Protein Exchange and Localization in the Organism of Fattened Bull-Calves after the Introduction of Various Dosages of Vitamin A into the Diets with Bagasse Pellets

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Abstract*: Research data are provided about the effect of various dosages of vitamin A (retinol acetate) on the metabolism and localization of the protein in the organism of experimental animals (fattened bull-calves), that is, conversion of proteins in the diet into the main nutrients of the edible portion of the carcass (cuts) of bull-calves fed on diets with bagasse pellets. It has been found that vitamin A preparations are to be introduced into such diets; in the experiment, the authors used retinol acetate with the biological activity of 1 mln IU in 1 g, so as to make their content in the diets about 25 – 27 thous. IU per 100 kg of live weight (the optimal dosage, depending on the body weight of the animal during the experiment). This helps improve the average daily live weight gain of bull-calves by 11.7 %, of the carcass weight – by 9.2 %, including flesh – by 11.1 %. In the flesh of the carcass, the content of protein increased by 15.4 %, of fat – by 15.2 %, and of energy – by 8.2 %. The conversion ratio of feed protein to food protein in the meat part of the carcass increased by 1.33 %, of feed energy – by 1.2 %.

***Index Terms*: bull-calves, fattening, bagasse pellets, meat yield, conversion, and localization of feed protein and energy.**

I. INTRODUCTION

In assessing the meat productivity of animals, not only carcass quality is studied, but also efficiency of using, further localization, or, one can say, conversion of protein and energy (Mdg) in the consumed feed into food proteins and energy of the meat products of animal origin [1, 2, 3, 4]. Good results in terms of these indicators may only be achieved with the organization of biologically complete feeding of animals, cattle in this case. For this purpose various biologically active additives of chemical origin, methods of distribution and dosages are used for making complete diets, which depend on the type of ruminants' feeding.

In industrial production of veal and beef, i.e., cattle growing and fattening, in addition to the traditional forages, wastes of food and technical industry are widely used, bagasse pellets in particular. They contain protein; therefore, they can make up for the missing protein in the diet and replace (partially) expensive grain concentrates. However, bagasse pellets do not contain provitamin A – carotene, which produces vitamin A in the organism of ruminants. At the same time, vitamin A plays a very important biological role in the metabolism of various molecular substances. Its deficiency in the diet results in retarded growth and development, disruption of mineral (macro and micro) substances metabolism, reduction of productivity, reduction of feed efficiency (muscle and adipose tissues), disease and subsequent death of the animals, therefore it causes substantial economic losses to livestock breeding [5, 6, 7].

Many scientists have proven the need for introducing vitamin A supplements into diets with low carotene content. With that, an increase in productivity and product quality is observed [8, 9, 10]. However, the issue of the dosages of vitamin A in various conditions of cattle feeding remains open. In this regard, studies aimed at determining the optimal level of vitamin A in the nutrition of animals given the type of feeding (presence of a certain type of various feeds) are very interesting from the scientific and practical point of view.

The purpose of the studies was the examination of the data about the effect of various dosages of vitamin A (retinol acetate) on the metabolism and localization of protein in the organism of the experimental animals (fattened bull-calves), i.e., using later in the article the concept of protein conversion from the fodder in the diet into the main nutrients of the edible part of the carcass (cuts) of the bull-calves fed on the diets with bagasse pellets, as well as morphologic indicators of an animal after slaughtering [11, 12].

II. METHODS

For the purpose of the scientific and economic experiment, 45 bull-calves of black-motley breed were selected at the age of 12 – 13 months with the live weight of 290 – 310 kg, which were distributed according to the principle of analogues (age, live weight, condition and fatness) into three experimental groups with 15 animals in each. The experiment lasted for 150 days, from January to May 2018.

At the beginning of the experiment, the animals were examined by veterinary specialists and recognized clinically healthy, were kept in the same room on the leash, all process activities - distribution of the feed mixture, removal of manure and fodder residues, watering and lighting – had the same duration throughout the experiment. All animals received the same diet intended for obtaining the average live weight daily gain of 1,100 – 1,200 g in accordance with the norms of the RAAS (according to Kalashnikov – 2003), except

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for carotene. The feed mixture (diet) contained bagasse pellets (50% of the concentrates in terms of the nutritional value), corn silage harvested in the phase of wax ripeness, legume-cereal haylage, coarse-grained cereal bran (wheat and barley), NaCl, macronutrients (g), minerals (mg). and fat-soluble vitamins A, D, E, and K [13, 14].

Bagasse pellets met the requirements of normative documents GOST 13456-82 PP.1.2, 1.3, certificate of conformity No. ROSS RU AY54.N16905.

The content of provitamin A – carotene – in the diet was 15 – 25 % of the RAAS norm (by Kalashnikov - 2003). Its deficiency was compensated for by the preparation "Fodder Mikrovit A" with the activity of 1,000 thousand IU of vitamin A in 1 g. "Fodder Mikrovit A" was carefully mixed with grain mixture (coarse-grained equal amounts of wheat and barley) and given to animals in the total dosage once per 10 days [15].

The groups of experimental animals differed only in the level of vitamin A supply [16].

The calves in the first group received it in the amount equivalent to the norms for carotene, the second group received 25 %, and the third – 50 % above the norm. In the absolute terms, the dosage of vitamin A in the first group was 20 – 22 thous. IU per 100 kg of live weight, in the second – 25 – 27 thous. ME of live weight, and in the third – 30 – 32 thous. IU/100 kg of live weight.

The animals were fed in groups, two times a day according to the schedule adopted at the farm. Feed consumption was calculated every day. The weight of all the fodders in the diet, their nutritional values, and composition were considered, as well as uneaten leftovers. The growth and the weight of animals were monitored every 10 days by individual weighing in the morning before feeding during the day [17, 18].

Carcass quality of the animals was studied by check slaughtering at the end of fattening in the amount of five animals (analogs) from each experimental group. According to the slaughtering data, the live weight before slaughtering was accounted for along with the weight of hot carcass, the yield of carcass and the slaughter yield, morphological composition of carcasses, the coefficient of meatiness, the chemical composition and the caloric content of average samples of the ribeye, after which, based on the experimental data, exchange of localization and protein and energy conversion into food animal protein were calculated [19].

III. DISCUSSION AND RESULTS

As a result of many calculations, it has been found that the experimental bull-calves consumed about the same amount of nutrients, including dry matter, protein and fodder energy. The calculation was performed according to the actual consumption of the set of feeds in the diet by experimental animals in groups (Table 1).

Table 1. Consumption of dry matter, protein, and energy feed by bull-calves

Indicator	Group		
	1	2	3
Dry matter, kg	1,543.7	1,546.3	1,563.0
Exchange energy, MJ	13,235.8	13,237.1	13,250.1
Crude protein, kg	201.5	203.9	205.1

However, the intensity of young bull-calves growth was significantly different among the groups. Daily gains in the first group that received vitamin A at the dosage of 20 – 22 thous. IU/100 kg of live weight, which corresponded to the RAAS norms for carotene (by Kalashnikov – 2003), over the entire period of feeding averaged to 958 g, in the second group that received 25 % more vitamin A (25 – 27 thous. IU/100 kg of live weight) – 1,069 g, or were by 11.7 % higher ($p < 0.01$) (Table 2).

Table 2. Indicators of the experimental bull-calves' meat productivity

Indicator	Group		
	1	2	3
Average daily gain, g	958 ± 10.1	1,069 ± 9.7*	1,066 ± 8.6*
Percentage to group 1	100.0	111.6	111.2
Pre-slaughter live weight, kg	427.5 ± 1.9	436.8 ± 2.3**	435.5 ± 2.5*
Weight, kg: hot carcass	228.9 ± 1.5	249.8 ± 2.2**	249.2 ± 2.4*
internal fat	13.0 ± 0.5	16.1 ± 0.6	15.9 ± 0.4
Slaughter weight, kg	241.9 ± 1.5	265.9 ± 2.6**	265.1 ± 2.8*
Slaughter yield, %	56.6	60.9	60.8

IV. ANALYSIS

The results of check slaughtering have shown that carcass weight of the bull-calves in the second group was greater by 20.9 kg ($p < 0.01$), and in the third group – by 20.3 kg ($p < 0.05$), or by 11 % and 10.9 %, respectively, compared to the calves in the first group that had received the

recommended dosages of vitamin A for carotene. Simultaneously, the amount of internal fat somewhat increased. At the end, the slaughter weight of the bull-calves in the second group was greater by 24 kg ($p < 0.01$), and of the bull-calves in the third group – by 23.2 kg ($p < 0.05$), or by 10.3 and 9.9 %, respectively. Their carcass yield was also somewhat higher. However, it should be noted that increasing the level of vitamin A by 50 % above the norm (group 3) did not ensure a significant increase in the meat yield, compared to the second group that had received vitamin A at the dosage of 25 % above the norm (by Kalashnikov - 2003).

In studying the morphological composition of carcasses after aging for 24 hours in a chilling chamber for carcasses in the slaughtering house, it has been found that their main increase occurred at the expense of the most valuable part of the carcass, flesh (muscle tissues obtained after deboning from the dorsal, pectoral and posterior pelvic-femoral parts of the carcass), which was higher in the second group by 11.1 % ($p < 0.01$), and in the third group – by 10.9 % ($p < 0.05$), compared to the first group of animals that had received a certain dosage of vitamin A in the diet [20, 21, 22].

The experimental bull-calves that had received vitamin A in addition to the basic diet provided a significantly higher flesh yield per 1 kg of bones (Table 3).

Table 3. Morphological composition of the experimental bull-calves' carcasses

Indicator	Group		
	1	2	3
Hot carcass weight, kg	228.9 ± 1.5	249.8 ± 2.2	249.2 ± 2.4
Chilled carcass weight, kg	226.6 ± 0.86	247.4 ± 0.43	246.9 ± 0.94
including:			
Flesh weight, kg	178.8 ± 0.57	197.2 ± 0.88	195.0 ± 0.90
%	78.6	79.7	79.6
the weight of bones, kg	42.5 ± 0.38	45.7 ± 0.29	45.4 ± 0.23
%	18.8	18.5	18.4
The weight of tendons, kg	7.0 ± 0.21	8.2 ± 0.25	7.2 ± 0.22
%	3.1	3.3	2.9
Flesh yield per 1 kg of bones, kg	4.21 ± 0.11	4.31 ± 0.12	4.30 ± 0.18

The data about the chemical composition of the average sample of muscle tissues obtained after the laboratory studies have shown that it contained more protein and fat. The protein yield (protein part) per 1 kg of pre-slaughter live weight was higher by 7.6 %, fat yield – by 8.8 % (Table 4).

Table 4. Conversion and localization of protein and energy from the feed rations into the edible parts of the carcass (on average per one experimental bull-calf)

Indicator	Group		
	1	2	3
Consumption of protein per 1 kg of weight gain, g	1,402	1,272	1,283
Energy consumption per 1 kg of weight gain, MJ	92.1	82.7	82.9
Contained in the flesh of the carcass, kg			
protein	39.1	44.9	44.2
fat	24.9	28.7	28.8
Yield per 1 kg of pre-slaughter live weight, g			
protein			
fat	86.57	91.95	91.28
energy, MJ	55.83	59.11	59.50
	30.00	30.36	30.45
Feed energy conversion rate, %	3.46	4.29	4.27
Feed protein conversion rate, %	6.21	7.54	7.49

The rate of feed protein conversion into food protein in the meat part of the carcass (muscle weight) increased by 1.33 %, energy – by 0.83 % (comparison of experimental group 2 to group 1, respectively) [23].

V. CONCLUSION

In fattening young cattle (bull-calves) using the diets with bagasse pellets, it is necessary to ensure the content of vitamin A (in the form of the Fodder Mikrovit A synthetic powder) in the amount of 25 – 27 thous. IU/100 kg of live weight, which was more than the recommended rates calculated for carotene by 25 %. This has resulted in more intensive growth of young bull-calves, the yield of meat products increased by 10.3 %; the increase was veracious, metabolic processes in the organism increased due to the introduction of vitamin A, and subsequent conversion of protein from feed sources and its subsequent localization into food protein increased by 1.33 %, and of energy – by 0.83 % of the edible part of the carcass. It should be noted that experimental group 3 (the data obtained as a result of the experiment) had no significant increase in the performance indicators before and after slaughtering (morphological state of tissues in the carcass). Therefore, given

the costs, the dosage (30 – 32 thous. IU/100 kg of live weight) being higher than that in group 2 was not recommended for beef production with tie-up keeping of calves at the age from 12 to 18 months on diets with the use of bagasse pellets. As mentioned above, the recommended dosage was 25 – 27 thous. IU per 100 kg of live weight. The obtained data were mathematically processed with high accuracy.

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