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OPTIMIZING THE USE OF PROTEIN IN THE YOUNG CATTLE BODY

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Abstract. The organization of complete feed rations for cattle meeting the needs of animals in energy, protein, amino acids, minerals and vitamins in terms of basic nutrients and biologically active substances represents the main condition to achieve the genetic potential of productivity. The purpose of the paper was to optimize the protein utilization in the body of young cattle by synchronizing the processes of fermentation of nitrogen-containing substances and carbohydrates in feed. Barothermal treatment of concentrated feed mixtures with high protein degradability and a high content of non-structural carbohydrates causes a more uniform fermentation of nutrients, intensification of microbial protein synthesis processes and an increase in the efficiency of energy use of carbohydrates and protein nitrogen by rumen microflora. This is evidenced by an increase in the number of ciliates by 4.4–8.1% and a decrease in the concentration of ammonia and volatile fatty acids in the rumen fluid by 5.2–9.2 % and 3.4–4.3 %, respectively. A decrease in nitrogen losses is indicated by a decrease in the content of urea in animals' blood by 2.0–9.0%. Extrusion of concentrated feeds with high protein degradability and high content of non-structural carbohydrates improves animal productivity and feed efficiency. The average daily gain in live weight increases by 4.8-6.0% in the experimental group. As a result, feed consumption is reduced by 2.7-6.9%, while protein consumption is reduced by 2.6-5.7%.

Key words: Bulls; Feed; Extrusion; Barothermal treatment; Protein; Carbohydrates; Productivity.

INTRODUCTION

The organization of complete feed rations meeting the needs of animals in energy, protein, amino acids, minerals and vitamins in terms of basic nutrients and biologically active substances represents the main condition for achieving the genetic productivity potential (Skoromna, O.I. et al., 2019; Golubenko, T.L. 2018; Razanova, O.P. et al., 2022). There are certain feeding rules for each farm animal. Nutrition can be influence in different ways, i.e., to enhance or inhibit the conversion of certain substances during the metabolic activity, as well as to enhance their synthesis or decomposition by changing the amount and properties of feed and feeding conditions ensuring the formation of animal products (Skoromna, O.I. et al. 2018; Razanova, O.P. 2018; Grymak, Y. et al. 2020).

Protein is the most valuable component of feed; its level and quality determine animals' productivity. A complete protein nutrition of ruminants means meeting the needs of the animals' body for amino acids available for metabolism. However, the deficiency of feed protein and its irrational use makes the protein to be one of the most important limiting factors in the systems of intensive milk and meat production (Magowan, E. et al. 2010; De Oliveira, P.T. et al. 2011; Acedo, T.S. et al. 2011).

It is difficult and not cost-effective to obtain high productivity from animals by increasing the amount of high-protein feed in rations. It causes overconsumption of feed and an increase of the outputs cost. It also negatively affects the health of animals entailing a reduction of their productive use (Jeroch, H. 2008; Ahmad, M., Ali, A.A. 1994).

The modern concept of nutritional physiology is based on the fact that animal's need for protein is satisfied by the amino acids of the microbial protein and the protein that is not degraded in the rumen (Johansson, B. et al. 2012; Gurin, V.K. et al. 2016).

Creating conditions in the rumen that ensure maximum synthesis of microbial protein with a simultaneous increase in the flow of fodder protein into the intestine is one of the main conditions for the effective use of protein in the body. Microbial protein is unable to meet the increasing needs of the body for amino acids with an increase in the productivity of animals. In this case, the role of the transit fodder protein increases. Although, the higher the productivity of animals, the greater the contribution of the dietary protein not degraded in the rumen to the total pool of amino acids in the body. Thus, a high-quality protein for ruminants is a protein with a low degradability in the rumen, with a valuable amino acid composition and well digested in the intestine (Montiel, M.D. et al. 2012).

Protein degradation in the rumen is a complex, multiphase, enzymatic process influenced by many factors. Some of them are associated with the nature and properties of the protein i.e., its susceptibility

to fermentation, other factors are associated with the features of cicatricial digestion (pH, of microorganism species composition, etc.) (Bessarab, G.V. et al. 2012).

The degradation level and rate are important factors determining the efficiency of the microbial protein biosynthesis in the rumen, the general digestibility of nutrients, and the feed nitrogen utilization by animals (Koksal, B.H. et al. 2011; Wang, C. et al. 2009).

The efficiency of nitrogen utilization is highly dependent on the concentration of energy available for exchange, it implies significant fluctuations in the degradability of the crude protein of individual feeds. It seems relevant to research the degradability dynamics of the crude protein derived from forage products changing the specific energy content.

The proteins present in the rumen for a long period of time degrade more intensively than the proteins quickly evacuated from it. The protein of roughage is hidden under the cell membrane, rich in cellulose and lignin. That's why longer exposure to proteolytic enzymes is required for its degradability. Cereal feeds are faster taken from the proventriculus but they are degraded to a large extent indicating the physicochemical properties of their protein (Antonovich, A.M., Bessarab, G.V. 2018).

The ability to regulate the degree of protein degradability in the proventriculus represents an important issue in the nutrition of ruminants. As a rule, it is required to reduce the degradability of feed protein without drastic changes in its digestibility in the intestine. It can be achieved in two ways. The first one is the selection of natural feeds; their protein should be resistant to degradation in the rumen. This method has found relatively wide application, but it is not always possible because the range of feeds for ruminants is limited or not economically justified. It is possible to reduce the breakdown of dietary protein by physically or chemically affecting the protein in the feed. Considering the physical methods, we should mention that the most famous technique is exposure to high temperature. Such techniques contribute to the preservation of nutrients in feed, they also reduce the solubility and degradability of protein in them. Heat treatment of high-protein feed can reduce the solubility and disintegration of protein by 1.5 - 2 times (Bessarab, G.V. et al. 2018).

The purpose of the paper was to optimize the protein utilization in the body of young cattle by synchronizing the processes of fermentation of nitrogen-containing substances and carbohydrates in feed.

MATERIALS AND METHODS

The researches were carried out on the experimental animals: black-and-white bulls at the age of 3-6, 6-9, 9-12 and 12-18 months (Table 1).

The animals from the control group were fed the ground mix of concentrates, while the experimental group was fed the extruded mix of concentrates. The samples of rumen fluid were taken during the experiments and the degradability of the concentrated feed protein was researched. The hematological parameters and growth energy of experimental animals were determined.

Table 1. *Feeding patters*

Group	Number of animals, heads	Age of animals, months	Duration, days	Feeding characteristics
Experiment No. 1				
I control	3	3-6	60	BD (ground mix of concentrates)
II experimental	3	3-6	60	BD (extruded mix of concentrates)
Experiment No. 2				
I control	3	6-9	60	BD (ground mix of concentrates)
II experimental	3	6-9	60	BD (extruded mix of concentrates)
Experiment No. 3				
I control	3	9-12	60	BD (ground mix of concentrates)
II experimental	3	9-12	60	BD (extruded mix of concentrates)
Experiment No. 4				
I control	3	12-18	60	BD (ground mix of concentrates)
II experimental	3	12-18	60	BD (extruded mix of concentrates)

Chemical composition of the feed used in the experiments was determined according to the scheme

of general zootechnical analysis. Therefore, the initial, hygroscopic and total moisture, mass fraction of crude protein were determined using the automatic analyzer UDK132 and UDK159 (VELP, Italy), the mass fraction of crude fiber using a semi-automatic FIWE-6 analyzer, the mass fraction of crude fat, mass fraction of crude ash and organic matter were determined in the feed according to the generally accepted zootechnical methods (Malchevskaya, E.N., Milenkaya, G.S. 1981; Petukhova, E.A. et al. 1989).

The intensity of bulls' cicatricial digestion was studied by sampling the liquid part of the rumen contents through the fistula 2-2.5 hours after morning feeding and it was filtered through four layers of gauze.

The following parameters were determined e liquid part of the of the cicatricial content, i.e., the concentration of hydrogen ions (pH), ammonia concentration and total nitrogen using the automatic analyzer UDK132 and UDK159 (VELP, Italy), the total amount of VFA by steam distillation in Markgam apparatus, the number of ciliates by counting in a 4-mesh Goryaev chamber (Kurilov, N.V. et al. 1987).

Feed protein degradability was determined according to GOST 28075-89. Samples of concentrated feed were placed in nylon bags. The incubation period of the researched concentrated feed in the rumen was 2, 4, 6, 8 and 12 hours.

We have also researched the feed intake by carrying out ten-day control feedings for two adjacent days according to the difference in weight of the given feed and uneaten residues, the growth rate and average daily gain in live weight of animals by individual weighing at the beginning and at the end of the experiment, as well as the efficiency of feed utilization by calculating energy and protein consumption.

Statistical evaluation of differences was performed using Student's t-test [30]. We proceeded depending on the volume of the analyzed material when evaluating the values of the reliability criterion. The differences were considered significant at $P < 0.05$.

RESULTS AND DISCUSSIONS

The experimental animals received a diet consisting of corn silage and compound feed in the first and second experiments. The control group was additionally fed by a mixture of ground barley grains and field peas, and the experimental group was additionally fed by an extruded mixture (Table 2).

The share of concentrated feed accounted for 36% in the diet structure. Herbal fodder accounted for 64% in the diet structure. The consumption of corn silage increased by 2.2% in the experimental group. The animals ate the concentrated feed completely.

The experimental young animals consumed 4.3-4.4 kg per head of dry matter per day. The metabolic energy content was 10.1 MJ/kg in 1 kg of dry matter of the diet in the experimental group. The share of crude protein accounted for 11.9%. Protein degradability of the control group was 80%, in the experimental one it was 76%. The amount of fiber in dry matter was 26%.

The effect of feeding an extruded mixture of concentrates with a high content of digestible protein and non-structural carbohydrates on indicators of cicatricial digestion was researched in the second physiological experiment. As a result, the regularity of the digestion processes in the rumen of 6-9-month-old young cattle was investigated. The share of concentrated feed was 38.4-39.5% in the diet structure. Herbal fodder accounted for 60.5-61.6%. The animals ate the concentrated feed completely. An increase of 4.9% in the consumption of corn silage was recorded in the experimental group. The experimental young animals received 6.21-6.43 kg/head of dry matter daily. The content of metabolizable energy in the dry matter of the diet of the experimental groups was 9.9 MJ/kg. The share of crude protein in dry matter was 12.6-12.8%, fiber share was 27%. According to research data, protein degradability in the corn silage was 75.6%, in the compound feed - 81%, in the mixture of ground barley and field peas - 82.1% and in the extruded mixture of barley and field peas it was of 53.8%. Thus, extrusion helped to reduce the disintegration of the grain mixture by 28.3%.

Total nitrogen content was by 8.3% higher, and the ammonia content was by 8.7% lower in the rumen of the 3-6-month-old animals fed extruded grain mixture (Table 3).

Table 2. *Diet of 3-9-month-old experimental animals*

Feed and nutrients	Age, months			
	3-6		6-9	
	Group			
	I	II	I	II
Corn silage, kg	9.2	9.4	14.20	14.90
Compound feed KR-3, kg	1.0	1.0	1.4	1.4
Ground grain mixture, kg	0.5		0.6	
Extruded grain mixture, kg		0.5		0.6
Diet components				
Feed units	4.48	4.58	5.89	6.09
Exchange energy, MJ	43.7	44.5	61.4	63.6
Dry matter, kg	4321	4397	6.21	6.43
Crude protein, g	518	527	795	816
Degradable protein, g	415	399	618	588
Non-degradable protein, g	104	128	177	228
Crude fat, g	225	230.0	230	240
Crude fiber, g	1,117	1,140	1,687	1,764
NFE, g	204	2,090	3,113	3,225
Calcium, g	28.8	29.3	41.0	42.6
Phosphorus, g	18.5	18.8	26.4	27.3
Magnesium, g	10.23	10.4	15.4	16.0
Potassium, g	55.13	56.2	84.1	87.6
Sulphur, g	8.59	8.74	12.9	13.5
Iron, mg	1,173	1,197	1,781	1,865
Copper, mg	88.5	88.9	98.4	99.6
Zinc, mg	189	191	266	275
Manganese, mg	329	334	468	486
Cobalt, mg	1.50	1.50	1.67	1.69
Iodine, mg	1.80	1.83	2.61	2.71

Table 3. *Parameters of cicatricial digestion of 3-9-month-old animals*

Indicator	Age, months			
	3-6		6-9	
	Group			
	I	II	I	II
pH	6.04±0.16	6.18±0.18	6.46±0.18	6.61±0.18
Volatile fatty acids, mmol/100 ml	10.6±0.40	10.23±0.18	10.73±0.28	10.36±0.21
Total nitrogen, mg/100 ml	134.5±14.5	145.7±14.89	100.3±1.95	103±1.05
Ammonia, mg/100 ml	13.8±0.6	12.6±0.40	13.35±0.65	12.27±0.74
Ciliates, thousand/ml	799±13.5	833±21.8	648±23.5	683±14.75

Ammonia level decrease and total protein level increase indicate an increase in the microbial protein synthesis due to the creation of more favorable conditions for the vital activity of microflora, its number increased by 4.4% in group II of 3-6-month-old animals. There was a decrease of 3.5% in the experimental group in the amount of volatile fatty acids. The reaction of the rumen pH did not change significantly reaching the level of 6.0-6.2 in all groups.

The pH level was slightly lower in the control group of 6-9-month-old animals being of 6.46. This indicator was 6.61 in the experimental group because of a decrease in the level of volatile fatty acids by 3.4%. There was a decrease in ammonia concentration of 8.1% in the experimental group. The increase in the total nitrogen amount and ammonia decrease may indicate an increase in the intensity of microbial protein synthesis due to a more uniform supply of nutrients to the rumen and the creation of favorable conditions for the vital activity of microflora, as evidenced by an increase in the number of ciliates by 5.4%.

However, all indicators were within the normal range despite some changes during the digestion processes in the rumen of animals.

According to research data, the hematological parameters were within the physiological norms (Table 4).

Table 4. *Hematological parameters of 3-9-month-old calves*

Indicator	Age, months			
	3-6		6-9	
	Group			
	I	II	I	II
Erythrocytes, 1012/l	6.24±0.13	6.49±0.12	6.74±0.13	6.99±0.120
Leukocytes, 109/ l	10.05±0.25	10.23±0.49	10.55±0.25	10.33±0.230
Hemoglobin, g / l	106.1±6.3	110.2±4.51	108.55±5.95	109.17±6.060
Total protein, g / l	75.75±2.25	78.77±1.56	77.8±2.3	81.87±1.620
Glucose, mmol / l	2.49±0.16	2.33±0.03	2.82±0.26	2.81±0.050
Urea, mmol / l	4.1±0.14	4.02±0.14	4.72±0.16	4.33±0.150
Calcium, mmol / l	2.82±0.12	2.64±0.06	2.93±0.125	2.74±0.0670
Phosphorus, mmol / l	1.59±0.15	1.66±0.05	1.54±0.1	1.66±0.050
Hematocrit, %	34.55±1.85	34.73±1.22	32.4±0.8	33.83±0.6740

The 3-6-month-old experimental animals recorded an increase in the number of erythrocytes by 4.0 %, hemoglobin by 3.9 %, total protein by 4.0 % and phosphorus by 4.4 %. The level of glucose decreased by 6.4%, urea decreased by 2.0 % and calcium decreased by 6.4%. However, the noted differences were not significant.

The extruded mixture application influenced the blood composition of 6-9-month-old animals. Thus, young experimental animals had an increase in the content of erythrocytes by 3.7%, total protein by 5.2 %, phosphorus by 7.8%, hematocrit by 4.4%, urea by 8.3%, and calcium by 6.5%. However, the differences noted are not significant.

The control weighing of animals was carried out at the beginning and at the end of the experiment in order to control the live weight. Also, it was investigated the effect of extruded grain mixture on the productivity of animals (Table 5).

Table 5. *Dynamics of live weight and efficiency of feed utilization by 3-9-month-old experimental young animals*

Indicator	Age, months			
	3-6		6-9	
	Group			
	I	II	I	II
Live weight, kg:				
at the beginning of the experiment	132.7±1.3	133.1±1.80	205.2±1.6	204.5±1.70
at the end of the experiment	178.3±3.5	181.3±2.40	252.2±0.8	254.3±1.80
Gross growth, kg	45.6±2.2	48.2±10	47±2.4	49.8±2.80
Average daily gain, g	760±37	803.3±17.7	783±40	830±46.80
% to control	100	105.7	100	106.0
Feed consumption per 1 kg gain, feed units	5.89	5.70	7.52	7.34
% to control	100	96.8	100	97.3
Protein consumption per 1 kg of gain, kg	0.68	0.66	0.98	0.95
% to control	100	97.1	100	97.4

According to weighing data, feeding an extruded mixture of field peas and barley instead of ground grain caused an increase in the average daily gain of 3-6-month-old animals. Higher gains were recorded by group II, 804 g per day, which is by 5.8% higher than in group I. Feed consumption in this group decreased by 3.2% being of 5.7 feed units. The feed protein efficiency also increased by 2.9%.

According to our research data, higher gain was registered in the experimental group formed by 6-9-month-old animals. It was of 830 g per day or by 6.0% higher than in the control group. In this

group, the feed consumption was by 2.7% lower than in group I, the efficiency of feed protein utilization has also increased by 2.6%.

The dependence of the cicatricial digestion indicators of 9-12-month-old cattle was researched in the third experiment, when the animals were fed an extruded mixture of high-protein and high-carbohydrate concentrates. The effectiveness of the nutrient utilization in the body of animals was researched.

The diet of 9-18-month-old experimental animals consisted of corn silage, compound feed and a mixture of cereals and legumes. Also, the animals received plenty of silage. The control animals received a mixture of ground barley and field peas, and the experimental group animals received an extruded one (Table 6).

Table 6. *Diet of 9-18-month-old experimental animals*

Feed and nutrients	Age, months			
	9-12		12-18	
	Group			
	I	II	I	II
Corn silage, kg	16.20	16.50	17.30	17.60
Compound feed KR-3, kg	1.4	1.4	1.6	1.6
Ground grain mixture, kg	0.6		0.7	
Extruded grain mixture, kg		0.6		0.7
Diet components				
Feed units	7.36	7.48	8.46	8.58
Exchange energy, MJ	73.6	74.7	86.6	87.9
Dry matter, kg	7.16	7.27	9.41	9.55
Crude protein, g	862	863	958	976
Degradable protein, g	656	612	679	662
Non-degradable protein, g	206	251	279	314
Crude fat, g	254	260	220	223
Crude fiber, g	1619	1647	2533	2576
NFE, g	4002	4062	5166.0	5237.8
Calcium, g	45.56	46.28	62.3	63.2
Phosphorus, g	28.79	29.20	25.4	25.7
Magnesium, g	17.18	17.47	18.6	18.8
Potassium, g	94.05	95.67	173	176
Sulfur, g	14.34	14.58	17.1	17.4
Iron, mg	2021	2057	3952	4019
Copper, mg	102	102	151	151
Zinc, mg	291	295	291	295
Manganese, mg	521	529	626	635
Cobalt, mg	1.73	1.74	2.99	3.00
Iodine, mg	2.89	2.93	2.52	2.55

The share of concentrated feed for 9-12-month-old animals was 31%, the share of herbal feed was 69%. The animals ate the concentrated feed completely. There was a slight increase in the consumption of corn silage by the experimental group animals. The experimental young animals received daily 7.16-7.27 kg per head of dry matter. The content of metabolizable energy in the dry matter was 10.3 MJ per kg. The share of crude protein in dry matter was 11.4-11.6% and fiber share was 22.6%. Researchers have found that protein degradability was 76% in the control group and 71% in the experimental one. A decrease in the degree of protein degradation occurred because of the extruded concentrates feeding. Thus, the degradability of the protein derived from ground barley and field peas mixture is 82%, while the degradability of the protein derived from extruded barley and field peas mixture is 54%.

Then, the dependence of the indicators of protein metabolism and cicatricial digestion was researched when concentrated feeds were included in the diet, with a high degree of protein and carbohydrate breakdown, subjected to barothermal treatment, carried out on 12-18-month-old calves. The share of

concentrated feed was 33% and the share of herbal feed was 67%. The animals consumed the concentrated feed completely. There was a slight increase of haylage consumption by 1.7% in group II. The experimental young animals received 9.38-9.53 kg per head of dry matter, consequently 1 kg contained 9.23 MJ of metabolic energy, 102 g of crude protein and 270 g of fiber. The degradability of the ground grain mixture protein was 84%, the degradability of the extruded grain mixture protein was 58%. It decreased by 3.1% because of replacing the ground pea and barley mixture with extruded one.

According to research data, there was a decrease of the volatile fatty acids level by 4.3% and ammonia concentration decrease by 5.2% in the rumen fluid of 9-12-month-old calves from the experimental group (Table 7).

The decrease of an ammonia level and increase of total nitrogen indicate an intensification of the microbial protein synthesis due to a more uniform supply of nutrients to the rumen and the creation of more favorable conditions for the vital activity of microflora, which is indicated by an increase in the number of ciliates by 8.1% (P <0, 05).

Table 7. *Parameters of cicatricial digestion of 9-18-month-old animals*

Indicator	Age, months			
	9-12		12-18	
	Group			
	I	II	I	II
pH	6.67±0.16	6.75±0.080	6.82±0.15	6.86±0.17
Volatile fatty acids, mmol / 100 ml	10.17±0.95	9.73±0.390	10.1±0.15	9.7±0.24
Total nitrogen, mg / 100 ml	97.6±5.65	97±0.9020	118.6±4.20	127.7±3.38
Ammonia, mg / 100 ml	14±0.4	13.27±0.2960	13.03±0.26	11.83±0.49
Ciliates, thousand / ml	750.5±7.5	811.33±9.61*	810.33±9.5	874±17.7*

According to research data on 12-18-month-old animals, the use of extruded mixture caused a volatile fatty acids level decrease by 4%, ammonia level decrease by 9.2%, total nitrogen increases by 7.7 % and ciliates increase by 7.9% (P <0.05) in the rumen (Table 6).

Ammonia level decrease and total protein increase indicate that the intensity of microbial protein synthesis has enhanced because of a more uniform release of protein nitrogen and energy from the extruded mixture into the rumen fluid and the creation of more favorable conditions for the vital activity of microflora. Despite some changes in the digestion processes in the animals' rumen, all indicators were within the normal range.

Extruded mixture feeding had an effect on the blood composition of animals, but the indicators were within the physiological norms (Table 8).

Table 8. *Hematological parameters of 12-18-month-old calves*

Indicator	Age, months			
	9-12		12-18	
	Group			
	I	II	I	II
Erythrocytes, 1012/l	6.32±0.31	6.36±0.20	6.82±0.15	6.86±0.17
Leukocytes, 109/ l	10.84±0.38	10.74±0.23	6.41±0.35	6.4±0.20
Hemoglobin, g / l	117.9±2.75	118.5±1.74	111.7±3.71	114.3±2.03
Total protein, g / l	73.5±2.3	74.23±1.64	73.8±1.56	77.4±1.81
Glucose, mmol / l	2.52±0.06	2.53±0.10	2.56±0.13	2.63±0.11
Urea, mmol / l	4.28±0.1	3.98±0.13	4.09±0.10	3.72±0.21
Calcium, mmol / l	2.6±0.13	2.66±0.10	2.66±0.06	2.75±0.02
Phosphorus, mmol / l	1.75±0.07	1.69±0.07	1.61±0.07	1.58±0.04
Hematocrit, %	32.67±2.515	33.55±0.97	34.33±1.42	35.13±1.14

There was a hematocrit increase by 2.7%, a urea decreases by 7.0 %, and a phosphorus decrease by 3.4% in the blood of 9-12-month-old animals of the experimental group. However, the noted differences are not significant.

There was an increase in the amount of total protein by 4.8%, glucose by 2.7 %, calcium by 3.4 %, hematocrit by 2.3% and a decrease in urea by 9%, phosphorus by 1.9% in the experimental group, and namely in the group of 12-18-month-old animals. However, the noted differences are not significant.

Feeding an extruded mixture of field pea and barley grains instead of ground grain caused an increase in growth energy and the efficiency of feed utilization (Table 9).

There was an increase in the average daily gain in live weight by 4.8% and a decrease in feed consumption by 6.9% in the 9-12-month-old animals from the experimental group. The feed protein efficiency also increased by 5.7%.

Table 9. *Dynamics of live weight and efficiency of feed utilization by 12-18-month-old experimental young animals*

Indicator	Age, months			
	3-6		6-9	
	Group			
	I	II	I	II
Live weight, kg:				
at the beginning of the experiment	132.7±1.3	133.1±1.80	205.2±1.6	204.5±1.70
at the end of the experiment	178.3±3.5	181.3±2.40	252.2±0.8	254.3±1.80
Gross growth, kg	45.6±2.2	48.2±10	47±2.4	49.8±2.80
Average daily gain, g	760±37	803.3±17.7	783±40	830±46.80
% to control	100	105.7	100	106.0
Feed consumption per 1 kg gain, feed units	5.89	5.70	7.52	7.34
% to control	100	96.8	100	97.3
Protein consumption per 1 kg of gain, kg	0.68	0.66	0.98	0.95
% to control	100	97.1	100	97.4

According to the results of weighing the 12-18-month-old animals, the higher gains were noted in the experimental group, and namely of 865 g per day, which is by 5.1% higher than in the control group. In the experimental group the feed consumption was lower by 3.6% than in the control one, the efficiency of feed protein utilization increased by 3.5%.

CONCLUSIONS

Extrusion of concentrated feed reduces the degradability of protein concentrates. The number of ciliates in the rumen fluid increases by 5.4-8.1%, total nitrogen increases by 8.3%, and the concentration of ammonia and volatile fatty acids decreases by 6.2-9.2% and 3.4-4.3%, respectively. Thus, the processing of concentrates stimulates the development of proventriculus microflora and reduces protein loss in the rumen.

Barothermal treatment of concentrates with a high protein degradability and a high content of non-structural carbohydrates increases the productivity of animals and the efficiency of feed utilization. The average daily gain in live weight of animals from the experimental group increased by 4.8-6.0%. As a result, feed consumption is reduced by 2.7-6.9%, protein consumption is reduced by 2.6-5.7%.

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