensive farming conditions, in the mountainous area of Neamț County. The aim was to investigate the influence of the mountainous area and the farming systems on the productive performance of the Brown Swiss breed. A comparative analysis of the productive performance by lineage shows that the best results were recorded for the Brown Swiss breed reared under semi-intensive conditions (6,471 kg of milk) compared with the extensive system, where the maternal grandmothers produced only 5,475 kg of milk. The average milk yield per lactation for the offspring was 6,383.26 kg in cows reared under a semi-intensive system, compared with the extensive system, where the offspring produced only 4,673 kg of milk. Furthermore, milk quality is superior in cows reared under the semi-intensive system, and the differences between the two rearing systems are distinctly significant. To maintain fat content above 3.9% and protein above 3.3%, the composition of the daily ration must ensure a perfect balance between energy, protein and digestible fibre. Increasing livestock production in cattle can be achieved by increasing the number of animals, but this is not the most cost-effective approach; therefore, the aim is to achieve higher milk production in this species by increasing the average yield per animal, which can be achieved through the combined action of genetic improvement and better farming conditions.

Key words: *cattle, Brown, milk, farming systems, performance, mountainous area*

INTRODUCTION

Situated in the north-eastern region of Romania, Neamț County covers an area of 5,890 km², lying in the central-western part of this region and bordering the following counties: Suceava to the north, Iași to the east, Bacău to the south and Harghita to the west [1, 2, 3]. The relatively large areas of natural grassland within Neamț County, which are used both as pasture (in summer) and for hay production, can provide, at least to a satisfactory extent, the quantities of fodder required to feed the cattle herds reared on farms and in households across the county.

This is a particularly complex issue, given the scale of dairy cattle rearing on small and medium-sized farms in Neamț County and the need for genetic improvement of the cattle on these farms, as well as improvements to technological factors relating to farming practices and management; this highlights the need for research based on a solid scientific foundation [4, 5, 6, 7].

Several breeds of cattle are reared and farmed within Neamț County, some of which are specialized for milk production (Holstein, Romanian Black-and-White, Red Holstein), some are dual-purpose milk-beef breeds (Brown Swiss, Romanian Spotted,

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Pinzgau), whilst others are specialized for meat production (Charolais, Aberdeen-Angus, Aubrac, Galloway, Romanian Spotted – meat line), as well as a large number of crossbreeds [8, 9, 10, 11, 12, 13].

It is worth noting that whilst most of these cattle breeds have been adapted to the climatic and forage conditions specific to this region, their technical and productive performance is variable and leaves considerable scope for improvement; consequently, they can and must be improved [14,15,16,17,18,19].

Cattle farmers in Neamț County have realized that, in order to make a profit on the farms they manage, they need to increase the number of animals they rear, because larger and better-equipped farms, high-quality feed, animal welfare, and the use of improved breeds, can positively influence the quantity and quality of phenotypic performance. The aim of the research was to identify, adopt and apply the most effective methods and means to increase the efficiency of cattle rearing, based on the premise that it is absolutely essential to understand the phenotypic characteristics required for the desired production of both the progenitors and the offspring of cattle populations, as well as the rearing and management technologies and the socio-economic conditions under which the animals are reared, in order to achieve maximum production performance.

MATERIAL AND METHOD

T The research was carried out on a herd of Brown Swiss cattle, totaling 223 head, comprising 114 dairy cows, of which 23 were reared under an extensive system and 91 under a semi-intensive system, in the mountainous area of Neamț County. It is well known that both internal factors and factors relating to farming practices and the environment influence the quantitative and qualitative performance of cattle

Several characteristics of milk production (quantitative and qualitative characteristics) were examined by querying the official production control (OPC) database for the active herd. The raw data were statistically processed ($\bar{X}, \pm s_{\bar{X}}$, s, V%) and subsequently summarized in tables and figures. Electronic data processing was carried out using statistical software (S.A.V.C. – Statistical Analysis of Variance and Covariance) developed within the Technology of Cattle Breeding course at the Faculty of Food and Animal Sciences (FIRAA) from Iași [11; 17]. Fisher's test was used to test the equality of variances between two normally distributed independent variables, whilst Tukey's multiple comparison test – also known as the 'honest significant difference' test – was employed, typically in conjunction with ANOVA statistical models [20, 1, 4].

When the null hypothesis of the F-test in the analysis of variance is rejected, it is important to determine the cause that led to this rejection; that is, the means cannot be considered equal. This gives rise to multiple comparison techniques, as a sequence of pairwise comparisons of means cannot be controlled in terms of the significance threshold. Tukey's method simultaneously tests all differences between pairs of means to determine whether at least one is significantly different from zero. The Tukey–Kramer test is very similar to Kramer's method for equal groups, but the denominator differs slightly. The formula for calculating Q using the Tukey-Kramer method is:

$$Q = \frac{M_i - M_j}{\sqrt{MS_{int\ ra} * \left(\frac{\frac{1}{n_i} + \frac{1}{n_j}}{2} \right)}}$$

where: n_i and n_j represent the number of subjects in the compared groups, and m_i and m_j the means of these groups.

The number of degrees of freedom is determined in a similar way to the Tukey method. The first degree of freedom is k (the

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number of groups in the experiment), and the second is N–k (d_f for within-group variance).

The *p*-value of the test, given as a number between 0 and 1, represents the probability of making an error if we reject the null hypothesis H_0. If *p* is less than the chosen significance level α – usually α = 0.05 – we reject the null hypothesis H_0 and accept the alternative hypothesis H_1 as true.

The interpretation of p-values in most statistical tests is as follows:

-p <0.05, the statistical relationship is significant (S, 95% confidence)

-p<0.01, the statistical relationship is significant (S, 99% confidence).

-p<0.001, the statistical relationship is highly significant (HS, 99.9% confidence).

-p>0.05, the statistical relationship is insignificant (NS)

The ANOVA test compares the means of several samples simultaneously.

H_0: m1 = m2 = m3 = m4 (for 4 samples)

H_1: at least two means differ significantly

The result is a p-value, which is interpreted in the same way as for the other tests:

If $p > 0.05$, H_0 is not rejected; the difference is insignificant at the 95% significance level.

If $p < 0.05$, H_0 is rejected at the 95% significance level. At least two means differ significantly.

If $p < 0.01$, H_0 is rejected at the 99% significance level. At least two means differ significantly; if $p < 0.001$, H_0 is rejected at the 99.9% significance level. At least two means differ highly significantly. Enhancing the genetic potential and productivity of cattle populations, alongside the optimisation of farming technologies on small and medium-sized family-run farms, and sound management and economic administration, are key strategies for increasing profitable milk production.

RESULTS AND DISCUSSIONS

On dairy farms, the daily work schedule is drawn up by first setting the times for milking and feeding the cows considered to be the most important, and then determining the times for the other tasks.

As can be seen from the data in Table 1, on farms specialising in dairy cattle, work begins at 05:00 and finishes at 10:00, followed by a rest period from 1000 to 1500, with the afternoon schedule running from 1500 to 1900. During the summer season, the animals are taken out to pasture (once all the activities scheduled in the programme have been completed by 10.00) and return to the farm at 16.30 for the afternoon activities (milking the cows, delivering the milk, etc.) [1, 2, 3].

Table 1 Schedule of activities on dairy farms

Farm production	Activity	Activity timeframe
Milk	- feeding roughage, preparing cows for milking (washing and drying the udder)	$5^{00} – 5^{30}$
	- cow milking	$5^{30} – 7^{30}$
	- milk delivery	$7^{30} – 8^{30}$
	- manure removal	$8^{00} – 8^{30}$
	- other activities (vaccinations, treatments, monitoring cows and heifers in heat, etc.)	$8^{30} – 9^{00}$
	- administration of concentrated feed and corn silage (fibrous, coarse feed)	$9^{00} – 10^{00}$
	- rest	$10^{00} – 15^{00}$
	- feeding cows	$16^{00} – 16^{30}$
	- manure removal	$16^{30} – 17^{00}$
	- preparing cows for milking (washing and drying the udder)	$17^{00} – 17^{30}$
	- milking the cows, delivering the milk	$17^{30}– 19^{00}$

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The production process involved in rearing and managing dairy cattle for milk production consists of a sequence and chain of the following operations: feeding and watering, maintenance, breeding, reproduction, milking of lactating cows, manure removal, and the utilisation of the produce obtained. The most important environmental factor for achieving high milk yields is feeding. The genetic productive potential of each individual can be maximised by providing rations that are balanced in terms of both quantity and quality.

At the Secuieni Agricultural Research and Development Station, the Maramureș Brown cattle breed – a dual-purpose dairy and beef breed – is reared and utilised.

Management encompasses all measures relating to housing, personal hygiene, the movement of dairy cows and the daily workflow on the farm, with the aim of ensuring that the animals' productive potential is realised and their health is maintained at a normal level.

This farm practises the tethered housing system, with the animals arranged in two rows, head-to-head, in enclosed sheds equipped with constant-level water troughs and natural lighting provided by large windows, for the following categories of animals: lactating cows, heifers, mated heifers, heifers aged 12–18 months, and young bulls for fattening.

The cows are housed head-to-head in two rows of stalls, separated by the feeding aisle which connects to the outside via wide doors; for milking, manure removal and animal movement, two circulation aisles are used, connected to the outside by two doors situated on the longitudinal wall. The cows are tethered vertically; accordingly, the stall is short, measuring 1.5–1.6 m in length and 1.1–1.2 m in width (fig. 1).

Ventilation is both natural and mechanical; manure removal is mechanical using a scraper plough; milking is carried out mechanically into cans; and the milk is processed in a closed system, which involves processing and marketing the products in the farm's own shops (fig. 2).



Fig. 1 Tethered housing (original photo)



Fig. 2 Milk pasteuriser and cream separator (original photo)

Dairy cows have an average body weight of 477 kg and are provided with 13.5 UN per head per day; the average daily milk yield per fed cow is 15–16 litres.

Lactating cows are given a feed ration that varies according to the season, namely summer and winter. Table 2 shows the feed ration administered to lactating cows during the winter season. Analysis of this ration reveals a surplus of dry matter (DM) of 6.51%, of protein (PDIN) of 7.74%, and of (PDIE) of 5.85% (table 2).

As regards macronutrients, there is a slight excess of calcium (Ca) of 0.43% and a slight excess of phosphorus (P) of 1.15%.

The summer ration exceeds the nutritional standards for dry matter (DM) by 2.37%, for protein (PDIN) by 19.23%, and for (PDIE) by 7.51%, respectively. However, there is an energy deficiency (-9.47%) in this ration [10, 16, 17].

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With regard to macronutrients, a more pronounced excess is observed for calcium (Ca) at +63.85%, whilst the surplus for phosphorus (P) is lower, at +7.02%. For dry cows, pregnant heifers, mated heifers, young female cattle aged 12–18, 6–12 months, 3–6 months and young bulls for fattening, the diet consists of the same types of feed, with the exception of brewers' grains, and the quantity is administered in proportion to age and body weight.

Table 2 Feed ration from the Secuieni farm, lactating cows, 500 kg live weight, 20 litres of milk per day, 4.6 % fat, winter

Forages	Gross kg	Dietary guidelines						
		16.43	13.2	1303	1303	106	62.00	15.70
		Kg DM	UFL	PDIN	PDIE	Ca	P	UIDL
				g	g	G	g	
Alfalfa hay	5.00	4.25	2.55	459.00	378.25	55.25	10.63	4.63
Maize silo	20.0	6.00	5.40	300.00	408.00	21.00	15.00	6.78
Wine or beer	15.0	3.15	0.60	144.90	122.85	2.11	0.54	-
BR contribution	*40.00*	*13.40*	*8.55*	*903.90*	*909.10*	*78.36*	*26.17*	*11.41*
Maize	1.50	1.31	1.66	107.42	157.20	0.39	4.59	-
Triticale	1.50	1.31	1.59	115.28	141.48	0.66	6.03	-
Peas	1.00	0.86	1.00	133.30	86.00	0.77	3.96	-
Prolactis feed	0.50	0.45	0.40	144.00	85.50	2.25	3.15	-
Salt	0.08	0.07	-	-	-	-	-	-
Dicalcium phosphate	0.11	0.10	-	-	-	24.03	18.81	-
RS contribution	*4.69*	*4.10*	*4.65*	*500.00*	*470.18*	*28.10*	*36.54*	-
TOTAL RATION	*44.9*	*17.50*	*13.2*	*1403.9*	*1379.2*	*106.46*	*62.71*	
Difference (±%) from the standard ration	-	+6.51	0.00	+7.74	+5.85	+0.43	+1.15	-27.32

Notes: *1) BR – basic ration; 2) RS – supplementary ration; 3) DM – dry matter; 4) UFL – milk feed unit; 5) PDIN – protein digestible in the small intestine of dietary origin and of microbial origin synthesised from fermentable nitrogen; 6) PDIE – protein digestible in the small intestine of dietary and microbial origin, synthesised from fermentable energy; 7) Ca – calcium; 8) P – phosphorus; 9) UIDL – digestive load unit for dairy cows.*

The PFA Olariu Neculai farm, which operates on an extensive system, has a tie-stall barn arranged in two rows, head-to-head, on 2.30 m long stalls 1.20 m wide, with a brick floor.

The 2.20 m wide feeding aisle is situated in the middle of the shed. All categories of cattle are housed in this barn: lactating cows, dry cows, pregnant heifers, mated heifers and young female cattle aged 12–18 and 6–12 months, as well as young male cattle for fattening. Calves aged 3–6 months are reared in free-stall systems, in group pens, whilst calves aged 0–3 months are kept in individual pens during the suckling period. Ventilation in the sheds is natural and is provided through the doors and windows [1, 2, 3].

At the end of the barn, a pen is set up where pregnant cows are housed approximately one week before calving, and after calving they remain in this pen together with their calf during the colostrum period, where the calves receive colostrum from their own mother for 7 days, after which they are moved to another pen in the same shed, reserved for this purpose.

Milking of lactating cows is carried out manually and using an individual milking parlour [1, 2, 3]. Manure is removed manually using a wheelbarrow, as there is no mechanised removal system. The herd of cows studied on this farm is reared as a purebred herd. The farm does not have a feed trailer for distributing feed. Lactating cows are fed manually, with the diet varying according to the season. In summer they graze on pasture with small amounts of hay, whilst in winter they receive a single feed ration as shown in Table 3. Analysis of this

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ration shows a slight deficiency of 0.66% compared with the feed standards for dry matter (DM). Conversely, there is an excess of metabolisable energy (UFL) of 10.78% and of protein (PDIN = 11.81% and PDIE = 8.97%).

Table 3 Feed ration at the PFA OLARIU NECULAI FARM – INTENSIVE FARMING

FEED	Gross kg	Food rations						
		15.10	11.60	1115	1115	100	54	15.90
		Kg DM	UFL	PDIN g	PDIE g	Ca g	P g	UIDL
Natural hay	1.00	0.85	0.66	72.25	73.95	5.53	2.98	0.88
Alfalfa hay	3.00	2.55	1.53	275.40	226.95	33.15	6.38	2.78
Maize silo	25.00	7.50	6.75	375.00	510.00	26.25	18.75	8.48
RB contribution	*29.00*	*10.90*	*8.94*	*722.65*	*810.90*	*64.93*	*28.11*	*12.14*
Maize	0.50	0.44	0.55	35.67	52.20	0.13	1.52	-
Wheat bran	3.00	2.64	2.38	300.96	253.44	3.96	33.79	-
Barley	0.50	0.43	0.48	34.30	43.43	0.17	1.37	-
Soya meal 44	0.50	0.44	0.50	153.12	106.04	1.50	3.08	-
Sare	0.07	0.06	-	-	-	-	-	-
Feed chalk	0.09	0.09	-	-	-	33.34	-	-
RS contribution	*4.66*	*4.10*	*3.91*	*524.05*	*455.11*	*39.10*	*39.76*	*12.14*
Total ration	33.66	15.00	12.85	1246.7	1266.1	104.03	67.87	-
Difference (±%) from the ration/standards	-	-0.66	+10.78	+11.81	+8.97	+4.03	+25.69	-23.65

Notes: 1) BR – basic ration; 2) RS – supplementary ration; 3) SU – dry matter; 4) UFL – milk feed unit; 5) PDIN – protein digestible in the small intestine of dietary origin and of microbial origin synthesised from fermentable nitrogen; 6) PDIE – protein digestible in the small intestine of dietary and microbial origin synthesised from fermentable energy, 7) Ca – calcium, 8) P – phosphorus; 9) UIDL – digestive load unit for dairy cows

Table 4 presents data on the mean values and variability of the milk production indices of the dams for the semi-intensive farm at the Secuieni station, Neamț, and we note that, in the case of the dam, the milk yield had a mean value of 6,258.38 kg ± 122.933 kg, whilst no production data are recorded in the database for the paternal grandmothers; specifically, for the mother's mother, the average value was 6,471.00 kg ± 178.614 kg.

Table 4 Mean values and variability of milk production indices for the maternal line: dams (M) and maternal grandmothers (MM) in Brown Swiss cows at the SCDA Secuieni farm

Ancestry	Characters	n	$\bar{X}$	$\pm s_{\bar{X}}$	s	V%	Min	Max
M.	Milk kg	34	6258.38	122.933	716.816	11.454	5308.00	8286.00
	Fat %	34	3.99	0.046	0.271	6.773	3.56	4.63
	Fat kg	34	250.00	5.679	33.112	13.245	204.00	308.00
	Protein %	34	3.49	0.026	0.150	4.289	3.21	3.91
	Protein kg	34	218.74	4.558	26.577	12.150	170.00	270.00
	G +P kg	34	467.75	10.394	58.797	12.570	386.00	578.00
MM	Milk kg	34	6471.00	178.614	535.843	8.281	5704.00	6993.00
	Fat %	34	4.28	0.139	0.416	9.700	3.57	5.01
	Fat kg	34	277.67	12.301	36.902	13.290	204.00	324.00
	Protein %	34	3.58	0.057	0.170	4.765	3.27	3.92
	Protein kg	34	231.67	7.853	23.558	10.169	198.00	254.00
	G +P kg	34	509.33	19.755	59.264	11.636	402.00	578.00

Notes: 1) M – mother. 2) MM – mother's mother

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Analysing the coefficient of variation, it can be seen that for maternal grandmothers the coefficient of variation for milk yield is less than 10%, V% = 8.281; for mothers, the coefficient of variation is just over 10%, V% = 11.454. From this, it can be concluded that this farm has a homogeneous population when considering the performance of the maternal grandmothers, and a population of average homogeneity among the mothers; this aspect must be taken into account when selecting animals for breeding [1, 2, 3].

Table 5 presents data on the mean values and variability of the milk production indices of the ancestry for the farm operating under an extensive system, and we observe that, in the case of the dam, milk yield averaged 5,413.89 ± 92.372 kg; for the paternal grandmothers, no production performance data are recorded in the database, whilst for the maternal grandmother it was 5,475.00 ± 206.730 kg. However, if we analyse the coefficient of variation, which is V% = 5.119 for the mothers and V% = 6.540 for the maternal grandmothers, we can conclude that the population is homogeneous in this respect

Table 5 Mean values and variability of milk production indices for the maternal line: dams (M) and maternal grandmothers (MM) for Brown Swiss cows at the P.F.A. Olariu Neculai Marius farm

Ancestry	Characters	n	$\bar{X}$	$\pm s_{\bar{X}}$	s	V%	Min	Max
M.	Milk kg	15	5413.89	92.372	277.117	5.119	5035.00	5857.00
	Fat %	15	3.54	0.168	0.504	14.240	2.40	3.98
	Fat kg	15	190.89	8.840	26.521	13.893	141.00	223.00
	Protein %	15	3.61	0.047	0.140	3.873	3.36	3.78
	Protein kg	15	195.44	5.347	16.040	8.207	174.00	221.00
MM.	Milk kg	15	5475.00	206.730	358.067	6.540	5147.00	5857.00
	Fat %	15	3.33	0.476	0.825	24.791	2.40	3.98
	Fat kg	15	180.67	21.759	37.687	20.860	141.00	216.00
	Protein %	15	3.70	0.052	0.091	2.455	3.60	3.78
	Protein kg	15	202.33	10.414	18.037	8.914	185.00	221.00
	G +P kg	15	383.00	17.156	29.715	7.759	362.00	417.00

Notes: 1) M – mother; 2) MM – mother's mother.

Table 6 presents the mean values and variability of milk production indices for the first lactation of the Brown Swiss cattle herd, reared under a semi-intensive system at SCDA Secuieni. An extension of the lactation period is observed, with the total lactation duration having a mean value of 473.55 ± 1 8.986 days, ranging from a minimum of 258.00 days to a maximum of 743.00 days [1, 2, 3].

Table 6 Average values and variability of milk production indices during the first lactation at the SCDA Secuieni farm

Characters	n	$\bar{X}$	$\pm s_{\bar{X}}$	s	V%	Min	Max
DTL (days)	91	473.55	18.986	117.036	24.715	258.00	743.00
Milk kg	91	7428.18	210.4	1297.024	17.461	4814.00	10024.00
Fat %	91	4.26	0.05	0.365	8.561	3.16	4.98
Fat kg	91	316.16	9.64	59.453	18.805	193.00	475.00
Protein %	91	3.59	0.03	0.193	5.367	3.28	4.13
Protein kg	91	263.68	6.90	42.548	16.136	168.00	364.00
DLN (days)	91	303.71	1.23	7.623	2.510	258.00	305.00
Milk kg	91	6383.2	90.2	556.304	9.788	4797.00	7722.00
Fat %	91	4.04	0.04	0.304	7.519	3.21	4.44
Fat kg	91	227.95	3.92	24.188	10.611	172.00	270.00
Protein (%)	91	3.47	0.02	0.138	3.959	3.28	3.77
Protein (kg)	91	200.16	3.01	18.602	9.294	168.00	245.00

Notes: *DTL – duration of total lactation. 2) DNL - Duration of normal lactation*

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The coefficient of variation is high, V% = 24.715, which indicates a heterogeneous population of cows. The average duration of a normal lactation is 303.71 ± 1.237 days. For total lactation, an average milk yield of 7,428.18 ± 210.405 kg was recorded, ranging from 4,814.00 kg to 10,024.00 kg of milk. With regard to the quantity of milk per normal lactation, it is observed that the average value was 6,383.26 kg, with a minimum of 4797.00 kg of milk and a maximum of 7722.00 kg of milk.

There is an extension of the total lactation period, whilst the normal lactation period is shortened, albeit by a relatively small number of days, as indicated by the standard deviation of s = 7.623 days and the coefficient of variation of V% = 2.510. It is worth noting that the Brown breed stood out for its superior milk quality, with fat % values ranging from 4.04% to 4.26% and average P % values ranging from 3.47% to 3.59%. Milk from the Brown breed is internationally recognised for its exceptional physico-chemical properties. It stands out not necessarily for its total volume per lactation, but for the structure and quality of its components.

Table 7 presents the average values and variability of milk production indices for the first lactation on the farm operating under an extensive system. The total lactation duration has a mean value of 441.17 ± 42.728 days, with a minimum of 315.00 days and a maximum of 582.00 days. The coefficient of variation is high (V% = 23.724), indicating a heterogeneous cow population. The average duration of a normal lactation is 305.00 ± 0.000 days. For the total lactation period, an average milk yield of 6,025.00 ± 672.833 kg was recorded, ranging from 3,461.00 kg to 8,150.00 kg of milk. Milk yields for normal and comparative lactations are shown in fig.1.

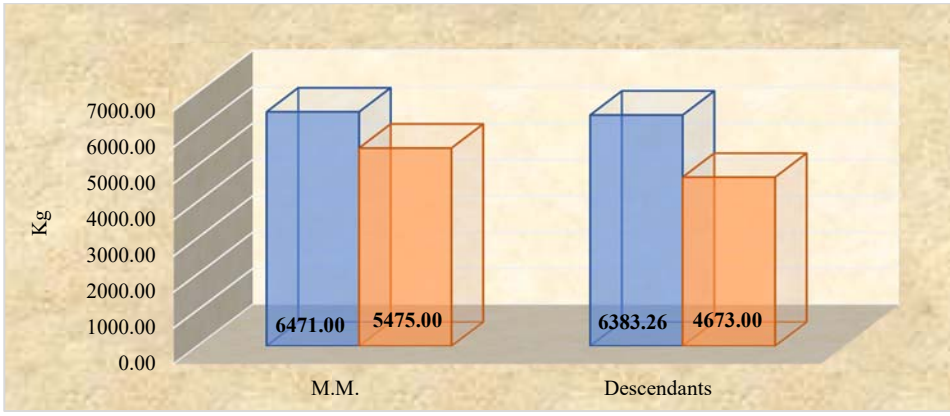


Fig. 1 Comparative milk yields per lactation in the ancestry and descendant lines

With regard to the quantity of milk per normal lactation, the arithmetic mean is 4,673.00 kg, with a minimum of 3,322.00 kg and a maximum of 5,567.00 kg. An extension of the total lactation period has been observed, and the normal lactation period is as indicated as reported in the specialist literature, namely 305 days, as can be seen from the standard deviation s = 0.000 days and the coefficient of variation, which is V% = 0.000 [10, 16, 17]

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Table 7 Average values and variability of milk production indices during the first lactation at the P.F.A. Olariu Neculai Marius farm

Characters	N	$\bar{X}$	$\pm s_{\bar{X}}$	s	V%	Min	Max
DTL (days)	23	441.17	42.728	104.662	23.724	315.00	582.00
Milk kg	23	6025.00	672.833	1648.097	27.354	3461.00	8150.00
Fat %	23	3.95	0.213	0.521	13.176	3.17	4.68
Fat kg	23	236.33	26.538	65.004	27.505	139.00	306.00
Protein %	23	3.50	0.104	0.254	7.268	3.19	3.75
Protein kg	23	211.50	24.986	61.204	28.938	111.00	287.00
DNL (days)	23	305.00	0.000	0.000	0.000	305.00	305.00
Milk (kg)	23	4673.00	424.11	1038.862	22.231	3322.00	5567.00
Fat %	23	3.82	0.166	0.407	10.644	3.17	4.28
Fat kg	23	184.17	12.510	30.643	16.638	133.00	224.00
Protein %	23	3.40	0.097	0.238	7.002	3.12	3.74
Protein kg	23	165.67	13.554	33.200	20.040	105.00	193.00

Notes: *DTL – duration of total lactation. 2) DNL - Duration of normal lactation*

Significance tests for milk yield in the first lactation revealed significant differences ($p < 0.05$) in favour of the semi-intensively managed cows at SCDA Secuieni, with the difference between the mean values for total lactation yield being 1,403 kg, whilst for normal lactation the differences were distinctly significant at $p < 0.01$, with a value of 1,707 kg. Significant differences at $p < 0.05$ were also observed for fat content (%); the value ranged between 0.22 and 0.31%.

Cattle feeding directly and decisively influences both the quantity of milk produced and its quality (fat content, protein content and flavour). Diet is the most important management factor through which a farmer can control animal performance and farm profitability. The quantity of milk produced depends directly on the energy intake and the volume of dry matter (DMI) consumed by the cow. If the ration does not provide sufficient energy (from silage maize, cereals), the cow will produce less milk and lose weight, entering an energy deficit.

High-quality hay, straw and silage stimulate rumination and the production of acetic acid in the rumen, which is the 'building block' for milk fat production. Too many concentrates (maize, wheat) and too little fibre lead to ruminal acidosis, and the fat content drops drastically. Accordingly, a ration rich in fermentable energy helps the bacteria in the rumen to multiply, increasing microbial protein (the highest-quality source of protein for the cow). Meals (soya, sunflower) provide the amino acids necessary for casein synthesis (the milk protein essential for cheese production).

On the semi-intensive farm at S.C.D.A. Secuieni, the results regarding milk quality indicators are presented in table 8. The milk produced by these cows was found to contain a much lower somatic cell count (SCC), with the statistical mean for this indicator being 157.64 ± 16.925 thousand/ml of milk. The significantly lower somatic cell count in the milk from the cows on this farm is directly linked to the feeding conditions and, in particular, to the husbandry and hygiene standards maintained at this livestock farm. The fat content of the milk from cows reared and milked at the Secuieni farm has a statistical mean of 4.64 ± 0.151%, with a range of variation between 3.29% and 5.65% and a coefficient of variation of V%= 13.450.

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Table 8 Average values and variability of milk production quality indices in the descendants of the cattle herd studied at the SCDA Secuieni farm

Indicators	n	$\bar{X}$	$\pm s_{\bar{X}}$	s	V%	Minim	Maxim
SSC (10^3/ml)	91	157.64	16.925	116.031	73.606	27.00	521.00
Fat %	91	4.64	0.151	0.624	13.450	3.29	5.65
Protein %	91	3.73	0.040	0.229	6.139	3.45	4.17
Lactose %	91	4.84	0.026	0.085	1.756	4.77	5.06
Urea (mg/dl)	91	23.37	0.684	5.762	24.653	11.00	39.90
Casein (g/l)	91	28.78	0.787	5.218	17.818	22.59	36.71
pH	91	6.60	0.012	0.050	0.757	6.50	6.70
Milk (kg) per day	91	19.66	1.382	5.595	28.456	17.00	36.06

The protein content of this milk ranged from 3.45% to 4.17%, with an average of 3.73 ± 0.040%. In this case, the coefficient of variation was lower, at 6.139%.

The lactose content of the milk from the Secuieni-Neamț farm stood at a statistical mean of 4.84 ± 0.026%, with a range of 4.77% to 5.06%; the coefficient of variation was 1.756%.

As regards the urea content of this milk, the analyses carried out revealed values ranging from 11.00 to 39.90 mg/dl, with a mean value of 23.37 ± 0.684 mg/dl. As the limits of variation are quite wide, the specific coefficient of variation is high, with a value of 24.653%.

The proportion of casein in the milk from the cows at the Secuieni farm (Brown) amounted to a statistical mean of 28.78 ± 0.787 g/l; the raw data fluctuated within fairly wide limits, namely 22.59 and 36.71 g/l resulting in a coefficient of variation of 17.818%. As regards the acidity of this milk, the values are within the range of 6.50 to 6.70 pH units, with a statistical mean of 6.60 ± 0.012 pH units. The variability for this trait is very low, at under 1.00%, specifically 0.757%.

The quantitative milk yield from this farm under study ranged between 17.00 and 36.06 kg/head, and the statistical mean stood at 19.66 ± 1.382 kg/head/day. The variability of this trait is high, with the coefficient of variation standing at 28.456%.

The results obtained for the milk quality indicators for the herd managed under an extensive system are presented in Table 9. The somatic cell count in milk has a statistical mean of 466.78 ± 207.121 thousand/ml with a very wide range of variation, the extremes being 22 thousand/ml and 1,755 thousand/ml respectively. The coefficient of variation in this case is extremely high and abnormal, namely 133.118%. The very high somatic cell count in the milk produced on this farm indicates a failure to comply with hygiene standards in the cows' housing and during milking, as well as possible cases of mastitis or other udder disorders in the cows

Table 9 Average values and variability of milk production quality indices in the offspring of the cattle herd studied at the P.F.A. Olariu Neculai Marius farm

Indicators	n	$\bar{X}$	$\pm s_{\bar{X}}$	s	V%	Min	Maxi
SSC (10^3/ml)	23	466.78	207.121	621.364	133.118	22.00	1755.00
Fat %	23	3.86	0.257	0.772	20.018	2.60	4.90
Protein %	23	3.36	0.137	0.412	12.270	2.73	3.87
Lactose %	23	4.68	0.076	0.229	4.896	4.29	5.04
Urea (mg/dl)	23	26.49	2.620	7.859	29.669	13.30	35.20
Cazein (g/l)	23	27.72	0.795	2.386	8.607	24.72	30.81
pH	23	6.72	0.027	0.082	1.220	6.61	6.85
Milk (kg) per day	23	16.72	1.787	5.361	32.062	8.40	24.08

The fat content of the milk produced on this farm has a statistical mean of 3.86 ± 0.257% with variations ranging from 2.60% to 4.90%; the coefficient of variation has a mean value of 20.018%.

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The protein content of the milk from the farm analysed here varied between 2.73% and 3.87%, with a statistical mean of 3.36 ± 0.137%.

The lactose content of this milk averaged 4.68 ± 0.076%, with values being very close to one another, namely between 4.29% and 5.04% and the coefficient of variation was low (V% = 4.896). The milk from the cows on this farm contains an average of 26.49 ± 2.62 mg/dl urea; the values ranged from 13.30% to 35.20% resulting in a high coefficient of variation of 29.669%.

The proportion of casein in the milk produced on this farm ranged from 24.72 g/l to 30.81 g/l; the statistical mean was 27.72 ± 0.79 g/l, and the coefficient of variation was 8.607% indicating a homogeneous cow population in this respect. As regards the quantitative milk yield on this farm, it stood at 16.72 ± 1.787 kg per cow, but the variability for this trait was more pronounced, namely 32.062%.

The acidity (pH) of the milk produced on the farm with an extensive farming system has a statistical mean of 6.72 ± 0.027 pH units, with values ranging from 6.61 to 6.85. The average daily milk yield per head on the farm with an extensive farming system is 16.72 ± 1.787 kg, ranging between 8.40 - 24.08 kg.

The quantity and quality of milk production are influenced by a complex interaction between genetic (internal) and environmental (external) factors. The Brown cattle breed (including the Romanian Maramureș Brown breed) is renowned for the quality of its milk, but its key parameters, such as fat and protein content and density, can be directly influenced by a range of environmental, management and physiological factors.

Energy expenditure for thermoregulation affects milk composition. Free-range grazing stimulates metabolism, influencing fat deposition.

Optimising the feed ration for Brown cows is essential as this breed makes excellent use of roughage, converting it into milk with a high percentage of k-casein, ideal for cheese-making.

To maintain fat content above 3.9% and protein above 3.3%, the composition of the daily ration must ensure a perfect balance between energy, protein and digestible fibre. Alfalfa or meadow hay fed at the start of the feeding period encourages the animal to ruminate. Rumination produces natural sodium bicarbonate in the saliva, the pH in the rumen remains stable (6.2–6.5), and cellulolytic bacteria produce acetic acid – the raw material from which the udder synthesises milk fat.

CONCLUSIONS

Following the study on the influence of the mountainous area and farming systems on the productive performance of the Brown cattle breed, we can draw the following conclusions:

The production process in our study differs significantly between the extensive and semi-intensive systems in terms of the level of environmental control, the inputs used (feed, technology) and the productivity achieved. The extensive system relies on natural resources and minimal intervention, whilst the semi-intensive system combines grazing with periods of stabling and controlled feeding;

The semi-intensive system incorporates machinery for feed distribution (feed trailers), mechanised manure removal and mechanised milking and milk processing systems, elements which are absent or rudimentary in the extensive system; A comparative analysis of the productive performance of the progeny highlights that the best results were recorded for the Brown Swiss breed reared under the semi-intensive system (6,471 kg of milk) compared with the extensive system, where the maternal grandmothers produced only 5,475 kg of milk;

The average milk yield per lactation for the offspring was 6,383.26 kg in cows reared under a semi-intensive system, compared with the extensive system, where the offspring produced only 4,673 kg of milk. Furthermore, milk quality is superior in cows reared under the semi-intensive system, and the differences between the two rearing systems are distinctly significant.

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The Brown cattle breed (including the Romanian Maramureș Brown breed) is renowned for the quality of its milk, but its key parameters – such as fat content, protein content and density – can be directly influenced by a range of environmental, management and physiological factors.

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