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IMPACT OF STIMULATION DIETS DURING PRE- AND POSTPARTUM PERIODS ON SHEEP LACTATION

Victoria CONSTANTIN[1, 3], Livia VIDU[1], Ion RADUCUTA[1], Rodica CHETROIU[2], Roxana STEFAN (VASILIU)[1], Mihaela Florentina SIMION[1], Monica Paula MARIN[1]

[1]University of Agronomic Sciences and Veterinary Medicine of Bucharest, 59 Marasti Blvd, District 1, Bucharest, Romania
[2]Research Institute for Agricultural Economics and Rural Development (ICEADR), 61 Marasti Blvd, District 1, Bucharest, Romania
[3]Veterinary Sanitary Directorate, Karditsa, Greece

Corresponding author email: stefanroxanaelena99@gmail.com

Abstract

The prepartum period (last 4-6 weeks of gestation) and the postpartum period (first 6-8 weeks after calving) are critical for the success of lactation. Sheep require adequate nutrition for optimal lamb development, preparation of the mammary glands for lactation, avoidance of metabolic problems (ketosis, hypocalcemia). A stimulation diet must provide: sufficient energy (through quality hay, organic cereals), good quality proteins (alfalfa, forage legumes, organic soybeans), essential vitamins and minerals (vitamin E, selenium, calcium, phosphorus). The aim of this study was to monitor the effect of administering a feed complex prepared in an organic dairy sheep farm and a supplement of organic concentrates and vitamin-mineral premix to determine the increase in production and quality of milk produced. Organically raised ewes fed with peripartum and postpartum stimulation diets achieved significantly higher milk production compared to ewes not receiving supplementary feed, the differences being highly statistically significant. The values of the physicochemical parameters analyzed in milk from ewes with supplementary feed indicated an improvement in milk quality, with an optimal milk composition (fat, protein, lactose, casein).

Key words: *concentrate supplements, dairy sheep, milk production, nutrition.*

INTRODUCTION

The productivity of farm animals (sheep, goats) is determined by their genotype and is influenced by their health status and the environment in which they are raised. By the term "rearing environment" we understand the housing conditions, the health of the animals and their nutrition (Nguyen, 2022). Nutrition is a fundamental element in the raising of all production animals, as it directly influences their performance and health (Bencini et al., 2010). It should be noted, however, that the topic of sheep nutrition, especially dairy ones, is quite complex and a nutrition plan with general applicability in all farms cannot be created. Thus, sheep nutrition must adapt to the recommendations of specialists in the field in order to optimally cover the nutritional needs of dairy sheep raised on farms with different breeding systems.

Stimulating milk production in organic farms with early lambing sheep in winter is a complex process that involves both nutritional strategies and management measures adapted to the specific winter conditions in terms of diet, mineral and vitamin supplementation, and stress management. During this period, ewes have to cope with a double stress: adapting to cold conditions and stimulating lactation, which can be more difficult due to higher energy and protein requirements.

Sheep with a balanced diet during this period have an easier calving, produce higher quality colostrum, start lactation in an optimal physiological state. This way of feeding allows for vigorous lambs at birth, a satisfactory production of colostrum, which allows the lambs to receive the antibodies necessary for their passive immunity, thus reducing the perinatal mortality rate and allowing a good stimulation of milk production, which will be increased both in quantity produced and in the duration of lactation (Tufarelli et al., 2009). After lambing, the main objective is to maintain milk production and quickly recover the sheep for the next reproductive cycle. A well-formulated diet, rich in protein, energy, vitamins and minerals, together with comfortable housing and constant access to water, will help ensure efficient milk production and the general health of the sheep and lambs (Pulina et al., 2006). The standards that regulate feed management in organic systems represent one of the most critical factors influencing milk production performance (Hernandez et al., 2016). Adapting the diet and management to meet the specific requirements of this period will contribute significantly to the success of an organic dairy sheep farming system. The impact of pre- and postpartum stimulation diets on lactation in organically raised sheep is a topic of great interest in animal husbandry, with direct implications for milk production, animal health and the sustainability of organic farming systems.

As a result, chemical analyses of the available feed (fibrous and concentrate) and the rations administered should be carried out at regular intervals. The last point is particularly important, because in practice it is proven that, in the steps that intervene between the development of a ration, for example, with the help of a computer, the mixing of the feed and its provision to the animals, the initial ration changes. These changes are due either to the lack of infrastructure for precise weighing of the ration components, or to the inattention of the staff involved in animal feeding.

Factors that influence feed intake are: the form, type and method of ration administration, the quality of fibrous feed, the ratio of concentrates/fibrous feed in the ration, the protein content of the ration, the size of the rumen, previous restrictions, the age of the animals, the physiological stage they are in, the availability, quality and consumption of water (Zervas & Tsiplakou, 2011).

The nutritional needs of dairy sheep vary significantly depending on the lactation period, the age of the animal and the physiological state (e.g. pregnancy, lactation). In the second part of gestation, especially in the last month of gestation and in the first part of lactation, the need for protein, energy and minerals is much higher (Francois & Caja, 2004). During this period, the reduced feed intake capacity, combined with the high energy requirements for fetal growth (in the prepartum period) and milk production (in the postpartum period), represents a significant metabolic challenge for lactating ruminants, therefore, during this period the need for energy will increase by 20-30% and for protein by 30-40% (Zarrin et al., 2021). Special attention must be paid to ensuring mineral substances (calcium, phosphorus) and vitamins A, D and E (Selmi et al., 2019).

The watering is an essential element for milk production. It is important that sheep have constant access to clean and sufficient water, since milk is mostly water and proper hydration contributes to optimal lactation.

The proper management of animal nutrition, with the selection and provision of appropriate feeds, is essential for achieving high performance and maintaining their health (Morand-Fehr et al., 2007).

This study aimed to analyze the influence of two variants of concentrated feed supplements administered during the prepartum (last 4 weeks of gestation) and postpartum (90 days after calving) periods on milk production obtained from crossbred ewes raised in an organic system.

MATERIALS AND METHODS

The organization of the experiment was conducted in accordance with the provisions of Directive 2010/63/EU of the European Parliament and of the Council on the protection of animals used for scientific purposes, as well as with all applicable national legislation governing animal welfare under experimental conditions. All procedures were reviewed and approved by the institutional bioethics committee.

The milk analyzed came from crossbred Lacaune and Karagouniko ewes raised organically on a farm located in the central region of Greece (Latitude: ~39.32° N; Longitude: ~22.52° E). The milk was collected over a 3-month period (January, February, March, 2025), during which the ewes were physiologically in the postpartum period.

The nutrient requirements of animals depend on a series of factors (species, sex, breed, age, body weight, quantitative and qualitative level of specific production), which condition the extent of the requirements, the degree of feed utilization in the elaborated production, as premises for establishing the feeding norms corresponding to the different physiological states (rest, mating, gestation, lactation) and productive levels (Sanz Sampelayo et al., 2007).

Stimulating milk production in organically raised ewes in the event of early lambing is essential for the success of a sustainable and efficient farming system. Early lambing, which occurs at the beginning of the winter season or even before, can put considerable pressure on the animals, especially in terms of energy and protein requirements for milk production and lamb development.

From Figure 1 it can be seen that the most critical periods, in terms of meeting the needs of ewes, are autumn (the last stage of pregnancy) and winter (the first phase of lactation - suckling the lambs), when there is no pasture available.

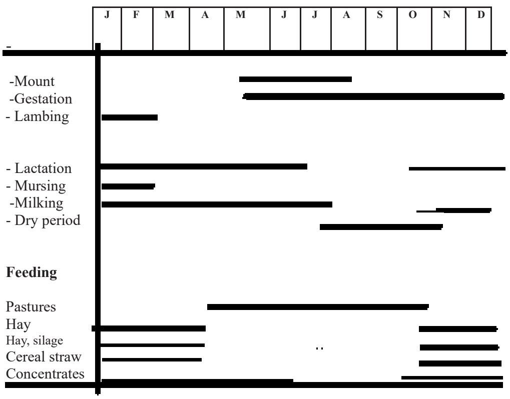

Figure 1. Schematic presentation of sheep rearing technology

During these periods, the farmer must provide the animals with sufficient and balanced supplementary feed, so that their physical condition does not have negative effects on milk production and, subsequently, on their fertility.

In the case of early lambing, the ewes are in a period of stress, as they have to adapt to the demands of lactation, even in the more difficult conditions of cold climate and more restricted feeding, since during winter, pastures are limited and the available feed may not be sufficient to meet the high energy and protein requirements necessary for lactation. The ewes may have less energy available to support milk production if they do not receive an adequate supply of nutrients.

In order to assess the effectiveness of lactation stimulation strategies, it is important to continuously monitor the health of the ewes and milk production. This may include: observing the amount of milk produced daily, analyzing the quality of the milk produced, checking the health of the mammary gland to prevent mastitis and other infections, as well as assessing the general condition of the animal, including body weight and animal behavior. (Nudda et al., 2014)

In this study, 120 crossbred ewes aged between 2 and 3 years were selected from a herd of 550 ewes raised organically in a semi-intensive farming system, which calved in the same month. The ewes were divided into two experimental groups and were fed according to the experimental scheme presented in Table 1.

The sheep were selected from the entire farm, before the start of the experimental period, being in the same physiological state of advanced gestation and were divided into two experimental groups (A and B), homogeneous in terms of physiology and age (2-3 years):

- Group A consisted of 60 sheep that were fed with feed from their own production, namely bulk feed (75% of the ration): 1.0 kg of clover silage, 1.0 kg of hay silage composed of legumes and grasses (peas, peas, wheat, oats, barley), 0.5 kg of clover hay, 0.5 kg of wheat and barley straw and organic concentrated feed (25% of the ration), respectively 1.0 kg of a mixture of organic cereals and legumes (0.6 kg of corn, 0.2 kg of barley, 0.2 kg of unmodified soybeans genetically), administered throughout the day, for one month before calving and until the end of the lactation period.
- Group B consisted of 60 sheep that received the same feed as group A, produced within the farm, in the same quantity. In addition, the sheep's ration was supplemented with 0.6 kg of combined feed to stimulate milk production with the addition of a premix containing essential vitamins, macroelements and mineral trace elements. This combined feed was administered in an amount of 0.6 kg/head/day in the first 45 days after calving and 0.3 kg/head/day in the milking period for another 45 days, in two feedings per day.

No food selectivity was observed, and no hay or concentrate residues were left after each feeding. Water was provided *ad libitum*.

Table 1. Experimental scheme

Experimental group	n	Administered feeds		Analyzed parameters
		Basic ration	Concentrate mix	
Group A	60	Roughage (75% of the ration): - 0.5 kg/head/day clover hay - 0.5 kg/head/day wheat and barley straw - 1.0 kg/head/day clover silage -1.0 kg/head/day hay silage composed of legumes and grasses (peas, beans, wheat, oats, barley)	Organic concentrate feed (25% of the ration): - 1.0 kg/head/day mixture of organic cereals and legumes (0.5 kg corn, 0.2 kg barley, 0.2 kg non-genetically modified soybeans), 0.1 kg vitamin-mineral premix; - administration for one month before calving and until the end of the experimental period (90 days after calving)	- milk production; - physicochemical and microbiological parameters of milk.
Group B	60	Roughage (65% of the ration): - 0.5 kg clover hay - 0.5 kg wheat and barley straw - 1.0 kg clover silage - 1.0 kg hay silage composed of legumes and grasses (peas, beans, wheat, oats, barley)	Organic concentrates (35% of the ration): - 1.0 kg/head/day mixture of organic cereals and legumes similar to Group A - 0.6 kg/head/day combined feed to stimulate milk production administered for one month before calving and during the suckling period (45 days-period I) and 0.3 kg/head/day in milking period (45 days-period II)	

The preparation of the total mixed ration on the farm involves a process of precise measurement, adequate preparation of the ingredients, uniform mixing and continuous monitoring using appropriate equipment (grain mill, chopper, mixer) with which all the ingredients will be combined into a homogeneous ration, without the hay remaining isolated or the silage being divided unevenly. The hay and silage were cut into smaller pieces to improve the mixture and prevent selection by the animals, using a chopper at a width of approximately 3-5 cm, to be more easily digestible. The cereals were ground using a grain mill, so that they were more easily digestible by the sheep. After measuring each ingredient, their combination was carried out using the mixer and finally, uniform distribution in the animal shelter using the distributor. If the mixture is not homogeneous, there is a risk that some animals receive a diet richer in some ingredients and poorer in others, which could lead to nutritional imbalances.

The compound feed administered with the role of stimulating milk production (Tables 2 and 3) was analyzed to determine the chemical composition, according to Commission Implementing Regulation (EU) 2024/771 on the methods of sampling and analysis for the official control of animal feed.

The sheep were milked twice a day, and the amount of milk was recorded separately for each sheep. The daily milk production of each sheep was recorded using graduated cylinders attached to individual milking units, during the experimental period, for two consecutive days, at the beginning of weeks 1, 2, 3, 4, 5, 6 of lactation (the period of lambing) and at the beginning of weeks 7, 8, 9, 10, 11, 12 of lactation (after lambing).

Table 2. Composition of the compound feed administered to sheep from group B

No.	Ingredients	Amount (%)
1	Maize	38.00
2	Barley	10.00
3	Non-genetically modified soybean meal	10.00
4	Maize DDGS (Dry Distillers Grains with solubles)	10.00
5	Wheat bran	12.00
6	Sunflower meal	11.80
7	Vegetable oil	1.50
8	Molasses	2.50
9	Calcium carbonate	1.40
10	Calcium diphosphate	0.40
11	Monosodium sulfate	0.50
12	Salt	0.50
13	Vitamin-mineral premix*	1.40
	Total	100.00

*The vitamin-mineral premix (MP-28 Power Mpletsas, Ioannina, Greece) contains the following analytical components, reported per 1 kg of product, according to the technical sheet: vitamin A 15,000 IU, vitamin D3 3,000 IU, vitamin E 300 mg, vitamin K32 mg, vitamin B15 mg, vitamin B2 3 mg, vitamin B6 0.2 mg, vitamin B12 30 mg, vitamin C 50 mg, biotin 2.5 mg, pantothenic acid 10 mg, inactivated yeast $30*10^9$, nicotinic acid 20 mg, folic acid 0.25 mg, choline chloride 200 mg, iron 50 mg, zinc oxide 70 mg, organic zinc 50 mg, zinc sulfate 90 mg, manganese oxide 45 mg, iodine 3 mg, cobalt 0.4 mg, sodium selenite 0.35 mg, organic selenium 0.24 mg.

Table 3. Chemical composition of the compound feed administered to sheep from group B

Chemical composition	Amount (%)	Analysis method
Moisture	11.64	Reg.(EU)771/2024
Dry matter	88.36	Calculated
Crude protein	19.05	Reg.(EU)771/2024
Crude cellulose	5.65	Reg.(EU)771/2024
Crude fat	5.33	Reg.(EU)771/2024
Crude ash	6.47	Reg.(EU)771/2024
Calcium	0.83	AOAC 968.08:2006
Phosphorus	0.64	AOAC 968.08:2006
Magnesium	0.35	AOAC 968.08:2006
Sodium	0.35	AOAC 968.08:2006

Milk samples for physicochemical and microbiological analyses were taken in sterile containers, respecting hygiene standards to avoid secondary contamination at the beginning of each week, until the end of the experimental period. Milk from ewes in the same group was collected separately.

After homogenization, three partial samples were taken from the total quantity of milk from each batch, which were homogenized, and the resulting sample constituted the laboratory sample, on which the following analyses were performed: physical parameters (pH determined immediately on the farm, density), chemical parameters (lactose, fat, protein, casein, total dry matter, non-fat dry matter), as well as microbiological analyses.

The milk was stored and transported at a temperature of +4°C, and the analyses were performed in the laboratory within approximately two hours of sampling.

The pH value was measured using a portable multimeter Multi 340i/SET WTW (Weilheim, Germany), equipped with a specific sensor for each parameter. The pH determination was performed immediately after milking, and calibration was performed with standard buffer solutions at pH 4.0 and 7.0, according to the manufacturer's instructions.

The chemical composition of the milk was determined by infrared stereoscopy, using a MilkoScan FT3, Foss Analytical A/S, (Hillerød, Denmark).

The determination of microbiological parameters was performed using the BactoScan™ FC+ bacteria analyzer, Foss Analytical A/S, (Hillerød, Denmark), equipment used for the rapid and accurate determination of the total number of bacteria in milk, which operates on the principle of flow cytometry, providing results in CFU/ml (colony forming units per milliliter).

For the statistical analysis of the experimental data, Microsoft Excel was used to calculate the mean, standard error of the mean, standard deviation (s). The Student t test was used to compare the means of two groups and check whether the difference between them is statistically significant. The program used displays a value called p-value, which can be $p>0.05$ (NS - the difference between the means is not significant), $p<0.05$ (* - the difference between the means is significant), $p<0.01$ (** - the difference is distinctly significant), $p<0.001$ (*** - the difference is very significant).

RESULTS AND DISCUSSIONS

Table 4 shows the evolution of milk production during the lactation period of lambs over six consecutive weeks in two experimental groups, Group A and Group B, each consisting of 60 ewes.

Throughout all weeks, Group B showed a constant and significantly higher milk production compared to Group A. In Week 1, the average milk production in Group B was 1128 ± 6.94 ml/head/day, exceeding Group A, which recorded 955 ± 8.60 ml/head/day ($p < 0.001$). This highly significant difference was maintained throughout the study period. By Week 6, Group B reached 1339 ± 7.23 ml/head/day, while Group A recorded 1061 ± 7.04 ml/head/day, reflecting an overall superior lactation performance in Group B.

The fluctuations in milk production over the weeks reveal a general upward trend from Week 1 to Week 3, with a slight decrease in Week 4, followed by stable or slightly increased values in the following weeks. Group A peaked in Week 3 (1083 ± 7.91 ml/head/day) and then showed a marginal decrease, while Group B showed a more sustained increase, peaking in Week 6 (1339 ± 7.23 ml/head/day).

The average daily milk production demonstrates the effect of administering the combined feed supplement to sheep in Group B, which recorded a higher productivity (1228 ± 7.35 ml/head/day) compared to sheep in Group A (1019 ± 7.74 ml/head/day), the difference being highly statistically significant ($p < 0.001$). In addition, the standard deviations (s) in both groups indicate moderate variability within the groups, although Group B consistently maintained a slightly lower variability, suggesting a more homogeneous performance.

Table 5 illustrates the progression of milk production during a 45-day milking period of the sheep in the two experimental groups, Group A and Group B, each with a number of 60 sheep.

Throughout the entire experimental period, the sheep in Group B demonstrated a constant and significantly higher milk production compared to Group A ($p < 0.001$ for all weeks). In Week 1, Group B recorded an average milk production of 2362 ± 19.98 ml/head/day, clearly exceeding Group A, which recorded 1925 ± 19.68 ml/head/day. This situation was manifested during all subsequent weeks, with Group B maintaining a substantial advantage in terms of production. The peak milk production in Group B occurred in Week 5 (2417 ± 17.12 ml/head/day), while ewes in Group A showed minimal variation from week to week, indicating a plateau in production capacity.

The calculated average daily milk production underlines these observations, with ewes in Group B reaching 2389 ± 17.21 ml/head/day, significantly higher than that of Group A, 1924 ± 18.23 ml/head/day ($p < 0.001$). The standard deviations (s) in both groups indicate moderate within-group variability, which remained comparable throughout the study period. It is important to note that despite the higher absolute production levels, Group B maintained a similar variability to Group A, suggesting that the increased yield was exhibited by all ewes.

Table 6 presents the evolution of the different physicochemical parameters of the milk obtained from the two experimental groups (Group A and Group B) during two distinct periods, suckling period (period I) and milking period (period II).

Table 4. Evolution of milk production obtained during suckling period (45 days) (ml/head/day)

Specification	Group A			Group B		
	n	M±SEM	s	n	M±SEM	s
Week 1	60	955±8.60	93.86	60	1128±6.94***	75.72
Week 2	60	946±7.52	82.08	60	1132±7.55***	82.36
Week 3	60	1083±7.91	86.29	60	1289±8.21***	89.54
Week 4	60	1050±7.60	82.95	60	1214±6.52***	71.08
Week 5	60	1020±7.77	84.72	60	1264±7.65***	83.47
Week 6	60	1061±7.04	76.83	60	1339±7.23***	78.87
Average daily milk production		1019±7.74	84.45		1228±7.35***	80.17

M = mean; SEM = standard error of the mean; s = standard deviation

Table 5. Evolution of milk production obtained during milking period (45 days) (ml/head/day)

Specification	Group A			Group B		
	n	M±SEM	s	n	M±SEM	s
Week 1	60	1925±19.68	214.73	60	2362±19.98***	218.01
Week 2	60	1922±19.01	207.42	60	2367±18.21***	198.60
Week 3	60	1918±18.57	202.62	60	2394±16.65***	181.67
Week 4	60	1921±17.88	195.09	60	2396±16.74***	182.59
Week 5	60	1927±17.37	189.46	60	2417±17.12***	186.85
Week 6	60	1931±16.86	183.92	60	2398±17.48***	190.70
Average daily milk production		1924±18.23	198.87		2389±17.21***	193.07

Table 6. Physico-chemical parameters of milk analyzed in the experimental period

Parameters	Group A		Group B		
	M±SEM	s	M±SEM	s	p
Density (g/l)					
Period I	1.986±0.057	0.128	2.370±0.053***	0.118	0.00061
Period II	1.035±0.0003	0.0007	1.035±0.0002^{NS}	0.0006	0.687
pH					
Period I	6.82±0.015	0.034	6.81±0.015^{NS}	0.033	1.00
Period II	6.80±0.005	0.011	6.81±0.004^{NS}	0.009	0.450
Total dry matter (%)					
Period I	16.73±0.131	0.289	16.84±0.080*	0.174	0.491
Period II	16.40±0.111	0.249	17.88±0.065***	0.146	0.00003
Non-fat dry matter (%)					
Period I	11.27±0.046	0.102	10.72±0.093***	0.208	0.00035
Period II	10.24±0.053	0.119	11.56±0.040***	0.090	0.0000006
Crude fat (%)					
Period I	5.92±0.097	0.216	6.23±0.079*	0.176	0.031
Period II	5.92±0.063	0.141	6.73±0.033***	0.074	0.0000005
Crude protein (%)					

Parameters	Group A		Group B		
	M±SEM	s		M±SEM	s
Period I	5.35±0.054	0.121	5.34±0.020^{NS}	0.045	0.822
Period II	5.28±0.045	0.102	5.56±0.087*	0.195	0.017
Casein (%)					
Period I	4.08±0.030	0.067	4.08±0.053^{NS}	0.119	1
Period II	4.02±0.038	0.084	4.16±0.023**	0.051	0.009
Lactose (%)					
Period I	4.75±0.031	0.069	4.75±0.063^{NS}	0.141	1
Period II	4.48±0.028	0.062	4.77±0.081**	0.182	0.007
Glucose (%)					
Period I	0.17±0.010	0.023	0.16±0.007^{NS}	0.017	0.446
Period II	0.20±0.007	0.016	0.22±0.007^{NS}	0.015	0.153
Galactose (%)					
Period I	0.10±0.016	0.036	0.08±0.013^{NS}	0.030	0.363
Period II	0.16±0.009	0.022	0.16±0.009^{NS}	0.021	1
Total Microbial Flora (cfu/ml)					
Period I	63,000±3,781	6,455	58,000±1,468^{NS}	3,283	0.068
Period II	80,166±5,728	5,863	51,000±1,913^{NS}	4,459	0.062

In Period I, the milk density was significantly higher in Group B (2.370 ± 0.053 g/l) compared to Group A (1.986 ± 0.057 g/l, p<0.001), indicating a notable improvement in the milk composition as a result of the administration of the dietary supplement. However, no significant difference was observed between the groups in Period II (p = 0.687).

The milk pH remained similar between the groups during both periods, with no statistically significant differences (p > 0.05), suggesting that dietary supplementation did not influence the acidity or alkalinity of the milk.

Although a minor, non-significant increase was observed in Group B during Period I (16.84 ± 0.080%) compared to Group A (16.73 ± 0.131%, p = 0.491), a highly significant increase occurred in Period II (17.88 ± 0.065% vs. 16.40 ± 0.111%, p = 0.00003). This indicates an improved nutritional density of milk over time due to the supplementary diet.

Group B showed a significantly lower SNG content in Period I (10.72 ± 0.093%) compared to Group A (11.27 ± 0.046%, p = 0.00035).

However, in Period II, the trend was reversed, with Group B showing a significantly higher level of SNF (11.56 ± 0.040%) than Group A (10.24 ± 0.053%, p = 0.0000006). This suggests a positive impact of the diet over time.

Fat content was moderately but significantly higher in Group B in both periods. In Period I, Group B recorded 6.23 ± 0.079% versus 5.92 ± 0.097% in Group A (p = 0.031). In Period II, the difference became highly significant (6.73 ± 0.033% versus 5.92 ± 0.063%, p = 0.0000005), confirming the strong effect of supplementation on fat synthesis.

Protein content was similar between groups in Period I (p = 0.822). However, by Period II, Group B demonstrated a significantly higher protein level (5.56 ± 0.087%) compared to Group A (5.28 ± 0.045%, p = 0.017), supporting the hypothesis that dietary supplementation improved milk protein synthesis over time.

Casein content was comparable in Period I (p = 1.00). A significant increase in casein was observed in Group B in Period II (4.16 ± 0.023% vs. 4.02 ± 0.038%, p = 0.009), which is important for improving cheesemaking potential and nutritional value of milk.

No differences in lactose content were detected in Period I (p = 1.00). In Period II, however, Group B showed a distinctly significantly higher lactose content (4.77 ± 0.081%) compared to Group A (4.48 ± 0.028%, p = 0.007), indicating an increased carbohydrate content.

No statistically significant differences were observed in either glucose or galactose concentrations between the two groups in either period (all p > 0.15), suggesting that these carbohydrate fractions were not affected by the dietary treatment.

Although not statistically significant, Group B consistently showed lower numbers of microorganisms in both periods.

From the analysis of the results obtained, it can be appreciated that the ewes in Group B, which received a supplement of combined feeds both in the prepartum and postpartum periods, showed significantly higher milk yields compared to the ewes in Group A, both in the lactation and milking periods.

The results showed that ewes in Group B, which received a dietary supplement both prepartum and postpartum, had significantly higher milk yields during both lactation and milking. This is in line with the findings of Zarrin et al. (2021), who reported that pre- and postpartum dietary restrictions negatively affected colostrum and milk yields in fat-tailed dairy ewes, highlighting the importance of adequate nutrition during these periods.

Similarly, studies have shown that pre- and postpartum supplementation with energy-rich feeds such as cracked corn can double colostrum production in ewes, thereby enhancing neonatal nutrition and immunity (Banchero et al., 2004).

Milk from ewes in Group B also had higher total solids, fat, protein and lactose content, especially during the postpartum period. This is in line with the study by de Sousa et al. (2018), who found that dietary supplementation in Santa Inês sheep during the pre- and postpartum periods improved milk production and influenced mineral metabolism.

Regarding microbial quality, although our study observed a lower number of microbes in Group B, the differences were not statistically significant. Maintaining a low somatic cell count is essential for milk quality, and nutritional strategies during the transition period can influence this parameter (Morand-Fehr et al., 2007).

The results obtained highlight the positive effects of specific nutritional supplementation during the pre- and postpartum periods on milk production and quality in sheep. These results are consistent with the existing literature, which highlights the significant role of nutritional and management practices in optimizing milk production and composition in sheep.

CONCLUSIONS

Administration of a concentrate feed supplement to sheep in Group B positively influenced milk production throughout the suckling period, leading to higher and more stable yields compared to Group A.

The same situation is observed in the case of the lactation period, the dietary stimulant administered to sheep in group B having a substantial and sustained positive effect on milk production during the milking period, leading to higher and more stable yields compared to Group A.

The combined feed supplement administered to Group B had a clear and significant positive impact on several key physico-chemical properties of milk, particularly in Period II. Enhancements in total solids, fat, protein, casein, and lactose content, along with trends toward lower microbial counts, indicate improved milk quality and nutritional value associated with the dietary intervention.

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