Influence of feed additive from secondary raw materials of starch-treacle production on sheep-producers productivity

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Abstract. Introduction to the diets of sheep-producers of wool (Jalgin merino) and meat-wool directions (Russian meat merino) productivity in the non-breeding and breeding period of the feed additive «corn Gluten» in the amount of 28 and 56 and 28 and 66 g per unit per day contributes to an increase in crude and digestible protein by 5,0 and 10,0 %, lysine by 1,52 and 3,0 %, methionine with cystine – by 5,2 and 12,7 %. In addition, the digestibility of dry matter of the diet (in the non-breeding period) is significantly increased by 3,85-6,74%, by 13,4-15,11% – raw protein, by 3,19-5,03% – raw fat, by 5,92-7,21% – raw fiber, as well as nitrogen-free extractive fraction – by 1,90-3,52%. Feed additive «corn Gluten» promotes a significant increase in the volume of ejaculate in breeding period by 2,4-5,7% and 2,8-7,0%, sperm activity and an indicator of resistance to 0,3-0,6 and 0,5-0,6 points and 450-800 units, sperm concentration – by 1,7-3,0 and 1,7-3,5 %, ewes' fertility – by 3,0-5,0 and 2,0-3,0 %. The additional income from the sale of sperm products with an increase in the protein level in the diets of sheep-producers Jalgin merino and Russian meat merino by 5% is 3,63-4,32, and by 10 % – 8,20-10,26 thousand rubles.

1 Introduction

Sheep breeding has historically been practically the only source of such important products as wool, meat, milk, lamb pelts, fur and fur sheepskins. This is one of the most unique sectors of animal keeping, as it is able to provide human from his birth to the end of his life with many diverse and valuable products [1-4]. Improving the efficiency of herd reproduction through the use of the most valuable pedigree producers is one of the urgent problems in sheep breeding and is of great importance for the further development of the industry [5-8]. This is closely related to providing animals with complete feeds that would satisfy the need for all nutrients [9-12].

From literary sources, most authors believe that only with optimal feeding the reproductive qualities of sheep-producers are maximally manifested [13-16]. When

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overfeeding, underfeeding or feeding defective diets for energy, protein, mineral and vitamin nutrition, all physiological and reproductive processes in the animal organism decrease [17-19].

Diets used in agricultural enterprises to feed animals most often do not cover nutrient requirements. Therefore, the need arises for its enrichment with various feed additives, incorporating biologically active substances and having positive effect on health and reproductive functions of animals [20-22]. In this regard, agribusiness secondary raw materials are of great interest, namely, starch-treacle production (gluten, germ, pulp, sirup and others) [23].

Differentiated feeding standards for farm animals have not been significantly revised and adjusted for a long time. However, in recent years, ideas about a complete balanced feeding based on achievements in the field of physiology and biochemistry of nutrition have changed.

The aim of our research was to study the effect of feed additives «corn Gluten» on the need for protein nutrition in sheep-producers of wool and meat-wool productivity. The following tasks were set:

- to study the producers' need for protein nutrition with additional feeding of corn gluten depending on the physiological state and sexual load;
- to study the effect of the studied feed additive on the qualitative and quantitative indicators of sperm of sheep-producers.

2 Materials and methods

Studies on the need for protein nutrition of sheep-producers of wool (Jalgin merino) and meat-wool (Russian meat merino) areas of productivity when feeding a feed additive «corn Gluten» were held in agricultural production cooperative «Plemzavod Vtoraya Pyatiletka», Stavropol region. For this purpose, 9 heads of sheep-producers of the Jalgin merino breed and Russian meat merino were selected and three groups of animals were formed according to the principle of analog pairs (by age, live weight, wool cut, quantity and quality of sperm production) of each breed, 3 heads in each.

Based on the analysis of feeds and additives, diets for sheep-producers were compiled taking into account the direction of productivity and physiological state.

The sheep-producers of wool and meat-wool direction of productivity of control groups in the non-breeding period received the main diet (MD) – steppe hay of various grasses – 2,4 kg, compound feed – 0,7 kg, beet feed – 1,0 kg, table salt – 18 g and premix (P 80-2) – 10 g. This diet contained: metabolic energy 24,3 MJ, raw protein – 285 g, lysine – 13,5 g, methionine with cystine – 11,5 g. Due breeding period, the sheep were fed a diet consisting of cereal-bean hay in the amount of 2,2 kg, compound feed – 1,2 kg, beet feed – 1,5 kg, table salt – 18 g, as well as premix (P 80-2) – 10 g. The diet contained metabolic energy 28,7 MJ, raw protein – 410 g, lysine – 19,8 g, methionine with cystine – 13,4 g.

Sheeps II and III – experimental groups of breeds Jalgin and Russian meat merino in addition to the main rations (MR), which were compiled according to the norms of All-Russian Institute of Livestock and All-Russian Research Institute of Sheep and Goat Breeding, additionally received a feed additive – «corn Gluten» due non-breeding period by 28 and 56 g per unit per day and due breeding period – respectively 28 and 66 g.

All studies were conducted in the laboratory of veterinary medicine at All-Russian Research Institute of sheep and goat breeding, a branch of the Federal State Budget Scientific Institution «North Caucasian Federal Scientific Agrarian Center» according to generally accepted methods.

3 Results and discussion

Sheep-producers of experimental (test) groups II and III were set on a diet including «corn Gluten» in the amount of 28 and 56 g per unit per day in a non-breeding period, the content of raw and digestible protein increased by 5,0 and 10,0 %, lysine by 1,41 and 3,7%, methionine with cystine – by 6,1 and 13,0 %. The introduction into the diets of sheep-producers of II and III of experimental groups in breeding period the above indicated feed additive in the amount of 28 and 66 g per unit per day increased the content of raw and digestible protein by 5,0 and 10,0 %, lysine by 1,52 and 3,0%, methionine with cystine – by 5,2 and 12,7 %.

Studies on the digestibility of feed nutrients were carried out on sheep-producers of meat-wool direction of productivity in the non-breeding period (table 1).

Table 1. Digestibility of dietary nutrients by stud rams of the Russian meat merino in the non-breeding period, %.

Index	Group		
	I control	II test	III test
Dry matter	61.09±0.128	63.44±0.133	65.21±0.137*
Organic matter	66.43±0.139	68.87±0.144	69.17±0.145
«Raw» protein	58.11±0.122	65.90±0.138*	66.89±0.141*
«Raw» fat	66.21±0.139	68.32±0.143	69.54±0.146*
«Raw» cellulose	57.13±0.119	60.51±0.127*	61.25±0.123*
Nitrogen-free extractive fraction	69.33±0.145	70.65±0.148	71.77±0.151*

Where *(P≤0,05).

With an increase in protein levels of 5,0 and 10,0% in the diets of sheep-producers due to the inclusion of «corn Gluten» the main nutrients of diets are better digested: dry matter by 3,85 – 6,74 % (P≤0,05), «raw» protein – by 13,4 – 15,11% (P≤0,05), «raw» fat – by 3,19 – 5,03 % (P≤0,05), «raw» cellulose – by 5,92 – 7,21 % (P≤0,05) and nitrogen-free extractive fraction – by 1,90 – 3,52 % (P≥0,05).

The obtained data indicates that an increase in the protein level of nutritional value of diets contributed to the improvement of metabolic processes, which positively affected the productive qualities of sheep-producers (table 2).

Animals of II and III of experimental groups of the Jalgin merino breed exceeded the peers of the control group during the development period by 2,90 and 3,14 % (P≤0,05), by Russian meat merino breed – by 3,8 and 4,2 % (P≤0,05).

Table 2. Live weight and wool productivity of stud rams, n = 3.

Index	Jalgin merino			Russian meat merino		
	Group					
	I control	II test	III test	I control	II test	III test
Live weight when tested. kg	123.0±3.44	124.1±3.47	124.1±3.26	127.6±3.57	128.0±3.61	127.9±3.42

Live weight before developing sheep. kg	124.1± 3.52	127.7± 3.58	128.0± 3.65*	128.7± 3.71	133.6 ± 3.77	134.1± 3.84*
Cut wool in physical weight. kg	9.10± 0.22	9.35± 0.23	9.39± 0.26*	8.70± 0.21	8.91± 0.19	8.97± 0.23*
Wool fineness. microns	20.0± 0.42	20.0± 0.41	20.0± 0.39	21.0± 0.40	21.0± 0.41	21.0± 0.42
Wool length. cm	11.80± 0.27	12.12± 0.28	12.34± 0.29*	9.50± 0.22	9.70± 0.23	9.90± 0.25*

Where * $P \leq 0,05$.

Increase protein level in animal diets affected the increase in wool productivity in sheep-producers of II and III experimental (test) groups respectively by 2,75-3,19 % and 2,41-3,10 %. So, the fineness of the wool fibers of animal experimental groups corresponded to the productivity directions and amounted to 20 and 21 microns. By the length of the coat, the animals of experimental groups of Jalgin merino exceeded analogues of the control group by 2,7 and 4,6 % ($P \leq 0,05$) or by 0,32 and 0,54 cm; of Russian meat merino this index was higher, respectively by 2,5 and 4,5% ($P \leq 0,05$) or by 0,2 and 0,4 cm.

Biochemical blood tests were performed during the development of sheep-producers, the results are presented in table 3.

The results show that when feeding with the additive «corn Gluten» the sheep-producers of wool productivity directions of II and III – experimental groups, compared with animals of I – control group, the content of erythrocytes increased by 8,1 ($P < 0,05$) and 17,4% ($P < 0,01$), leukocytes by 6,8 and 9,5% ($P < 0,05$), hemoglobin by 4,5 and 10,5% ($P < 0,05$), the amount of total protein in blood serum increased by 10,3 and 15,5% ($P < 0,01$), calcium by 15,5 and 25,4 % ($P < 0,001$), phosphorus by 9,6 ($P < 0,05$) and 16,3 % ($P < 0,01$). In animals of experimental groups, when feeding with the additive in blood serum, enzymatic activity (aspartate aminotransferase and alanine aminotransferase) significantly increases, which indicates an increased metabolism. The same trend was observed when gluten was fed to corn sheep-producers of meat and wool productivity. The hematological parameters obtained during the studies in all experimental animals were within the physiological norm and are confirmed by the productivity indicators of the rams.

Table 3. Hematological and biochemical indices of stud rams, n=3.

Index	Norm	Jalgin merino			Russian meat merino		
		group					
		I contr ol	II test	III test	I contr ol	II test	III test
Erythrocyte. 10 ¹² /l	6-12	8.6± 0.18	9.3± 0.20*	10.1± 0.22**	9.0± 0.19	9.6± 0.21*	10.5± 0.23**
Leukocyte. 10 ⁹ /l	6-14	7.4± 0.16	7.9± 0.17	8.1± 0.18*	7.8± 0.17	8.2± 0.18	8.7± 0.19*
Hemoglobin. g/l	70-120	99.1± 2.18	103.6 ± 2.28*	109.5 ± 2.41*	104.1 ±2.29	111.2± 2.45*	115.2± 2.53**
Total protein. g/l	65-75	58.0± 1.28	64.0± 1.41**	67.0± 1.47**	61.0± 1.34	65.0± 1.43*	71.0± 1.56**

Glucose. mmol/l	2.2-3.3	2.14± 0.05	2.62± 0.06**	3.15± 0.08**	2.25± 0.05	2.97± 0.07**	3.21± 0.08**
Urea. mmol/l	3.3-5.8	4.83± 0.11	4.12± 0.09	3.75± 0.08	5.11± 0.11	4.35± 0.10	3.82± 0.06
Total bilirubin. mmol/l	0.01-0.3	0.12± 0.01	0.16± 0.01**	0.20± 0.02**	0.13± 0.01	0.18± 0.01**	0.22± 0.02**
Phosphorus. mmol/l	1.45- 1.84	1.35± 0.03	1.48± 0.03*	1.57± 0.04**	1.42± 0.03	1.62± 0.04**	1.78± 0.04**
Calcium. mmol/l	2.5-3.13	2.32± 0.05	2.68± 0.06**	2.91± 0.06**	2.44± 0.05	2.78± 0.06**	3.08± 0.07**
AST. mmol/l	38-80	41.0± 0.90	52.0± 1.21**	63.0± 1.39**	43.0± 0.95	54.0± 1.18**	67.0± 1.47**
GPT. mmol/l	2-10	7.0± 0.15	8.0± 0.18**	9.0± 0.20**	8.0± 0.18	9.0± 0.20**	10.0± 0.22**

Where *P<0,05; **P<0,01.

In terms of quantity and quality of sperm production, its fertilizing ability, sheep-producers of the experimental (test) groups of the wool and meat-wool directions of productivity with an increased protein level in diets of 5 and 10% had an advantage (table 4).

Larger volume of ejaculate was obtained from sheep-producers of the Jalgin merino II and III experimental groups 2,4 and 5,7 % (P<0,05), higher sperm activity and resistance to 3,3-5,5 %, sperm concentration – by 1,8-3,0 %, fertilization of ewes – by 3,0-5,0 %. The same pattern is also observed among the sheep-producers of meat and wool direction of the Russian meat merino breed. The difference in the quantity and quality of sperm production between the breeds is not reliable, but there is some advantage in the volume of ejaculate – by 2,8-7,0 % (P<0,05), sperm activity – by 5,4-6,5%, sperm concentration – by 1,7-3,5%, fertilization of ewes – by 2,0-3,0 %.

From sheep-producers of the wool productivity direction of the experimental groups compared with animals of the control group for breeding period, more than 15-36 sperm doses were received in the amount of 3,85-8,65 thousand rubles, and from sheep of the meat and wool direction – by 18-45 sperm dose and 4,54-10,71 thousand rubles.

Table 4. Efficiency of sperm production in stud rams per 1 head (of prices 2019).

Index	Jalgin merino			Russian meat merino		
	Group					
	I control	II test	III test	I control	II test	III test
Ejaculate volume. ml	2.11± 0.044	2.16± 0.45	2.23± 0.48*	2.13± 0.045	2.19± 0.47	2.28± 0.48
Sperm activity. points	9.1± 0.24	9.4± 0.25	9.6± 0.27	9.2± 0.23	9.7± 0.25	9.8± 0.29
Sperm concentration. billion/ml	3.38± 0.06	3.44± 0.06	3.48± 0.07	3.45± 0.07	3.51±0. 07	3.57±0. 08

Fertility. %	79.0	82.0	84.0	81.0	83.0	84.0
Sperm doses received. units	633	648	669	639	657	684
Cost realizable sperm.thousand rubles	144.32	148.17	152.97	145.69	150.23	156.40
Additional income. thousand rubles	-	3.63	8.20	-	4.32	10.26

The additional income from the sale of sperm products (with an average prevailing selling price of 228,66 rubles per sperm dose) with an increase in the protein level in the diets of sheep producers by 5% is 3,63-4,32, and by 10 % – 8,20-10,26 thousand rubles.

4 Conclusion

Thus, the research results showed that an increase in protein nutrition of the diets of sheep-producers of various directions of productivity by 5.0 and 10.0% of raw protein due to the additional introduction of «corn Gluten» had a positive effect on the digestibility of dietary nutrients, an increase in ejaculate volume, sperm activity and an indicator of resistance, sperm concentration, fertilization of ewes and additional income from the sale of sperm production.

References

1. V.A. Pogodaev, A.N. Arilov, B.K. Aduchiev, V.I. Komlatsky, V.U. Edgeev, *Research Journal of Pharmaceutical, Biological and Chemical Sciences* **8(6)**, 515–519 (2017)
2. N.I. Belik, A.Kh. Khaitov, A.P. Marynich, T.I. Antonenko, A.M. Andrushko *Research Journal of Pharmaceutical, Biological and Chemical Sciences* **8(6)**, 569-573 (2017)
3. L.J. Farrell, P.R. Tozer, P.R. Kenyon, T. Ramilan, L.M. Cranston, *Agricultural Systems* **174**, 125-132 (2019)
4. B.A. McGregora, S.P. de Graafb, S. Hatcherc, *Small Ruminant Research* **137**, 138–150 (2016)
5. V.A. Pogodaev, A.N. Arilov, B.K. Aduchiev, V.I. Komlatsky, V.U. Edgeev, *Research Journal of Pharmaceutical, Biological and Chemical Sciences* **9(3)**, 765–769 (2018)
6. V.I. Trukhachev, S.A. Oleinik, E.N. Chernobai, A.P. Marynich, S.P. Sklyarov, *Agriculture for the next 100 years proceedings of the 26th njf congress*, 130-133 (2018)
7. V.A. Uthlaut, G.E. Moss, R.H. Stobart, B.A. Larson, B.M. Alexander, *Small Ruminant Research* **100**, 63-66 (2011)
8. E. (Raducuta) Iona, I. Calin, I. Raducuta, M. Paula Marin, C. Georgeta, *Agriculture and Agricultural Science Procedia* **6**, 206–210 (2015)
9. N.V. Konik, V.I. Guzenko, A.P. Marynich, A.A. Khodusov, A.M. Andrushko, *Research Journal of Pharmaceutical, Biological and Chemical Sciences* **9(6)**, 1797-1799 (2018)

10. E. Verbeek, J.R. Waas, L. McLeay, L.R. Matthews, *Applied Animal Behaviour Science* **132**, 121-130 (2011)
11. R.R. Cockrum, R.H. Stobart, S.L. Lake, K.M. Cammack, *Small Ruminant Research* **113**, 313-322 (2013)
12. Y.X. Fan, Z. Wang, C.F. Ren, T.W. Ma, Y.L. Zhang, *Theriogenology* **119**, 198-207 (2018)
13. V. Pogodaev, B. Aduchiev, N. Sergeeva, *XII International Scientific Conference on Agricultural Machinery Industry*, IOP Conf. Series: Earth and Environmental Science **403** (2019) doi:10.1088/1755-1315/403/1/012111
14. T. Sezenler, A. Ceyhan, M. Yildirim, İsmail Erdogan, *Small Ruminant Research* **117**, 109–118 (2014)
15. S.T. Morris, P.R. Kenyon, *Meat Science* **98**, 330-335 (2014)
16. B. Wang, L. Yang, Y. Luo, R. Su, Y. Jin, *Small Ruminant Research* **169**, 127-133 (2018)
17. V. Pogodaev, N. Sergeeva, V. Marchenko, *XII International Scientific Conference on Agricultural Machinery Industry*, IOP Conf. Series: Earth and Environmental Science **403** (2019) doi:10.1088/1755-1315/403/1/012114
18. V.A. Pogodaev, B.K. Aduchiev, V.V. Marchenko, M.A. Nesterenko, E.N. Belkina, *Research Journal of Pharmaceutical, Biological and Chemical Sciences* **9(4)**, 671–675 (2018)
19. M. Clauss, M. Stewart, E. Price, A. Peilon, A. Munn, *Small Ruminant Research* **138**, 12-19 (2016)
20. A. Arilov, V. Pogodaev, B. Appaev, E. Lidzhiev, S. Mashtykov, *XII International Scientific Conference on Agricultural Machinery Industry*, IOP Conf. Series: Earth and Environmental Science **403** (2019) doi:10.1088/1755-1315/403/1/012109
21. V.A. Pogodaev, B.K. Aduchiev, A.N. Ratoshny, E.B. Lidzhiev, A.B. Ulyumdzhev, *Research Journal of Pharmaceutical, Biological and Chemical Sciences* **9(3)**, 776 – 781, (2018).
22. D. Blache, S.K. Maloney, D.K. Revell, *Animal Feed Science and Technology* **147**, 140-157 (2008)
23. I.D. Hermisdorff; I.C. Ferreira, A.M.S. Franca, T.A. Morais, M.F. Goncalves, C.P. Monteiro, G.F. Morais, *Bioscience journal* **32(5)**, 1286-1295 (2016)