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The Effect of the Drug "Enterocol" on the Humoral Factors of Calf Body Resistance

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Abstract | As world experience shows, of particular importance in the prevention and treatment of gastrointestinal diseases of young animals is replacement therapy, aimed at restoring intestinal biocenosis through the regulatory injection of live bacteria representing the normal intestinal microflora. Currently, the veterinary service has a sufficient number of domestic and imported probiotic products of various species composition, intended for the prevention of gastrointestinal diseases of young animals and birds. However, monitoring of the probiotic market shows that the vast majority of developments are not in demand by practice. This circumstance gives grounds to assume that the approach to the development of probiotics should be based on the study of many parameters, including, first of all, a comprehensive assessment of the properties of microorganisms – probionts. The article presents the results of studying the effect of "Enterocol" from the strain *E.coli 64G* on the total amount of protein, quantitative and qualitative content of immunoglobulins in the blood serum of newborn calves. It was found that feeding off of the newborn calves with "Enterocol" helped to increase the concentration of total protein and immunoglobulins of all classes in the blood. The authors of the study came to the conclusion that the degree of the above increase depends on the dose of the drug given.

Keywords | Probiotic, Protein, Immunoglobulins, Blood serum, Calves

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INTRODUCTION

Fundamental research of modern biological science as well as successful understanding of the multifaceted aspects of relationships between macro- and microorganisms allowed developing and introducing into the practice of healthcare and veterinary medicine a new class of biological products – probiotics, which are based on living microbial cultures with a complex of properties useful for the macroorganism (Grigorieva et al., 2001). The practice of using probiotics has proved their positive effect on intestinal microbiocenosis, increasing the overall body resistance. According to a number of researchers (Grigorieva et al., 2001; Biyashev et al., 2013; Biyashev, et al., 2016), the effectiveness of bacterial products is determined by the biological properties of strains within them. Cultures used for the preparation of probiotics must meet certain international requirements: be normal inhabitants of the gastrointestinal tract of healthy animals; be non-pathogenic and non-toxic; be able to pass through the stomach (have a certain level of resistance to bile and hydrochloric acid); have the ability to adhere to the epithelium and engraft in the digestive tract; have antagonistic activity and be stable and able to remain viable for a long time when stored under production conditions.

As a result of many years of research, using a genetic method we were able to obtain a probiotic strain – *Escherichia coli* 64G (Patent No. 28311 registered in the State Register of Inventions of the Republic of Kazakhstan on March 19,

2014). The strain *E. coli* 64G meets the above international requirements. It was used for the manufacture of Enterocol.

There is still uncertainty associated with the interpretation of the effects of probiotic products and the criteria for evaluating their biological properties, ensuring the safety and therapeutic efficacy of the drug. The problem of constructing and using environmentally safe probiotics from representatives of the normal microflora is currently extremely relevant (Antipov and Subbotin, 1980; Vorobyov, 1999).

The effective prevention of diseases of newborn calves requires, first of all, determining the level of humoral resistance factors. Then, on the basis of their indicators, corrective therapy may be applied (Voronin et al., 2008; Kondaurov, 2001).

MATERIALS AND METHODS

The object of the study was the drug "Enterocol", prepared from the strain *E. coli* 64G, in order to use it for the treatment and prevention of gastrointestinal diseases of newborn young farm animals and birds.

Modern certified and standardized biochemical, microbiological, molecular biological studies were used during the job.

The morphological, cultural, and biochemical properties of the cultures were studied according to generally accepted schemes (N.I. Rozanov, 1952).

The identification of selected cultures was conducted by determinant of Bergie. During the experiments, laboratory animals and chickens were used for studying pathogenicity of cultures, isolated from dead, sick and healthy birds. Standard methods of finding averages and their mean errors will be used for mathematical processing of results.

The effect of "Enterocol" from the strain *E. coli* 64G on the total amount of protein as well as on the quantitative and qualitative content of immunoglobulins in the blood serum of newborn calves was studied after a single oral administration of "Enterocol" at doses of $2x10^{10}$ CFU, $3x10^{10}$ CFU and $4x10^{10}$ CFU for 20-30 min (before feeding colostrum) in a volume of 40 ml. The experiment involved 45 calves (10 calves for each dose, and 15 in the control group, which were fed with saline).

The total amount of protein as well as the quantitative and qualitative content of immunoglobulins were determined by the FT-2 automatic immuno-analyzer manufactured by AMS (Italy).

RESULTS

One of the components of humoral immunity is immunoglobulins. They are in the body throughout the whole life of the animal and react differently to the stimulus when inherited.

The experimental results are presented in Tables 1, 2 and 3. As can be seen in Table 1, before being fed with Enterocol, the newborn calves of the control and experimental groups had the same amount of total protein and immunoglobulins. Changes in the indicators occurred after the administration of "Enterocol" at a dose of $2x10^{10}$ CFU.

The amount of total protein, Ig G, Ig M, and Ig A increased with the increasing age of the calves and remained high during the entire study period. It should be noted that their maximum level was in the 2-day age.

Thus, by this period, the number of total protein in the control calves increased by 42.2%, Ig G – by 28.5 times, Ig M – by 4.3 times, Ig A – by 3 times, and in the experimental calves, respectively – by 50.0 %, Ig G – by 36 times, Ig M – by 4, 7 times, Ig A –by 3 times.

The amount of immunoglobulins in the control group increased by 11.4 times, and in the experimental group – by 15.8 times.

Analysis of the data on the percentage of individual immunoglobulin classes to total protein shows that Ig G takes a large proportion. If before feeding "Enterocol", the proportion of Ig G in the control and experimental calves was 1.81% and 1.80%, then after feeding the drug on day 1 of life their level in the control calves amounted to 36.2%, and in the experimental calves – to 44.2%.

The proportion of Ig M before feeding the drug in the experimental calves was 2.1%. After feeding colostrum in the control group of calves, it rose to 6.1%, and in the experimental group – to 6.6%.

The percentage of Ig A to total protein after feeding colostrum increased, reaching its maximum value by day 2 after birth. Starting from day 3, it decreased and remained at a low level until the end of the experiment. It should be noted that the indicators of Ig A in both the control and experimental groups had a slight difference.

The percentage of the amount of immunoglobulins to total protein from the first hours of life increased by day 2. In the subsequent days of life, the level of immunoglobulins was somewhat reduced, and by day 21 after birth it amounted to 24.1% in the control calves and to 32.1% in the experimental calves.

Table 1: The content of immunoglobulins in the blood serum of newborn calves before and after feeding them with Enterocol at a dose of $2x10^{10}$ CFU

Indicators		Group	Experimental days						
			before	after 1 hour	after 24 hours	after 48 hours	after 7 days	after 14 days	after 21 days
Total protein (g%)		C	4,6 ± 0,16	5,1 ± 0,42	5,2 ± 0,24	5,9 ± 0,31	5,7 ± 0,23	5,5 ± 0,41	5,2 ± 0,24
		E	4,7 ± 0,41	5,1 ± 0,42	5,9 ± 0,43	6,8 ± 0,22	7,1 ± 0,36	6,8 ± 0,44	5,8 ± 0,11
Ig G (mg/ml)		C	0,81 ± 0,04	20,8 ± 0,06	21,1 ± 0,07	28,1 ± 0,04	17,8 ± 0,03	14,8 ± 0,05	12,5 ± 0,08
		E	0,80 ± 0,02	22,9 ± 0,03	28,7 ± 0,04	29,8 ± 0,05	20,4 ± 0,07	18,8 ± 0,08	15,8 ± 0,09
Ig M (mg/ml)		C	0,91 ± 0,08	3,31 ± 0,06	4,15 ± 0,04	4,25 ± 0,05	1,81 ± 0,01	2,1 ± 0,02	1,61 ± 0,08
		E	0,90 ± 0,06	3,68 ± 0,01	4,51 ± 0,02	4,91 ± 0,03	3,11 ± 0,05	2,81 ± 0,04	2,1 ± 0,03
Ig A (mg/ml)		C	0,81 ± 0,02	1,8 ± 0,04	2,1 ± 0,05	2,4 ± 0,03	0,71 ± 0,04	0,61 ± 0,07	0,39 ± 0,05
		E	0,81 ± 0,01	2,1 ± 0,02	3,2 ± 0,04	3,9 ± 0,05	1,21 ± 0,06	0,91 ± 0,04	0,49 ± 0,01
Amount of immunoglobulins (mg/ml)		C	2,61 ± 0,14	23,1 ± 0,21	28,4 ± 0,41	30,1 ± 0,46	18,1 ± 0,16	16,1 ± 0,42	13,1 ± 0,26
		E	2,62 ± 0,15	28,1 ± 0,24	34,4 ± 0,51	32,1 ± 0,42	20,1 ± 0,26	18,1 ± 0,32	15,1 ± 0,24
Percentage of individual immunoglobulin classes to total protein	Ig G	C	1,84 ± 0,06	28,1 ± 0,21	39,4 ± 0,41	37,1 ± 0,42	25,1 ± 0,16	24,1 ± 0,32	21,1 ± 0,24
		E	1,83 ± 0,01	33,1 ± 0,41	49,4 ± 0,42	42,1 ± 0,32	34,1 ± 0,14	29,1 ± 0,22	28,1 ± 0,14
	Ig M	C	2,1 ± 0,16	4,1 ± 0,42	6,1 ± 0,36	6,4 ± 0,44	3,1 ± 0,26	2,6 ± 0,41	2,5 ± 0,46
		E	2,2 ± 0,41	4,9 ±0,21	6,9 ± 0,45	7,5 ± 0,12	4,5 ± 0,31	3,8 ± 0,25	3,1 ± 0,45
	Ig A	C	1,8 ± 0,21	2,1 ± 0,26	3,2 ± 0,22	3,9 ± 0,11	1,2 ± 0,14	0,9 ± 0,15	0,7 ± 0,13
		E	1,8 ± 0,19	3,1 ± 0,46	3,6 ± 0,42	4,1 ± 0,31	2,6 ± 0,25	1,4 ± 0,28	0,9 ± 0,29
Percentage of the amount of immunoglobulins to total protein		C	5,8 ± 0,22	44,1 ± 0,36	49,2 ± 0,32	47,2 ± 0,13	31,2 ± 0,24	25,1 ± 0,22	22,7 ± 0,15
		E	5,6 ± 0,24	48,2 ± 0,26	54,8 ± 0,42	57,4 ± 0,18	42,1 ± 0,21	32,8 ± 0,24	32,1 ± 0,12

Note: C – control group, E – experimental group

In conclusion, it should be noted that the feeding of "Enterocol" at a dose of $2x10^{10}$ CFU has a weak stimulating effect on the morphological, cellular and humoral factors of the natural resistance of the organism of newborn calves.

The results of studying "Enterocol" at a dose of $3x10^{10}$ CFU are presented in Table 2.

The use of the drug at this dose increases the amount of total serum protein. The maximum increase in the amount of total protein in the calves of the experimental group was observed on day 2 within 72.7%, compared with the data obtained before feeding the drug. In the subsequent days of life, the level of total protein tended to decrease. However, in the calves of the experimental group, the amount of total protein was higher throughout the entire study period, and by 21 day after birth it exceeded the control group by 16.5%. As a result of the research, it was found that the blood serum of newborn calves before feeding the drug had three immunoglobulin classes in a small amount: Ig

Table 2: The content of immunoglobulins in the blood serum of newborn calves before and after feeding them with Enterocol at a dose of $3x10^{10}$ CFU

Indicators		Group	Experimental days						
			before	after 1 hour	after 24 hours	after 48 hours	after 7 days	after 14 days	after 21 days
Total protein (g%)		C	4,5 ± 0,11	5,1 ± 0,22	5,3 ± 0,23	6,4 ± 0,35	6,5 ± 0,24	5,9 ± 0,45	5,1 ± 0,22
		E	4,4 ± 0,42	5,8 ± 0,44	6,4 ± 0,33	7,8 ± 0,22	7,1 ± 0,31	6,9 ± 0,44	5,8 ± 0,14
Ig G (mg/ml)		C	0,82 ± 0,01	20,9 ± 0,05	22,4 ± 0,08	28,4 ± 0,01	17,9 ± 0,06	14,9 ± 0,02	12,6 ± 0,03
		E	0,81 ± 0,03	26,8 ± 0,06	34,1 ± 0,04	39,8 ± 0,07	27,4 ± 0,01	21,8 ± 0,04	19,6 ± 0,09
Ig M (mg/ml)		C	0,92 ± 0,05	3,32 ± 0,05	4,15 ± 0,03	4,20 ± 0,05	2,6 ± 0,02	2,1 ± 0,02	1,62 ± 0,04
		E	0,91 ± 0,03	3,7 ± 0,02	4,9 ± 0,02	5,96 ± 0,02	3,8 ± 0,04	2,9 ± 0,02	2,5 ± 0,02
Ig A (mg/ml)		C	0,82 ± 0,02	1,8 ± 0,04	2,1 ± 0,04	2,4 ± 0,03	0,6 ± 0,04	0,59 ± 0,06	0,39 ± 0,04
		E	0,82 ± 0,01	2,3 ± 0,03	3,5 ± 0,03	4,2 ± 0,04	1,2 ± 0,06	0,92 ± 0,05	0,5 ± 0,01
Amount of immunoglobulins (mg/ml)		C	2,62 ± 0,11	23,5 ± 0,22	28,5 ± 0,31	30,2 ± 0,45	18,9 ± 0,15	17,1 ± 0,42	14,1 ± 0,16
		E	2,62 ± 0,12	31,1 ± 0,23	39,5 ± 0,41	46,1 ± 0,32	26,1 ± 0,16	23,6 ± 0,22	21,1 ± 0,11
Percentage of individual immunoglobulin classes to total protein	Ig G	C	1,83 ± 0,04	28,2 ± 0,22	39,5 ± 0,31	37,3 ± 0,46	25,5 ± 0,15	24,1 ± 0,32	21,2 ± 0,25
		E	1,82 ± 0,01	36,1 ± 0,21	54,5 ± 0,52	59,5 ± 0,34	38,9 ± 0,15	29,5 ± 0,21	29,1 ± 0,11
	Ig M	C	2,1 ± 0,12	4,2 ± 0,41	6,1 ± 0,36	5,4 ± 0,24	3,1 ± 0,22	2,6 ± 0,31	2,5 ± 0,16
		E	2,2 ± 0,21	5,1 ± 0,22	7,1 ± 0,42	7,9 ± 0,11	4,9 ± 0,21	4,8 ± 0,23	4,5 ± 0,11
	Ig A	C	1,8 ± 0,22	2,1 ± 0,26	3,3 ± 0,21	3,9 ± 0,12	1,2 ± 0,14	0,9 ± 0,14	0,8 ± 0,13
		E	1,8 ± 0,18	3,4 ± 0,44	3,9 ± 0,42	4,6 ± 0,31	2,7 ± 0,25	1,5 ± 0,22	1,2 ± 0,29
Percentage of the amount of immunoglobulins to total protein		C	5,7 ± 0,22	44,2 ± 0,35	49,2 ± 0,32	47,2 ± 0,13	31,2 ± 0,25	25,1 ± 0,22	22,8 ± 0,15
		E	5,8 ± 0,25	50,2 ± 0,36	64,4 ± 0,41	59,3 ± 0,17	44,2 ± 0,23	36,8 ± 0,22	34,6 ± 0,11

Note: C – control group, E – experimental group

G, Ig M, and Ig A.

The highest content of immunoglobulin (Ig) G was observed on day 2 in the blood serum of newborn calves fed with "Enterocol". Thus, compared with the control calves, the level of Ig G in the experimental calves fed with the drug was 54.2% higher than in the control calves not fed with "Enterocol". Further, the level of these proteins in the blood serum of the studied calves decreased. However, the concentration of these proteins in the blood serum of the experimental calves was higher throughout the experiment. For example, by day 21, the amount of Ig G in the calves of the experimental group was 35.2% higher than in the control group.

Analysis of the research results showed that the maximum level of immunoglobulin (Ig) M in the calves of each experimental group was observed on day 2 after birth. The

Table 3: The content of immunoglobulins in the blood serum of newborn calves before and after feeding them with Enterocol at a dose of $4x10^{10}$ CFU

Indicators		Group	Experimental days						
			before	after 1 hour	after 24 hours	after 48 hours	after 7 days	after 14 days	after 21 days
Total protein (g%)		C	4,5 ± 0,12	4,8 ± 0,23	5,3 ± 0,24	6,4 ± 0,32	6,0 ± 0,25	5,7 ± 0,44	5,1 ± 0,24
		E	4,4 ± 0,22	4,9 ± 0,44	5,4 ± 0,31	6,3 ± 0,22	6,1 ± 0,31	6,0 ± 0,42	5,2 ± 0,16
Ig G (mg/ml)		C	0,83 ± 0,01	20,2 ± 0,05	22,8 ± 0,08	23,7 ± 0,01	16,9 ± 0,06	12,9 ± 0,02	13,6 ± 0,03
		E	0,82 ± 0,03	22,8 ± 0,05	23,1 ± 0,04	25,1 ± 0,07	15,4 ± 0,01	11,8 ± 0,04	14,6 ± 0,09
Ig M (mg/ml)		C	0,94 ± 0,03	3,1 ± 0,05	3,38 ± 0,02	4,2 ± 0,02	1,86 ± 0,02	2,1 ± 0,02	1,89 ± 0,04
		E	0,93 ± 0,02	3,2 ± 0,02	3,49 ± 0,02	4,1 ± 0,02	1,78 ± 0,03	1,9 ± 0,02	1,7 ± 0,02
Ig A (mg/ml)		C	0,83 ± 0,02	1,6 ± 0,01	1,8 ± 0,05	2,4 ± 0,03	0,76 ± 0,04	0,49 ± 0,02	0,34 ± 0,04
		E	0,84 ± 0,01	1,3 ± 0,03	1,9 ± 0,02	2,2 ± 0,04	1,72 ± 0,06	0,38 ± 0,04	0,52 ± 0,01
Amount of immunoglobulins (mg/ml)		C	2,62 ± 0,13	21,5 ± 0,22	25,5 ± 0,31	30,2 ± 0,45	18,6 ± 0,15	14,1 ± 0,42	15,3 ± 0,15
		E	2,62 ± 0,14	25,1 ± 0,23	28,5 ± 0,31	31,1 ± 0,32	18,1 ± 0,16	13,6 ± 0,22	16,1 ± 0,11
Percentage of individual immunoglobulin classes to total protein	Ig G	C	1,84 ± 0,04	29,8 ± 0,22	39,2 ± 0,31	37,0 ± 0,46	25,5 ± 0,25	24,5 ± 0,32	25,9 ± 0,22
		E	1,83 ± 0,01	34,1 ± 0,21	41,5 ± 0,51	39,5 ± 0,34	24,9 ± 0,14	23,2 ± 0,21	27,5 ± 0,11
	Ig M	C	2,1 ± 0,12	4,2 ± 0,41	6,4 ± 0,34	6,6 ± 0,24	3, ± 0,22	2,4 ± 0,31	3,7 ± 0,16
		E	2,2 ± 0,21	4,2 ± 0,22	6,4 ± 0,41	6,5 ± 0,11	2,9 ± 0,21	2,7 ± 0,23	3,3 ± 0,11
	Ig A	C	1,8 ± 0,22	1,9 ± 0,24	3,4 ± 0,21	3,6 ± 0,12	1,2 ± 0,14	1,0 ± 0,14	0,8 ± 0,11
		E	1,8 ± 0,18	1,8 ± 0,42	3,5 ± 0,42	3,5 ± 0,31	1,2 ± 0,25	0,98 ± 0,22	1,2 ± 0,25
Percentage of the amount of immunoglobulins to total protein		C	5,7 ± 0,22	44,2 ± 0,35	49,1 ± 0,32	47,2 ± 0,13	30,2 ± 0,25	25,6 ± 0,22	30,8 ± 0,15
		E	5,8 ± 0,25	45,2 ± 0,36	51,4 ± 0,41	49,3 ± 0,17	28,2 ± 0,23	22,8 ± 0,22	31,6 ± 0,11

Note: C – control group, E – experimental group

highest amount of Ig M was observed in the calves of the experimental group – 5.96 ± 0.02 mg/ml, and in the control calves it constituted 4.20 ± 0.05 mg/ml. Starting from day 3, the level of Ig M in the blood serum of the calves of both groups decreased. However, the amount of immunoglobulin (Ig) M in the blood serum of the calves of the experimental group was higher throughout the entire study period.

The research results showed that the highest concentration of serum immunoglobulin (Ig) A also fell on day 2 of life of newborn calves. Moreover, the content of immunoglobulin of this class in the calves fed with "Enterocol" by this time was 43.5% higher than in the calves not fed with the drug. In the subsequent days of life of newborn calves, the level of Ig A gradually decreased, and by day 21 after birth this figure was close to normal.

Analysis of the percentage of individual immunoglobulin classes to total protein showed that Ig G takes a very large

proportion. For example, by day 1 of life in the experimental calves, it accounted for 50.5%, and in the control calves – for 30.2%. In the subsequent days, the concentration of these proteins decreased, and by 14 day their share was 27.4% and 17.1%, respectively.

In contrast to Ig G, immunoglobulins (Ig) M and (Ig) A have a lower share. For example, on day 1 of life, the proportion of Ig M in the experimental calves was 7.4%, on day 2 – 6.9%. Further, the concentration of serum Ig M sharply decreased, and by day 14 in the calves of the experimental group it was 3.5%.

The maximum percentage of Ig A to total protein fell on day 2 of life of the studied calves. This indicator in the calves of the experimental group was higher than in the control group – 4.3% against 3.6%.

The maximum level of immunoglobulins considered in this study was observed on day 2 of life, and the maximum proportion of immunoglobulins in relation to total protein – on the first days of life of newborn calves. Moreover, the calves fed with "Enterocol" had higher indicators. In the subsequent days of life of newborn calves, the percentage of the amount of immunoglobulins to total protein decreased. This process was most intense in the calves of the control group.

Thus, based on the research results, we can conclude that the feeding of "Enterocol" at a dose of $3x10^{10}$ CFU contributed to a significant increase in the number of immunoglobulins in the blood serum of newborn calves.

When feeding newborn calves with "Enterocol" at a dose of $4x10^{10}$ CFU, there was no significant difference in total protein indicators during the first 20 days of life in both groups (Table 3).

The dynamics of total protein content in each group was the same. The maximum increase in the amount of total protein in both groups fell on day 2 after birth. Starting from day 7, the level of total protein in the experimental calves increased and became higher than that in the control calves.

The conducted studies showed that by 48 hours the level of Ig G in the experimental calves was 5.9% higher than in the control calves. Further, the concentration of Ig G in both groups decreased. At the same time, there was no significant difference in Ig G values in both experimental and control calves. By day 21 of life, compared with the indicators of the first 2 days, it decreased in the control calves by 44.7% and in the experimental – by 43.0%.

The values of immunoglobulin (Ig) M in the calves of the control group were slightly higher than in the experimental ones until day 7 of life. The maximum level of Ig M in both groups of calves was observed by 48 hours of life. In the subsequent days of life, the amount of Ig M decreased, but in the calves of the control group it was slightly higher. The amount of immunoglobulin A in both groups had no significant difference. It should be noted that the level of Ig A in the experimental calves was slightly lower during the first 10 days. But starting from day 14 of life, the Ig A concentration in the calves of the experimental group slightly exceeded the indicators of the control calves.

The results in Table 3 illustrate that in the calves of the experimental group, the amount of immunoglobulins was 3.9% higher during the first 48 hours. In the subsequent days of life of newborn calves, the amount of immunoglobulins in the experimental group was slightly lower than in the control group, and only by day 21 of life did their level increase.

Analysis of the percentage of individual immunoglobulin classes to total protein showed that Ig G accounted for the main share. For the first 48 hours, the proportion of Ig G in the experimental calves was higher than in the control, but in the subsequent periods – lower. The proportion of immunoglobulins (Ig) M and (Ig) A in relation to total protein in the control group of calves was slightly higher than in the experimental group.

It should be noted that for the first 2 days of life, about half of the total protein fell on immunoglobulins, which made up 49-51%. With increasing age, the proportion of immunoglobulins gradually decreased, reaching by day 21 30.1% in the control calves and 31.9% in the experimental calves. Thus, the research results showed that Enterocol at a dose of $4x10^{10}$ CFU moderately suppresses the synthesis of immunoglobulins, as evidenced by their lower levels in the blood of the experimental calves.

DISCUSSION

The percentage of the amount of immunoglobulins to total protein from the first hours of life increased by day 2. In the subsequent days of life, the level of immunoglobulins was somewhat reduced, and by day 21 after birth it amounted to 24.1% in the control calves and to 32.1% in the experimental calves.

In conclusion, it should be noted that the feeding of "Enterocol" at a dose of $2x10^{10}$ CFU has a weak stimulating effect on the morphological, cellular and humoral factors of the natural resistance of the organism of newborn calves. The highest content of immunoglobulin (Ig) G was observed on day 2 in the blood serum of newborn calves fed with "Enterocol". Thus, compared with the control calves,

the level of Ig G in the experimental calves fed with the drug was 54.2% higher than in the control calves not fed with "Enterocol". Further, the level of these proteins in the blood serum of the studied calves decreased. However, the concentration of these proteins in the blood serum of the experimental calves was higher throughout the experiment. For example, by day 21, the amount of Ig G in the calves of the experimental group was 35.2% higher than in the control group.

Analysis of the percentage of individual immunoglobulin classes to total protein showed that Ig G takes a very large proportion. For example, by day 1 of life in the experimental calves, it accounted for 50.5%, and in the control calves – for 30.2%. In the subsequent days, the concentration of these proteins decreased, and by 14 day their share was 27.4% and 17.1%, respectively.

Analysis of the percentage of individual immunoglobulin classes to total protein showed that Ig G accounted for the main share. For the first 48 hours, the proportion of Ig G in the experimental calves was higher than in the control, but in the subsequent periods – lower. The proportion of immunoglobulins (Ig) M and (Ig) A in relation to total protein in the control group of calves was slightly higher than in the experimental group.

Thus, the research results showed that "Enterocol" at a dose of $4x10^{10}$ CFU moderately suppresses the synthesis of immunoglobulins, as evidenced by their lower levels in the blood of the experimental calves.

CONCLUSION

Based on the research results, it was established that the feeding of newborn calves with "Enterocol" helped to increase the concentration of total protein and immunoglobulins of all classes in the blood. The degree of increase depends on the dose administered. On day 2 after birth, at a dose of $2x10^{10}$ CFU, the amount of total protein increased by 18%, Ig G – by 21.5%, at a dose of $3x10^{10}$ CFU – by 39.2% and 52.3%, respectively, and at a dose of $4x10^{10}$ CFU – by 6.9% and 5.9%, respectively. Starting from day 3, large doses cause a decrease in the concentration of total protein and immunoglobulins.

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CONFLICT OF INTEREST

We declare that we have no conflict of interest.

AUTHORS CONTRIBUTION

Madina Bulegenova, Kadyr Biyashev, Zhumagul Kirkimbaeva, Birzhan Biyashev, Svetlana Ermagambetova, Kairat Oryntayev and Abdirazak Altenov conducted the research, while all the authors participated in writing and proof reading of the manuscript.

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