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VITAMIN A STATUS AND MEAT PRODUCTIVITY OF THE CALVES FED ON THE DIETS WITH BAGASSE PELLETS OBTAINED AFTER PROCESSING SUGAR BEET

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ABSTRACT

This research paper provides some results of the research aimed at finding the optimal content of vitamin A in the diets with bagasse pellets for experimental calves that causes certain pharmacological effect during final fattening. Three groups of calves at the age of 12 - 13 months with the body weight of 290 - 310 kg were formed for the scientific and economic experiment by the principle of pairs-analogs, 15 animals in each group. The calves in the first group received 20 - 22 thousand Weight Units (WU) of vitamin A per 100 kg of live weight, which was equivalent to the standards of the RAAS (according to Kalashnikov-2003) in terms of carotene (1 mg of carotene is equal to 400 WU of vitamin A), in the second group - more by 25 % (25 - 27 thousand WU/100 kg of live weight), and in the third group - more by 50 % (30 - 32 thousand WU/100 kg of live weight). The level of vitamin A was regulated by Microvit A with the pharmacological activity of 500 thousand WU per 1 g. It has been found that the optimal pharmacological level of vitamin A in the diet is about 25 - 27 thousand WU per 100 kg of live weight. This improves the average daily gain by 11.5 %, increases the weight of the carcass by 6.4 %, including boneless meat - by 7.4 %, and improves beef quality.

Keywords: calves, fattening, feeding diets, Microvit, bagasse pellets, average daily gain, live weight, calves' liver, calves' blood plasma, carotene, vitamin A.

INTRODUCTION

At the present stage of livestock breeding development in the Russian Federation, one of the most important tasks is increasing beef production, improving its quality, and reducing the cost. In the system of measures aimed at solving this problem, the main role is played by ensuring biologically complete alimentation of animals based on the use of home-produced forages, such as silage, haylage, green mass, as well as food industry wastes, in particular, bagasse pellets obtained after beet sugar production. Pressed and dried sugar beet bagasse is a good feed product for young cattle and dairy cows. Bagasse pellets are very well stored and technologically adapted to adding to feed mixtures along with other feeds in the diet. They are a byproduct of sugar production with processing sugar beet, and a valuable feed. Therefore, they are widely used in feeding cattle, as already mentioned, as an additional source of nutrients. However, bagasse pellets do not contain vitamin A, which is studied, which plays an important physiological role in the metabolism of the organism. Low concentrations result in vitamin deficiency accompanied by decreased appetite and growth retardation, exhaustion, dry eye syndrome, lesions of tissues in the gastrointestinal and the respiratory tract, reduced fertility, infertility, and considerable mortality of newborn calves due to increased susceptibility to various infectious diseases (Kairov, 2003; Kuznetsov, 2010; Reznichenko *et al*., 2007). Despite this fact, there is still no norm for vitamin A content in cattle; there are only norms for its predecessor and provitamin A - carotene. Its rationing is based on the quantitative content of carotene in the diets of animals of various age groups of cattle. However, with certain types of cattle feeding (on bagasse pellets, on distiller grains, on brewer's grains, and on malt sprouts), the carotene contained in the feed is little used in the diets, or the substance is contained in inactive form, for example, beta-carotene (with the activity of about 30 % by the activity scale for carotene); therefore, synthetic A-vitamin preparations are to be used. Microvit was used in the experiment (Kairov, 2003; Krisanov *et al*., 2015; Lyubin, Lyubina, 2014). This resulted in an increased productivity of animals and quality of the resulting products, beef in particular. Therefore, the existing norms of animals' needs in the feed and biologically active substances, including vitamin A, require further improvement and clarification of norms and pharmacological dosages.

Based on the above, studies aimed at determining the optimum content of vitamin A to compensate for its deficiency in the diets of animals are important and relevant for agricultural science and practical use in production.

The purpose of the research was studying the effect of various dosages of vitamin A on the vitamin status and meat efficiency of the calves fed with the diets containing bagasse pellets, and determining its optimum level on this basis (Krisanov *et al.,* 2017; Conn *et al*., 1992).

OBJECTS AND METHODS

The scientific-economic experiment was performed in 2017 - 2018 at OOO Niva in the Republic of Mordovia, Russian Federation, at a private enterprise for beef production. Black-motley calves at the age of one year with the live weight of 290 - 310 kg were chosen, which were distributed according to the principle of analogs (age, live weight) into three groups 15 animals in each. All animals were clinically healthy (had a veterinary

certificate and support for the time of the experiment), had a good appetite, and were held in the same room on a leash. The diet was based on the norms of the RAAS (by Kalashnikov - 2003) taking into account the chemical composition of local feeds, and was intended for ensuring 1, 100 - 1, 200 g average daily live weight gain (Kalashnikov, 2003). It consisted of corn silage, alfalfa haylage from herbal alfalfa mass, grain mixture pellets (wheat and barley in equal shares), bagasse pellets, and mineral and vitamin supplements in the form of a premix.
The experimental animals differed only in the level of A-vitamin nutrition. The calves in the first group received 20 - 22 thousand WU of vitamin A per 100 kg of live weight, which was equivalent to the standards of the RAAS (according to Kalashnikov-2003) in terms of carotene (1 mg of carotene is equal to 400 WU of vitamin A), in the second group - more by 25 % (25 - 27 thousand WU/100 kg of live weight), in the third group - more by 50 % (30 - 32 thousand WU/100 kg of live weight).

The level of vitamin A (retinol palmitate) was regulated by Microvit A with the pharmacological activity of 500 thousand WU per 1 g. The preparation was thoroughly mixed with concentrates (3 mixings with increasing the volume of concentrates) and distributed in a total dose once every 10 days before the main feed.

The duration of the scientific and economic experiment was 150 days (Fidge *et al.*, 1969; Mahan, Vallet, 1997; Ortega *et al*., 1997).

RESULTS

Numerous studies of scientists have shown that vitamin A status is most accurately indicated by the content of vitamin A in the liver. This organ contains 90 - 95 % of the total amount of vitamin A in the organism. The rest is concentrated in the internal fat, in the kidneys, and is found in trace amounts in the muscle tissues (Georgievsky *et al*., 1991; Dvinskaya *et al*., 1979; Dusheiko, 1989; Schurevich, 1986).

The authors have also found that in the calves from the first group that over the entire period had received 20 - 22 thousand WU of vitamin A per 100 kg of live weight, the concentration of vitamin A in the liver was 23 µg/g of raw tissue (Table-1).

Table-1. Concentration of vitamin A in the liver of calves.

Groups	mg per 1 g of raw tissue
1 - reference	23.0±1.13
2 - experimental	37.0±0.55
3 - experimental	39.5±0.57

According to the literature, such concentration indicated a partial deficiency of vitamin A (Dvinskaya, 1989; Schurevich, 1986).

Increasing the dosage of vitamin A by 25 %, or bringing it to 27 - 25 thousand WU/100 kg of live weight considerably improved the vitamin A nutrition of animals. Retinol concentration in the liver of the calves in the second group by the end of the fattening period increased to 37 µg/g of raw tissue, which was consistent with the physiological norm.

Increasing the dosage of vitamin A in the third group by 50 % contributed to further increase in the level of retinol in the liver, although by a small amount (8 %, compared to the second group), and also was consistent with the physiological norm. Such content of vitamin A in the liver is characteristic of clinically healthy animals and is the evidence of favorable vitamin A metabolism in the body, which had a positive effect on the growth intensity in young animals and their meat productivity.

Another more available criterion of vitamin A sufficiency in the animal organism is its content in the blood plasma. According to the data of the authors, retinol concentration in the blood plasma of the calves from the first group at the end of the fattening period amounted to 27.0 µg % in 1 ml (Table-2), which, in the opinion of many scientists, also indicates its deficiency in the organism of young cattle (Dvinskaya, 1989; Shubin, Gerashchenko, 1976).

Table-2. Concentration of vitamin A in the blood plasma of calves, µg %.

Groups	µg % in 1 ml of blood plasma
1 - reference	27.0±1.05
2 - experimental	38.6±0.56
3 - experimental	39.8±0.64

Upon increasing the level of vitamin A in the diets of the calves from the second group by 25 % (25 - 27 thousand WU/100 kg of live weight), the concentration of retinol increased to 38.6 µg % or reached the optimum level of the physiological norms for young cattle.

With further increasing the dosages of vitamin A in the diets of the third group by 50 % (30 - 32 thousand WU/100 kg of live weight), retinol concentration in blood plasma slightly increased by 39.8 µg % in comparison with the second group. This confirms the conclusions made by the scientists previously involved in studying vitamin nutrition (vitamin A) that vitamin A concentration in the blood plasma remains more or less stable when its stock in the liver is restored. It should be noted that retinol content was studied during the entire experiment on five animals from each experimental group. Biological material was taken and donated at the beginning, in the middle, and at the end of the experiment in the experimental animals. The samples of liver, blood, and plasma obtained from it were taken for the research. The quantitative determination of retinol content was performed on a Milihrom - 5 - 3 unit and at the Institute of Nutrition, Moscow, using HPLC. The veracity of the research was high; every quantitative determination of one sample was paralleled.

Optimization of the vitamin A nutrition of young animals that ensures the normal course of the metabolic processes in the organism had a positive effect on the

growth rate and on the formation of animals' meat productivity. While the average daily weight gain in the young cattle from the first group that received vitamin A at the dosage of 20 - 22 thousand WU/100 kg of live weight according to the norms of RAAS (by Kalashnikov - 2003) in terms of carotene over the entire fattening period was 913, in the second group that received more vitamin A by 25 % (25 - 27 thousand WU/100 kg of live weight), it was 1,017 g, or higher by 11.4 % ($p < 0.01$) (Table-3).

Table-3. Calves' meat productivity indicators.

Indicator	Groups		
	I	II	III
Average daily gain, g	942±7.3	1,098±9.2*	1,095±5.6*
Percent to group one	100.0	116.5	116.2
Pre-slaughter live weight, kg	429.2±1.5	442.1±3.1**	439.9±3.2*
Weight, kg: hot carcass internal fat	228.5±1.7 11.7±0.1	251.4±2.7** 12.5±0.3	248.8±2.5* 12.8±0.1
Slaughter weight, kg	240.2±1.4	263.9±1.9*	261.6±2.7*
Slaughter yield, %	55.9	59.5	59.4
Morphological composition: the weight of chilled carcass, kg incl. flesh weight, kg % the weight of the bones, kg %	 106.8±0.76 83.2±0.79 77.9 20.5±0.24 19.2	 113.2±0.98* 89.2±0.91 78.8 21.0±0.35 18.6	 113.0±1.04* 88.8±1.10 78.6 21.1±0.33 18.7
The weight of tendons, kg %	3.1±0.15 2.9	3.0±0.15 2.6	3.1±0.09 2.7
Beefiness coefficient	4.06±0.04	4.25±0.06*	4.21±0.13

Note: * $p < 0.05$, ** $p < 0.01$

Results of the check slaughtering showed that carcass weight of the calves in the second group had been higher by 13.9 kg ($p < 0.01$), and in the third group - by 12.6 kg ($p < 0.05$), or by 6.3 and 5.7 %, respectively, compared to the calves in the first group that had received a diet with the recommended norm of vitamin A as calculated by carotene. Simultaneously, the amount of internal fat also increased. As a result, the slaughter weight of the calves from the second group was higher by 15.1 kg ($p < 0.01$), and that of the calves from the third group - higher by 13.3 kg ($p < 0.05$), or by 6.6 and 5.8 %, respectively. They also had higher slaughter yield. However, it should be noted that increasing the level of vitamin A by 50 % compared to the norm (group III) did not ensure an adequate increase in meat productivity, compared to the second group that had received vitamin A at the rate by 25% higher than the norm.

CONCLUSIONS

In studying the morphological composition of semi-carcasses it has been established that their weight gain mainly occurred at the expense of its most valuable part - boneless meat, which in the second group was higher by 7.2 % ($p < 0.01$), and in the third - by 6.7 % ($p < 0.05$), compared to the first group that received vitamin A in normal dosages.

The calves that received vitamin A in addition to the main diet had a significantly higher yield of boneless meat per 1 kg of bones.

Feeding diets with the level of vitamin A higher by 25 - 50 % increased dry matter, protein, and fat content in the meat. In terms of the calorific value of the meat, no significant difference was found between the groups.

Thus, when fattening calves on the diets with malt sprouts, it is necessary to ensure the vitamin A content in the diets in the amount of 25-27 thousand WU per 100 kg of live weight, which increases their meat productivity and improves the product quality.

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