ЕПІЗООТОЛОГІЯ ТА ІНФЕКЦІЙНІ ХВОРОБИ

UDK 619:615.37:636.4

The effect of dry blood plasma as a biological supplement on pigs

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OPEN ACCESS

Sysa L. The effect of dry blood plasma as a biological supplement on pigs. Naukovyj visnyk veterynarnoi' medycyny, 2020. № 1. PP. 32–39.

Рукопис отримано: 29.10.2019р.
Прийнято: 05.12.2019р.
Затверджено до друку: 21.05.2020р.

doi: 10.33245/2310-4902-2020-154-1-32-39

The effect of preparations from whole blood (dry plasma) on the animal organism was studied. In the course of our research, 2 groups of animals with 15 animals in each of 10 days of age were formed on the basis of analogues. The first group of animals was given dry plasma mixed with mixed feed (based on 5% of the feed weight), the second group was the control one and received no additives. Piglets of both groups were kept in the same sanitary and hygienic conditions, every day they evaluated the clinical status of animals, took into account morbidity, mortality, mortality, weighed, and blood was taken for morphological and biochemical blood tests.

It was found that in the group of animals that used dry plasma, they gained weight more intensively during 1.5-2 months than the pigs of the control group, a low percentage of the incidence of pathologies from the gastrointestinal tract and respiratory system was established (2-4% whereas in the control group - 9-14%), higher weight gain (10-15%), mortality was not observed (whereas in the control group 2 pigs fell on the background escherichiosis and salmonellosis). Piglets of the experimental group were mobile, active, appetite expressed. In the control group, in addition to the above morbidity and mortality, low daily weight gain was observed (350 grams per day), some animals were inactive, lethargic, and a decrease in appetite was observed (50% of the animals of the group). The results of laboratory studies showed that the use of dry plasma in the diet of piglets contributes to the fastest restoration of blood counts to physiological norm. So already on the 15th day after giving dry plasma, the number of red blood cells was in the range 6.0 ± 0.42 x 10^{12} / l, platelets 180.5 ± 1.3 x 10^{9} / l, the amount of hemoglobin in the range of 90.5 ± 0, 95 g / l, white blood cells 15.33 ± 0.62 x 10^{9} / l, a decrease in ESR to 1.55 ± 0.07 mm / h was observed, the amount of total protein was in the range of 64.55 ± 2.12 g / l , the level of albumin is 18.89 ± 3.52 g / l, the activity of the enzymes AsAT, AlAT 0.55 ± 0.06 μkat / l and 0.66 ± 0.03 μkat / l, respectively, the activity of alkaline phosphatase was at level 1, 01 ± 0.12 μkat / l, bilirubin 7.51 ± 0.168 mmol / l, which indicates an improvement in metabolism, in the first The next step is protein metabolism.

Feeding dry plasma increases the average daily growth (500 grams per day), positively affects the improvement of the overall metabolism (especially protein metabolism), which leads to an increase in the body's resistance and, as a result, a decrease in the incidence and mortality of animals.

Key words: antibiotics, antibiotic resistance, piglets, prebiotics, probiotics, synbiotics, blood products, dry blood plasma.

Introduction. When raising animals, their adequate feeding is important. Swine being omnivorous animals, feeds of both plant and animal origin are used. For the animal to develop properly, it is necessary to balance the diet so that it should include all types of food and the necessary additives. The composition of a complete feed must include: grain crops, meals of various types, chalk,

salt and premixes. It is more likely to achieve the desired result and to obtain high-quality palatable meat with the use of a balanced mixed feed, with vitamin supplements, than with the use of food waste and root crops [8].

The absorption and digestion of nutrients in pigs occurs primarily in the intestines. In pigs, intestinal digestion predominates. The main functions of the intestine, such as secretory, absorption, and motor, take place simultaneously, which determines the structure of the intestine: secretion is secreted by the glands, absorption by the special structure of the intestinal epithelium and villi, the movement of food masses is carried out by the action of smooth muscles [5].

An abrupt change in feeds during this period, as well as poor zoohygienic conditions can easily cause disorders in the nervous activity of the digestive organs of growing young animals [1].

To achieve high production and economic indicators, a rhythmic supply of livestock with adequate feeds, strict adherence to the technological processes, requirements, rational use of all sources, and ensuring of material interest of workers in their working activities are necessary.

The state of the pig's body and its productivity depends on proper nutrition. It is very important to correctly design a diet for feeding pigs, as well as calculate the norms of feeding. If the pigs do not receive the nutrients in the right amount, then the weight gain will decrease, and excessive consumption of feed will lead to farm losses [8].

In recent years, two major problems have occurred in the antibiotic therapy: an increase in the frequency of isolation of antibiotic-resistant strains and the constant introduction of new active antibiotics and their new dosage forms into medical practice [16].

The development of resistance of microorganisms is inevitable even with the administering of antibiotics in a therapeutic dose. This is facilitated by many factors, among them - inadequate access to medicines, improper diagnosis, lack of objective information and others [2].

As antibiotics lose their efficiency, it becomes more difficult (and sometimes impossible) to treat infections that affect both humans and animals, including pneumonia, tuberculosis, sepsis and gonorrhea [13].

Most countries are already taking measures to reduce the use of antimicrobials in food livestock. For example, since 2006, the use of antibiotics to stimulate growth has been prohibited in the European Union. Some large food producers adopt a policy of providing meat products "free from antibiotics", and there is an increase in demand for meat from animals raised without the regular use of antibiotics [17, 18].

Today, there is a large number of feeds and additives for feeding pigs. Of all the nutrients in the feed, proteins are most important. However, the excess amount of protein in feed can lead to its poor use in animals, which in its turn, leads to higher costs for pork production. The lack of protein in the diet negatively influences the productivity of pigs.

Due to the fact that the industry constantly feels the need to reduce the use of antimicrobial agents because of the development of antibiotic resistance, it becomes necessary to search for new therapeutic agents. In the literature, there are few data on the introduction of new treatment regimens that would help reduce the number of antibiotics used in animals. To date, there is evidence of the use of probiotics and prebiotics, blood products (dry hemoglobin, dry plasma) for the prevention of infectious diseases by improving metabolism and increasing body resistance, and, due to this, reducing the use of antibiotics [11, 12].

A prebiotic fails to be digested in the stomach and intestine and reaches the colon practically unchanged. Normal intestinal microflora. Bifidobacteria and lactobacilli utilize the prebiotic, secrete lactic acid, which suppresses the growth of putrefactive and pathogenic microflora. Suppression of the growth of pathogenic microflora leads to the formation in animals of a powerful protective barrier, such as normal intestinal microflora [14].

The probiotic recovers the normal intestinal microflora. In the process of microbial metabolism, biologically active substances (volatile fatty acids, vitamins, amino acids, etc.) are formed. This drug promotes the propagation of beneficial microflora, prevents the multiplication of pathogenic microorganisms, enhances the detoxification functions of microflora, increases the ability of the intestinal microflora to support all types of metabolism in the body, and all gastrointestinal functions [3, 15].

Synbiotics are complex preparations that are microflora stimulants, consisting of prebiotics and probiotics, which allows to quickly obtain the desired effect [7].

Let us mark the beneficial properties of the blood plasma: specific immunoglobulins bind antigens; glycoproteins block the E. coli receptors; glycoproteins bind plant ANF; short chain fragments can block receptors; appetency; stimulation of the secretion of enzymes in the intestine; effect on intestinal morphology; stimulation of growth hormone releasing factors; It is easily digested and does not contain ANF,

which are usually present in plant sources of raw materials. Hygienic taking of samples is carried out in animals that have undergone a pre- and post-slaughter veterinary examination. The action of Ig in the intestine: IgG can trigger the immune response of the GALT system; in different animal species the serotypes of pathogenic bacteria are often identical; Specific IgGs can attach to adsorption sites of nonspecific pathogenic microorganisms; IgG can block the mannose receptors in the intestine; IgG can have a positive effect on the length of the villi and the depth of the crypts [9].

The use of blood plasma proteins can improve intestinal function, intestinal barrier integrity, tissue repair, immune response, range of motion, step length, growth, feed intake, digestibility, stool quality and volume, bone strength, reproductive ability. Also, plasma proteins can reduce inflammation, stress, ulcers, diarrhea, respiratory symptoms, drug treatment, and mortality [4].

Given the relevance of the issue of full-fledged feeding of pigs, especially at the stages of early development, the need to correct the immune status of young animals in order to reduce the incidence of infectious diseases, it is necessary to select environmentally friendly, complete biological additives to the diet of pigs, allowing to solve the above issues.

Today, both in the Republic of Belarus and in a number of European and former CIS countries, blood preparations (dry hemoglobin, dry plasma, dry blood) are widely used as biological additives. Despite the fact that the largest pig-breeding enterprises of the republic today already use a number of blood supplements when feeding animals, this direction is only beginning to develop.

The **objective** of our research was to determine the effect of the dry blood plasma on the body of pigs, indicators of morbidity and mortality in production conditions.

Methodology and methods of research. To determine the effect of additives obtained from the whole blood on the animal organism, two groups of piglets were formed in each with 15 animals, 10 days old, on the basis of analogues. The following indicators served as the criterion for the selection of animals in the groups: growth and development retardation (hypotrophy), incline to diseases (infectious and non-infectious pathologies of the upper respiratory tract and gastrointestinal tract), and higher mortality in the nest.

The first group of animals was given a mixture of dry plasma and mixed feeds (calculated on 5 % of the feed weight), the second group was the control and received no additives.

Every day, an assessment was made of the clinical status of animals, taking into account morbidity and mortality rate. Before using the drug and after each administration, the animals were weighed. Before the experiment, on the 15th, 30th, 45th and 60th days of the studies, blood samples were taken for morphological and biochemical analysis of the blood. Blood samples were taken from the orbital sinus in two dry clean tubes in compliance with the rules of aseptics and antiseptics. In one of the tubes, blood was stabilized with heparin (2.0 U / ml), and the other was used to obtain serum [10].

In the blood the number of red blood cells, white blood cells, platelets, ESR, hemoglobin content was determined, the leukogram was developed. The concentration of total protein, albumin, the level of alkaline phosphatase, bilirubin, and the activity of aminotransferases (AcAT, AlAT) were determined in blood serum).

In the study of the blood and its serum, the following technics were used:

• Counting the number of red blood cells and white blood cells in 1 mm 3 was carried out on a Mindray BC-2800 Vet automatic hematology analyzer and the counting in the Goryaev chamber was monitored.

• To derivate the leukocyte formula, blood smears were prepared on slides, dried in the air, fixed for 5 minutes with methyl alcohol, and stained with azure-eosin according to Romanovsky-Giemsa. Differential leukocyte counts were performed using the four-field method. 200 blood cells in each smear were counted.

A biochemical study of blood serum was performed on a Mindray BC-2800 Vet veterinary automatic hematological analyzer [10].

Findings. The blood counts of piglets reflect the clinical status of the animal organism at the time of the experiment. Thus, from table 1 it can be seen that in piglets of all groups, before treatment with blood products, the number of erythrocytes was either at the lower limit of the norm, or even below the norm (with a norm of 6.0–7.5 x 10^{12}/l), platelets (with a norm of 180,0–300.0 x 109/l), some animals showed an increase in ESR (with a norm of 0.5–1.5 mm/h), an increase in the number of leukocytes (with a norm of 8–16.0 x 10^{9}/l). In individual animals, a decrease in the amount of hemoglobin was noted (at the normal rate of 90–110 g/l).

On the 15th day after giving dry plasma, the improvements were recorded in the blood counts of piglets. In the 1st group of animals there was an increase in the number of red blood cells, platelets, an increase in the amount of hemoglobin, a decrease (normalization) in the number of leuko-

cytes, a decrease in ESR, which indicates an improvement in the clinical status of animals and the absence of serious pathologies in the animal body.

Table 1 shows that by the 30th day of the experiment, all the studied morphological blood parameters in the 1st group of animals to which the dry plasma was given, were within the physiological norm, while in the control group the blood parameters in a number of animals differed from that, and showed the presence (development) in animals of pathological processes. On the 45th and 60th days of receiving dry plasma, blood counts were within the physiological norm.

According to the experimental conditions, we selected the weaker animals into the groups, with reduced resistance, prone to various diseases. From table 2 it is obvious that in piglets of all groups at the beginning of the experiment was observed: hypoproteinemia (from changes in the concentration of total protein, at a norm of 63–78 g/l). In the study of serum protein fractions, we revealed hypoalbuminemia (at a rate of 12–60 g/l). The activity of enzymes such as AcAT, AlAT is increased (at a rate of 0.10–0.55 μkat/L, 0.10–0.68 μkat/L, respectively). The activity of alkaline phosphatase in animals of all groups was also in-

Table 1 – **Morphological indicators of the blood in piglets**

Groups n = 15	White blood cells, 109/l	Erythrocytes, 1012/l	Hemoglobin, g/l	ESR, mm/h	Platelets 109/l
Physiological standard	8-16	6,0 – 7,5	90-110	0,5 – 1,5	180,0-300,0
Before the use of drugs					
Dry plasma	18,3±0,2***	4,1±0,07**	78,4 ±7,15*	3,01±0,23**	163,5±0,58*
The control	19,3±0,14	4,5±0,13	85,3±4,2	2,03±0,06	161,3±0,91
15th day					
Dry plasma	15,33±0,62*	6,0±0,42*	90,5±0,95*	1,55±0,07***	180,5±1,3***
The control	18,10±1,2	4,5±0,64	87,3±1,24	2,25±0,18	164,3±4,2
30th day					
Dry plasma	13,05±0,98**	7,3±0,79*	94,5±3,7**	1,5±0,03*	186,5±3,92***
The control	17,55 ±1,5	4,9±0,86	82,3±2,39	2,54±0,28	162,4±5,23
45th day					
Dry plasma	9,05±0,98***	7,4±0,8*	99,05±5,4**	1,3±0,09***	198,5±7,5**
The control	17,05 ±1,94	5,1±0,79	81,3±3,6	2,7±0,37	158,3±7,98
60th day					
Dry plasma	8,77±0,93***	7,23±0,76*	103,4±5,33**	1,1±0,09***	215,3±12,9***
The control	16,35 ±1,84	5,05±0,74	84,3±4,48	2,9±0,48	155,3±9,92

Note: * p≤0.05, ** p≤0.01, *** p≤0.001.

Table 2 – **Biochemical blood parameters of piglets**

Groups	Albumen, g/l	total protein, g/l	AsAT mkkat/l	AlAT, mkkat/l	Alkaline phosphatase mkkat/l	Bilirubin, μmol/l
Before the use of drugs						
Dry plasma	10,25±0,1*	58,3±0,36*	0,65±0,03*	0,77±0,007*	1,33±0,01*	8,87± 0,06*
The control	10,53±0,09	59,4±0,4	0,73±0,02	0,75±0,007	1,28±0,02	8,68±0,07
15th day						
Dry plasma	18,89±3,52*	64,55±2,12*	0,55±0,06*	0,66±0,03*	1,01±0,12*	7,51± 0,168*
The control	10,01±2,52	59,32±1,41	0,74±0,07	0,76±0,038	1,37±0,127	8,03± 0,19
30th day						
Dry plasma	32,68±5,6***	68,23±2,41*	0,47±0,05*	0,54±0,04*	0,55±0,15*	5,65± 0,72*
The control	9,05±3,2	62,33±1,56	0,70±0,1	0,74±0,09	1,33±0,35	8,35±1,1
45th day						
Dry plasma	38,15±7***	72,15±4,2*	0,38±0,09*	0,41±0,06*	0,32±0,16*	3,45± 0,9*
The control	10,23±3	61,23±3,27	0,72±0,14	0,76±0,16	1,36±0,48	8,32±2,19
60th day						
Dry plasma	45,46±9,3***	74,44±4,9*	0,29±0,09*	0,33±0,09*	0,28±0,18*	2,34± 0,97*
The control	9,34±3,2	60,19±4,92	0,70±0,178	0,78±0,2	1,39±0,51	8,41±2,8

Note: * p≤0,05, *** p≤0,001.

creased (at a rate of 0.10–0.68 μkat/l). An increase in bilirubin (with a norm of 0.3–8.2 mmol/l).

When blood tests were performed in animals of the 1st group on the 15th day after the administration of the preparations, positive dynamics of the indicators was established: a gradual increase in the amount of total protein, an increase in the level of albumin, a decrease in the activity of AsAT, AlAT enzymes and a decrease in the activity of alkaline phosphatase, a decrease in the level of bilirubin indicates an improvement in metabolism, protein metabolism mainly.

By the 30th day of treatment, all blood parameters analyzed (morphological and biochemical) were within the physiological norm, and the best indicators were in the group where dry plasma was used. While in the control group throughout the experiment, the positive dynamics was insignificant (table 2).

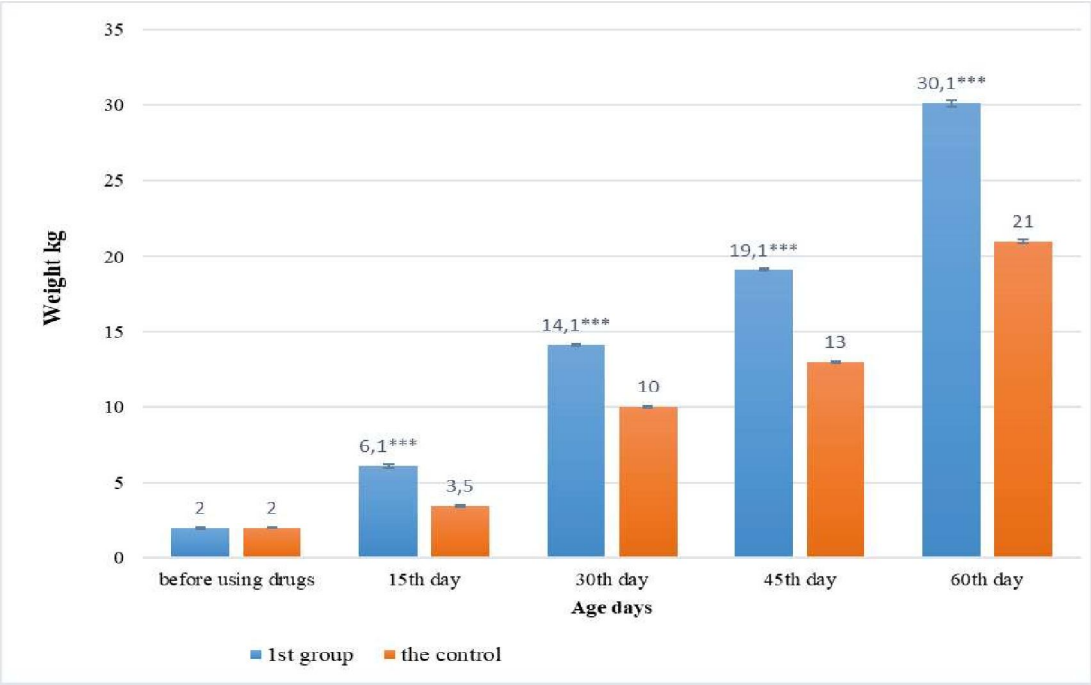
On the 45th and 60th days of using dry plasma in the 1st group of animals, the biochemical parameters of the blood of piglets continued to improve and were within the physiological norm.

As it can be seen from the Figure 1, during 1.5-2 months, the piglets given the dry plasma gained weight more intensively than the control group pigs. Thus, by the 30th day of the experiment, the weight in the group using dry plasma was 14.1 kg, while in the control group it was 10 kg, and by the 60th day of the study the weight difference was 9.1 kg.

It should be noted, that in the group of animals that were given the dry plasma, a low percentage of incidence of Escherichiosis, salmonellosis of the gastrointestinal tract and respiratory system was established (2–4 %, while in the control group – 9–14 %), higher weight gain (by 10–15 %); there was no mortality observed (whereas in the control group 2 pigs died on the background of escherichiosis and salmonellosis). The Animals in the experimental group were mobile, active, with marked appetite. In the control group, in addition to the above mentioned morbidity and mortality rate, a low daily weight gain was observed, some animals were inactive, lethargic, and a decrease in appetite was observed.

Discussion. The findings obtained during the studies allow us to conclude that the introduction of the dry plasma into the diet will improve the clinical status of piglets. The piglets were active, willingly taking the food, the weight gain was higher than in the control group (in the experimental group 500 grams, in the control group 350 grams), a low percentage of the incidence of pathologies in the gastrointestinal tract and respiratory system was found (2–4 % whereas in the control group – 9–14 %), there was no mortality observed (whereas in the control group 2 pigs died on the background of escherichiosis and salmonellosis).

Our studies have shown that the use of plasma is effective at an early age, while in a number of works the authors describe the use of plasma



Note: *** p<0,001.

Fig. 1. **Dynamics of body weight of piglets.**

at older ages, however, as to our opinion in this issue, we more incline towards the use of dry hemoglobin for older ages [4, 6]. The essence of using dry plasma at an early age is, first of all, the increase of the resistance to diseases due to the work of immunoglobulins contained in plasma, and their availability is high especially in the first days of life. At older ages, where the optimal amount of complete protein is necessary for active growth and development, it is more economically feasible to use dry hemoglobin [7].

Conclusion. According to the results of our studies, it can be concluded that the introduction of the dry plasma into the diet with the prophylactic purpose facilitates the improvement of protein metabolism which, in turn, influences the increase of the body resistance and general metabolism, and as a result, an increase in the average daily gain, a decrease in the morbidity and mortality rate in animals.

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Вплив сухої плазми крові як біологічної добавки на свиней

Сиса Л.В.

Вивчено вплив препаратів з цільної крові (сухої плазми) на організм тварин. У ході досліджень було сформовано за принципом аналогів 2 групи тварин по 15 голів у кожній, 10-добового віку. Першій групі тварин задавали суху плазму в суміші з комбікормом (з розрахунку 5 % від маси корму), друга група була контрольною і ніяких добавок не отримувала. Поросята обох груп перебували в однакових санітарно-гігієнічних умовах, кожен день

проводили оцінку клінічного статусу тварин, враховували захворюваність, смертність, летальність, зважували, відбирали проби крові для проведення морфологічного і біохімічного аналізів.

Встановлено, що в групі тварин, яким застосовували суху плазму, впродовж 1,5–2 місяців набирали масу тіла більш інтенсивно, ніж поросята контрольної групи, було встановлено низький відсоток захворюваності патологіями з боку шлунково-кишкового тракту і дихальної системи (2–4 %, тоді як в контрольній групі – 9–14 %), більш високі прирости (на 10–15 %), летальності не спостерігалося (тоді як в контрольній групі загинуло 2 поросят на тлі ешерихіозу і сальмонельозу). Поросята дослідної групи були рухливі, активні, апетит виражений. У контрольній групі, крім вищевказаних захворюваності та летальності, відзначали низькі середньодобові прирости (350 г на добу), окремі тварини були малорухливі, мляві, спостерігалося зниження апетиту (50 % тварин групи). Результати лабораторних досліджень показали, що за застосування сухої плазми в раціоні поросят сприяє якнайшвидшому відновленню показників крові до норми. Так вже на 15-у добу після дачі сухої плазми кількість еритроцитів становила 6,0±0,42×1012/л, тромбоцитів – 180,5±1,3×109/л, гемоглобіну – 90,5±0,95 г/л, лейкоцитів – 15,3±0,62×109/л, ШОЕ – 1,55±0,07 мм/год, загального протеїну 64,5±2,12 г/л , альбуміну – 18,9±3,52 г/л, активність ферментів: АсАТ, АлАТ – 0,55±0,06 і 0,66±0,03 мккат/л та лужної фосфатази – 1,0±0,12 мккат/л, білірубіну 7,51±0,168 мкмоль/л, що свідчить про поліпшення обміну речовин, насамперед – білкового обміну.

Згодовування сухої плазми підвищує середньодобові прирости (500 г на добу), позитивно впливає на поліпшення загального обміну речовин (особливо білкового обміну), що приводить до підвищення резистентності організму і, як результат, зниження захворюваності та летальності тварин.

Ключові слова: антибіотики, антибіотикорезистентність, поросята, пребіотики, пробіотики, синбіотики, препарати крові, суха плазма крові.

Влияние сухой плазмы крови как биологической добавки на свиней

Сыса Л.В.

Изучено влияние препаратов из цельной крови (сухой плазмы) на организм животных. В ходе исследований были сформированы по принципу аналогов 2 группы животных по 15 голов в каждой, 10-суточного возраста. Первой группе животных задавали сухую плазму в смеси с комбикормом (из расчета 5 % от массы корма), вторая группа была контрольной и никаких добавок не получала. Поросят обеих групп содержали в одинаковых санитарно-гигиенических условиях, каждый день проводили оценку клинического статуса животных, учитывали заболеваемость, смертность, летальность, взвешивали, отбирали кровь для проведения морфологического и биохимического анализов.

Установлено, что животные группы, которым применяли сухую плазму, в течении 1,5–2 месяцев набирали вес более интенсивно, чем поросята контрольной группы. У них был низкий процент заболеваемости патологиями со стороны желудочно-кишечного тракта и дыхательной системы (2–4 %, тогда как в контрольной группе – 9–14 %), более высокие привесы (на 10–15 %), летальности не отмечали (тогда как в контрольной группе пало 2 поросенка на фоне эшерихиоза и сальмонеллеза). Поросята опытной группы были подвижны, активны, аппетит выражен. В контрольной группе, помимо вышеуказанных заболеваемости и летальности, отмечали низкие среднесуточные привесы (350 г в сутки), отдельные животные были малоподвижные, вялые, наблюдалось понижение аппетита (50 % животных группы). Результаты лабораторных исследований показали, что применение сухой плазмы в рационе поросят способствует быстрейшему восстановлению показателей крови до нормы. Так, уже на 15-ые сутки после дачи сухой плазмы количество эритроцитов составляло 6,0 ± 0,42 × 1012 / л, тромбоцитов - 180,5 ± 1,3 × 109 / л, гемоглобина - 90,5 ± 0,95 г / л, лейкоцитов - 15,3 ± 0,62 × 109 / л, СОЭ - 1,55 ± 0,07 мм / ч, общего протеина 64,5 ± 2,12 г / л, альбумина - 18,9 ± 3,52 г / л, активность ферментов: АсАТ, АлАТ - 0,55 ± 0,06 и 0,66 ± 0,03 мккат / л и щелочной фосфатазы - 1,0 ± 0,12 мккат / л, билирубина 7,51 ± 0,168 мкмоль / л, что свидетельствует об улучшении обмена веществ, прежде всего - белкового обмена. Скармливание сухой плазмы повышает среднесуточные приросты (500 г в сутки), позитивно влияет на улучшение общего обмена веществ (в особенности белкового обмена), что приводит к повышению резистентности организма и, и как результат, снижение заболеваемости и летальности животных.

Ключевые слова: антибиотики, антибиотикорезистентность, поросята, пребиотики, пробиотики, синбиотики, препараты крови, сухая плазма крови.