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Protected fat in the diet of lactating ewes affects milk composition, lamb body weight and their biochemical parameters

Elena Zdorovieva[1*], Gennady Boryaev[1], Elena Kistanova[2], Alexey Nosov[1], Yuri Fedorov[1], Nikolay Semigodov[1]

[1]*Penza State Agrarian University, Penza 440026, Russia*
[2]*Institute of Biology and Immunology of Reproduction, Bulgarian Academy of Sciences, 1113 Sofia, Bulgaria*
[*]*Coresponding author:* lenochka_z87@mail.ru

Abstract

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Providing the right supplementary feeds at critical periods of ewe life as pre-lambing and lactating can maximise efficiency and profit of sheep breeding. The aim of the research was to study how the feed supplement, based on the protected fat and selenopyran added to the diet of lactating ewes, influents their milk composition as well as the biochemical status and productive characteristics of their lambs. The experiment was carried out with sheep of the Tsigay breed in the conditions of the agro-enterprise Biokor-S Ltd in the Penza region, Russia. It was found that the use of fodder additive in the feeding of ewes increased the fat content in the milk of animals with about 39% compared with the control group. The level of total protein in the serum of lambs, suckling experimental ewes, was significantly lower in comparison with the animals of the control group at the 60th day of the experiment. A significant decrease of the total cholesterol as well as the triglycerides in the blood of lambs was established. The results allow concluding that the use of the protected fat in the feeding of lactating ewes at a dose of 1% of the feed content was optimal, since it compensated the lack of the metabolisable energy, leading to an increase of the fat content in the milk and a weight of their lambs. Also protected fat exerted a positive effect on the lipid spectrum of lamb blood, reducing the level of total cholesterol, and keep the protein content in the physiologic range.

Keywords: Tsigay sheep; lactating ewes; protected fat; milk composition; lambs; blood protein; cholesterol

Introduction

The main tasks in sheep breeding are the preservation of the genetic fund of animals, the improvement of breed qualities of all pedigree animals (Mungin, 2009; Filatova et al., 2014; Costa et al., 2018). Properly feeding gives possibility to get the maximum amount of products from animals. It also allows identifying the genetic potential of animal productivity, to increase the duration of animal use and to improve the quality of the products (Levakhin et al., 2012; Gallardo et al., 2014; Sazonova, 2015).

The most demanding to the observance of the standards and rules of feeding are in the pregnant/pre-lambing and lactating ewes, in connection with the intense metabolic processes in the body. The level of basal metabolism in pregnant and lactating ewes is higher than in non-pregnant ewes, and has a positive relationship with milkiness (Bobretsov et al., 2016; Razumovsky & Sobolev, 2017; Frutos et al., 2018).

The aim of the research was to study how the feed supplement, based on the protected fat and selenopyran, introducing to the diet of lactating ewes, influents on their milk composition as well as on the biochemical status and productive characteristics of their lambs.

Materials and Methods

The experiment was carried out with sheep of the Tsigay breed in the conditions of the enterprise Biokor-S Ltd of the Penza region. Studies were carried out against a background of balanced feeding according to the main indicators of norms and rations. 45 lambing ewes were randomly divided in three groups of 15 animals by age, weight and number of lactation. All ewes were at first lactation and had one lamb, so the total number of lambs per group was 15. The average age of animals was between 12-14 months and the average live body weight was 41.68±1.25 kg. Ewes of the control group received the basic diet; ewes of the 1st and 2nd experimental groups, starting from the third day after lambing, received respectively 1% and 2% of the fodder additive on the basis of protected fat and selenopyran from the fodder weight to the ration of feeding (Table 1).

The duration of the experiment was 60 days. The evaluation of ewes' milk composition, lamb body weight and their blood biochemical parameters was done at 25th, 45th and 60th days of the experiment.

Table 1. Fodder composition

Components, %	Control group	First group	Second group
Naked oat	32	30.0	27.0
Barley	43	43.0	43.0
Flax cake	5.0	5.0	5.0
Wheat middling	19.0	20.0	22.0
Premix	1.0	1.0	1.0
Protected fat	–	1.0	2.0
Contained in 1 kg metabolisable energy, MJ	10.23	10.40	10.41
Raw protein, g	142.0	140.0	139.0
Calcium, g	1.91	1.94	1.96
Phosphorus, g	5.05	5.11	5.20

Laboratory studies were conducted in the inter-departmental biochemistry laboratory of FSBEI HE Penza SAU. The following serum indicators were determined according to standardized procedures: total protein, urea, albumin, glucose, total cholesterol, high-density lipoproteins, and triglycerides by Bioanalyzer (Mindray BA-88A, China). The milk quality was determined on a LactoScan milk quality analyzer (LactoScan SP, Bulgaria).

The obtained experimental data were statistically processed; the calculation of the mean value, standard (mean-square) deviation and standard mean error was performed. The value of the significant differences between the two means was assessed by the Student t-test and $p<0.05$ (Glantz, 1999).

Results and Discussion

As a result of the experiment, it was found that the milk of the ewes from the experimental groups differs from the milk of control animals in fat content (Table 2).

On the 25th day of the experiment, there was found a statistically significant increase in the fat content – by 2.62% in the first group and by 2.4% in the second group in absolute value. These results are in agreement with data of Morozova (2011), who reported that the use of protected fat in the diet of ewes increases the utilization of the nutrient components of forage through the enhancement of the fermentation in rumen and impacts the fat content in the milk at the beginning of the lactation.

In the milk, taken in the middle of the experiment, there were no statistically significant differences in the content of physicochemical parameters.

At the end of the experiment, the significant difference of the fat content in the ewes' milk between the control and experimental groups was in the range of 2.32-2.33% (Table 2).

Table 2. Physicochemical composition of ewes' milk on the 25th, 45th, 60th days of the experiment

Groups	Fat, %	Nonfat milk solids, %	Protein, %	Density, g/cm^3
25th day of the experiment				
Control group (n = 15)	5.20±0.685	10.2±0.152	3.35±0.100	1.034±0.119
First group (n = 15)	7.82±0.635*	9.61±0.094	2.96±0.051	1.029±0.058
Second group (n = 15)	7.60±0.543*	9.67±0.108	3.04±0.086	1.030±0.096
45th day of the experiment				
Control group (n = 15)	6.88±0.456	8.77±0.472	2.725±0.161	1.028±0.098
First group (n = 15)	7.14±0.256	9.83±0.154	3.12±0.049	1.031±0.076
Second group (n = 15)	8.10±0.556	9.79±0.127	3.03±0.074	1.031±0.083
60th day of the experiment				
Control group (n = 15)	5.93±0.282	9.79±0.157	3.16±0.061	1.031±0.065
First group (n = 15)	8.22±0.533*	9.94±0.138	3.05±0.067	1.030±0.072
Second group (n = 15)	8.23±0.337*	9.99±0.197	3.10±0.075	1.031±0.080

*$p < 0.001$ – the difference is significant compared to the control group

Our results confirmed the research of Garcia et al. (2005) with fat, protected by calcium. They established that addition of 45 g of fatty acids from olive oil as calcium soap to the diet of lactating ewes increases the fatness of milk.

According to the results of biochemical studies, it can be noted that the basic biochemical parameters of lambs' blood were within the physiological range during the whole experiment.

The level of lipid fractions in the blood reflects the state of lipid metabolism in the body, which depends on various factors, mainly on the diet of animals (Juraev, 2015).

A significant decrease in the level of total cholesterol in the blood of lambs of both experimental groups was established at 25th day. There was an increase in the level of high-density lipoproteins in the serum of lambs in the experimental groups (Table 3). This fact can be considered as positive, since the main function of high-density lipoproteins (HDL) is the capture of cholesterol in tissues and its transfer to the liver, where it is absorbed, converted into bile acids and excreted from the body with bile – the so-called cholesterol reverse transport process (Broderick, 2018).

On the 45th day of the experiment, a statistically significant decrease in the urea concentration, total cholesterol and triglycerides in the blood serum of the lambs from the 1st experimental group was observed relative to the indicators in the control.

On the 60th day the level of total protein in the serum of all experimental animals was significantly lower in comparison with the animals of the control group (Table 3). At the same time the level of total cholesterol and triglycerides was significantly lower only in the 1st experimental group compared with the control and 2nd experimental group.

Analyzing the level of total cholesterol throughout the entire experiment, it can be noted that on the 25th day of the experiment, the greatest concentration of total cholesterol in the serum of lambs was observed in all experimental groups. During whole experiment in the 1st experimental group there was a statistically significant decrease in total serum cholesterol level compared with both the control group and the 2nd experimental group (Fig. 1). The constantly decrease of total cholesterol in the blood serum of lambs from the first experimental group may indicate a more intensive metabolic processes and a high energy requirement of these lambs, which is replenished by blood lipids (Afanasyeva & Simonova, 2012). In support of that are our results related to the more intensive weight gain in lambs from the 1st experimental group.

The analysis of the quality of milk of the Tsigai breed ewes showed that feeding a high-energy feed supplement based on protected fat and selenopyran promotes an increase in the milk quality of sheep, which reflects the growth rate of the offspring and have a positive effect on its meat production.

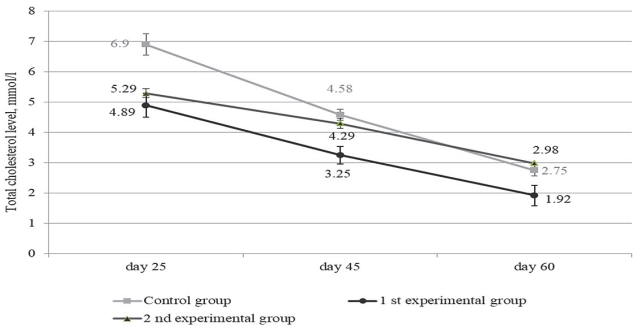

Fig. 1. Changes of the total cholesterol content in lamb serum during the experimental period

Table 3. Biochemical parameters of lambs blood on the 25th, 45th, 60th days of the experiment

Groups	Total protein, mmol/L	Albumen, mmol/L	Urea, mmol/L	Total cholesterol, mmol/L	HDL, mmol/L	TG, mmol/L	Glucose, mmol/L
25th day of the experiment							
Control group (n = 15)	64.5±1.72	33.5±3.29	6.15±0.736	6.90±0.356	2.71±0.068	1.57±0.236	8.26±0.384
First group(n = 15)	65.5±3.33	30.6±2.24	5.99±0.779	4.89±0.177*	3.32±0.175*	1.32±0.126	8.35±0.292
Second group (n = 15)	73.6±5.66	22.8±1.00	8.12±0.433	5.29±0.191	3.33±0.119	1.259±0.124	8.27±0.193
45th day of the experiment							
Control group (n = 15)	58.07±2.46	26.19±0.716	5.99±0.302	4.58±0.391	2.55±0.206	1.89±0.245	5.42±0.349
First group (n = 15)	46.88±1.73	26.37±0.617	3.39±0.262*	3.25±0.284*	2.11±0.186	0.533±0.078*	6.44±0.316
Second group (n = 15)	56.92±1.77	24.53±0.819	4.09±0.152	4.29±0.337	2.15±0.134	0.435±0.081*	6.19±0.147
60th day of the experiment							
Control group (n = 15)	62.18±0.746	35.95±0.765	8.37±0.255	2.75±0.147	2.45±0.185	0.843±0.059	6.59±0.325
First group (n = 15)	55.39±1.127*	35.62±1.049	8.06±0.376	1.92±0.163*	2.28±0.110	0.385±0.008*	5.33±0.259
Second group (n = 15)	57.42±1.37*	34.87±1.77	8.21±0.328	2.98±0.185**	2.23±0.219	1.01±0.059**	5.32±0.421

*$p < 0.001$ – the difference is significant compared to the control group

**$p < 0.001$ – the difference is significant compared between experimental groups

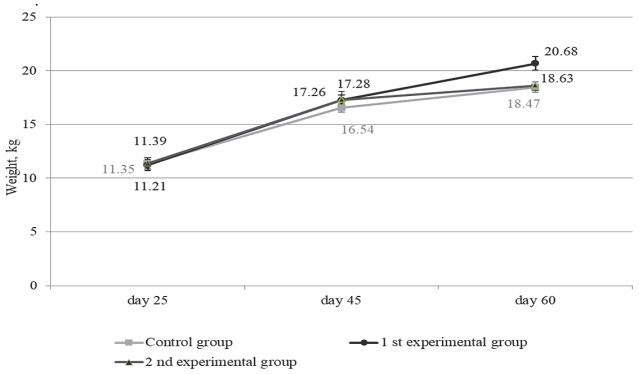

Fig. 2. Dynamic of lamb body weight during the experimental period

Analyzing the weight of lambs during the experiment, it was established that at the beginning of the experiment on the 25th day the weight of the lambs of all groups was within the limits of 11.21-11.39 kg. On the 60th day of the experiment, the weight of lambs in the 1st experimental group was significantly higher that in control and 2nd experimental group (20.68±0.664 kg against 18.47±0.494 kg and 18.63±0.473 kg respectively, $p<0.01$). The increase was 6.55% compared with the lambs of the control group and 5.63% compared with the lambs of the 2nd experimental group (Fig. 2).

Conclusion

According to the results of the scientific and production experiment conducted on ewes, it was found that the inclusion of 1% high-energy feed supplement based on protected fat and selenopyran in the feeding ration of lactating ewes had a positive effect on the physicochemical composition of the ewes' milk. The range of the increase of fat in the milk of experimental animals was between 2.3% and 2.6% in absolute value. The changes in the milk fat content reflect the growing ability of lambs. At the end of the experiment, the weight of lambs, sukling the mothers received 1% high-energy feed supplement, was higher than in control and 2nd experimental group. Observing the biochemical parameters of the lambs' blood, it can be concluded that the parameters of protein, lipid and energy metabolism in experimental animals were within the physiological norm. Moreover, the introduction of a feed supplement based on protected fat and selenopyran had a positive effect on the lipid spectrum of the blood. At the end of the experiment, the level of this indicator in all groups was within the range of 1.92-2.98 mmol/l, but in the first experimental group it was significantly lower than in the control group and the second trial group.

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