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The effective use of adaptogens of various origins on the cattle productivity

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Abstract
Background: In conditions of industrial animal husbandry, it is necessary to pay attention to the immune system, which regulates metabolic processes in the body of animals. To do this, additives with adaptive properties attract attention.
Aim: The aim is to define a way to increase productivity using adaptogens of plant and animal origin in feeding cattle.
Methods: In the farms of the Orenburg region and the Republic of Bashkortostan, which differ in climatic conditions, scientific and economic experiments were done on Kazakh white-headed bulls and first-calf cows of black-and-white breed, whose diet was introduced in the form of tinctures (at the rate of 0.01 ml of tincture per 1 kg of body weight), adaptogen may change (for animals of the II experimental group), drone homogenate (experimental group III), and pantocrine (experimental group IV), while the animals of group I were assigned to the control group and did not receive additives.
Results: The results of the evaluation of the live weight of bulls by age periods indicate that young animals consuming plant adaptogen exceeded control peers by 18 months of age by 18.60 kg (3.72%); animal origin—by 28.50 kg (5.71%; $p < 0.05$) and 21.00 kg (4.21%). A similar pattern was observed in cows, in which, against the background of the use of may chang, the milk yield for 305 days of lactation increased by 312 kg (5.61%; $p < 0.05$), drone homogenate—by 726.1 kg (13.04%; $p < 0.001$), pantocrine—by 494.4 kg (8.88%; $p < 0.001$). In all animals participating in the experiment, blood values were within the limits of physiological norms but with a slight increase toward the upper regulatory limits in the experimental samples. There is an improvement in the qualitative composition of the final livestock products. Thus, the indicator of the biological usefulness of beef was higher in samples taken from experimental animals by 0.18–0.36 units ($p \leq 0.05$).
Conclusion: The most significant nutritional, biological, and energy value was characterized by milk obtained from cows, in whose diet drone homogenate was introduced. Thus, the results of complex studies indicate the effectiveness of introducing adaptogens of both plant and animal nature into the diet. Still, the best effect is obtained from drone homogenate.
Keywords: Bulls, First-calf cows, Drone homogenate, Meat, Milk.

Introduction

Self-sufficiency in vital food products is characteristic of the entire world community due to the annual increase in the population of our planet. European experience shows that it is advisable to develop the meat industry of animal husbandry by breeding specialized meat breeds, which makes it possible to achieve a higher yield of meat of better quality (Xie *et al.*, 1996; Wang *et al.*, 2006; Decree of the Government of the Russian Federation of 14.07.2012 N 717, 2020).

In the Russian Federation, state programs aimed at the development of agriculture were implemented, which resulted in increasing meat products and the gross milk yield, but did not reach its maximum. In this regard, the work on the development of both meat and dairy farming continues, as it is aimed at providing the country with food, and it is a priority among various areas of agriculture (BIF, 1996; Makarov *et al.*, 2017).
There are over a thousand breeds of cattle in the world, but only a few dozen are specialized breeds of meat,

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and only seven breeds are considered effective for Russia, including the Kazakh white-headed, approved only in 1950. The breed was bred in the farms of the Orenburg and Volgograd regions, Kazakhstan, by crossing Kazakh and partially Kalmyk cattle of the local population with Herefords. It is characterized by a meaty body type, red color, white head, chest, belly, lower legs, and tail brush. By being resistant to cold weather, animals form a long thick coat with curly hair. The cattle are precocious, well-fed, and fattened. It is used for crossing with dairy cattle to improve its meat qualities. It is concentrated mainly in Kazakhstan, the Lower and Middle Volga regionS (Kharlamov *et al.*, 2013; Sulimova *et al.*, 2016; Gorlov *et al.*, 2020).

The average number of cows in the world reaches a billion heads. And if beef can be replaced with pork, lamb, or poultry, then it is almost impossible to produce milk without cows. In addition, there are several breeds of the universal direction of productivity, including the black-and-white breed in the USSR. In Russia, it is pretty popular; it ranks third in number (Basarab and Markus, 2006; Chabaev *et al.*, 2018; Lyashuk, 2020).

In the conditions of industrial animal husbandry, it is important to create and maintain a solid feed base to balance diets by resorting to more affordable methods that reduce economic costs per unit of production. It is necessary to pay attention to the immune system, which regulates metabolic processes in the body of animals. For this purpose, drugs with adaptive properties attract attention (Bagautdinov *et al.*, 2018; Nikolaeva *et al.*, 2020).

Plants with adaptogenic properties can include maral root or, as it is also called, big-head or maral root, which is relatively cheap, technologically advanced, and, as a result, affordable to use. The plant grows on the territory of Central Asia in the Fergana range of the Tien Shan, Altai, and Sayan. The composition contains vitamins A and C, inulin, calcium oxalate, phosphoric acid salts, tannins, essential oil, phytoectisones, alkaloids, triterpene, and anthocyanin glycosides, flavonoids (Akhmadullina *et al.*, 2019; Khabibullin *et al.*, 2020).

The second group of adaptogens includes preparations of animal origin. The most common and active representative of this group is pantocrine. Its production is carried out from deer antlers. Their habitat is the Far East of Russia. Studies of their composition indicate that they include lipids, peptides, amino acids, nucleic acids, and minerals (Kaiser, 2006; Osintsev and Osintsev, 2011).

The same group of adaptogenic preparations should include such a beekeeping product as drone brood (homogenate), the study of which is actively conducted in our country (Mardanly *et al.*, 2016; Dementyev *et al.*, 2018; Chervyakov *et al.*, 2019).

The chemical composition that determines the biological activity of drone homogenate: protein, amino and nucleic acids, a large group of enzymes, phospholipids, fatty acids, steroid hormones, carbohydrates, flavonoids, a significant variety of micro- and macroelements, water- and fat-soluble vitamins and several other biologically active components (Lercker *et al.*, 1981; Melliou and Chinou, 2005; Buttstedt *et al.*, 2014).

The scientific novelty of the work lies in the fact that, for the first time, comprehensive research has been conducted to study the effect of the use of different types of adaptogenic additives as part of standard diets on the dairy and meat productivity of bulls and cows, as well as the composition and properties of milk and beef.

The obtained results during the experiment complement the theoretical knowledge in terms of a comparative assessment of the use of adaptogens of plant and animal origin and their impact on physiological and productive qualities.

However, the study of the productive qualities of purebred bulls and cows when using adaptogens, despite a large amount of literature, has yet to receive specific coverage in either Russian or foreign works.

The study aims to increase the productivity of cattle through the use of plant and animal adaptogens in the diets. Tasks for realizing the goal: to assess the nitrogen balance of cows under the influence of a new additive; to study the growth dynamics of bulls, the milk productivity of first heifers, the morphological and biochemical composition of animal blood; the quality of the obtained products.

The experiment was done within the framework of the thematic research plan of the Bashkir State Agrarian University No. 01201058950, "Development and improvement of livestock production technologies," and its relevance is confirmed by the certificate of state registration of the computer program (RU 2020613030 dated 06.03.2020) "Software package for calculating nitrogen balance for cattle."

We assume that the conducted studies will make it necessary to determine the most effective type of adaptogen for bulls and first-calf cows. Using safflower leucea, pantocrine, and drone homogenate, it is possible to increase meat and dairy productivity and the qualitative composition of dairy and meat products.

Materials and Methods

Research conditions: Orenburg region (FARM "Zhukovo," Buguruslansky district) and the Republic of Bashkortostan of the Russian Federation (LLC "Agro-Alliance," Chishminsky district). The same conditions were created for all animals.

The experiment period: on bulls from September 2019 to February 2021 and first-calf cows from November 2019 to September 2021. All studies in the Orenburg Region and the Republic of Bashkortostan were conducted in the same period.

The formation of groups was carried out from bulls of 6 months of age. The scientific and economic experience lasted until they reached 18 months.

Objects of research: 40 bulls of the Kazakh white-headed breed at the age of 6 months before reaching the period of 18 months, 40 first-calf cows of the black-and-white breed. All animals were divided into 4 groups of 10 animals, each according to the principle of analog groups, which were assigned the numbers group I (control), group II, III, and IV (experimental).

When forming groups of animals, the method of analog groups was used when the selection of animals into groups takes into account the breed, origin, gender, physiological condition, etc.

All animals were divided into four groups according to the principle of analog groups. The control group of bulls was given only the basic diet, and it was a control one. She was assigned the number I. Group II bulls consumed, in addition to the main diet, Safflower leucea. Group III received drone homogenate, and Group IV received pantocrine.

Experimental material: adaptogens of plant nature (maral root) and animal nature (drone homogenate and pantocrine). The studied components were introduced in the form of ready-made alcoholic tinctures, the rate of administration of which was determined at the rate of 0.01 ml per 1 kg of animal body weight. The calculated volume was dissolved in 200 ml of water and given to the animals to drink in the morning. The tested agents were given for 2 weeks with breaks of 2 weeks.

The ration for first-calf cows consisted of vetch and oat hay, corn silage, fodder beet, barley, oats, yellow corn, sunflower cake, molasses, table salt, feed L-tryptophan, feed monocalcium phosphate, cobalt sulfate, potassium iodide, trivitamin, L-lysine monochloride, DL-methionine. The share of coarse feed accounted for 32.11%, concentrated—32.48%, and juicy—35.41%. The bulls' diet included grass-grain hay, alfalfa hay, corn silage, barley, oats, meat and bone flour, table salt, and monocalcium phosphate feed. Coarse feed was 40.47%, concentrated—22.37%, juicy—37.16%.

Research methods: before starting the main stage of the experiment, a preparatory period of 1 month was organized to achieve uniformity of groups. Feeding was carried out according to diets based on detailed norms. The nutritional value of the diet for all groups of animals was equal. The diets were based on the physiological state of the animals, the quality of the feed, and the level of meat and dairy productivity and were periodically adjusted. The diet was balanced in a patented software package that makes it possible to calculate the nutritional value and feed consumption by the periods of their content.

The growth of bulls was recorded individually by weighing them in the morning hours before feeding and watering them once a month. The obtained results formed the basis for calculations of absolute and average daily growth, relative growth rate, and the coefficient of increase in animal weight.

The milk productivity of the black-and-white breed's first heifers was considered for 100 and 305 days of lactation according to the results of monthly control milking. According to the data of the average daily milk yield, the lactation curves of cows of the control and experimental groups were constructed, and the milk yield coefficient was calculated, taking into account the milk yield for lactation (305 days) and the live weight of cows, as well as the coefficients of stability and fullness of lactation.

Blood sampling for the study of morphological and biochemical composition was carried out in the morning hours 1 hour before giving food and water to three healthy animals, from each group from the jugular vein in bull calves aged 10 and 18 months and in heifers—at the age of 21 months.

The studies were carried out on a hematological analyzer of the brand HEMA 8-01- "Astra" (Manufacturer: LLC "Scientific and Production Center "ASTRA," Ufa) and an automatic biochemical analyzer DIRUI CS-T240 (Dirui, China).

The chemical composition of the longest back muscle was studied according to the All-Russian Research Institute of Metrological Service methodology and was supported by the study of the biological value of meat. Tryptophan (an essential amino acid) was determined by the method of G.E. Graham, E.P. Smith in the modification of E. Wierbicki and E. Deatherage, oxyproline (an interchangeable amino acid) according to the method proposed by R.E. Neuman, M.A. Logan in the modification of Stejeman–Stalder. The obtained values were used to calculate the biological usefulness of meat.

The composition of milk was analyzed by physicochemical methods in selected milk samples, for fat content–by the acid Gerber method, dry skimmed milk residue–by the refractometric method, lactose–by the photoelectrocolorimetic method, energy value–by calculation according to the VIZHA formula.

Blood sampling for the study of morphological and biochemical composition was carried out in the morning hours 1 hour before giving food and water to three healthy animals, from each group from the jugular vein in bull calves aged 10 and 18 months and in heifers—at the age of 21 months.

The nutritional value of meat and milk is due to their chemical composition was determined by the content of proteins, fats, and mineral salts in them. To calculate the energy value, the following formula was used: $E = 9X1 + 4X2 + 3.8 X 3$,

where E is the energy value of the food product, kcal;

X 1—a mass fraction of fat in the development, g;

X 2—a mass fraction of protein in the development, g;

X 3 is the mass fraction of carbohydrates in the product.

1 kcal = 4.184 kJ.

In general, general-technical research methods were used.

The study conditions were the same for all animals. To be able to carry out mathematical processing of the obtained data, groups were formed from 10 animals; blood samples were taken from three animals from each group, bull calves were also slaughtered by three animals from each group, and milk samples were taken from five animals from the group.

The results of the experimental data were subjected to mathematical-statistical processing on three levels of probability *p* ($p > 0.05$; $p > 0.01$; $p > 0.001$), according to the Student's table.

Ethical approval

The animals were served according to the instructions and recommendations of Russian Regulations, as well as Washington. During the research, efforts were made to minimize the suffering of animals and the smallest number of samples used (Institute of Laboratory Animal Resources (US), 1996; Russian Regulations, 1987).

Results

An important predictive zootechnical and economic indicator of meat productivity is the determination of the animal's live weight. Our experience makes it possible to consider the impact of adaptogens of different origins on the young stock of the Kazakh white-headed breed.

The analysis of the obtained data indicates the necessity of enriching the diet with adaptogens of both plant and animal nature (Table 1).

It is noted that the cyclical period of giving adaptogenic agents with a 2-week break demonstrates an increase in live weight. Thus, in bulls consuming plant adaptogens by the age of 9 months, body weight increased by 3.8 kg (1.51%) compared to control analogs, by 8.2 kg (2.49%) by 12 months, by 14.1 kg (3.37%) by 15 months, and by 18 months—by 18.6 kg (3.72%).

A similar trend is observed for groups of young animals consuming adaptogens of animal nature. Thus, bulls of the experimental group III, against the background of consumption of a product of biological genesis, grew better than peers of the I (control) group and by 9, 12, 15, and 18 months became 6.5 kg (2.59%); 13.4 kg (4.07%); 22.6 kg (5.41%; $p \leq 0.05$) and 28.5 kg (5.71%; $p < 0.05$). In young animals of the IV experimental group, with pantocrine enrichment of the diet, the live weight increased by 5.4 kg (2.15%), 10.4 kg (3.16%), 17.2 kg (4.12%) and 21.0 kg (4.21%) during the growth periods compared to animals of the I group.

Summing up the intermediate result, one can note that the most significant increase in live weight was recorded in a group of bulls whose diet was enriched with drone homogenate at 0.01 ml per 1 kg of body weight. The absolute (gross) increase for the period from 6 to 18 months was 346.6 kg, which is higher than that of the analogs of group II by 9.4 kg (2.79%); group IV—by 8.1 kg (2.39%) and group I—by 29 kg (9.13%). The average daily increase in body weight in the intergroup distribution was similar (Fig. 1).

The studied indicator in animals of all experimental groups gradually increased until the age of 15 months and decreased by the age of 18 months.

Thus, in bulls belonging to the control group, the average daily increase by the second period (9–12 months) increased by 93.4 g (12.25%), by the third (12–15 months)—by 118.69 g (13.86%), and by the fourth (15–18 months) decreased by 78.03 g (8.70%), in animals of the II–IV experimental groups–by 95.6–98.9 g (11.73%–11.78%); 122.0–130.8 g (13.39%–13.93%); 86.8–107.7 g (9.18%–11.2%), respectively.

The maximum average daily increase in live weight was demonstrated by bulls of the III experimental group receiving adaptogen drone homogenate with a diet that was 949.59 g, which was higher than that of peers consuming maral root by 25.75 g (2.79%), pantocrine—by 22.19 g (2.39%), the main diet—by 79.45 g (9.13%; $p \leq 0.05$).

The relative growth rate of the bulls was calculated by age periods, the results of which indicate the superiority of the animals of the experimental groups. It is important to note that for the entire period of the experiment from 6 to 18 months, the value of the studied indicator in control young was at the level of 93.23%, which is lower than in the experimental analogs—by 3.26%–4.41% ($p \leq 0.05$–0.001). The maximum relative growth rate was shown by bulls consuming the adaptogen drone homogenate, surpassing similar peers of the experimental group with maral root by 1.25%, with pantocrine—by 1.34%.

The second stage of the experiment was devoted to the influence of adaptogens on the milk productivity of first-born cows of a black-and-white breed. This stage is very important because, at the stage of lactation

Table 1. Age dynamics of live weight of bulls, kg.

Reached age, months.	Group			
	I (control)	II	III	IV
6	181.8 ± 1.52	180.8 ± 1.68	181.3 ± 1.71	181.9 ± 1.75
9	251.2 ± 2.58	255.0 ± 2.74	257.7 ± 1.94	256.6 ± 2.17
12	329.7 ± 2.83	337.9 ± 3.81	343.1 ± 2.87	340.1 ± 3.09
15	417.8 ± 3.10	431.9 ± 4.25	440.4 ± 2.99*	435.0 ± 3.75
18	499.4 ± 4.37	518.0 ± 4.53	527.9 ± 3.14*	520.4 ± 4.10

* $p > 0.05$.

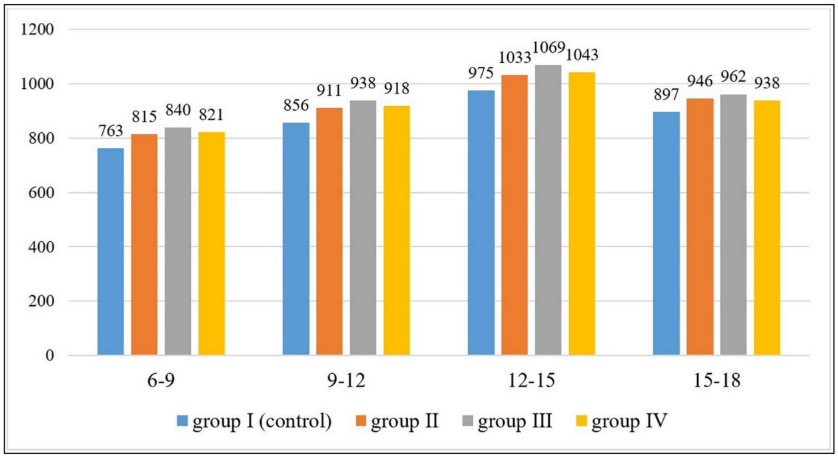

Fig. 1. Age dynamics of the average daily increase in live weight of bulls, kg.

formation in animals, physiological and biochemical metabolic processes are pretty active, the transformation of a significant proportion of the energy and nutrients of the feed into milk. The initial lactation period (100 days) is accompanied by an active consumption of the body's nutrient reserves for milk synthesis, and if they are deficient, productivity may decrease. Thus, it is possible already in the initial lactation period to forecast the diet's balance for all controlled substances.

Analysis of milk productivity data for both 100 and 305-day lactation periods indicates an increase in these indicators in groups of animals consuming adaptogens. In control animals, the indicators were at the level of 2,490 kg and 5,566.2 kg, respectively.

The first value in animals of the II, III, and IV experimental groups was higher than in the peers of the I (control group) by 36.1 kg (1.45%); 94.4 kg (3.79%; $p < 0.05$); 60.1 kg (2.41%), the second—by 312.0 kg (5.61%; $p < 0.05$); 726.1 kg (12.04%; $p \leq 0.001$) and 494.4 kg (8.88%; $p \leq 0.001$).

The highest yield, including the average daily (19.25 kg), was in the first heifers consuming adaptogen drone homogenates at 0.01 ml per 1 kg of live weight.

To establish the direction during the metabolic processes in cows, the coefficient of milk content was calculated, characterizing the mass of milk produced for every 100 kg of live weight. This indicator indirectly determines the constitutional orientation of animals.

The calculation showed that all animals had a high coefficient of milk production, which indicates a pronounced dairy type of first-calf cows participating in the experiment. In control peers, the coefficient of milk production reached values of 1,165.95 kg, which is lower than in experimental analogs by 33.84–101.92 kg (2.90%–8.04%; P0.05–0.001).

To establish the peak productivity during the lactation activity of cows, the average daily milk yield of black-and-white first-calf cows was evaluated during the experiment (Fig. 2).

The graph data indicate an increase in milk yield by the third month of lactation with a gradual decrease until the end of the experiment, which, in principle, is physiologically conditioned. In group I animals, the maximum average daily milk yield by this period reached 26.14 kg, which is lower than in the peers of the II, III, and IV experimental groups by 0.76 kg (2.91%); 1.99 kg (7.61%; $p < 0.01$); and 1.32 kg (5.05%; $p < 0.05$), respectively. Thus, the period of separation in the animals of the control group proceeded less intensively than in the experimental animals, which indicates the activation of metabolic processes in the body of the first heifers of the experimental groups consuming adaptogens against the background of the main diet.

It is important during the second phase of lactation to keep the peak of milk productivity in animals as long as possible, even though the middle of lactation is naturally accompanied by its fall. It was noted that a smoother decrease in the average daily milk yield in the second phase of lactation was observed in animals of the II, III, and IV experimental groups, and the third phase of productivity reduction in all animals was similar to the second.

For an objective assessment of the lactation activity of animals, they resort to the analysis of the coefficients of lactation stability and the indicator of the usefulness of lactation, characterizing the degree of its equalization (Table 2).

These table data confirm the previously suggested assumption about the best manifestation of lactation activity in cows against the background of consumption of adaptogens. Thus, the maximum value of the lactation stability coefficient was 93.6% in animals consuming the adaptogen drone homogenate, which is 6.7% higher compared to group I peers (P0.001). A comparative analysis of the data of control animals with experimental analogs of groups II and IV indicates the superiority of the latter, 2.8% (P0.01) and 4.6% (P0.001).

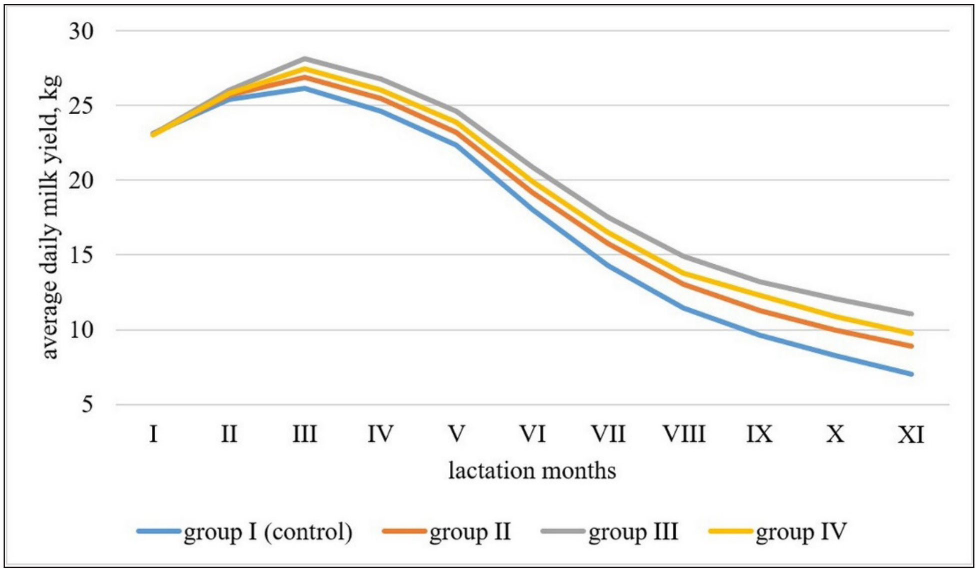

Fig. 2. Average daily milk yield of cows by months of lactation, kg.

Table 2. Coefficients characterizing lactation of first-calf cows, % (X ± Sx).

Indicator	Group			
	I	II	III	IV
Lactation stability coefficient	86.9 ± 0.84	89.7 ± 0.98**	93.6 ± 1.04***	91.5 ± 0.88***
The coefficient of the fullness of lactation	69.7 ± 0.43	71.5 ± 0.45**	73.3 ± 0.45***	72.4 ± 0.44***

**$p < 0.01$.
***$p < 0.001$.

According to the coefficient of lactation usefulness, the intergroup distribution remained the same. In animals of groups II–IV, the studied indicator increased relative to control peers by 1.8%–3.6% (P0.01–0.001).

Thus, a comprehensive analysis of the data on the milk productivity of the first-born cows of the black-and-white breed indicates that with the consumption of adaptogens of both plant and animal nature, the lactation of animals is intensified, characterized by constancy and fullness. The best effect was manifested when drone homogenate was administered to animals of the III experimental group.

The state of a living organism is judged by its internal environment–blood and its derivatives. Blood participates in metabolism and performs the function of maintaining the relative constancy of the internal environment of the body. A constant chemical composition characterizes blood as a complex system but, at the same time, reflects metabolic changes in the body of animals to one degree or another. Thus, due to the significant role of blood in determining the physiological state of animals, and its direct connection with productivity, we conducted studies of the morphological and biochemical composition of the blood of Kazakh white-headed bulls and first-born heifers of the black-and-white breed that received adaptogens of plant and animal nature.

It is important to note that the analyzed morphological indicators corresponded to the physiological norm, despite the established intergroup differences (Fig. 3).

In the blood of bulls of the II, III, and IV experimental groups, the proportion of erythrocytes increased compared with analogs of the I (control) group at ten months of age, respectively, by 0.05 * 1012/l (0.85%); 0.14 *1012/l (2.39%); and 0.13*1012/l (2.22%), and at 18 months of age—by 0.22* 1012/l (3.57%); 0.44* 1012/l (7.13%); and 0.35*1012/l (5.67%). An increase of red blood cells in the blood of bulls of experimental groups against the background of their consumption of adaptogens shows a more active metabolism in their body.

The hemoglobin content in the blood of bulls of all experimental groups was also high. At the same time, the increase relative to control peers in the blood of bulls consuming maral root at ten months was 1.49 g/l (1.18%), at 18 months—1.52 g/l (1.19%); drone homogenate—3.24 g/l (2.56%; $p < 0.01$) and 2.87 g/l (2.25%; $p < 0.05$) and pantocrine—2.02 g/l (1.60%) and 2.31 g/l (1.81%; $p < 0.05$), respectively.

In cows, the morphological composition of blood is closely related to the speed of movement and productivity. In the process of milking, milk productivity increases, and the concentration of erythrocytes and

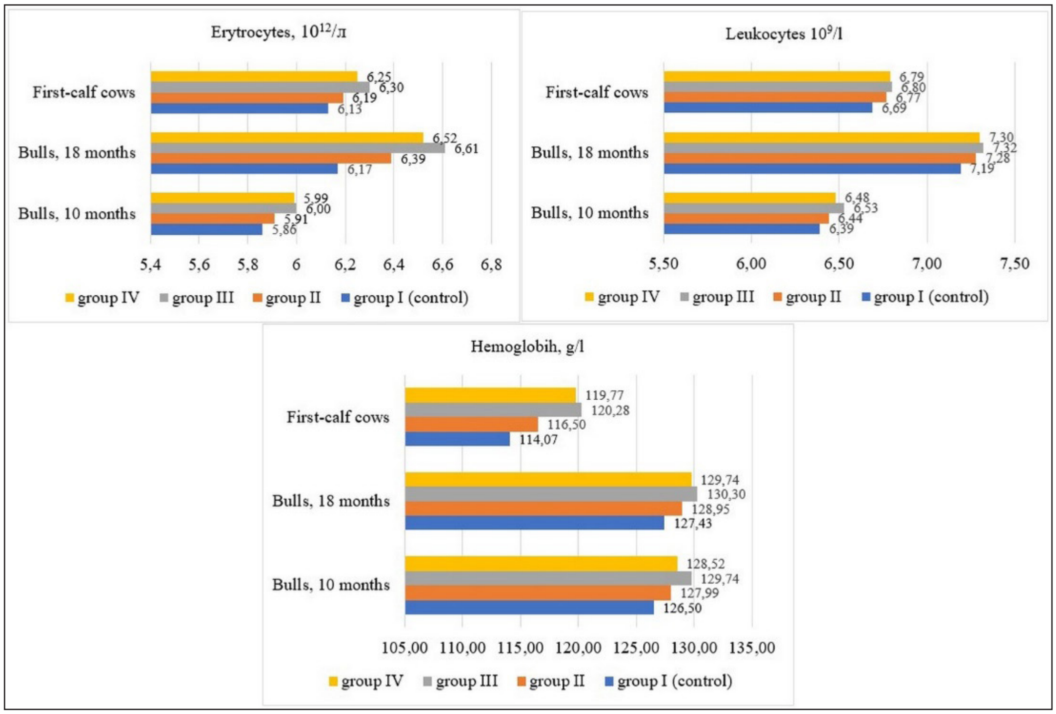

Fig. 3. Morphological parameters of blood.

hemoglobin in the blood of animals increases. So, in animals against the background of the consumption of the adaptogen drone homogenate, there is a significant ($p \leq 0.05$) increase in red blood cells by 0.17 * 1012 / l (2.77%) relative to the control, proving the activation of protein metabolism in their body. The concentration of hemoglobin in cows of the III and IV experimental groups compared with the base analogs also increased significantly ($p \leq 0.05$) by 6.21 g/l (5.44%) and 5.70 g/l (5.00%), which shows a better transport of amino acids and oxygen into their body.

According to the leukocytes of the blood of first-calf cows, a slight shift in the direction of increase can be noticed in the experimental samples, with a difference relative to the control analogs 0.08–0.11*109/ l (1.20%–1.64%). This characterizes a considerable metabolic activity, including the hematopoiesis system and redox reactions in their internal environment.

Blood serum samples of experimental animals were studied according to biochemical parameters, the results of which indicate that the synthesis of total protein and its fractions depends on the characteristics of their feeding (Table 3).

Thus, it was found that the concentration of total protein in the blood of experienced 18-month-old bulls of groups III and IV ($p < 0.05$) increased significantly by 1.79 g/l (2.25%) and 1.58 g/l (1.99%), respectively, in first-calf cows of similar groups by 1.84 g/l (2.54%) and 1.49 g/l (2.06%), against the background of the corresponding control analogs.

The intergroup distribution of albumins and globulins was similar to the total protein. At the same time, the ratio of albumins to globulins in the blood serum of animals of all experimental groups was optimal.

It can be noted that in all animals, the amount of total protein increased due to globulin fractions, which indicates that in growing bulls, along with the growth of active tissues, the process of fat formation begins to form. So, for globulins in blood serum by 18 months of age compared with ten months of age in group I bulls increased by 3.33 g/l; II—by 3.59 g/l; III—by 3.38 g/l; and IV—by 3.45 g/l. At the same time, among the experimental samples, the studied indicator was the highest in young animals receiving drone homogenate, the lowest—maral root, and the intermediate position—pantocrine.

Analysis of the content of globulin fractions indicates some age-related increase in the blood samples of bulls. At the same time, the maximum growth by 18 months was recorded for the group of γ-globulins in all experimental bulls. Thus, this indicator in the control group became higher by the end of the experiment by 144 g/l, group II—by 1.51 g/l, group III—by 1.36 g/l, and group IV—by 1.43 g/l. In the intergroup aspect of γ-globulins, experienced young animals were in the lead, surpassing the control at ten months by 0.04–0.23 g/l, at 18 months—by 0.11–0.15 g/l, and first-calf cows—by 0.06–0.15 g/l. An increase in the gamma-globulin fraction in the blood serum is associated with an increase in the synthesis of immune proteins in the body.

Table 3. Biochemical composition of blood serum.

Age, months	Group of bulls			
	I (control)	II	III	IV
Total protein g/l				
Bulls, 10 months	73.03 ± 0.71	73.35 ± 0.40	74.32 ± 0.44	74.08 ± 0.60
Bulls,18 months	79.59 ± 0.45	80.72 ± 0.60	81.38 ± 0.90*	81.17 ± 0.72*
First-calf cows	72.36 ± 0.45	73.20 ± 0.86	74.20 ± 0.82*	73.85 ± 0.22*
Albumins g/l				
Bulls, 10 months	30.08 ± 0.51	30.20 ± 0.39	30.61 ± 0.27	30.56 ± 0.33
Bulls,18 months	33.31 ± 1.01	33.98 ± 1.38	34.29 ± 0.95	34.19 ± 0.54
First-calf cows	33.34 ± 0.80	33.89 ± 0.91	34.42 ± 0.47	34.23 ± 0.22
Globulins g/l				
Bulls, 10 months	42.95 ± 0.20	43.15 ± 0.31	43.71 ± 0.19*	43.52 ± 0.51
Bulls,18 months	46.28 ± 0.67	46.74 ± 0.80	47.09 ± 0.67	46.97 ± 0.75
First-calf cows	39.01 ± 0.60	39.31 ± 0.55	39.78 ± 0.45	39.61 ± 0.12
α-globulins				
Bulls,10 months	10.11 ± 0.04	10.19 ± 0.31	10.37 ± 0.16	10.32 ± 0.12
Bulls,18 months	11.08 ± 0.21	11.26 ± 0.17	11.47 ± 0.08	11.40 ± 0.07
First-calf cows	10.28 ± 0.19	10.41 ± 0.10	10.60 ± 0.32	10.53 ± 0.16
β-globulins				
Bulls, 10 months	13.19 ± 0.35	13.27 ± 0.52	13.46 ± 0.59	13.42 ± 0.51
Bulls,18 months	14.11 ± 0.07	14.28 ± 0.08	14.39 ± 0.36	14.36 ± 0.11
First-calf cows	11.04 ± 0.17	11.15 ± 0.51	11.34 ± 0.18*	11.27 ± 0.33
γ-globulins				
Bulls, 10 months	19.65 ± 0.51	19.69 ± 1.08	19.88 ± 0.84	19.78 ± 0.71
Bulls,18 months	21.09 ± 0.92	21.20 ± 0.74	21.24 ± 1.03	21.21 ± 0.91
First-calf cows	17.69 ± 0.93	17.75 ± 0.91	17.84 ± 0.38	17.82 ± 0.21
A/G				
Bulls, 10 months	0.70	0.70	0.70	070
Bulls, 18 months	0.72	0.73	0.73	0.73
First-calf cows	0.86	0.86	0.87	0.86

*$p < 0.05$.

The blood composition of all the animals involved in the experiment was subject to various changes, which are associated with the processes of growth, formation of the organism, and the background of feeding, which was different. At the same time, all changes in the blood status proceeded strictly within physiologically determined regulatory limits.

To conduct a qualitative analysis of muscle tissue and assess the distribution of intramuscular fat in it, a sample of the longest back muscle was selected for the research. It makes it possible to give a comprehensive conclusion on the entire muscle tissue of the carcass. Physico-chemical studies of the longest back muscle were carried out on the content of water, protein, fat, and ash, as well as the energy and biological usefulness of meat (Fig. 4).

Thus, the protein content in all the studied samples was quite high, amounting to 20.14%–20.56%, with a maximum concentration in the III experimental sample. A similar trend can be traced in terms of fat content. In the meat sample of bulls of the II experimental group, this indicator was higher by 0.17%; III—by 0.25%, and IV—by 0.23% compared with the I control sample. Against the background of an increase in the proportion of intramuscular fat in the longest back muscle in the experimental samples, the amount of moisture decreased. The established pattern was reflected in the energy value of 1 kg of muscle. The maximum energy value was characterized by meat obtained from bulls consuming adaptogen-drone homogenate 4,391 MJ, surpassing the control by 169 MJ (4.00%), experienced

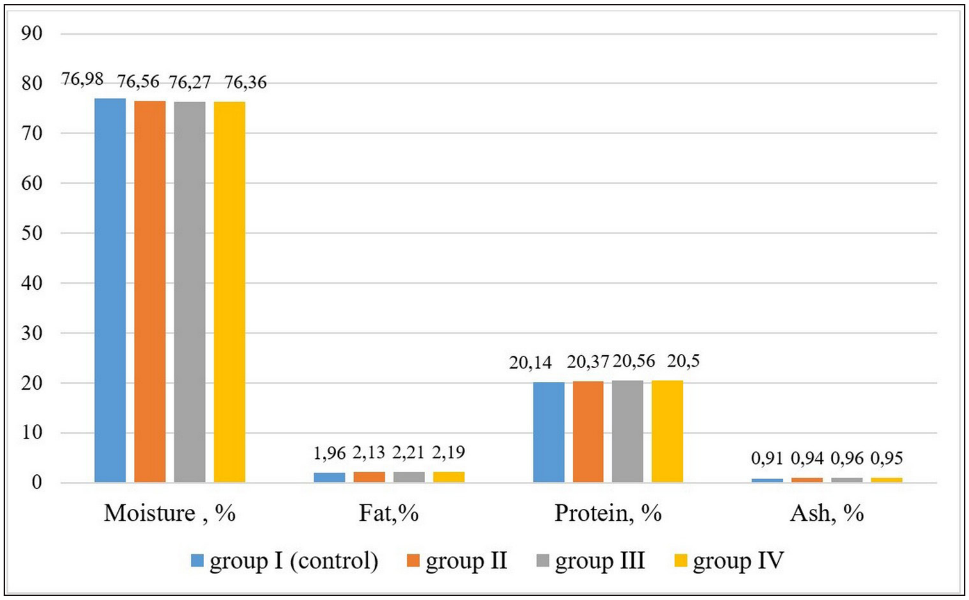

Fig. 4. Chemical composition of the longest back muscle of bulls.

bulls consuming maral root—by 64 MJ (1.48%) and pantocrine—by 20 MJ (0.46%).

Considering the chemical composition, meat protein has the most significant value due to the content of essential amino acids that cannot be synthesized in the human body. To do this, the content of the limiting amino acids tryptophan and oxyproline was determined. The first amino acid represents a group of full-fledged proteins, and the second is defective. Laboratory analysis showed a large concentration of tryptophan concentrated in the experimental samples (334.73–344.17 mg%) and a smaller one—in the control sample (326.70 ml%). The intergroup calculation showed the proportion of tryptophan in group I bulls relative to group II peers by 8.03 mg% (2.46%), III—17.47 mg% (5.35%; $p < 0.01$), IV—by 15.21 mg% (4.66%; $p < 0.01$).

The accumulation of oxyproline was the opposite, that it affected the protein quality index. Although the protein quality index in all animals participating in the experiment was quite high (5.57–5.93), exceeding the indicator equal to 5, but somewhat higher values were in the bulls of the experimental groups, exceeding the control by 0.18–0.36 ($p \leq 0.05$), which indicates its high quality.

Consequently, the analysis of the chemical composition, localization of intramuscular fat, and protein quality index makes it possible to give a high nutritional assessment of the meat of bulls of all experimental groups. At the same time, against the background of the use of adaptogens of plant and animal nature, the qualitative composition of beef improves.

Milk selected by conventional methods from cows consuming the main diet and adaptogens was subjected to the research. When enriching the diet of first-calf cows with adaptogens, their positive effect on the composition and properties of milk was revealed (Fig. 5).

Dry skimmed milk residue is a dry residue without water and without fat; first, reflects the naturalness and usefulness of raw materials. In the milk of cows of the control group, it reached 8.39%, which is lower than that of peers of the experimental groups by 0.16%–0.27%.

Milk protein, being the most important protective factor capable of neutralizing substances harmful to health, was contained in sufficient quantities in all milk samples. At the same time, its content in the milk of animals of experimental groups (II, III, and IV) increased relative to the control sample by 0.03%, 0.06%, and 0.04%, respectively, with an unreliable difference.

Milk fat can increase the biological value of milk. In our experiment, against the background of the use of adaptogens, its share increased by 0.07–0.13% ($p \leq 0.05$–0.01).

Milk sugar (lactose) is the only representative of the group of carbohydrates present in milk. Its concentration was higher in experimental milk samples, significantly ($p < 0.05$) exceeding the control by 0.12%–0.18%.

The increase in the content of the main nutrients in the milk of the first-calf cows of the experimental groups also affected the energy value. The maximum energy value is noted in the milk of cows consuming drone homogenate, amounting to 73.57 kcal, which is higher than in the control sample by 2.24 kcal (3.14%; $p \leq 0.001$).

The results obtained by us show the enrichment of the diets of bulls and dairy cows with adaptogens (maral root extract, pantocrine, and drone homogenate) to be effective since meat and dairy productivity increases, and the quality of raw materials of animal origin.

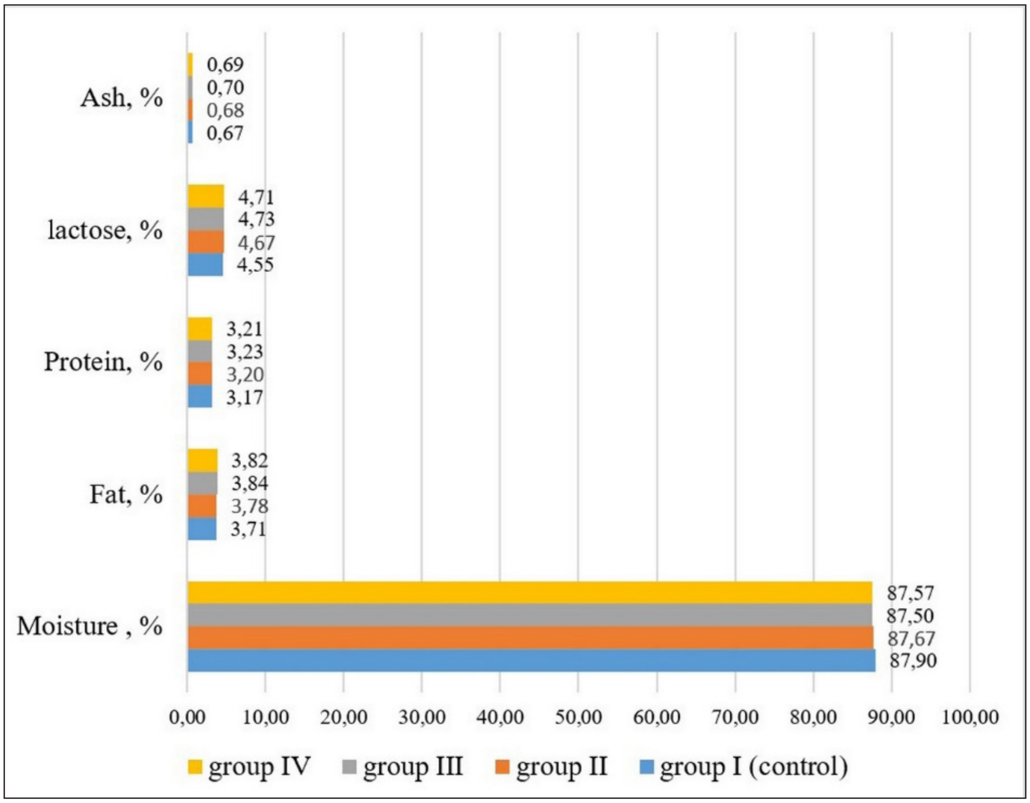

Fig. 5. Chemical composition of milk of first-born cows of the black-and-white breed.

Discussion

The experience of foreign researchers indicates the close attention to be paid to the issues of studying the productivity of farm animals, including the analysis of the growth and development of young animals' lactation activity of cows when enriching their diet with additives made from regional raw materials.

Thus, the results of research by Tran *et al.* (2016) showed that the addition of a plant adaptogen—red ginseng improved growth rates, nutrient absorption, and reduced meat loss without significantly affecting the blood profile and carcass quality in fattening pigs.

Our research data confirm the results of Tran *et al.* (2016) on the expediency of including a plant adaptogen; in our case, *Leucea safflower,* in the diet of bulls.

In the work of Carlos Fernández *et al.* (2018), a description of the use of lemon leaves in cow feeding is given, which affects the growth of milk productivity. Our results indicate that adaptogens of both plant and animal nature have a stimulating effect on milk productivity.

Numerous studies by domestic and foreign authors testify to the positive effect of enriching the diet of cattle (Wang *et al.*, 2006; Sulimova *et al.*, 2016; Makarov *et al.*, 2017). Thus, the research on beef quality in relation to blood composition was carried out by Colombo *et al.* (2022). In all experimental animals, the morphological composition of the blood was closely related to feeding and productivity. The mass fraction of protein in milk in all milk samples was in sufficient quantity. At the same time, its content in the milk of animals of the experimental groups tended to increase according to the control sample. The study of the chemical composition of the longest back muscle due to changes in the traditional feeding scheme was carried out by Lobo (2017), Custodio *et al.* (2018), and the chemical composition of milk by Ding *et al.* (2016), Carneiro *et al.* (2016).

It should be noted that there is practically no data confirming the effectiveness of the use of the adaptogens studied by us (maral root extract, pantocrine, and drone homogenate) used in meat and dairy cattle breeding. Rezaei *et al.* (2017) studied the effectiveness of the use of plant adaptogen extract Yucca schidigera in the diet of male-broilers; at the same time, there are only isolated data on the use of pantocrine in Russia (Lisakovskaya, 1997).

A generalized analysis of the data shows that there is no single approach in the world to determine the productivity of animals against the background of the use of adaptogens.

Conclusions

Currently, there are separate data from both Russian and foreign scientists on the characteristics of adaptogens and their effect on the body. But all of them are of a fragmented nature and do not describe their impact on the dairy and meat productivity of bulls and cows. Thus, comprehensive studies on the effect of different types of adaptogenic additives as part of standard diets on the dairy and meat productivity of bulls and cows, as well as the composition and properties of milk and beef, are timely and relevant.

The data from the conducted studies made it possible to determine the most effective type of adaptogen used in the diet of bulls and first-calf cows. Scientific and economic experiments conducted on Kazakh white-headed bulls in the conditions of the Orenburg region showed that contrasted with the use of drone homogenate, the live weight by the end of the experiment increases by 28.5 kg (5.71%; $p < 0.05$), while with the use of safflower leucea by 18.60 kg (3.72%), and pantocrine—by 21.00 kg (4.21%), the protein content increased by 0.25%; 0.17% and 0.23%; energy value—by 169 MJ (4.00%), 64 MJ (1.48%) and 20 MJ (0.46%), compared with the I control sample.

In the first-calf cows of the black-and-white breed, there is an activation of lactation activity contrasted with the use of drone homogenate, reaching a milk yield of 6,292.3 kg in 305 days of lactation, 12.5% dry matter in milk, including protein 3.23%, while when using safflower leucea, productivity increased by 312 kg (5.61%; $p < 0.05$), pantocrine—by 494.4 kg (8.88%; $p < 0.001$), dry matter—by 0.23 and 0.33%; protein in milk—by 0.03 and 0.04%, respectively.

To increase meat and dairy productivity, as well as the quality indicators of milk and beef, it is advisable to recommend that manufacturers introduce adaptogens into the diet.

Prospects for further development of the issue will be to analyze the histological composition of the internal organs of bulls consuming adaptogens of plant and animal nature as part of the diet. In addition, it is advisable to conduct studies of the tested types of adaptogens on other types of farm animals.

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Conflict of interest

The authors declare that there is no conflict of interest.

Author contributions

IM contributed conceptualization and methodology; RK and DB contributed data curation and formal analysis; OK and IK contributed methodology and writing—review & editing. All authors read and approved the final manuscript.

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