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The Use of Microvit and Trivit As Synthetic Vitamin Additives for Fattened Bull Calves and Their Effect on Meat Production in The Distillers Grain Fattening

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Abstract*: *The article considers the issues of vitamin nutrition of bull calves and their meat production in distillers grain fattening. The authors argue, through reasoning, research and analysis, that with the distillers grain fattening of cattle, an increase in the synthetic vitamin A dose contributes to the intensive growth of animals and increases the yield of bull calves fattened. The diet in the distillers grain fattening should contain 50 % of distillers grains, 20 % of coarse fodder, 30 – 40 % of cereal grains, and sufficient amount of mineral supplements and vitamins, especially fat soluble ones. Such is vitamin A, that is, retinol in various chemical forms and types. Retinol plays a very important biological role for cattle. To date, there have been no rules for the introduction of various additives and forms of retinol in the diet of cattle.

Index Terms*: *bull calves' nutrition, fattening, product yield, growth.

I. INTRODUCTION

Distillers grains are a waste of the alcohol industry; they are a watery feed containing little dry matter and having low energy nutrition (0.07 – 0.12 feed unit per 1 kg). Their dry matter is relatively rich in protein and phosphorus, poor in fiber, fat, soluble carbohydrates, calcium, magnesium, microelements, and it does not contain carotene. When a large amount of distillers grains is fed, an increased washout of mineral substances from the body is observed. In this regard, when fattening, their rates should be increased by 30 – 40 %. In order to ensure the usefulness of distillers grain diets, obtain high meat production, and extend the fattening period, it is necessary to include therein the optimum amount of coarse fodder (hay), cereal grains rich in starch and fat (corn, barley), chalk, sodium chloride, trace elements, and fat-soluble vitamin drugs. Failure to comply with these requirements leads to metabolic disorders, deterioration of nutrient digestibility, reduced productivity, specific diseases and even animal death after several months of inadequate feeding. To compensate for the calcium deficiency, chalk is included in the diet in the amount of 40 – 80 g per day for young animals and 90 – 100 g per day for adult animals per one animal unit. Sodium chloride is given in the amount of 15 – 20 g per 100 kg of live weight. Chalk is given mixed with concentrates, and the distillers grains are flavored with salt. Microelements, vitamin and enzyme drugs, other biologically active substances are widely used [1, 2].

Distillers grains are fed warmed up (25 – 30°C). In winter, warm and fresh distillers grains are added to the silage ones at a ratio of 1:1. Animals eat with an appetite such a mixture. At the same time, they must be watered.

Animals are gradually habituated to distillers grains, as follows: in the first 7 to 10 days they receive 20 to 30 liters per day, and then this amount is brought up to 70 to 100 liters. By the 35th to the 40th day, the animals' appetite noticeably worsens, the palatability of distillers grains decreases, sometimes they even refuse them. In this case, instead of a straw, a small amount of haylage (hay) is included in the diet, and the proportion of concentrates is increased.

The cattle should be fed with distillers grain fodder promptly at the scheduled time. It is necessary to ensure that the distillers grains do not remain in the feeders after feeding. The daily feed rate should be given not in one, but in two-three steps, adding distillers grains as necessary. After each feeding, the feeders shall be cleaned and washed with a lime solution at least once in ten days. In order to avoid illnesses with biting midge, it is necessary to strictly adhere to the zoohygienic requirements: ventilate well the premises, use litter regularly and have it in sufficient amount, and periodically disinfect the limbs of animals with creolin solution as directed by veterinary staff [3, 4].

The existing RAAS recommendations stipulate only dosages for carotene, which is transformed into vitamin A only in the animal's body. Not all diets contain carotene, or it is present in insufficient quantities and to a greater extent in the ß-form, which is not active, thus, in the body it is not transformed into vitamin A. Carotene is almost absent in the distillers grain fattening, and therefore various vitamin drugs should be used to compensate for the carotene and vitamin A deficiency. There are few contradictory studies on this topic, this fact giving rise to a need for further clarification of the dosages and methods for administering fat-soluble vitamins to an animal, in particular, various forms of vitamin A, both the alcoholic form of retinol and retinyl palmitate and retinyl acetate [5, 6].

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II. METHODS

The purpose of the research is to determine the optimal rate of vitamin A in the diets of the bull calves on a distillers grain fattening, which will bring out the most appropriate dosage of the synthetic additive and methods of its introduction into the diet, taking into account that distillers grain fattening has its own specifics, since the main feed is the distillers grains – waste of the alcohol industry in liquid form with low content of dry matter and absolutely not containing carotene and especially vitamin A [7].

Distillers grains are the alcohol industry waste, which is a good food means, especially when being fresh, that is, warmed up. Animals drink distillers grains being saturated with nutrients, especially protein, minerals, and potassium, well. The presence of coarse feed and concentrates, as well as the introduction of critical minerals, especially calcium, which is washed away when animals consume distillers grains, contribute to the high average daily growth of growing young cattle [8].

The studies were conducted on young Simmenthal breed cattle within the industrial complex of the Foundation for Rural Development of the Republic of Mordovia. Next to this farm is the Meltsan Distillery OJSC Mordovspirt, which produces a large amount of fresh distillers grains, thus, the decision was taken to conduct research in this farm. According to the analogue principle, three groups of bull calves (10 animal units each) were formed at the age of 13 – 14 months with the average live weight of 300 kg. The animals were in good health, were active, showed no signs of disease, and were selected for the experiment with the advisory support and assistance of the farm's veterinary service [9, 10].

Feeding diets were compiled as per the RAAS standards taking into account the chemical composition of local feeds, and were designed to produce at least 1,000 g of average daily live weight gain of the experimental bull calves.

During the experiment, the groups of experimental animals differed only in their level of vitamin A nutrition. Bull calves of the first group received vitamin A as per the RAAS standards (20 thousand IU of vitamin A per 100 kg of live weight) calculated from carotene (for cattle, 1 mg of carotene is equivalent to 400 IU of vitamin A), the second group received 25 % above the norm (24 thousand IU), and the third group – 50 % above the norm (30 thousand IU per 100 kg of live weight). The level of vitamin A was adjusted using Microvit and Trivit (the solution of retinyl acetate in oil) drugs (1 mg contains 300 thousand IU of vitamin A). Both drugs were fed with grain concentrates (ground barley) with a cumulative dose once per 10 days in the morning before the distribution of the main food – distillers grains. Many scientists differ in the methods of introducing various vitamin A additives into the animal's body. It was previously believed that the Trivit injection into the muscle tissue was more effective than the oral administration of these drugs since in the intestinal tract it was destroyed more than when injected into the muscle tissue. We used the second method, i.e. the oral method, both with Microvit (dry powder) and Trivit (oil solution). We considered this method more efficient and cost-effective, especially in the industrial fattening of bull calves. Microvit was mixed and uniformly distributed through introducing the powder into barley stock feed in layers in a ten-liter bucket, as well as it was done with vegetable Trivit, each layer pre-mixed to achieve greater and more accurate distribution of synthetic additives to be given to each experimental animal in three groups of bull calves [11, 12].

Against the background of a scientific and economic experiment, a physiological study, i.e. a balance experiment was conducted in the middle of the fattening cycle (bull calves having 350 kg of live weight). In order to study the effect of different levels of vitamin A in diets on meat production of animals, a track was kept of the growth rate of young cattle by weighing once every 30 days in the morning before feeding, and at the end of the scientific and economic experiment, a control slaughter of bull calves from each group three animal units each was performed.

III. DISCUSSION AND RESULTS

As a result of the research, it has been found that in distillers grain type of fattening, increasing the dose of retinol by 25 % against the existing RAAS standards contributes to increasing the digestibility of dry matter by 3.3 % ($P > 0.05$), organic matter – by 3.6 ($P > 0.05$), protein – by 3.5 ($P > 0.05$), fat – by 2.5 ($P > 0.05$), fiber – by 4.2 ($P > 0.05$) and nitrogen-free extractive substance – by 3.3 % ($P > 0.05$) (Table 1).

Table 1. Nutrient digestibility ratio for experimental groups

Indicator	Group		
1	2	3	4
Digestibility ratio, %			
Dry matter	74.0 ± 1.10	77.3 ± 1.46	77.7 ± 0.02
Organic matter	76.5 ± 0.96	80.1 ± 1.41	80.2 ± 0.92
Protein	73.6 ± 0.64	77.1 ± 0.33	78.9 ± 0.60
Fat	71.5 ± 0.54	74.0 ± 0.52	75.2 ± 0.12
Cellulose	59.5 ± 1.05	63.9 ± 0.72	64.2 ± 0.05
Free-nitrogen extracts	86.3 ± 0.95	89.6 ± 2.38	88.7 ± 0.34
Nitrogen deposited in the body, g	39.4 ± 0.65	43.8 ± 0.62	44.4 ± 1.15
% of administered	14.3 ± 0.24	16.1 ± 0.23	16.4 ± 0.33
% of digested	19.4 ± 0.16	20.8 ± 0.21	20.8 ± 0.15

The retinol level in the diets of the bull calves in the second group had the greatest influence on the protein and fat digestibility. It is known that vitamin A is actively involved in protein and fat metabolism, therefore the experiment confirmed the research by other scholars who had studied the effect of retinol on the growth and development of various animal species [3, 13]. The increased level of retinol by 50 % in the third group did not cause further significant increase in the digestibility of nutrients, their indicators remaining almost identical with those in the second group. As compared to the first group of bull calves that had received the existing rate of retinol,

the digestibility ratios in the third group were significantly higher not only for protein and fat but also for dry and organic matter, NFES (nitrogen-free extractive substances), and fiber. Through the analysis of the nitrogen balance data, it has been found that with the distillers grain feeding, an increase in the dose of retinol by 25 % as compared with the existing rate contributed to better absorption of nitrogen from the proposed diet [14].

11.2 % more nitrogen ($P > 0.01$) was deposited in the body of the bull calves of the second group, and the use of that taken with feed was higher by 1.76 %, and of the digested one – by 2.12 % compared to the first group.

The bull calves of the third group, which had received an increased by 50 % level of vitamin A in the diet, retained the ability to make better use of nitrogen. Compared to the first group, 4.99 g, or 12.7 % ($P > 0.01$) more nitrogen was deposited in their body. The nitrogen use ratio from the adopted one was higher by 2.12 %, and from the digested one – by 1.38 % ($P > 0.01$). At the same time, the difference in these indicators between the second and third groups was insignificant.

The bull calves, which had received elevated levels of retinol, excreted less nitrogen with the feces, resulting in the increased ratios of its use from that taken with food. It should be noted that in the distillers grain fattening, bull calves excrete a large amount of nitrogen with the excreted urine. Increasing the dose of vitamin A in the calf diets increased nitrogen excretion. However, its total losses were significantly lower than in animals in the first experimental group [15, 16].

As a result of the experiment, it has been found that in the second and third experimental groups receiving vitamin A, there was more efficient use of nutrients from the diet, which probably contributed to an increase in body weight and a yield of meat for slaughter.

The average daily gains in bulls in the second group were 870 g, or by 10.7 % more than in their analogues from the first group. More intensive growth resulted in their live weight higher by 16.0 kg by the end of fattening than that of the first group.

The increase in the level of retinol in the diets of bull calves in the third group by 50 % above the norm practically did not affect the further increase in animal growth, although the average daily growth of the young stock remained high and exceeded their peers from the first group by 12.4 % ($P < 0.05$).

The data from the control slaughter have shown that in the animals of the second group the mass of the hot carcass was 234.5 kg, and in the third group it was 235.7 kg, i.e., respectively, by 11.0 kg and 12.2 kg, or by 4.9 and 5.5 % ($P < 0.01$) more than in the young cattle that received a diet with the carotene standard recommended by RAAS [17].

Based on the results of boning the half carcasses of the experimental bull calves, it has been found that the main weight gain in the bull calves that had received higher doses of synthetic vitamin A was due to the most valuable part thereof – fillet, which was higher in the second group by 5.4 %, and in the third – by 6.0 % ($P < 0.01$) compared with the first group of animals receiving the standard retinol rate [18].

As it is known, various forms of vitamin A play a certain role in the protein metabolism in the body and this, apparently, has resulted in the better muscle tissue formation during the enhanced growth, especially during the final fattening between the ages of 14 and 18 months, from 300 to 450 kg, respectively.

During boning, the bull calves that received higher doses of retinol had significantly higher fillet yield per 1 kg of bones [19, 20].

The vitamin A nutrition optimized through the addition of synthetic additives of retinol in the diets of young cattle had positive effect on the chemical composition of the meat of the beef under study. The feeding diets with the content of retinol higher by 25 – 50 % have significantly increased the content of dry matter and protein in meat.

The best fattening and beef-making qualities of animals were also characterized by higher content of total protein in the blood plasma of the experimental bull calve groups. The use of elevated levels of retinol by animals caused some changes in the protein spectrum of the bull calves' blood. In the second group, the albumin content increased by 5.5 %, which had led to an increase in the albumin-globulin index by 2.9 %, and the increase of the same indexes in the third group was by 6.1 % and 1.4 %, respectively [21].

IV. CONCLUSION

1. In the three groups of the bull calves that received higher doses of synthetic retinol, an increase in blood hemoglobin, red blood cells, inorganic phosphorus and calcium has been noted.
2. The results of the scientific and economic experiment have been subjected to production testing, and on large groups of fattened bull calves they have confirmed the high economic efficiency of introducing synthetic additives into the bull calves' diets in the distillers grain fattening.
3. Thus, of the three doses of retinol tested: 20, 24 and 30 thousand IU of vitamin A per 100 kg of live weight, the doses of 24 – 30 thousand IU/100 kg of live weight have been effective for distillers grain fattening of young cattle.
4. The use of elevated levels of retinol provides, above all, the enhanced growth of young animals, and increases the yield of beef from bull calves fattened.

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