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Probiotic Additives In The Rings Of Young Pigs Under The Conditions Of Technogenous Environmental Pollution.

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ABSTRACT

Nowadays, when feeding pigs with the same type of feeding, probiotic supplements are included in the diet in order to preserve the beneficial microflora in the gastrointestinal tract and improve metabolism and energy. The article aimed at studying the effect of probiotic supplements in diets of young pigs kept in areas with a high degree of soil contamination with radiocaesium-137 (15-40 Ku/km^2) on productivity, morphological and biochemical blood parameters and the level of mineral elements in organs and tissues given the data of scientific and economic experience. The experiment was conducted on four groups of crossbred young pigs with an initial live weight of 7,5 kg. The first group was the control and received the basic diet (OR), balanced for the main nutrients. The second group added 15ml of probiotic supplement to the OR, which included Lactobacillus acidophilus, and the third group of young pigs was supplemented with symbiotic cultures of bifidum bacteria and thermophilic streptococci in the same dose. The young pigs of the fourth group to the OR received in the complex the probiotic supplements studied at a dose of 15 ml/kg of dry matter of the feed mixture. In the course of the experiment, control weighings were carried out, blood samples were taken for morphobiochemical studies, and at the end of the experiment there was a control slaughter. It was established that in young pigs in the experimental groups the average daily gain is greater than in the control by 8,0-20,9%. In animals that received lactobacillus in their diet, the highest average daily weight gain was observed, which amounted to 443 g (P <0,05). In young pigs treated with a probiotic supplement based on bifidobacteria, blood levels of glucose were higher by 56,9% (P <0,05), erythrocytes by 5,6%, and leukocytes by 30,2% of the relative indicators in the control group. The inclusion in the diet of young pigs of 15 ml per 1 kg of dry matter of bifidobacterial (group II) and lactobacterial (group III) supplementation caused an increase in serum total protein by 5.4% (P <0,05). The feeding of complex probiotic supplements to group IV animals resulted in a 9.5% increase in total protein compared to the control. Analysis of the content of mineral elements in the organs and tissues of young pigs showed that the iron content in the liver of animals of group II was 9,31% (P <0,05) and in group III, 7,57% higher than the relative control. Thus, the feeding of young pigs with probiotic supplements containing bifidobacteria, lactobacteria separately and when used together contributed in the experimental groups to increasing the average daily gains and reducing the level of radioactive cesium in muscle tissue samples due to the intensification of metabolism.

Keywords: young pigs, probiotic supplements, increments, morphobiochemical blood parameters, mineral elements in organs and tissues, radiocaesium-137

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INTRODUCTION

The largest nuclear technogenic catastrophe at the Chernobyl NPP at the end of the twentieth century has its consequences, as the radioactive isotopes of cesium-137 and strontium-90 that have entered the atmosphere have half-lives of 29,5 and 30,5 years, respectively. The Bryansk region turned out to be the most "polluted" in the Russian Federation in terms of area and amount of fallen radionuclides, the entire territory of the region, including agricultural land, was divided into 4 zones (0-5; 5-15; 15 40; > 40 Ku/km^2). According to the forecast of NPO Typhoon, the territory of the region will become "clean" only after 320 years. Intensive rehabilitation of contaminated areas has led to the creation of new science-based methods of crop and livestock production. At the same time, methods of tillage, crop rotation systems, fertilizer complexes were improved, more promising crops were introduced, this contributed to the improvement of the food supply for animals [1-3]

Pig breeding is an early maturing branch of animal husbandry; therefore, raising animal productivity and obtaining high-quality pork is based on three components: a physiologically healthy livestock, a reliable forage reserve, and compliance with feeding technology. The beneficial microflora of the gastrointestinal tract plays a significant role in the vital activity of animals, which, even if the feeding technology is observed, can significantly change under the influence of the drugs used and environmental factors. To optimize metabolism, probiotic supplements containing various microorganisms, primarily lacto-and bifidobacteria, have been increasingly introduced as an alternative to antibiotics in the rations of young pigs, especially during early weaning [4, 5]. The bacteria that make up probiotics normalize the intestinal microflora, adjusting the pH, inhibiting the growth, development and colonization of conditionally pathogenic microorganisms [6, 7], improve the function of the intestinal barrier [8] synthesize various biologically active substances (amino acids, enzymes, vitamins of group B, antioxidants), inactivate toxic substances [9, 10], contribute to the formation of protective-adaptation mechanisms of the body [11-13], thanks to this, they are used for the prevention and treatment of diseases of the gastrointestinal tract alimentary th and infectious etiology [14, 15]. A rather rich experience has been accumulated of the positive effect of probiotics in the composition of rations of pigs on the digestibility of nutrients, productivity and quality of the products obtained [16-19]. However, there are very few experimental data on the effect of probiotic preparations on the body of young pigs kept in areas with high radionuclide contamination.

The aim of our research was to study the effectiveness of the use of exogenous lactic and bifidobacteria in the diets of young pigs kept in an environmentally unfavorable zone with partially their own feed resources.

MATERIALS AND METHODS OF RESEARCH

Scientific and economic experience was carried out on a three-breed mixed young stock of pigs (large white x large black landrace) contained in the conditions of soil contamination density ^{137}Cs 15-40 Ku/km^2 (ZAO "BIO-M", Novozybkovsky district, Bryansk region). The probiotic feed supplements based on lacto-and bifidobacteria served as the research material.

Four groups of analogs of weaned piglets with 12 heads each with an initial average live weight of 7,5 ± 0,6 kg were formed. The duration of the experiment is 90 days. The first group was the control group and received a basic diet balanced in essential nutrients. At the beginning of the experiment, young pigs received granulated feed, 1 kg of which contained 16 MJ of exchangeable energy. Further, with the change in live weight, the basic ration consisted of a multicomponent feed mixture, in which 1 kg of dry matter contained 14,3 MJ of exchangeable energy. Young pigs of the experimental groups in addition to the basic ration in the morning feeding included liquid probiotic supplements containing at least 108 microbial cells in 1 ml of the preparation, at a dose of 15 ml per 1 kg of dry matter of the ration. The second group received an additive consisting of Lactobacillus acidophilus, calcium lactate, chalk, lactic acid, polysaccharides, bacterial protein. The third group of young pigs was fed a supplement containing symbiotic cultures of bifidum bacteria and thermophilic streptococci, calcium lactate, vitamins, immunoglobulins, and albumin. In addition to the basic ration, the animals of the fourth group received both additives in a complex of 15 ml / kg of dry matter of the feed mixture.

In the course of the experiment, control weighings of animals were carried out, blood samples were taken monthly for biochemical studies, which were carried out according to generally accepted methods

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described in reference literature [20]. At the end of the study there was a control slaughter of 12 gilts (3 heads in each group). In samples of blood, muscle tissue (the longest muscle of the back), liver and kidneys, concentrations of mineral elements were determined by atomic absorption spectroscopy. In the longest back muscle, the 137Cs level was studied on a scintillation gamma spectrometer using the Progress software package. The experimental data obtained were statistically processed on a personal computer using the Excel software package. The results were considered as reliable, starting with $P < 0,05$.

RESEARCH RESULTS AND THEIR DISCUSSION

Live weight gain is one of the indicator indicators of the physiological state of animals. The initial live weight of the piglets was 7,3-7,9 kg. It was established that for three months of research in all experimental animals the gains were quite high and varied from 30-38 kg - gross and 325-443 g - average daily. In all experimental groups, the average daily gain was higher than in the control by 8,0-20,9%.

Animals treated with lactobacillus ration (group III) showed the highest average daily gain in live weight, which amounted to 443 ± 23,9 g ($P < 0,05$) and was higher than in other groups: by 26,4% compared with the control group, by 9,7% relative to a similar increase in young pigs fed bifidobacteria (group II) and 15,8% in the fourth group of young pigs, where the lacto-and bifidobacteria complex was used.

It was also found that in the first month of rearing, when animals received granulated feed, the gains in all groups were high (average 386-445 g), then wheat (40%) and barley (25%), grown in conditions of an ecologically tense economic zone and average daily gains were less. The sharpest decrease in live weight gain was observed in the control group - by 32,5% and in the fourth experimental group of animals, to which the complex additive was added - by 12,7%.

Probably, the quality of the feed mixture had a similar effect and supplements containing separately lactobacteria and bifidobacteria contributed to the normalization of the microbiocenosis of the gastrointestinal tract, stimulated the immune system and metabolism.

Analysis of the dynamics of the morphological and biochemical parameters of the blood allows you to monitor the state of metabolic processes in the body and, if necessary, to correct it. We studied blood samples in each period of experience and found that the studied parameters underwent some changes, but all of them were within the framework of reference standard values. Below are some of the blood parameters of experimental young pigs taken for analysis at the end of the studies before the control slaughter (Table 1).

1. Morphological and biochemical blood parameters young pigs with the inclusion of probiotic supplements based on lacto-and bifidobacteria in the ration, M±m

Indicators	Group			
	1 (control) (n=3)	II (experienced) (n=3)	III (experienced) (n=3)	IV (experienced) (n=3)
Erythrocytes,, 10^{12}/л	7,1 ±0,41	6,4 ±0,17	7,5 ± 0,22	8,9 ±0,10
Leukocytes, 10 /л	11,6 ±0,31	11,3 ±0,61	15,1 ±0,75	13,9 ±0,28
Hemoglobin, g/l	113,3 ±2,77	87,6 ± 4,79	104,6 ±5,08	117,7 ±8,60
Reserve alkalinity, vol.% CO_2	49,0 ± 0,39	48,6 ± 1,04	46,4 ± 0,53	47,1 ± 0,95
Glucose, mmol/l	6,5 ± 0,47	7,0 ± 0,60	10,2 ± 1,48*	6,9 ± 1,14
Total protein, g/l	74,0 ± 2,3	78,0 ± 1,8*	78,0 ±2,8*	81,0 ± 12,0
ALT, E/l	57,2 ± 6,24	68,0 ± 1,80	54,2 ± 3,85	62,6 ± 6,98
AST, E/l	80,7 ± 7,02	101,8±3,32	59,0 ± 5,29	78,6 ±4,13
Urea, mmol / l	5,5 ± 0,62	5,2 ± 0,22	4,8 ± 0,65	5,0 ± 0,68
Uric acid, mmol/l	33,1 ± 8,92	27,8 ± 7,53	24,8 ± 7,33	17,5 ±2,07
Cholesterol, mmol/l	1,4 ±0,1	1,5 ±0,14	1,5 ±0,12	1,4 ±0,20

* P<0,05

In young pigs receiving an additive based on bifidobacteria, an increase in the energy metabolite of the blood — glucose by 56,9% (P <0,05), erythrocytes by 5,6% and leukocytes by 30,2% in comparison with the control group and the same trend indicators, respectively, 45,7; 17,2 and 33,6% relative to group III.

The inclusion of 15 ml per 1 kg of dry matter of bifidobacterial (group II) or lactobacterial (group III) in the basic ration of young pigs resulted in a statistically significant increase in serum total protein by 5,4% (P <0,05) and a tendency to its increase by 9,5% when giving an additive complex (group IV) in comparison with the control group.

An increase in the protein level in the blood serum of experimental animals naturally led to a decrease in other nitrogen-containing substances - urea and uric acid, which contributed to more intensive protein biosynthesis, as evidenced by high levels of aminotransferases (ALT and AST) and average daily weight gain.

The obtained values of physiological and biochemical blood parameters suggest a stimulating effect of probiotic supplements on metabolism, which is consistent with the data of a number of authors [21-22].

In the process of rehabilitation of contaminated areas, a large amount of mineral and organic fertilizers is introduced into the soil, thereby changing the mineral composition of the feed and, consequently, the quality indicators of the rations. When probiotics are fed to animals, the composition of the intestinal ecosystem changes, which is closely related to mineral elements [23, 24]. In this regard, we studied the concentrations of the most important mineral elements (calcium, iron, copper and zinc) in the liver and kidneys (metabolic processes are most intense in them) and in muscle tissue (to study the quality of pork) and found the indirect effect of probiotic additives on their level. The results obtained are presented in table 2.

Blood is the most labile tissue of the body, therefore its physiological and biochemical characteristics are important both for assessing the state of metabolism and for diagnosing pathologies.

It was established that in the serum of all experimental animals the phosphorus concentration is higher than the standard values (1,29-1,95 mmol/l) by 1,6-1,8 times, while the calcium level is within the reference parameters, which led to violation of calcium-phosphorus ratio.

This is probably due to the high content of this mineral element in the soils of our zone and the soil-plant phosphorus system enters the body of animals. It should also be noted an increase in the level of iron by 19,6% (P> 0,05) relative to the control in serum samples of young pigs fed a complex of lacto-and bifidobacteria, which is consistent with a higher number of red blood cells in this group and indicates a high metabolism. In animals treated with a lactobacterial supplement, there is a tendency for copper concentrations to increase by 13,4% and zinc levels decrease by 15,1% compared to control animals. Perhaps, this is a manifestation of the antagonistic relationship between these metals, especially since the group is the highest, and zinc is the lowest, and these changes have a positive effect on their ratio.

2. The content of mineral elements in the organs and tissues of crossbred young pigs when feeding probiotic supplements based on lacto-and bifidobacteria, M ± m

Indicators	Group			
	1 (control) (n=3)	II (experienced) (n=3)	III (experienced) (n=3)	IV (experienced) (n=3)
Serum				
Calcium, mmol/l	3,12 ±0,19	2,98 ±0,12	3,20 ±0,19	3,44 ± 0,25
Phosphorus, mmol/l	3,19 ±0,13	3,61 ± 0,06	3,32 ± 0,09	3,34 ± 0,16
Iron, µmol/l	24,65 ±1,51	24,84 ± 1,20	24,63 ± 2,97	29,50 ±2,31
Copper µmol/l	24,43 ± 0,78	26,08 ± 0,83	27,71 ±3,30	24,63 ± 2,03

Zinc, µmol/l	18,30 ±0,19	17,57 ±0,58	15,54 ±0,52	18,56 ± 1,81
Liver				
Calcium, mmol/l	0,908±0,093	0,769±0,068	0,911±0,154	1,101±0,136
Phosphorus, mmol/l	1,088±0,041	1,189±0,000*	1,170±0,000	1,098±0,089
Iron, µmol/l	0,161±0,000	0,174±0,024	0,127±0,005	0,281±0,022
Copper µmol/l	0,569±0,057	0,709±0,03642	0,503±0,245	0,601±0,215
Kidneys				
Calcium, mmol/l	0,849±0,024	0,764±0,060	0,913±0,108	0,868±0,105
Phosphorus, mmol/l	0,838±0,243	0,619±0,088	1,025±0,376	1,140±0,460
Iron, µmol/l	0,0938±0,011	0,115±0,007	0,315±0,056	0,274±0,075
Copper µmol/l	0,276±0,092	0,259±0,020	0,367±0,066	0,530±0,193
Muscle (longest back muscle)				
Calcium, mmol/l	2,151±0,146	4,974±2,878	2,151±0,197	2,246±0,258
Phosphorus, mmol/l	0,098±0,004	0,203±0,041	0,166±0,023	0,178±0,002
Iron, µmol/l	0,011±0,001	0,013±0,002	0,015±0,002	0,014±0,002
Copper µmol/l	0,086±0,001	0,103±0,004	0,086±0,016	0,069±0,006
Cesium-137, Bq/kg	2,91±2,1	2,59±2,1	2,18±2,1	2,19±2,0

* P≤0,05

Through the kidneys excretion of a large number of mineral elements that are in water-soluble form or in the form of conjugates. Feeding the young pigs with a bifidobacterial supplement at a dose of 15 ml per 1 kg of dry matter ration (group 2) caused a tendency for kidney levels to decrease in calcium, iron and zinc, respectively, by 10, 25 and 6%, while the copper content increased by 22,7% relative to control group of animals. At the same time, the inclusion in the main ration of young pigs of the same amount of lactobacterial supplement (group III) and the complex of lacto-and bifidobacteria (group IV) led to an increase in the concentration of all the studied metals, especially copper - by 3,37 times (P <0,05) and 2,93 times and zinc - by 33,1 and 92,1%, respectively, in groups III and IV in comparison with the control.

The gross composition of mineral elements in the liver may indirectly indicate the state of metabolism of the organism as a whole, since many microsomal enzymes are metalloenzymes. We found a higher iron content in the liver of animals in the 2nd group - by 9,31% (P <0,05) and in the 3rd group - by 7,57% in comparison with the 1st group. The same pattern was observed for copper and zinc: a decrease of 21,1 and 11,6% with the indirect effect of lactobacteria and an increase of 8,3 and 24,4% with the use of bifidobacteria and the complex additive of 74,1 and 5,6% against similar indicators in the control group.

The mineral composition of muscle tissue is positively correlated with product quality. In the samples of the longest back muscle of an experienced young pigs of II, III and IV groups, there was more than the control animals in iron, respectively, in 2,06 (P <0,05), 1,69 (P <0,05) and 1,81 times (P <0,01). There was also a tendency to increase the concentration of copper by 22-38% with a decrease in the level of zinc. It should be noted the high calcium content (4,97 mmol / kg) in the muscle tissue of young pigs fed lactic acid bacteria, which was 2,31 times (P <0,01) higher than in the control group.

The experimental data obtained indicate the ambiguous effect of probiotic supplements on the mineral status of pigs, but they are able to identify the features of metabolism.

Feeding young pigs with probiotic supplements containing bifidobacteria (group II), lactobacilli (group III) and their complex (group IV) contributed to a decrease in the level of radioactive cesium-137, while the greatest decrease was in muscle samples of animals from groups III and IV, where there were lactobacilli (on average by 25% against control).

CONCLUSION

The inclusion of lactobacilli and bifidobacteria in the diet of young pigs separately and comprehensively led to changes in the concentration of mineral elements in organs and tissues, a decrease in radiocaesium level in muscle tissue, while simultaneously increasing the average daily weight gain, indicating normalization of metabolic processes in the body of an experienced young. In our studies, all probiotic supplements had a positive effect. As a result of our studies, we preferred a probiotic supplement containing lactobacilli, since we obtained the highest average daily gain (443g), which turned out to be higher than 26.4% and contained 25.1% less radiocaesium-137 compared to the control.

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