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Hemocytopoiesis and microelements metabolism's indices in calves under the influence of national vitamin-amino-acid complex

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In Ukrainian veterinary medicine the study of the effectiveness of new complex drugs remains relevant. The effect of the vitamin-mineral complex "Alphabet for Animals" on the state of hemocytopoiesis and the microelements metabolism in calves of 1.5–2.5 months of age were studied.

The composition of this drug includes the biologically active substances: vitamins A, D_3, E, B_1, B_3, B_5, B_6, B_{12}, K_3 and essential amino-acids: DL-methionine, L-lysine and arginine. It is used in farm animals and poultry for the normalization of hemocytopoiesis, the prevention and treatment of vitamins and trace elements metabolism's disorders.

In the first week of drug administration, the number of erythrocytes in the experimental animals group has increased significantly ($p<0.05$) and after its second feeding, the positive effect on erythrocytopoiesis in calves has became even greater ($p<0.001$), compared to the calves in control group.

The level of hemoglobin in calves of experimental group also increased significantly from the beginning of the drug to the end of the experiment, whereas in calves of the control group there was a tendency to decrease its level throughout the all experiment.

The color index and erythrocyte saturation by hemoglobin (MCH) at the first and second blood samples were significantly decreased ($p<0.05$) in control calves group, whereas in animals of experimental group there was no significant difference between these parameters ($p<0.1$). The average volume of red blood cells did not differ between control and test calves during the experiment ($p<0.1$).

Under the drugs influence the Ferum blood content in calves of experimental group increased by 24.2 %. In the control calves group, this tendency was not so noticeable (the increase of Ferum serum level at the end of experiment was only +7.8 % ($p<0.1$), compared to the initial indices). The Zinc metabolism, on the contrary, has not undergone significant changes. The Cuprum serum level in experimental calves group remained always significantly higher than in control animals group.

"Alphabet for Animals" has a positive effect on hemocytopoiesis in calves due to its complex composition (fat-soluble and water-soluble vitamins, amino-acids) and improves the metabolism of microelements, including Ferum and Cuprum. The influence on these processes the vitamins of B group, which are a part of this drug, we consider especially valuable in the conditions of the unformed rumen digestion in young cattle.

Key words: vitamin-amino acid complex, erythrocytopoiesis, hypochromia, microcytosis, hemoglobin, color index, hematocrit.

Problem statement and analysis of recent research. In veterinary medicine of Ukraine and abroad it is often used complex preparations of fat-soluble vitamins by different names and with different ratio of separate biologically active substances [1, 5, 8, 14, 16]. Some drugs contain of the complex of fat and water-soluble vitamins (Oligovit, Introvit, Megavit, Gep-A-Stress, etc.), trace elements and differently affect hemocytopoiesis and metabolism, in particular trace elements, in animals of different species [2–4, 6, 7, 9–13, 15–18]. Therefore, further study of

the efficacy of new complex drugs in veterinary medicine remains relevant [19–24].

The purpose of our work is to study the effect of the vitamin-mineral complex "Alphabet for Animals" on the state of hemocytopoiesis and the metabolism of microelements in calves of 1.5–2.5 months of age.

Material and methods of research. 1 ml of the vitamin-amino acid complex "Alphabet for Animals" contains such active substances: Vitamin A (retinol acetate) - 5000 IU; D_3 (cholecalciferol) - 1000 IU; E (tocopherol acetate) - 10 mg; B_1 (thiamine hydrochloride) - 2 mg; B_3 (calcium pantothenate) - 10 mg; B_5 (pantothenic acid) - 5 mg; B_6 (pyridoxine hydrochloride) - 3 mg; B_{12} (cyanocobalamin) - 30 mcg; Vitamin K_3 - 1.0; DL-methionine - 10 mg; L-lysine - 2.5 mg; Arginine - 3 mg. The drug is used in horses, cattle, pigs and poultry for normalize hemocytopoiesis and metabolism, for increase total resistance, for prevent and treat the vitamins and microelements metabolism disorders.

At the beginning of the research, two calves groups of 10 animals each were formed under the analogues principle. Before the drug administration, the blood samples from both groups (hereinafter the control and experimental ones) were selected for laboratory testing.

Research results. Analysis of the results of the study at the first blood sampling showed that the content of red blood cells in calves had no significant difference ($p<0,1$) and calves in the control group was 6.3±0,19 T/l (Lim – 5,2–7,1 T/l) and 6,3±0,22 T/l – in animals of the experimental group (Lim – 5,1–7,2 T/l).

The drug "Alphabet for Animals" was drunk with water at a dose of 2 ml per 1 liter of water daily during 7 days to the calves of the experimental group. After a week-long break, the drug giving was continued with taking blood for the second time, according to the same scheme and for a week break blood was collected from calves for the third time.

Analysis of the results of the blood test showed that changes of the erythrocytes number in calves of the control group during the experiment were not significantly ($p<0.1$). The number of erythrocytes in calves of the experimental group changed significantly more interestingly. Thus, in the first week of drinking, the number of erythrocytes in animals in this group increased significantly ($p<0.05$) from 6.3±0.22 to 7.1±0.22 T/l. The second drug's feeding caused more positive effect on erythrocytopoiesis. In particular, the number of erythrocytes in these calves was significantly ($p<0.001$) increased to 7.4±0.13 T/l, which was also significantly ($p<0.01$) greater than in the calves in control group after the end of the experiment (6.5±0.24 T/l fig. 1).

In our opinion, the positive effect of the drug "Alphabet for Animals" on erythrocytopoiesis in the calves of the experimental group throughout the experiment was mainly caused by the influence of vitamin B_{12}, which is the part of the drug (30.0 µg/ml).

This is confirmed by the dynamics of the hemoglobin blood concentration in calves of the experimental group. In particular, after the drug's administration the hemoglobin blood level in calves of both groups did not differ ($p<0.1$), and weekly drinking of the drug caused a pronounced tendency ($p<0.05$) to increase the concentration of hemoglobin from 99.4±4.15 to 111,0±3.08 g/l. The second feeding of the drug allowed the calves of the experimental group to keep this index at 111,1±3,26 g/l, which was significantly better compared to the animals of the control group (96,3±2,46 g/l; $p<0,01$ fig. 2).

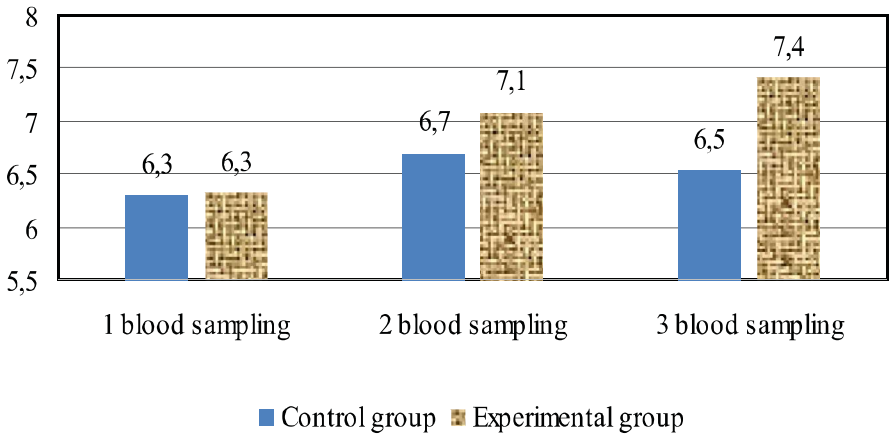

Fig. 1. **The number of red blood cells in the blood of calves,** T/l.

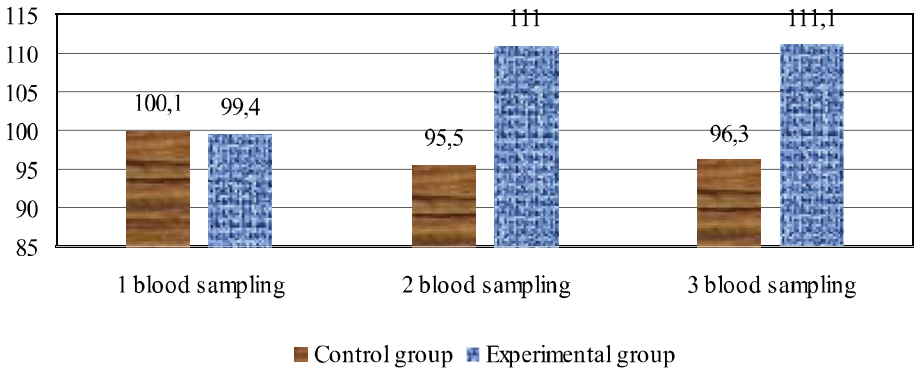

Fig. 2. **Hemoglobin blood level in calves,** g/l.

At the same time, throughout the experiment, we observed a tendency to decrease the hemoglobin concentration in the blood of the control group. Such changes of this index can be explained by the processes of replacement of fetal hemoglobin with hemoglobin in adult animals, which is a common physiological phenomenon. And the increase of hemoglobin blood concentration in calves of the experimental group indicates a positive stimulating effect of the drug on hemoglobin synthesis in this life period of animals. In our opinion, Cyanocobalamin, which is the part of the "Alphabet for Animals", is the direct stimulator of hemocytopoiesis.

It is quite difficult to give an objective characterization of erythrocytopoiesis in general without indicators of hematocrit, which allows us to make conclusions not only about the state of erythrocytopoiesis, but also is objective for assessing the degree of animal dehydration and the relative changes of blood parameters against this background.

Analysis of the results of animal blood tests we obtained showed that there were no changes in hematocrit level which is a characteristic of a dehydrated organism. This is confirmed by the fact that the calves of the control group showed only a tendency to decrease the hematocrit from 34.3±0.84% to 31.1±0.5% throughout the study ($p<0.1$). Dehydration was not observed in the animals of the experimental group, but the ratio of liquid blood to its shaped elements in these animals was more stable. During the whole experiment, this index in calves of the experimental group did not change and did not differ from the index in the animals of the control group (33.3±1.17 at the beginning and 33.6±0.81% – at the end of the experiment (Table 1).

It is known that the hematocrit level is depend on the number of red blood cells, the degree of body dehydration, the average volume of red blood cells and other factors. In this case, it is worth noting that we have not established a significant difference in the average erythrocyte volume in calves of the control and experimental groups (54.5±1.57 and 52.9±2.23 μm^3 in the first blood sampling ($p<0,1$), 49.3±1.06 and 46.7±1.19 – the second ($p<0.1$) and 48.0±1.45 and 45.2±0.58 μm^3 – the third blood sampling ($p<0,1$).

In our opinion, it was interesting the change of this index in animals of both groups in the age aspect. Analysis of the results of the studies indicates a decrease in the average erythrocyte volume (MCV) in calves of both groups. Thus, MCV at the first, second and third blood samples from the calves of the control group decreased significantly from 54.5±1.57 μm^3 in the first to 49.3±1.06 in the second ($p<0.05$) and 47.8±1.45 μm^3 – the third ($p<0.01$) blood sampling, in calves of the experimental group – from 52.9±2.23 μm^3 to 46.7±1.19 ($p<0.01$) and 45.2±0.58 μm^3 ($p<0.05$), respectively.

It is known that excessive stimulation of erythrocytopoiesis to be accompanied by polycythemia and microcytosis. Therefore, it can be argued that the drug "Alphabet for Animals" has erythrocytopoiesis stimulatory properties for calves without adverse development of microcytic phenomena, because the changes in MCV are similar in animals of both groups and are age and physiological.

In support of our opinion, color blood index – Color Index and MCH was testified. At the beginning of the experiment, CI – 1.0±0.03 in control versus 1.0±0.05 in the experiment ($p<0.1$) and erythrocyte saturation with hemoglobin (16.0±0.5 pg – in control and 15,8±0.74 pg – in experiment ($p<0,1$) the total number of erythrocytes in calves of both groups did not differ.

At the same time, it should be noted that the color index and erythrocyte saturation with

Table 1 – **Indices of hemocytopoiesis in calves**

Indicator		Blood sampling		
		1	2	3
Ht, %	control	34,30±0,84	32,90±1,03	31,30±0,50
	p<	–	° 0,1	°° 0,01
	experiment	33,30±1,17	32,90±0,62	33,60±0,81
	p<	* 0,1	' 0,1	" 0,1
				** 0,1
MCV, μm³	control	54,5±1,57	49,3±1,06	47,8±1,45
	p<	–	° 0,05	°° 0,01
	experiment	52,9±2,23	46,7±1,19	45,2±0,58'
	p<	* 0,1	' 0,05	" 0,01
				** 0,1
Color index (CI)	control	1,0±0,03	0,9±0,02	0,9±0,03
	p<	–	° 0,05	°° 0,1
	experiment	1,0±0,05	1,0±0,04	1,0±0,03
	p<	* 0,1	' 0,1	" 0,1
				** 0,1
MCH, pg	control	15,9±0,50	14,3±0,36	14,9±0,50
	p<	–	° 0,05	°° 0,1
	experiment	15,8±0,74	15,8±0,62	14,9±0,22
	p<	* 0,1	' 0,1	" 0,1
				** 0,1

Notes: p< – the criterion of probability;
° – compared to indices of control group 1 and 2 sampling;
°° – compared to indices of control group 1 and 3 sampling;
' – compared to the indices of experimental group 1 and 2 sampling;
" – compared to the indices of the experimental group 1 and 3 sampling;
* – compared to indices of control and experimental groups 1 sampling;
** – compared to indices of control and experimental groups 3 sampling.

hemoglobin (MCH) in calves of the control group for the first and second blood sampling were significantly decreased (p<0.05) from 1.0±0.03 (CI) and from 15.8±0.74 pg (MCH) to 0.9±0.02 and 14.3±0.36 pg (p<0.05), respectively, whereas in the animals of the experimental group there was no significant difference in these indices: CI practically did not change from 1.0±0.05 at the beginning to 1.0±0.04, and MCH – from 15.8±0.84 to 15.8±0.62 pg – after the second blood collection (p <0.1).

According to the description it is known that the vitamin-amino acid complex "Alphabet for animals" in its composition does not contain trace elements. However, our research has identified some positive changes in the metabolism of certain trace elements, including Ferum, Zinc and Cuprum.

Analysis of the laboratory study results of Ferum serum level in calves has showed that in the body of young cattle under the influence of the drug improves the metabolism of this microelement. In particular, after the first feeding of the drug "Alphabet for Animals" the Ferum serum level in calves of the experimental group increased from 102.4±5.05 μg/100 ml at the beginning to 127.2±4.72 μg/100 ml at the end of the experiment (+ 24,25%), which indicates a tendency to increase its content, then at the same time in the calves of the control group the trend was not so noticeable (increase the Ferum level at the end of the experiment was only + 7,8% (p<0,1) compared to the beginning indices.

The metabolism of another microelements – Zinc, under the influence of the "Alphabet for Animals", on the contrary, did not have significant changes. This is evidenced by the results of a laboratory blood test, according to which the indices of Zinc serum level in calves of both groups did not differ at the beginning and after the end of the experiment (p<0,1). Therefore, the testing drug does not have a positive effect on the Zinc metabolism in young cattle.

The most noticeable changes during the period of the experiment occurred in the exchange of Cuprum, which occupies a noticeable position in the processes of hematopoiesis in animals, they were similar, but not unambiguous. It should be noted that before testing, the level of this microelement in the calves of the control and experimental groups was quite high and was equal 103.5±3.74 μg/100 ml and 100.9±3.18 μg/100 ml, respectively, and the difference between them was not significant (p<0.1). According to the second and third blood sampling of calves of the control group, the level of Cuprum decreased significantly,

compared to the initial data, the difference was almost – 33% (p<0,001). The Cuprum blood level in calves of the experimental group has also decreased, but the difference from the beginning of the experiment was not so significant (–16.6%, p<0.01). Despite the fact that these changes were parallel in the animals of both groups, at the end of the experiment a significant difference remained between the indices in the animals of the experimental and control groups. In addition, the Cuprum serum level in calves of the experimental group always remained significantly higher than in the animals of the control group (Table 2).

the experience was mainly due to the influence of Vitamin B_{12}, which is the part of the drug. And the confirmation of this phenomenon is the dynamics of increase the hemoglobin blood level in calves of the experimental group. In our opinion, Cyanocobalamin, which is the part of the "Alphabet for Animals", is a direct stimulator of hemocytopoiesis.

At the same time, the hematocrit level and the average erythrocyte volume during the experiment did not undergo significant change in calves of both groups, although it is known that excessive stimulation of erythrocytopoiesis is accompanied

Table 2 – **The microelements serum levels in calves**, μg/100 ml

Indices		Fe	Zn	Cu
1 sampling	C	100,8±3,31	102,6±3,62	103,5±3,74
	E	102,4±5,05	108,9±4,42	100,9±3,18
2 sampling	C	97,6±4,62	104,7±5,06	69,2±1,96
	E	112,1±4,5	105,8±4,77	82,4±4,31
3 sampling	C	108,7±5,01	103,6±4,02	69,7±2,54
	E	127,2±4,72	109,7±4,07	84,2±3,71
p°<		0,1	0,1	0,001
p°°<		0,1	0,1	0,001
p'<		0,1	0,1	0,01
p"<		0,01	0,1	0,01
p*<		0,1	0,1	0,1
p**<		0,1	0,1	0,01

Notes: p< – the criterion of probability;
° – compared to indices of control group 1 and 2 sampling;
°° – compared to indices of control group 1 and 3 sampling;
' – compared to the indices of experimental group 1 and 2 sampling;
" – compared to the indices of the experimental group 1 and 3 sampling;
* – compared to indices of control and experimental groups 1 sampling;
** – compared to indices of control and experimental groups 3 sampling.

Thus, the drug "Alphabet for Animals" has a positive effect on the Ferum metabolism in calves, practically does not change the Zinc level and has some effect on the Cuprum metabolism.

Discussion. There are many vitamin preparations and vitamin-mineral complexes on the market, the use of which primarily involves not only ensuring the health of animals, but also maintaining their high productivity. Therefore, it is important for veterinary medicine doctors to ensure that the animal body is provided with nutrients and biologically active substances that are poorly absorbed or poorly absorbed in the diet.

For more effective use of a drug it is important to study its effects on animals in general and metabolism in particular.

We found that "Alphabet for Animals" had a positive effect on erythrocytopoiesis in calves, as the number of erythrocytes in animals in the experimental group was significantly increased (p<0.001). The likely positive effect of this drug on the state of erythrocytopoiesis throughout by polycythemia and microcytosis, and thus changes of these indices (Ht, MCV). Therefore, it can be argued that the test drug stimulates erythrocytopoiesis in calves without adverse development of microcytic phenomena in them.

The microelements (Fe, Cu, Zn) metabolism in calves under the influence of the "Alphabet for Animals" had the largest positive changes in the side of Cuprum, slightly smaller – Ferum and no changes according the Zinc level, although it is known that these microelements was not included in the drug. It is obvious that other biologically active substances that are the part of the vitamin-mineral complex, in particular B vitamins, namely Cyanocobalamin (B_{12}), have a positive effect on the Cuprum and Ferum metabolism.

Conclusions. 1. Vitamin and amino acid complex "Alphabet for Animals" has hematopoietic properties, as evidenced by the increase in the total number of erythrocytes (from 6,3±0,22 (p<0,05) to 7,4±0,13 T/l (p<0,001) and the hemoglobin level (p<0,05), without causing

development microcytosis, hypochromia and hypochromemia.

2. The "Alphabet for Animals" complex has a positive effect on hemocytopoiesis in calves due to its complex composition (fat-soluble and water-soluble vitamins, amino acids). Therefore, we consider the influence on this process of vitamins B, which are a part of the complex, especially valuable in the conditions of the unformed rumen digestion in young cattle.

3. The "Alphabet for Animals" improves microelements' metabolism, as evidenced by the increase the Ferum blood level, the stability of Zinc level and probably greater Cuprum serum level in calves of the experimental group.

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Показники гемоцитопоезу та обмін мікроелементів у телят за впливу вітчизняного вітамінно-амінокислотного комплексу

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У ветеринарній медицині України вивчення ефективності нових комплексних лікарських препаратів залишається актуальним. Вивчали вплив вітамінно-амінокислотного комплексу «Абетка для тварин» на стан гемоцитопоезу та обмін мікроелементів у телят 1,5–2,5-місячного віку. До складу препарату входять біологічно активні речовини: вітаміни А, D_3, Е, B_1, B_3, B_5, B_6, B_{12}, K_3 та незамінні амінокислоти: DL-метіонін, L-лізин, аргінін. Його застосовують сільськогосподарським тваринам і птиці для нормалізації гемоцитопоезу, профілактики і лікування порушень обміну вітамінів та мікроелементів.

За перший тиждень застосування препарату кількість еритроцитів у тварин дослідної групи вірогідно ($p<0,05$) зросла, а за другим його випоюванням позитивний ефект на еритроцитопоез у телят став ще більшим ($p<0,001$), порівняно з показниками у телят контрольної групи.

Концентрація гемоглобіну у телят дослідної групи також вірогідно зростала від початку застосування препарату й до завершення досліду, тоді як у телят контрольної групи упродовж всього досліду спостерігалася тенденція до зменшення його вмісту.

Колірний показник та насиченість еритроцитів гемоглобіном (МСН) у телят контрольної групи за першим та другим відборами крові вірогідно ($p<0,05$) зменшувалися, тоді як у тварин дослідної групи вірогідної різниці між цими показниками не встановлено ($p<0,1$). Середній об'єм еритроцитів протягом досліду у телят контрольної і дослідної груп не відрізнявся ($p<0,1$).

Під впливом препарату уміст феруму в сироватці крові телят дослідної групи зріс на 24,2 %. У телят контрольної групи ця тенденція була не так помітна (збільшення вмісту феруму у кінці досліду становило лише +7,8 % ($p<0,1$), порівняно з початковими показниками). Метаболізм цинку, навпаки, не зазнав істотних змін. Уміст купруму у телят дослідної групи завжди залишався вірогідно більшим, ніж у тварин контрольної групи.

Препарат «Абетка для тварин» позитивно впливає на гемоцитопоез у телят завдяки своєму комплексному складу (жиророзчинні та водорозчинні вітаміни, амінокислоти) та покращує обмін мікроелементів, зокрема феруму та купруму. Вплив на ці процеси вітамінів групи В, що входять до складу препарату, вважаємо особливо цінним за умов ще несформованого рубцевого травлення у молодняку великої рогатої худоби.

Ключові слова: вітамінно-амінокислотний комплекс, еритроцитопоез, гіпохромія, мікроцитоз, гемоглобін, колірний показник, гематокрит.

Показатели гемоцитопоэза и обмена микроэлементов у телят под влиянием отечественного витаминно-аминокислотного комплекса

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В ветеринарной медицине Украины изучение эффективности новых комплексных лекарственных препаратов остается актуальным. Изучали влияние витаминно-аминокислотного комплекса «Азбука для животных» на состояние гемоцитопоэза и обмен микроэлементов у телят 1,5-2,5-месячного возраста. В состав препарата входят биологически активные вещества: витамины А, D_3, Е, B_1, B_3, B_5, B_6, B_{12}, K_3 и незаменимые аминокислоты: DL-метионин, L-лизин, аргинин. Его применяют сельскохозяйственным животным и птице для нормализации гемоцитопоэза, профилактики и лечения нарушений обмена витаминов и микроэлементов.

За первую неделю применения препарата количество эритроцитов у животных опытной группы достоверно ($p<0,05$) выросло, а после второй его выпойки положительный эффект на эритроцитопоэз у телят стал еще больше ($p<0,001$), по сравнению с показателями у телят контрольной группы.

Концентрация гемоглобина у телят опытной группы также достоверно возрастала от начала применения препарата и до завершения опыта, тогда как у телят контрольной группы в течение всего опыта наблюдалась тенденция к уменьшению его содержания.

Цветовой показатель и насыщенность эритроцитов гемоглобином (МСН) у телят контрольной группы после первого и второго отборов крови достоверно ($p<0,05$) уменьшались, тогда как у животных опытной группы достоверной разницы между этими показателями не установлено ($p<0,1$). Средний объем эритроцитов в течение опыта у телят контрольной и опытной групп не отличался ($p<0,1$).

Под влиянием препарата содержимое железа в сыворотке крови телят опытной группы выросло на 24,2 %. У телят контрольной группы эта тенденция не так заметна (увеличение содержания железа в конце опыта составляло лишь +7,8 % ($p<0,1$), по сравнению с исходными

показателями). Метаболизм цинка, наоборот, не претерпел существенных изменений. Содержание меди у телят опытной группы всегда оставалось достоверно больше, чем у животных контрольной группы.

Препарат «Азбука для животных» положительно влияет на гемоцитопоэз у телят благодаря своему комплексному составу (жирорастворимые и водорастворимые витамины, аминокислоты) и улучшает обмен микроэлементов, в частности железа и меди. Влияние на эти процессы витаминов группы В, входящих в состав препарата, считаем особенно ценным в условиях еще формирующегося рубцового пищеварения у молодняка крупного рогатого скота.

Ключевые слова: витаминно-аминокислотный комплекс, эритроцитопоэз, гипохромия, микроцитоз, гемоглобин, цветной показатель, гематокрит.

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