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Some physiological and biochemical indices in young cattle fattened using antioxidant and absorbent preparations in feeding

Victor Khamitsevich Temiraev^{1,*}, Valery Ramazanovich Kairov¹, Rita Vladimirovna Kalagova²

¹Federal State Budgetary Educational Institution of High Vocational Education, "Gorsky State Agrarian University", The Republic of North Ossetia-Alania, 362040, 37 Kirov Street, Vladikavkaz, Russia.

²Federal State Budgetary Educational Institution of High Vocational Education, "North-Ossetian State Medical Academy", Ministry of Public Health of the Russian Federation, The Republic of North Ossetia-Alania, 362007, 40 Pushkinskaya Street, Vladikavkaz, Russia.

*Corresponding author

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Abstract

In recent years, use of mycotoxins and antioxidants sorbents in cattle breeding is of considerable interest. Feeding these sorbents makes it possible to improve digestion process, metabolism, and productivity of animals, and improve product quality and economic performance. To this end, the aim of the research was to determine feasibility and advisability of treating fattening young cattle with a combination of biologically active preparations as a biological stimulant in order to improve their physiological and biochemical status and, consequently, to increase indicators of nutrients conversion into food products, fattening and meatiness, and profitability. Studies have shown that simultaneous presence of the ehpophen antioxidant and the toxisorb sorbent in rations of fattening young cattle stimulates physiological and biochemical processes in the organism, contributes to growth intensity, and reduces forage consumption per unit of output.

Keywords: Fattening bull-calves; forage, ration; blood; sorbent; antioxidant; digestibility.

Introduction

Promotion of advanced technologies of livestock production creates conditions for most complete manifestation of animals' genetic potential. Solving this problem requires a comprehensive approach based on intensification of the industry, which stipulates strengthening of the forage reserve and organization of adequate animals feeding, improving the technology of growing and fattening, selection of breeds that show the highest growth rate in specific conditions [1,2].

In addition to the above, economic efficiency of beef production depends, in the first place, on organization of feeding, feeding technique, and preparation of forage. In order to reduce its cost, it is advisable to use low-cost forage, including home-made feed materials [3].

Under the influence of metabolism, the technological characteristics of meat are changed in animals, i.e., structure, color, moisture-retaining power, consistence, chemical

composition, degree and nature of fat distribution, flavor and aromatic properties, as well as losses during heat treatment.

However, productivity, physico-chemical and technological properties of meat products and metabolic processes in the organism of fattened bull-calves are strongly influenced by contaminants of chemical and biological nature. Among them, a special place is occupied by mycotoxins and products of fat oxidation [4-7].

For example, cereal grains (corn, barley, wheat, etc.) during storage are affected by mold fungi, which leads to accumulation of B1 aflatoxin metabolite that has a pronounced hepatotropic effect [8].

Besides, during storage, fats are oxidized in grains of maize, barley, wheat, and other crops, with formation of peroxides that destroy structures of vitamins and reduce activity of many enzymes.

As mentioned above, in forage conditions of the Republic of North Ossetia-Alania,

the problem of studying production indicators and biochemical status of young bull-calves organism fattened with the use of antioxidants and sorbents preparations in forage seemed rater relevant to us.

Methods

In accordance with the established research goals and tasks, we performed scientific and economic experiment to study efficiency of using ehpophen antioxidant and toxisorb mycotoxin sorbent as a part of the ration for fattened young bull-calves.

The object of research was young fattening cattle. The experiment was performed in accordance with the general scheme of research, according to which 40 motley-black bull-calves in the age of 9 months were selected, out of which 4 groups, 10 animals in each, were formed by the method of par-analogs with regard to breed, age, and live weight [9].

According to the feeding scheme, bull-calves in the reference group received the basic ration (BR). Analogs from the first experimental group, in addition to the BR, received ehpophen antioxidant in the amount of 3 g per head, the second experimental group received toxisorb sorbent in the amount of 1,500 g/t of forage, and the third experimental group received a mixture of these agents in indicated dosages.

Experimental bull-calves were fed with experimental rations balanced in accordance with detailed rules of feeding [10]. Experimental feed rations for bull-calves were formed on a monthly basis, taking into account the live weight and the planned weight growth. During ration formation, the mandatory condition was strict adherence to the sugar-to-protein ratio by feeding beet molasses.

Throughout the whole scientific and economic experiment, experimental animals were fed on a strictly individual basis. Animals housing conditions in the compared groups were similar. Zoo-hygienic parameters indoors during the period of the experiment net requirements of the standard. Animals were tethered.

Results and Discussion

The degree of satisfying growing animals' needs in energy, nutrients, and bioactive substances,

quantitative and qualitative assessment of rations and individual forages can be assessed by the dynamics of live weight and the average daily gain of experimental animals.

The research has shown that feeding of rations composed of antioxidant preparations and sorbent, both individually and collectively, had a positive effect on bull-calves growth dynamics in experimental groups.

For example, at the beginning of the experiment, live weight of the experimental bull-calves was virtually the same. However, by the end of fattening period, bull-calves that received the studied biologically active preparations as a part of the ration had higher live weight of bull-calves in the reference group by 14.2; 11.5, and 24.3 kg, or by 3.3%, 2.7%, and 5.7%, respectively ($p > 0.95$).

It should also be noted that under the productive effect of joint feeding, the content of antioxidant preparations and sorbent in the ration was higher, which resulted in veracious superiority in live weight increase in bull-calves in the third experimental group in whole for the experiment by 24.27 kg, or 10.5% more ($p > 0.95$).

When fattening young cattle using biologically active preparations, special attention should be paid to conversion of nutrients into product, i.e., the costs of energy and nutrients per kg of live weight gain.

The research showed that the best forage payback conversion had bull-calves in experimental groups that received the studied biologically active additives as a part of the ration, both separately and in combination. With that, the best indicators of forage payback had bull-calves in the third experimental group that received antioxidant and sorbent jointly as a part of the ration, which manifested itself in less energetic feed units and digestible protein consumption per kg of live weight gain, as compared to analogs, by 9.53% and 9.77%, respectively.

The better growth stimulating effect of joint adding the studied biologically active preparations is due to better use of the exchange energy and nutrients in the forage, which we explain by the fact that ehpophen antioxidant and toxisorb mycotoxin sorbent have a positive effect on rumen metabolism.

Study of rumen metabolism peculiarities in bull-calves showed that in rumen chyme of bull-calves in the third experimental group, total nitrogen increased by 23.7, and the level of albuminous nitrogen in the rumen content

increased by 39.9%, as compared to reference analogues.

In bull-calves of the third experimental group, biosynthetic processes in the rumen intensified, which is confirmed by concentration of ammonia nitrogen decrease down to 12.8 vs. 16.0 mg per 100 ml in the reference group.

In chyme of bull-calves in the third experimental group, concentration of bacterial dry matter increased by 19.0; animalcules – by 15.5; and volatile fatty acids (VFA) – by 42.9%, which also a direct confirmation of biosynthetic processes intensification in rumen of bull-calves.

Joint feeding of the studied biologically active preparations not only increased the intensity of the fermentation processes in the rumen but also changed their focus toward increased propionic acid fermentation, which is evidenced by higher propionic acid value in the total VFA content in the rumen of bull-calves in the third experimental group by 5.8% in absolute units ($p > 0.95$), as compared to the reference group.

We can conclude that the obtained experimental data evidence about the favorable effect of antioxidant and sorbent co-feeding in the forage on the intensity of biosynthetic and fermentation processes, as well as propionic acid fermentation in rumen contents of experimental bull-calves.

In physiological studies performed against the background of the scientific and economic experience, there was a general tendency to increasing digestibility of all nutrients in the forage by bull-calves in experimental groups compared to the reference group.

Thus, bull-calves in the experimental groups showed better compared to their counterparts in the reference group digestion of dry matter – by 2.4, 2.2, and 2.7; organic matter – by 2.8, 2.3, and 3.2; crude protein – by 2.6, 2.4, and 3.3; fat – by 1.8, 1.1, and 2.6; crude fiber – by 3.1, 2.6, and 3.6; and nitrogen-free extractive substances – by 3.5, 3.0, and 4.2%, respectively, in absolute units. It should also be noted that the highest tendency to increasing digestibility of nutrients in the forage was found in case of joint feeding of the antioxidant and the sorbent.

Studying protein metabolism showed that bull-calves in the third experimental group, as compared to reference counterparts, had better use of nitrogen from the eaten amount by 1.98%, and from digested amount by 2.43% in absolute units.

We explain the obtained results by the fact that co-feeding antioxidant and sorbent in the forage helped to increase hydrolysis of protein and easily soluble carbohydrates of the forage due to activation of proteolytic and amylolytic enzymes in the gastrointestinal tract.

In order to determine the effect of tested preparations on the physiological state of fattening young cattle, hematologic studies were made on three bull-calves from each group at the beginning and at the end of the experiment, blood was taken from animals' jugular vein in the morning before feeding.

The results of hematological study showed that animals of all groups at the beginning of the experiment were analogous not only in terms of live weight but also in terms of blood morphological indicators, since no veracious variance was found between them in terms of any parameters of liquid internal environment.

Feeding the studied biologically active preparations in the forage rations, either separately or in a mixture, did not have an adverse effect on health of experimental young cattle at the end of fattening.

It should be noted that their blood morphological parameters changed with age according to biological laws. With that, as growth intensity increased under the influence of age-related peculiarities, absolute values of erythrocytes, hemoglobin, and white blood cell values in experimental young cattle increased as well. However, morphological and biochemical parameters of blood in bull-calves in the age between 9 and 18 months in the groups, as compared to the normative parameters, showed that they were within the physiological norm.

Out of blood morphological parameters, erythrocytes and hemoglobin proved most subject to changing under the influence of feeding conditions. They deliver oxygen and nutrients that had been sucked into organs and tissues through the intestinal mucosa.

Use of the studied biologically active preparations as part of the rations encouraged increasing of these parameters in the blood of bull-calves in experimental groups by the end of the fattening period. Thus, the highest concentration of red blood cells and hemoglobin was found in blood of bull-calves in the third experimental group, which outperformed their counterparts in reference group by these parameters by $0.60 \times 10^{12}/l$ and 14.2 g/l, respectively.

Feeding the studied biologically active preparations as a part of the forage also had most significant effect with age on biochemical composition of blood serum of calves in experimental groups.

It is known that plasma proteins have protective function, they transport fats, vitamins, and metabolism products. Therefore, total protein content in serum was found, in order to study the effect of the tested preparations on the level of protein metabolism in the organism of bull-calves.

In course of the research, it was found that with age, bulls in the compared groups had an increased total protein content in blood serum, which corresponds to biological characteristics of growing animals' organism formation. With that, at the end of the experiment, the best score for this indicator had animals in the experimental group 3, which outperformed their counterparts in the reference group by 1.89 g/l.

Under the influence of the studied preparations, changes occurred in the structure of blood serum proteins in experimental animals. So, the research established that despite the tendency to decreasing concentration of globulin fraction in animals in experimental groups by 0.89-1.26%, there was a veracious increase in concentration of total protein albumin fraction; the difference with the reference group was 2.25-3.15% in absolute units.

Protein index in blood serum of bull-calves in experimental groups was higher than that in reference group by 11.1-14.3%, which indicates intensity and efficiency of protein metabolism in animals. This assumption is also favored by the tendency to some increase toward transamination enzymes activity in blood of bull-calves in experimental groups; so, index of alanine aminotransferase (ALT) exceeded that in the reference group by 3.6-9.9%, and serum glutamic oxalacetic transaminase (AST) – by 3.6-7.1%.

Indirect indicator that reflects an increase of metabolism in muscle tissue is creatinine concentration in blood, and by this indicator bull-calves in the experimental groups outperformed their counterparts in the reference group by 6.3-10.5%. With that, level of urea in blood of animals in experimental groups was lower than in the reference group by 5.5-17.1%.

Under the influence of co-additives, an increase in sugar concentration was observed in blood of 18-yrs old bull-calves in the experimental

groups. With that, the highest content of glucose in blood was in young cattle of experimental group 3-3.96 mmol/l that is 0.20 mmol/l higher than in the reference group, which indicates activation of carbohydrate metabolism in this experimental group of calves under the influence of the studied biologically active preparations.

Along with total protein content in the blood serum, level of protein metabolism in the organism may be assessed by the concentration of ketone bodies. It has been found that by joint use of the studied preparations, as compared to the reference group, bull-calves in the experimental group 3 featured a significant decrease in blood ketone bodies by 1.16 mmol/l, which is an indirect confirmation of the fact that protein metabolism increased in the fore-stomach of experimental animals.

It is known that the calcium to phosphorus ratio in blood of the animals depends not only on their amount but also on elements ratio in the ration. The use of the tested feed additives had a positive effect on mineral metabolism in body of fattening young calves in experimental groups, which is shown by calcium and phosphorus content in the blood serum. Moreover, when compared to the reference group, bull-calves in three experimental groups featured higher content of these macro-elements in blood serum by 0.23 and 0.18 mmol/l, respectively.

Therefore, joint feeding ehpophen antioxidant and toxisorb mycotoxin sorbent to young cattle as a part of the ration contributed to improving of intermediary metabolism due to optimization of rumen digestion mechanism.

Conclusion

Joint feeding of ehpophen antioxidant and toxisorb mycotoxin sorbent causes a veracious increase in growth energy by 10.5% (average per experiment), as compared to the reference group, with the use of 9.5% of forage units and 9.8% of digestible protein per kg of live weight growth.

An increase in bio-synthetic processes has been found in the rumen of bull-calves from three experimental groups, which was manifested in an increase in bacteria dry matter concentration in chyme by 19.0%, the animalcular – by 15.5%, and volatile fatty acids (VFA) – by 42.9%, as compared to their counterparts in the reference group.

In the course of physiological experiments, animals from the third experimental group, compared to the reference group, showed higher rates of dry matter digestibility by 2.7%; organic matter – by 3.2%; crude protein – by 3.3%; crude fat – by 2.6%; crude fiber – by 3.6%; and nitrogen-free extractive substances – by 4.2%, and greater deposition of nitrogen in their body – by 13.6%.

Under the influence of the studied preparations, bull-calves from the third experimental group, as compared to the reference group, showed a veracious increase in albumin fraction concentration of total protein by 3.15%, protein index in blood serum – by 14.3%, which is an evidence of intensity and efficiency of protein metabolism in animals.

In general, the effect of a combination of biologically active preparations used as biological stimulants on the organism of fattening young cattle contributed to improvement of physiological and biochemical status of their organisms and, consequently, to improving conversion of feed nutrients into meat product.

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