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RESEARCH ON THE INFLUENCE OF LACTATION STAGE ON GOAT'S MILK CHARACTERISTICS

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Abstract

Goat's milk is a very important food for human nutrition and is also an important raw material for a whole series of dairy products. This paper aims to investigate the qualitative variations of goat's milk during the lactation period. For this purpose, milk samples at different times of the lactation period were collected and analysed, such as: density, total dry matter, percentage of fat, protein substances and lactose. The obtained results, compared to the second month of lactation, showed significant decreases ($p<0.05$) in milk production with 9.9% in the fourth month and with 42.84% in the eighth month. Significant decreases were also obtained in the case of milk density with 0.38% in the fourth month and in the case of milk total dry matter with 9.53% in the fourth month and with 10.42% in the sixth month. Regarding the percentage of fat, significant decreases were observed ($p<0.05$) for the fourth months (with 18.68%) and for the sixth month (with 20.94%), compared to the second month of lactation. Significant decreases ($p<0.05$) in milk protein were also observed in the fourth months (with 10.68%), in the sixth month (with 9.50%) and in the eighth month (with 5.7%), compared to the second month. Regarding the percentage of lactose, significant increases were observed ($p<0.05$) for the fourth months (with 0.91%) and for the eighth month (with 1.37%).

Key words*: fat, goat, lactose, milk, proteins.*

INTRODUCTION

Goat breeding is an activity with a tradition in Romania country, meeting in the past mainly in peasant households. Today, due to the growing consumer interest in goat's milk and dairy products from goat's milk obtained in proper hygiene conditions (Răducuță, 2011; Gonciarov et al., 2004; Oprea et al., 2019; Petcu et al., 2020), goat farming is intensive, with an increasing trend in the number of farms. Goat's milk is superior to cow's milk due to its nutritional, toning, antirachitic, antianemic and anti-infective effects (Oprea et al., 2020; Petcu et al., 2021). Because fat globules are very fine, goat's milk is easily absorbed by intestinal villi with higher digestibility (Savu & Petcu, 2002). Compared to cow's milk, goat's milk is richer in minerals and has a high content of vitamin A, and is especially indicated in the diet of children and the elderly (Petcu et al., 2020). As goats rarely get tuberculosis, goat's milk can be consumed raw, thus maintaining its maximum effectiveness in proteins, lipids, sugars, vitamins, enzymes and mineral salts.

Due to its varied and rich chemical composition, milk provides the body with the substances necessary for the metabolic processes that take place in the body (Răducuță, 2004; Răducuță et al., 2015; Oprea et al., 2019).

Particular attention must also be paid to food safety, from obtaining to packaging of dairy products (Visoescu et al., 2015; Petcu, 2006).

Goat's milk is considered superior to cow's milk because it is easier to digest (its consumption rarely causes pathological conditions such as allergies and digestive intolerance), and is also richer in minerals and trace elements (Savu & Petcu, 2002). Organoleptically, goat's milk is easily recognizable by its light white colour, as well as by the fact that it does not need to be homogenized, because the fats it contains are evenly dispersed. Goat's milk is also characterized by its sweet taste and characteristic odour (Savu & Petcu, 2002).

The quality of goat's milk is influenced by several factors, among which we can mention: breed, age, health (general health and udder health), gestation, feeding regime (Răducuță et al., 2015). Also, the quality of milk may vary

depending on the season in which the calving take place, this being directly influenced by the onset oestrus (Douhard et al., 2013; Bociu et al., 2015; Ghiță & Cotor, 2019).
At present, the consumption of goat's milk is a much healthier alternative to the consumption of cow's milk (especially when it is fresh and organic), offering a wide variety of health benefits (Escareño et al., 2012). The aim of this research is to evaluate the quantitative and qualitative evolution of goat milk production, during a lactation stages.

MATERIALS AND METHODS

In our study, we wanted to observe how the quantity and quality of goat's milk changes during lactation period. For this purpose, we harvested milk samples every first day of the month of lactation that interested us, in order to obtain data on the quality of goat's milk at the beginning, middle (in two moments) and at the end of the lactation period. In this way, the milk samples used in our determinations were harvested in the 2nd, 4th, 6th and 8th months of lactation, taking into account the following parameters: quantity, milk density, the percentage of fat, total dry matter, the percentage of protein and the percentage of lactose. The milk samples harvested were rapidly refrigerated at 4°C and transported immediately to the laboratory for processing.
The milk quantity was determined using a graded cylinder. The milk density was determined with a lactodensimeter.
The percentage of fat was determined using the acid-butyrometric method (Gerber method).
The determination of the total dry matter was made using the following formula, were:

$$S.U.T. = (1,2xG) + 266,5\,\frac{D-1}{D} + 0,5$$

G - the percentage of fat;
D - the density of milk at 20°C;
1.2 and 266.5 – coefficients;
0.5 - correction factor for the density determined at 20°C.
The determination of the percentage of protein substances was done by the titration method.
Lactose was determined using the potassium ferricyanide method (Savu & Petcu, 2002).
The biological material was represented by a herd of 10 goats (*Carpathian* breed), from which a total 40 samples were collected. These animals were individualized and benefited from normal maintenance conditions.
During the winter, the goats were kept in the shelter and fed with dry fodder (coarse) and feed concentrates, and during the warm season, they were taken to grassland and fed with grass and concentrates (in the morning and in the evening). Comparisons on the statistical relevance of differences between obtained values were processed using the t-Student test.

RESULTS AND DISCUSSIONS

The results obtained will be presented in the form of Table 1 and figures as follows: determination of milk quantity, determination of milk density, determination of total dry matter, determination of fat percentage, determination of protein percentage and determination of lactose percentage during lactation period.
The values obtained will be presented in the form of average values.
Comparisons are made with the values recorded in the second month (beginning of lactation).
Changing the food regime by increasing the amount of green mass in the diet, explains the high milk production during the summer, while its decrease causes a decrease in the amount of milk during the autumn season. Another explanation for the change in milk production is the intervention of neuro-hormonal changes that occurred with the decrease of daylight (Codreanu, 2020).
The results regarding the quantity obtained in the four experimental lactation periods are presented in Table 1 and Figure 1.
Comparisons (values recorded in lactation months 4, 6 and 8) were made with values recorded in the 2nd lactation month).
Analysing the data presented in Table 1 and Figure 1, it is observed that the highest amount of milk is obtained in the fourth month (middle of lactation), it is maintained at a high level until the sixth month, after which it decreases (end of lactation). The results indicate a significant decrease in milk production in the sixth month (9.9%) and eighth month (42.84%), compared to second month of lactation.

Table 1. The values of the parameters analysed during the lactation period (mean and standard deviation)

Parameter	2nd month of lactation	4th month of lactation	6th month of lactation	8th month of lactation
Quantity (ml)	1974.67 ±84.482	2180.69 ±102.240	1779.15 ±73.821	1128.2 ±64.521
Density	1.033 ±0.002	1.029* ±0.003	1.031 ±0.002	1.032 ±0.003
Total dry matter	13.42 ±1.42	12.14* ±1.86	12.02* ±2.11	13.28 ±1.24
Fat (%)	4.87 ±0.55	3.96* ±0.64	3.85* ±0.82	4.94 ±1.22
Protein (%)	4.21 ±0.14	3.76* ±0.74	3.81* ±0.42	3.97* ±1.11
Lactose (%)	4.35 ±0.28	4.39* ±0.42	4.37 ±0.31	4.41* ±0.53

*P<0.05

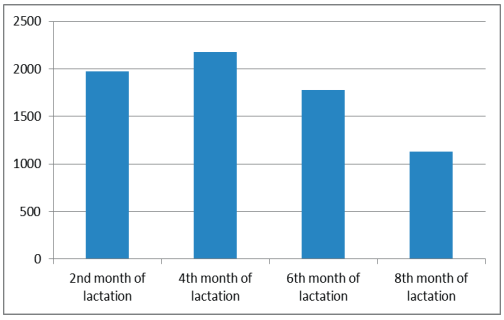

Figure 1. Variation of the average of milk quantity in the four experimental moments

These results are explained by the change in diet (increasing the amount of green mass in the diet, explains the large production of milk during the summer, while its decrease causes a decrease in the amount of milk). Another explanation (Codreanu, 2018) is represented by the intervention of neuro-hormonal changes that appeared with the decrease of the light day duration.

The results regarding the **milk density** obtained in the four experimental lactation periods are presented in Table 1 and Figure 2.

Table 1 shows that the highest value of milk density was recorded in the second month (the beginning of lactation) and the lowest value was recorded in the fourth month (middle of lactation), while in the sixth months and eighth (towards the end of lactation), the value of milk density was between the two limits.

The results indicate a significant decrease ($p < 0.05$) in milk density in the fourth month of lactation (0.38%), compared to the second month of lactation.

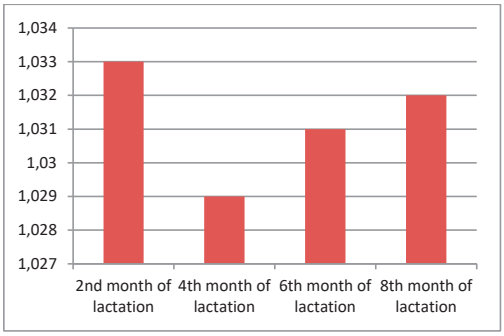

Figure 2. Variation of the average density value of milk in the four experimental moments

This observation can be explained by changing the food regime, feeding with green fodder, causing an increase in the milk quantity, to the detriment of the decrease in its density, a fact also reported in the literature consulted (Cotor et al., 2011).

For the **total dry matter** over the four experimental lactation periods, the results obtained are presented in Table 1 and Figure 3.

Analysing the results obtained, it was observed that the highest percentage of total dry matter is obtained at the beginning (13.42%) and the end of lactation (13.28%), while in the middle of lactation this percentage is lower (varies between 12.14 % and 12.02%).

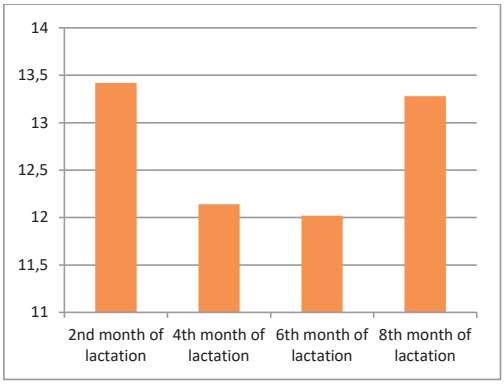

Figure 3. Variation of the percentage of total dry matter in the four experimental moments

The results indicate a significant decrease ($p<0.05$) in the total dry matter of milk in the fourth months (9.53%) and sixth months (10.42%), compared to the second month of lactation. These results are similar to those found in the literature consulted (Antunac et al.,

2001; Cotor et al., 2015) and are due to the feeding of animals during the summer, which in the case of our group corresponds to the middle of the lactation period.

The results regarding **the percentage of milk fat** in the four experimental lactation periods are presented in Table 1 and Figure 4.

Analysing the data, it was observed that the percentage of fat had the highest value towards the end of lactation (4.94%) and at the beginning of lactation (4.87%), while the lowest values were recorded in the middle of the lactation period (3.96% and 3.85%).

The results obtained indicate a significant decrease ($p<0.05$) in milk fat in the fourth months (18.68%) and sixth months (20.94%), compared to the second month.

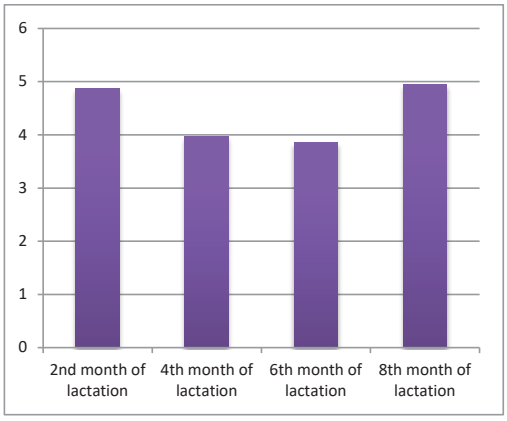

Figure 4. Variation of fat percentage in the four experimental moments

The explanation of these results is represented by the consumption of coarse fodder, being known that their consumption influences the concentration of fatty acids in milk (Cotor et al., 2009; Codreanu, 2018).

The results on **the percentage of milk protein** in the four experimental lactation periods are presented in Table 1 and Figure 5.

According to the results obtained, it was observed that the highest percentage of protein is recorded at the beginning of the lactation period (4.21%), while in the other lactation periods, the percentage of milk protein is less than 4% (3.76% and 3.81%, in the middle of the lactation period, respectively 3.97%, at the end of the lactation period).

The results obtained by us, indicate a significant decrease ($p<0.05$) of milk protein in the fourth months (10.68%), in the sixth months (9.50%) and in the eighth months (5.7%), compared to the second month of the lactation period, fact explained by the functional status of the mammary gland (Cotor et al., 2012) and the feeding regime of the studied periods (Bălăceanu et al., 2017).

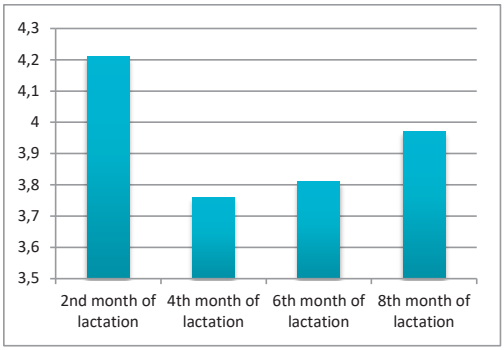

Figure 5. Variation of protein percentage in the four experimental moments

Regarding the **percentage of lactose in milk** in the four experimental lactation periods, the results obtained are presented in Table 1 and Figure 6.

Analysing the data obtained, we notice that its percentage varied quite a bit, with values between 4.35% (at the beginning of the lactation period) and 4.41% (at the end of the lactation period).

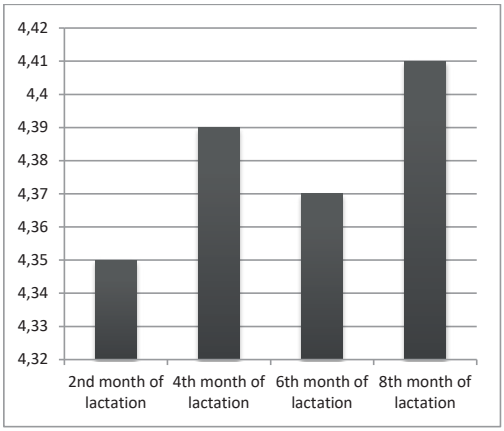

Figure 6. Variation of the percentage of milk lactose in the four experimental moments

The results indicate a significant increase ($p<0.05$) in the milk lactose in the fourth month (0.91%) and eighth month (1.37%), compared to the second month. These data do not coincide with the results obtained by other researchers in the field, constituting a particular aspect, resulting from the specific conditions in which the experimental protocols in our work were conducted.

CONCLUSIONS

Milk production marked a significant decrease in the sixth month (9.9%) and eighth month (42.84%) compared to the second month.

Milk density decreased significantly in the fourth month (0.38%), compared to the second month of lactation. The total dry matter in milk registered a significant decrease in the fourth (9.53%) and sixth months (10.42%), compared to the second month of lactation. The percentage of fat in goat's milk decreased significantly in the fourth (18.68%) and sixth months (20.94%), compared to the second month of lactation. The percentage of milk proteins showed a significant decrease in the fourth month (10.68%), sixth month (9.50%) and eighth month (5.7%), compared to the second month of lactation. The percentage of lactose in goat's milk marked a significant increase in the fourth (0.91%) and eighth months (1.37%), compared to the second month of lactation.

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