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OPTIGEN DOSE INFLUENCE ON THE HAEMATOLOGICAL INDICES OF HIGH-PRODUCING COWS

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Abstract

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The goal of the research was to determine how the dose of the feed additive Optigen in the ration of cows affects their haematological indices. The cattle were divided into four groups of 10 cows each. During the research, the animals of the control group received their basic ration, while the animals of the experimental groups were additionally fed with the 80, 100, and 120 g of feed additive Optigen. The blood indices were studied through generally accepted methods on certified equipment. It was discovered that 100 g of the feed additive Optigen in the ration of cows during the lactation period significantly improves the cellular components of the blood, increases the content of hemoglobin, total protein, albumins, and globulins, reduces the beta-globulin index, and provides a threshold level of the enzymes Alanine transaminase (ALT) and Aspartate transaminase (AST). The authors determined the blood indices of high-producing cows at the lactation peak characterizing the optimal Optigen dose of 100 g in the ration with 44.95% of dry basis. The obtained data can be used to develop a criterion for controlling the introduction of the feed additive Optigen in the ration of cattle, with the milk production level, feeding ration, and physiological state taken into account.

Key words: blood; Optigen; haemoglobin; leucocytes; protein

Introduction

Blood plays an important role in an animal body since it ensures the main property of living matter, namely, the metabolism. Blood regulates hormones and morphofunctional state of an animal body. Blood is the internal environment that reflects the physiological state of an animal depending on the housing, feeding, age, etc. The change in the ration structure causes the corresponding changes in the blood composition. A low level of feeding results in a sharp decrease in the haemoglobin content and an increase in the alkaline reserve of blood. Some data proves that adequate feeding of dairy cows contributes to an increase in the calcium and protein in the blood serum. Proteins consist of amino acids. It is necessary to point out that some of them are irreplaceable and since they are not synthesized in sufficient quantities in

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an animal's body, they are necessarily introduced with feeds. The deficiency or absence of these amino acids in the ration deteriorate the use of proteins, decrease productivity and disturbs the metabolism. The critically irreplaceable amino acids are lysine and methionine (Aleksandrov, 2015:7; Desyatov, Pykhtina, Chernyshkova, 2015:114; Gonzáles, 2017:47; Lin, 2015:1051).

Along with the breakdown of fodder protein and non-protein nitrogen compounds, a microbial protein synthesis takes place in the rumen. The host animal uses it to form proteins of its own body, milk, and wool. At the expense of the microbial protein, ruminants largely satisfy their need for amino acids. Since microorganisms synthesize all essential amino acids during protein formation in the rumen, the quality and biological value of fodder proteins are more important for ruminants than for monogastric animals and birds. In cattle breeding, the amino acids balance of rations was neglected for a long time. The microbial synthesis in the rumen was believed to provide cattle with all the amino acids. The protein that the rumen microorganisms produce does not satisfy the need for amino acids of the high- or even medium-producing cows. Cows' need for amino acids has recently attracted significant attention especially in dairy cattle breeding. If only digestible protein is taken into account when compiling a ration, it is impossible to calculate the expected level of cattle productivity and get the maximum milk yield (Lin, 2015:1049; Meyer et al., 2012:1273).

One approach of feeding high producing cows consists in replacing expensive protein feed in the ration of dairy cattle with an affordable source of non-protein nitrogen, for example, Optigen, which is a slowly fermented urea. It is released gradually due to the protection of urea molecules with a fatty shell, which guarantees the optimal concentration (availability) of ammonia for the growth of bacteria in the rumen. However, the dose of the feed additive Optigen depending on the dry basis in the ration, the milk productivity level, and the lactation period with a consideration of haematological indices characterizing the morphofunctional state of an animal body has not been determined either in foreign or domestic practices (Henao-Velásquez et al., 2014:33; Broderick, Reynal, 2009:2834).

Research Relevance. It is known that at the lactation peak, a cow's body undergoes intensive stress. In case of insufficient energy, the body uses its own reserves, which can lead to various metabolic disturbances (Klimienė et al., 2005:102). In this connection, it is essential to determine how different doses of the feed additive Optigen influence cows' haematological blood indices at the peak of lactation for optimizing this feed additive doses introduced to the ration structure.

The research goal was to determine the haematological indices of cows depending on the dose of the feed additive Optigen in the ration. Accordingly, the following objectives were set:

– to study the morphological blood indices in the studied groups of cows;

– to determine the influence of the feed additive Optigen on the biochemical blood indices.

Literature Review

The issues of balanced feeding of dairy cattle attract a lot of attention. There are systematic studies of the nutritional value of fodder and animals' need macro- and microelements considering their genetic potential. One improves the technology of fodder conservation and fodder mixtures preparation and constantly introduces new feed additives (Kurdoglyan, 2012: 49; Henao-Velásquez et al., 2014: 32; Gonzáles Blanco et al., 2017: 47; Rao et al., 2015: 109).

A number of authors believe that balanced feeding alone is not sufficient for animals' manifestation of their genetic potential for dairy productivity (Rogachev et al., 2012: 89; Zhai et al., 2006: 520; Stoop et al., 2007: 1986).

Due to the intensification of livestock agriculture, the problem of complete feeding of farm animals keeps becoming increasingly important in recent years. It has been proved that in addition to satisfying animals' need for basic nutritional factors, it is important to ensure the correct ratio of individual nutrients (sugar-protein, energy-protein, acid-alkaline), and the absence of anti-nutrition and toxic substances in feeds (Aleksandrov, 2015: 8; Kurdoglyan, 2012: 48; Broderick and Reynal, 2009: 2831).

According to a number of authors (Ivanova et al., 2015: 218; Chaveiro et al., 2011: 225), it is necessary to pay attention to the content of macro- and micro-nutrients in animals' feed, since they ensure the production of high-quality products and, in the first place, have a positive effect on animals' physiological state by normalizing their cellular metabolism.

The normal vital activity and high productivity of modern farm animals breeds can be primarily achieved through imposing higher requirements on the quality of animals' feeding. One can fulfil these requirements by using rations that balance all basic nutrients and biologically active substances and including highly effective feed additives (Batanov and Knyazeva, 2012: 30; Zakirov et al., 2014: 86; Broderick and Reynal, 2009: 2832).

Vitamin and mineral supplements to mixed fodders contain all vitamins, micro- and macro-nutrients required for an animal's body. Mineral and vitamin concentrates are homogeneous powder-like mixtures of biologically active

substances with filler. The action mechanism of premixes is conditioned by the availability of vitamins A, D3, E, K, C, group B), micro-nutrients (iron, copper, manganese, cobalt, iodine, selenium), macro-elements (magnesium, sulfur), antioxidants, and anti-microbial preparations (fodder antibiotics, etc.) in optimal quantities and ratios (Aleksandrov, 2015: 8; De Kruif et al., 2008: 33; Mamun et al., 2013: 56; Oetzel and Miller, 2012: 7060).

In recent years, researchers have substantiated the expediency of introducing various feed additives, including energetic ones, into the formula for cattle. First of all, this is related to the increased genetic potential of animals and the development of new technologies in the production of feed additives (Kurdoglyan, 2012: 49; Chaveiro et al., 2011: 224; Stoop et al., 2007: 1986).

Cow's need for mineral substances is quite high, since any function of cellular activity in an animal's body is due to the presence of the corresponding macro- and micro-nutrients (Zakirov et al., 2014: 85; Fayzrakhmanov et al., 2015: 228; Lin et al., 2015: 1053).

The insufficient supply of the above-mentioned nutrients into the body leads to a disruption in the functional activity of organs and systems. First of all, this affects cows' blood indices that condition their reproductive ability, the development of an offspring, the appearance of diseases, the decrease in productivity and milk quality, as well as the inefficient use of nutrients in the ration of cows, which leads to an increase in the cost of feed for the production of products (Desyatov et al., 2015: 116; Rogachev and Stepanenko, 2012: 89; Chaveiro et al., 2011: 223; Gonzáles Blanco et al., 2017: 48; Klimienė and Matusevičius, 2005: 101).

Many researchers believe that the detailed feeding of high producing cows requires the control of the following basic macro- and micro-nutrients: calcium, phosphorus, magnesium, potassium, sodium, sulfur, chlorine, iron, copper, zinc, cobalt, manganese, iodine, selenium, cerium (Fayzrakhmanov et al., 2015: 229; Gaikwad et al., 2007: 381; Lin et al., 2015: 1050).

According to a number of researchers, mineral elements are necessary for the formation of organs and tissues, as well as the normal functioning of the body. In addition, they participate in enzymatic processes, regulate metabolism, and maintain osmotic pressure and acid-base balance in fluids and tissues. They play an important role in the exchange of water and organic substances, and the absorption and assimilation processes of nutrients from the gastrointestinal tract. Besides, mineral elements create normal conditions for the work of the heart, muscles and nervous system (Gaikwad et al., 2007: 381; Jezek et al., 2006: 214; Doska et al., 2012: 27; Oetzel and Miller, 2012: 7059).

In recent years, domestic and foreign scientists suggest that when feeding high producing cows, it is necessary to take into consideration the quantitative and qualitative composition of the rumen microflora that mainly ensures the formation of "cicatricial proteins". In domestic and foreign practices, there have been attempts to feed dairy cows with carbamide to meet the requirements of non-protein nitrogen and compensate for the lack of proteins in the feed (Lushnikov et al., 2011: 55; Monashok et al., 2013: 58; Broderick and Reynal, 2009: 2825; Chaveiro et al., 2011: 223; Doska et al., 2012: 28).

To cover the demand for ammonia, along with the proteins of the feed, non-protein nitrogen compounds (NPN), for example, feed urea, can be used. However, it is fraught with danger, as it dissolves in a moist environment (mixer). Besides, it quickly disintegrates into the rumen, is quickly absorbed and, subsequently, not fully used. Overdose loads the cow's liver and even leads to death in some cases (Kurdoglyan, 2012: 49; De Kruif et al., 2008: 32).

Since 2008, the company Alltech has been producing a slowly fermented urea (Optigen), which is gradually released due to a combination of urea and fat and guarantees the optimal concentration (availability) of ammonia for the growth of bacteria in the rumen. When using this feed additive, it is necessary to calculate the ration in advance. 100 g of Optigen replaces 800 g of soybean meal. The released volume can be filled with the main feed (corn and grass silage), or, if necessary, with concentrates to boost energy (Lushnikov et al., 2011: 54; Stoop et al., 2007: 1985).

Rumen bacteria, especially those destroying the fibre, need a constant ammonia concentration of 10-15 mg / dL. This is necessary to ensure that bacteria can utilize all the resources from which milk is produced efficiently and continuously. The result is the optimal use of fibre and increased production of microbial proteins (Sizova, 2014: 117; Zhai et al., 2006: 521).

Rations that ensure the effective operation of an animal's rumen are the best way to maximize the benefits without compromising the health of dairy cows. Optigen contains nitrogen in a concentrated form. This allows the introduction of nitrogen instead of voluminous sources of vegetable proteins, thereby «freeing up space» for the introduction of additional energy sources or coarse fodder grown on a farm, which have a lower cost and are more useful for the rumen (Lushnikov et al., 2011: 55; Broderick and Reynal, 2009: 2820; Marques Meyer et al., 2012: 1275).

Based on the literature analysis, the authors established that the feeding of high producing cows requires great attention, depending on the level of milk productivity, the lactation period and the content of the dry basis in the ration. However, the use of high-quality feed, the preparation of

feed, and the balancing of the ration with macro- and micronutrients without a consideration of protein metabolism does not ensure the normalization of the physiological functions of the body and the milk-forming process. For the normalization of protein metabolism, it is necessary to create conditions for increasing the rumen microflora and maintaining a constant concentration of nitrogen. In connection with this, the development of new techniques to increase milk productivity and quality, and the preservation of animals' health when introducing a source of protected non-protein nitrogen into the feeding ration taking into account the blood indices are pressing. Thus, it has determined the goal of the research.

The literature review revealed no data on how the dose of the feed additive Optigen affects the haematological indices during the lactation period of cows. The studies of the Optigen influence on the haematological blood indices are fragmentary and do not take into account the physiological state of animals, their milk production level and lactation period.

Materials and Methods

The research was conducted to Holstein cows in ZAO ''Niva'' in the Samara Region. Four groups of cows were formed by the principle of pair analogues with ten cows in each group (control, experimental 1, experimental 2, experimental 3). The cows involved in the experimental study groups had been in the lactation peak period for 60 days (30 days after calving and 90 days before lactation). The milk productivity in the cows of the study groups amounted to an average of 40.2 L. During the research, the animals of the control group received their main ration, while the animals of the experimental groups were additionally fed with the feed additive Optigen. The dry basis in the ration of cows in the control and experimental groups was 44.95%.

The animals in the experimental groups 1, 2, and 3 received additional 80.0 g, 100.0 g, and 120.0 g of Optigen respectively. Five animals of each group had their blood tested to study the morphological and biochemical indices. The blood samples were collected using a closed Monovette system at the end of the experiment. The blood was tested in the morning (9-10 a.m.). It was kept in two containers. The first container was used to get the serum. The second one was used for the analysis of whole blood and plasma. As a preservative, heparin was added. The studies of the morphological and biochemical blood indices were carried out using certified equipment in the haematology laboratory of the Samara Scientific Research Veterinary Station, a Federal State Budget Research Institution.

The selection of the research methods was fully substantiated by the following facts. The study of the morphological blood indices involves determining the intensity of the oxidation-reduction reaction in cows' bodies, while the study of the cellular composition of blood makes it possible to determine the degree of animals' immune status. When establishing the optimal dose of the feed additive Optigen in accordance with the structure of the cows' ration, the milk productivity level, breed, and lactation period, it is necessary to determine the content of alanine aminotransferase (ALT) and aspartate aminotransferase (AST) enzymes in the blood serum of animals of the study groups. The increased number of metabolic disorders at the lactation peak among cows fed with the 120 g and 130 g of the feed additive Optigen appeared one of the main triggers for this research. In this connection, the research did not require a permit.

All of the obtained materials were processed biometrically. The digital materials of the experimental data were processed by the method of variational statistics on the reliability of the differences between the compared indicators using the Student's test widely used in biology and veterinary medicine together with the Microsoft Excel software package. The reliability degree of the processed data is reflected in the following values: * -$P<0.05$; ** – $P<0.01$; *** – $P<0.001$.

Results

According to the data of the conducted research, the blood indices of cows receiving different doses of the feed additive Optigen in their ration are not the same. Apparently, by ensuring a constant concentration of nitrogen in the rumen, the feed additive Optigen contributes to an increase in the production of microbial protein, which is undoubtedly reflected in the indicators of oxidation-reduction reactions in the body of high producing cows. The influence of the feed additive Optigen on the morpho-biochemical indices of blood depends on the dose of its introduction in the ration of cows.

When the animals of the first, second and third groups were fed with the feed additive Optigen, the content of haemoglobin in their blood increased significantly (Table 1). In the first experimental group, the haemoglobin content was 98.4 ± 0.43 g / l, which is 7.2 and 6.94 g / L less than in the second and third experimental groups of animals respectively fed with the feed additive Optigen in doses of 100 g and 120 g. The increase in the content of haemoglobin in the blood is confirmed by the increase in the number of red blood cells. The increase in the number of red blood cells was 0.14 million / mm^3 in animals fed with the feed additive Optigen in a dose of 80 g. In animals of the third experimental group fed with the feed additive Optigen in a dose of 120

g, the number of red blood cells was 5.62 ± 0.08 million / mm^3, which is 0.42 million / mm^3 more than in animals fed with the feed additive Optigen in a dose of 80 g.

The greatest increase in the number of red blood cells was observed in the second experimental group of animals fed with the feed additive Optigen in a dose of 100 g. The number of red blood cells in this group was 5.71 ± 0.12 million / mm^3, which is 0.51 million / mm^3 more than in animals fed with the feed additive Optigen in a dose of 80 g, and 0.09 million / mm^3 more than in the animals of the third experimental group fed with a fodder supplement Optigen in a dose of 120 g.

The number of white blood cells in the animals of the first experimental group was 8.65 ± 0.04 thousand / mm^3, which is 0.49 and 0.45 thousand / mm^3 higher than the rates of cows in the second and third experimental groups. The decrease in the number of white blood cells in the animals of the second and third groups can probably be explained by the optimization of cicatricial metabolism when the animals were fed with the feed additive Optigen in a dose of 100 g and 120 g respectively.

The number of basophils in the blood of cows after feeding them with 80 g of Optigen was 1.20 ± 0.24% in the first experimental group; 1.02 ± 0.18% in the second experimental group with 100 g dose, and 0.70 ± 0.22% in the third experimental fed with 100 g of Optigen. After feeding the animals with the feed additive Optigen, the degree of decrease in the number of basophils in the blood of the cows in the study groups indicates the level of increase in the synthesis of gamma globulins that perform a protective role.

Comparing the blood value of animals in the study groups by eosinophils, it was recorded that the percentage of eosinophils in the blood varied depending on the dose of Optigen. The content of eosinophils in the blood was 5.58 ± 0.6%, 6.83 ± 0.27%, and 7.72 ± 0.20% when the animals were fed with a dose of 80 g, 100 g, and 120 g respectively. The content of eosinophils in the second and third experimental groups of animals is significantly higher than in the first experimental group, which indicates the normalization of metabolic processes and the absence of an inflammatory process in the body.

After feeding the cows with the feed additive Optigen, the number of immature forms of neutrophils, such as young and stab neutrophils, reduced in the blood of the animals. The content of young neutrophils in the first experimental group of animals was 1.15 ± 0.04%, which is 0.16% higher than in the second experimental group of cows and 0.07% higher than in the third experimental group. The content of stab neutrophils in the third experimental group of cows was 4.21 ± 0.18%, which is 1.69% and 0.94% less than in the control and the first experimental groups of animals respectively, and 0.11% more than in animals of the second experimental group. The reduction in the content of young and stab neutrophils indicates the normalization of the haemopoiesis.

After using the feed additive Optigen in the structure of cows' rations, the content of segmented neutrophils increases significantly. However, the value of this indicator depends on the dose of the feed additive in the studied animal groups. In the animals of the first experimental group (80 g of feed additive), the number of segmented neutrophils was 25.90 ± 0.72%, which is 4.26 less than in the second experimental group (100 g of feed additive), and 2.27% than in the third experimental group (120 g of feed additive) respectively. An increase in the number of segmented neutrophils in the blood

Table 1
Morphological blood indices in the cows of the study groups

Indicators	Animal groups			
	control	experimental-1	experimental-2	experimental-3
Hemoglobin, g / L	92.30±0.74	98.40±0.43	105.60±0.62***	105.34±1.14***
Red blood cells, mln / mm^3	5.06±0.81	5.20±0.21	5.71±0.12***	5.62±0.08***
White blood cells, thousand / mm^3	10.13±0.94	8.65±0.04	8.16±0.05*	8.20±0.05*
Leukogram, %				
Basophils	2.40±0.17	1.20±0.24	1.02±0.18	0.70±0.22
Eosinophils	3.13±0.28	5.58±0.36	6.83±0.27*	7.72±0.20*
Neutrophils including				
Young neutrophils	2.40±0.16	1.15±0.04	0.99±0.02	1.08±0.06
Stab neutrophils	5.90±0.35	5.15±0.28	4.01±0.18	4.21±0.18**
Segmented neutrophils	18.40±1.42	25.90±0.72	30.16±0.91*	28.87±0.53***
Lymphocytes	63.67±2.50	57.18±0.70	54.63±1.18**	55.02±0.74**
Monocytes	4.10±0.32	3.84±0.27	2.36±0.12**	2.40±0.11

The reliability degree of the processed data is reflected in the following values: * -P < 0.05; ** – P < 0.01; *** – P < 0.001

upon introducing 100 g of the feed additive into the ration of the cows in the second experimental group indicates a rise in the defences of the animals' bodies.

The number of monocytes and lymphocytes in the blood of animals in the experimental groups was not the same. The highest percentage of monocytes was observed in the first experimental group where the cows were fed with 80 g of the feed additive Optigen, and was 3.84 ± 0.27%. It is 1.48% and 1.44% more than in the animals of the second and third experimental groups of cows fed with 100 g and 120 g of Optigen respectively. In the third experimental group of cows, the percentage of lymphocytes in the blood was 55.02 ± 0.74%, which is 0.39% more than in the animals of the second group, and 2.16% and 8.65% less than in the animals of the first experimental and the control groups. The decrease in the percentage of monocytes and lymphocytes in the animals indicates the absence of an inflammatory process in the animals' bodies.

The study of biochemical blood indices is of great importance since it helps a specialist to determine the overall condition of an animal's body and to adjust the ration of animals in a timely manner.

The data of Table 2 shows a change in the biochemical indices of the cows' blood serum when they are fed with the feed additive Optigen. The content of the total protein in the blood serum in the animals of the control group is less than in those of the experimental groups fed with the feed additive Optigen in the course of the research. The biochemical blood indices in the cows of the studied groups depend on the dose of the feed additive Optigen in the structure of the cows' ration. After feeding the cows with 80 g of the feed additive Optigen, the content of calcium and inorganic phosphorus in the blood serum of animals in the first experimental group was 2.04 ± 0.05 mmol / L. It is 0.43 and 0.37 mmol / L less than in the animals of the second and third experimental groups where the ration of cows included 100 g and 120 g of the feed additive Optigen respectively. The decrease in the calcium content when fed with 80 g of Optigen is apparently due to the incomplete cicatricial digestion caused by the lack of crude protein. The alkaline reserve of the blood serum in the cows of the control group was 43.82 ± 0.12% CO_2. In the third experimental group, the content of the alkaline reserve was 48.07 ± 0.24% CO_2, which is 0.57% CO_2 less than in the animals of the second experimental group and 3.87% CO_2 more than in the animals of the first experimental group respectively. These parameters of the alkaline reserve of the blood serum in the cows of the second and third experimental groups after feeding the animals with the feed additive Optigen in a dose of 100g and 120 g indicate the absence of an acid-base balance in the animals.

When comparing the content of sugar depending on the Optigen dose, the greatest content of sugar, 51.56 ± 1.35 mg /%, was observed in the second experimental group, while it was 50.01 ± 1.13 mg /% in the third experimental group fed with 100 g and 120 g of Optigen respectively. The obtained data confirm the positive effect of the feed additive Optigen on the animals' metabolism.

The index of the total protein in the blood serum of animals of the second test group was 82.05 ± 0.54 g / L, which is 2.21 and 11.59 g / L higher than in animals of the third and first experimental groups respectively. Apparently, introducing 100 g of Optigen, compared to 80 g, in the ration at the

Table 2
Biochemical blood indices in the blood serum in the cows of the study groups

Indicators	Animal groups			
	control	experimental-1	experimental-2	experimental-3
Total calcium, mmol / L	2.37±0.02	2.44±0.05	2.47±0.03	2.41±0.04
Inorganic phosphorus, mmol / L	1.56±0.03	1.57±0.03	1.77±0.05**	1.68±0.07*
Alkaline reserve vol.% CO_2	43.82±0.12	44.20±0.27	48.64±0.18***	48.07±0.24***
Sugar, mg /%	47.80±4.52	49.48±2.10	51.56±1.35***	50.01±1.13**
Total protein, g / L	65.72±1.12	70.46±0.26	82.05±0.54**	79.84±0.38**
Protein fractions,%:				
Albumins	41.35±0.64	41.80±0.69	42.05±0.28	40.72±0.61
Globulins,%, including:	58.65±0.72	58.20±0.44	57.95±0.36	59.28±0.47
Alpha globulins	18.70±0.42	18.23±0.41	18.14±0.48	18.85±0.37
Beta globulins	18.58±0.44	17.20±0.24	16.85±0.44	18.58±0.36*
Gamma globulins	21.37±0.29	22.77±0.18	22.96±0.15**	21.85±0.22
ALT unit / L	44.17±2.11	46.83±3.04	52.18±2.08**	80.16±2.10***
AST unit / L	74.22±1.86	75.07±2.06	84.15±1.77*	104.03±2.13**

The reliability degree of the processed data is reflected in the following values: * -P < 0.05; ** – P < 0.01; *** – P < 0.001

lactation peak (2 experimental group) increases the total protein content in the blood serum. The difference of the total protein content in the blood serum between the second and third experimental groups is insignificant.

The serum albumins in the control group were 41.80 ± 0.69%, which is 0.45 and 0.70% less than in the first and second experimental groups, where the cows were fed with 80 g and 100 g of the feed additive Optigen. When the dose of the feed additive is increased to 120 g, a decrease in the albumin content by 0.63% is observed. An increased number of albumins in the blood serum of the cows in the first and second experimental groups indicate the optimality of the Optigen dose.

The content of globulins in the animals of the third experimental group was 59.28%, which is 1.33% and 0.08% higher than in the animals of the second and first experimental groups respectively. The structural expression of globulins in the blood serum was not the same. In the animals of the first and second experimental groups, where the cows were fed with 80 and 100 g of the feed additive Optigen, the content of alpha globulins was 0.47% and 0.56% less than in the cows of the control group. It is necessary to point out that the content of alpha and beta globulins of the animals in the third experimental group, whose ration included 120 g of Optigen, exceeded the content of alpha and beta globulins of the animals in the first and second experimental groups by 0.62%, 0.71% and 1.38%, 1.73% respectively. The content of gamma globulins of the animals in the first experimental group, where the cows were fed with the feed additive Optigen in a dose of 80 g, was 0.19% less than that of the animals in the second experimental group and 1.11% more than that of the animals in the third experimental group. An increase in the content of gamma globulins in the animals of the second experimental group in case of a significant decrease in the content of beta globulins indicates an increase in the protective forces of the cows' bodies when they are fed with the feed additive Optigen in a dose of 100 g.

Metabolism includes a combination of many chemical reactions occurring in the body. The reactions are carried out with the help of biological catalysts, i.e. enzymes, such as the class of transferases that catalyze the reactions of hydrolytic cleavage of intra-molecular bonds. Upon adding the feed additive Optigen in the structure of the cows' ration during the lactation period, the authors of the research observed an increase in alanine aminotransferase (ALT) and aspartate aminotransferase (AST), which directly depended on the increase in the dose of the feed additive Optigen. In the cows of the third experimental group, where the animals were fed with the feed additive Optigen in a dose of 120 g, the content of ALT and AST was 80.16 and 104.03 units / L respectively. These indicators are significantly higher than those in the animals of the control, the first and the second experimental groups. The increased activity of AST and ALT in the blood serum indicates an initial impairment of the liver function.

Discussion

Dealing with the problem, the authors of the research repeatedly studied the influence of the dose of the feed additive Optigen on the haematological indices of the cows during the peak of lactation. It is essential to fully provide animals with exchange energy at the beginning of lactation. If there is a lack of energy, animals use their own reserves (Aleksandrov, 2015: 7).

In order to find an optimal Optigen dose, the groups of cows at the lactation peak received 80, 100 and 120 g of Optigen respectively. The use of the feed additive Optigen in a dose of 100 g improves the cellular composition of the blood, increases the number of red blood cells. The increase in the content of segmented neutrophils indicates the activation of defences in the animals' bodies. It is necessary to point out that when the cows of the second and third experimental groups were fed with 100 and 120 g of the feed additive Optigen respectively, the difference between the morphological blood indices was minimal and statistically not reliable.

The introduction of the feed additive Optigen in a dose of 100 g normalizes metabolism, which is confirmed by an increase in the number of albumins, alpha and gamma globulins, total protein and alkaline reserve upon a decrease in the indicators of beta globulins. Apparently, this indicates that 100 g of the feed additive Optigen is sufficient to normalize the concentration of ammonia in the rumen and contributes to an increase in the synthesis of microorganisms of cicatricial protein from non-protein nitrogen. The authors' data coincide with the viewpoint of A.A. Kurdoglyan (2012), Andrés F. Henao-Velásquez, Oscar David Múnera-Bedoya, Ana Cristina Herrera, Jorge H. Agudelo-Trujillo, and Mario Fernando Cerón-Muñoz (2014), who state that in the interval between feeding, the level of ammonia in the rumen falls and the growth of bacteria that require a constant concentration of ammonia decreases. The optimal dose of the feed additive Optigen in the cows' ration in the period of the lactation peak indicates the indicators of enzymes alanine aminotransferase (ALT) and aspartate aminotransferase (AST). When using the feed additive Optigen in a dose of 120 g, the indicators of the enzymes ALT and AST are above the threshold level, which, according to a number of researchers, negatively affects the structure of the liver (Ivanova et al., 2015: 49; De Kruif et al., 2008: 32).

The experimental data on the morphological and biochemical blood indices of the cows, whose ration containing 44/95% of dry basis included 100 g of the Optigen a day, at the lactation peak producing 40 kg of milk were obtained for the first time. This data can be used to correct metabolic disturbances in cows' bodies and serve as a criterial indicator.

According to a number of researchers, it is necessary to optimize the ration of cows during the peak of lactation, because at the beginning of lactation an animal's body uses its own reserves to generate energy, which can lead to various metabolic disturbances in the future. The results of the study on the haematological indices prove the need to regulate protein metabolism in cows in the given period by using the feed additive Optigen in a dose of 100 g.

Conclusion

100 g of the feed additive Optigen is the optimal dose for feeding cows during the peak of lactation. It improves the cellular components of the blood and contributes to an increase in the content of red blood cells by 0.65 million mm^3, segmented neutrophils by 11.76%, hemoglobin by 13.3 g / L, total protein by 16.33%, the alkaline reserve by 4.82%, and gamma globulins by 1.59% in the blood serum, as well as calcium and phosphorus. In addition, it optimizes the content of the enzymes, namely alanine aminotransferase (ALT) and aspartate aminotransferase (AST) at 28-45% as compared with the doses of 80 g and 120 g of the feed additive Optigen.

The obtained data contributes to the knowledge about the blood indices of cattle depending on the animals' breed and physiological condition. Besides, it complements the haematology of highly productive cows when feeding different doses of the feed additive Optigen, and complements the data of haematology of high producing cows when feeding them with different doses of the feed additive Optigen.

The haematological indices of the cows at the lactation peak, when the cows are fed with 80 g of the feed additive Optigen, can serve as a criterion for assessing the morpho-functional state of cows when using the feed additive Optigen.

For the first time, the authors of the research studied the morpho-biochemical blood indices of the cows during the peak of lactation depending on the dose of the feed additive Optigen introduced into the animals' ration provided that the dry matter content is 44.95% and the level of cows' milk productivity is 8 500 kg. This is a completely new contribution to the world and domestic science and can help to develop a criterion for controlling the introduction of the feed additive Optigen into the cows' ration depending on their physiological state in different periods of lactation.

The development of the optimal dose of the feed additive Optigen in the ration of cows in the lactation peak period is a great contribution to the world and domestic science on hematology and feeding of high producing cows, as it will make it possible to develop methods for the rational use of the feed additive Optigen, taking into account the age and sex group of animals, their productivity and the availability of a ration with dry matter.

In the course of subsequent studies, the interrelation of the haematological indices in cows will be determined upon the introduction of the feed additive Optigen in a dose of 100 g with the qualitative indicators of milk, namely fat, protein, urea and productive longevity of cows.

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