ISSN: 0975-8585

Research Journal of Pharmaceutical, Biological and Chemical Sciences

Internal Criteria of Young Pigs if Prebiotics and Probiotics with Sorbing Properties are used in the Diet of Breeding Pigs.

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ABSTRACT

It has been established that the presence of Biokoretron-Forte pre-probiotic in the diet of breeding pigs has a positive impact on the embryonic growth and development of young pigs; their live weight at birth; the growth of their internal organs and improvement in the chemical composition of the liver and muscle tissue. During the suckling period, young pigs born from breeding pigs included in experimental groups grow faster and virtually have a larger body weight; the mass of internal organs and a better chemical composition of the liver and muscle tissue, which have a higher concentration of Vitamin A and silicon.

Keywords: pre-probiotic; breeding pigs; young pigs, internal organs, Vitamin A and silicon.

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ISSN: 0975-8585

INTRODUCTION

Research in the area called "ecobiotechnology", which studies the development and use of probiotics and prebiotics in livestock farming, has experienced intensive development in recent years. These ecologically safe biologies contribute to the reduction of technogenic and biological burdens on an animal's organism in conditions of intensive production of livestock products thus preventing the development of many pathologies in animals and consequently in humans [2,5].

In this connection, prebiotics and probiotics should be considered to be part of proper nutrition of animals necessary for maintaining their health and obtaining high-quality products –safe both in bacteriological terms and from the point of view of contamination with xenobiotics of technogenic and biological origin.

New probiotics, which need to be studied in detail prior to being introduced in hog farming, have recently appeared. A laboratory, which tests the quality of biological facilities of the Ulyanovsk State Agricultural Academy along with the Diamix Limited Liability Company (LTD) in the Inza district of Russia's Ulyanovsk region has developed a new probiotic Biokoretron-Forte on the basis of a natural mineral called Diatomite, which was subjected to thermomechanical treatment. The new Biokoretron-Forte is grey powder with a good flow rate, high chemical reactivity and optimal electrical conductivity. The mineral's major quality is that it is porous at the nanometric level. The formula's biological effect is guaranteed by its enormous adsorption properties and surface activity deriving from the nano-porous silicon structure of the filler which makes it possible to absorb a wide range of mycotoxins, pesticides, toxic metals, radioactive nuclei; decrease toxic load on the organism and simultaneously increase the activity of a number of enzyme systems of animal organisms. Biokoretron-Forte has conspicuous pre- and pro-biotic properties and anti-oxidative activity; it optimizes the microbiocenosis of the digestive tract; adsorbs toxic substances and intensively raises the gut-associated and systemic immunity of an organism whose composition contains chelated microelements (Zn, Cu, Mn); the B group vitamins and probiotic bacteria (Bacillussubtilis and Bacilluslichenformis with 1:1 proportion and concentration of $1,6x10^{12}$ spores/g). The purpose of our research is to study the impact of the use of Biokoretron-Forte prebiotics and probiotics in the diet of breeding pigs on the embryonic and postembryonic growth and development of pigs; their internal organs and chemical composition of the liver and muscle tissue.

OBJECT AND METHODS OF STUDY

A scientific and economic experiment on breeding pigs of the Large White breed was conducted at a hog breeding farm of the Strojplastmass-Agroprodukt Limited Liability Company in Russia's Ulyanovsk region by using a group method.

Table 1 presents the scheme of an experiment in which two groups of clinically healthy breeding pigs (17 animals in each group) were formed along the principle of analogues (the origin, age, body weight and physiological state were taken into account) after their successful artificial insemination.

Table: 1 The Experiment Scheme

Group of breeding pigs	The number of animals	Duration of Study in days		Feeding conditions
		Period of pregnancy	Suckling period	
I control group	17	112-114	35	Basic Diet (BD)
II-experimental group	17	112-114	35	BD + pre-probiotic Biokoretron-forte 30 g/per animal daily

The breeding pigs in the comparative groups had the same kind of basic diet, which was balanced with nutrients in accordance with individual ratios and took account of the chemical composition of the local fodder. The difference in feeding consisted in the fact that Biokoretron-forte – 30 grams a day per animal – was included in the basic diet of breeding pigs in the experimental group. The pigs in the control group did not

receive Biokoretron-forte. The enrichment of the grain mixture with Biokoretron-forte reduced its acid-sequesting ability from 4.0 to 2.2 units.

That, in turn, by comparison with the pigs in the control group, pre-determined that the main hydrochloric acid consumption in the animals' stomach was used to increase the digestion of fodder rather than decrease its buffering capacity.

The researchers drew their conclusions on the impact Biokorteron-forte in the diet of breeding pigs has on the embryonic and post-embryonic growth of young pigs by results of their slaughter at birth and at the age of 35 days (4 animals in each group). Their body weight and carcass mass; the mass of the head, legs and internal organs were taken into account. The tests were designed to determine the following measurements of the liver and muscles: the moisture content by means of drying a hitch in a moisture testing oven to a constant weight under a temperature of 105°C; protein was measured by using the Kjeldahl procedure; the Soxhlet method was used to measure the fat content; the cinder content was measured by means of burning a meat hitch in a muffle furnace under a temperature of 550-600°C; the Vitamin A content in the liver and muscles of young pigs was measured by using the highly effective High Performance Liquid Chromatography (HPLC) method; the silicon content was measured by using the photocolorimetric molibdate method of paranitrophenol [6].

THE FINDINGS AND THEIR DISCUSSION

The study of the peculiarities of development of young pigs dependent on the fodder factor was carried out on the basis of their control slaughter, which makes it possible to judge fully and objectively the interior measurements and meat qualities of each animal. The slaughter results are given in Table 2.

Table: 2 Development of Internal Organs of Young Pigs

Values	Newborns		35-days old	
	I control	II experimental	I control	II experimental
Body mass, kg	1.08±0.02	1.26±0.012***	7.73±0.07	10.04±0.007***
Carcass mass, kg	0.52±0.007	0.54±0.005	4.37±0.19	6.18±0.25***
Head mass, kg	0.11±0.004	0.4±0.025	0.95±0.04	1.18±0.03***
Heart, g	9.74±0,089	10.66±0,25**	43.63±5.34	53.13±4.64*
Lungs, g	25.88±0,63	29.05±0.26***	125.3±7.34	180.50±4.34***
Liver, g	32.51±0.578	37.22±0.15***	229.38±6.52	278.13±2.42***
Kidneys, g	8.7±0.17	10.16±0.06***	38.13±0.8	54.88±2.18***
Lien, g	8.7±0.07	8.23±0.12	13.50±1.06	20.75±0.32***

*-P<0.05; **-P<0.01; ***-P<0.001

The inclusion of Biokoretron-forte in the breeding pigs' diet had a positive impact not only on the live weight of their offspring at birth and the body weight of young pigs during the weaning period as well as the growth and development of their internal organs. The newborn pigs in the experimental group, compared to the control group, had a larger weight of heart (by 9.45%); lungs weight - (by 12.25%); liver weight - (by 14.49%); kidneys weight - (by 14.54%). The lien weight in comparable groups was relatively the same. Consequently, breeding pigs fed with the addition of Biokoretron-forte produced pigs with more developed internal organs. The weight difference of internal organs of young pigs in the two comparable groups increased in the post-natal period.

Weaned pigs born from breeding pigs, whose diet contained biologies, had a much larger weight of internal organs than the pigs born from the breeding sows in the control group; absolute heart weight – by 21.77%; lungs weight – by 43.68%; liver weight – by 21.25%; lien weight – by 53.7% and kidneys weight – by 43.93%. Consequently, the inclusion of Biokoretron-forte in the diet of breeding pigs produced a significant impact on changing the weight of the internal organs of the newborn pigs and ensured their faster growth in the post-natal period. By comparison, at the age of 35 days the young pigs from the control group registered heart growth by 4.48 times; lungs – by 4.85 times; liver – by 7.06 times; kidneys – by 4.3 times and lien – by 1.65 times. The respective figures for the young pigs in the experimental group are: heart weight – by 4.98 times; lungs – by 6.21 times; liver – by 7.47 times; kidneys – by 5.4 times and lien - by 2.52 times.

ISSN: 0975-8585

The optimization of gastrointestinal microbiocenosis, immunobiological processes and the reduction of toxicological load on the organism of breeding pigs under the impact of sorbing probiotic Biokoretron-forte has a positive impact on establishing the metabolic and plastic functions of their organisms and obtaining a healthier litter of young pigs, which grow more intensively. That growth can be proven by the huge weight of their internal organs.

Chemical composition of liver and rib eye. The physiological role of the liver is vital and multi-faceted. It is the main organ for metabolism. Any metabolic function in a live organism is linked to the liver directly or indirectly. Metabolism is an integrated process, which proceeds with close interaction and interdependence of elements with each other [8]. The chemical composition of the animal liver is linked directly to numerous metabolic reactions in the organism.

The enrichment of diet of breeding pigs with Biokoretron-forte had a positive impact on their lactation function and, consequently, on the growth and development of the young pigs which they produced. Consequently, these changes could not but impact the functional state and the chemical composition of the organs and tissues of the young pigs (Table 3). The liver of the newborn young pigs virtually had a lower fat content and higher (P<0.01- 0.001) protein and cinder content which are signs of more effective and intensive development of their organisms in the embryonic period. In the post-natal period of ontogeny the difference between the groups in terms of the liver protein content was levelled out. However, the young pigs that were produced and reared by the sow-pigs in the experimental group continue having a lower fat content and a higher liver cinder content as compared to the animals in the control group. Correspondingly, the silicon content in the liver of newborn pigs in group II is 34.62% higher (P<0.05) than in the control group and is 42.85% higher in the weaning period (P<0.01).

Table: 3Chemical composition, Vitamin A and Silicon content in the liver and rib eye of young pigs

Values	Group			
	I-C	II-E	I-C	II-E
	In liver		In muscle	
	Newborns			
Total moisture content, %	71.55±0,10	70.35±0,07***	68.35±0.07	68.58±0.13
Protein, %	18.31±0.05	19.37±0.07***	16.73±0.02	17.50±0.04***
Fat, %	5.69±0.03	5.36±0.04***	4.93±0.02	4.77±0.02**
Cinder, %	0.96±0.01	1.17±0.01***	0.96±0.01	1.09±0.02***
Silicon, %	0.26±0.03	0.35±0.02*	0.13±0.01	0.29±0.01***
Vitamin A, mg	0.58±0.06	1.55±0.05***	0.46±0.03	0.96±0.02***
	35-day old pigs			
Total moisture, %	71.75±0.12	72.10±0.07*	73.83±0.09	74.35±0.10**
Protein, %	18.30±0.05	18.28±0.03	17.43±0.06	17.63±0.06*
Fat, %	5.37±0.03	5.25±0.02*	2.91±0.03	2.70±0.03**
Cinder, %	1.03±0.02	1.21±0.01***	0.96±0.01	1.14±0.01***
Silicon, %	0.14±0.01	0.20±0.06**	0.14±0.01	0.22±0.01***
Vitamin A, mg	1.01±0.09	1.42±0.03**	0.92±0.04	1.25±0.12*

*P<0.05;**P<0.01; ***P< 0.001

The Vitamin A concentration in the liver of young pigs is, to a large extent, determined by the amount of vitamins accumulated in their mothers' organism. But even if the pig mother receives vitamin A in abundance, small amounts of it are accumulated in the embryo's liver. That is why getting Vitamin A with colostral milk is crucial for a newly born pig. The inclusion of the Biokoretron-Forte- pre-probiotic in the diet of breeding pigs had an impact on the Vitamin A accumulation in the organisms of young pigs (Table 3). The vitamin A content in the liver of young pigs produced by the Group II breeding sows stood at 1.55±0.05 mg, which is 26.7% higher (P<0,001) than the measurements in the control group. Similar regularities were noticed in the development of pigs in the post-weaning period. The Vitamin A content in the liver of young pigs in the experimental group is 40.59% (P<0.01) higher than that in the control group.

ISSN: 0975-8585

Consequently, the inclusion of the sorbing pre-probiotic Biokoretron-Forte in the diet of breeding pigs in combination with the carotene content has a positive impact on saturating the organisms of the breeding pigs and their newborns with Vitamin A. That, in the long run, influenced positively the live weight of pigs at birth and the intensity of the offspring's growth in the post-natal period. Similar measurements are contained in the studies carried out by other authors. V.A. Zlepkin [4] claims that the rib eye of young pigs from experimental groups, if bishofite with the Krass-6 mineral vitamin premix is used in their diet, has higher concentrations of dry substances; proteins and fats than the rib eye of pigs in the control group. N.M. Guzlyayev and I.I. Stetsenko [1] recorded that the enrichment of the diets of breeding pigs from the experimental group with a «β-rost with lipids" biology had accelerated the Vitamin A accumulation in the liver of day-old pigs by 0.6% and by 25.5% in the weaning period compared to the control group.

The study of the rib eye of young pigs produced by the breeding pigs in the comparable groups showed that the introduction of biologies in their daily diets has a positive effect on the level of biosynthetic processes in the muscular tissue of young pigs. The rib eye virtually shows a 4.6% surge in the content of ($P<0.05$-0.001) proteins of newborn pigs and a 1.15% surge in the protein content of weaning pigs from the experimental group than the young pigs in the control group (Table 3). The silicon concentration in the muscles of newborn pigs was also 123.8% higher in the experimental group than in the control group.

The inclusion of Biokoretron-forte in the diet of breeding pigs also affected the Vitamin A content in the muscles of the newborns and weaned pigs. The Vitamin A concentration in the organisms of the newborns in the experimental group was 108.7% higher than in the organisms of young pigs produced by the breeding pigs in the control group. The Vitamin A content in the muscles of weaned pigs produced by the breeding pigs in Group II increased by 35.87% compared to the muscles of the young pigs in the control group.

A single-factor disperse analysis revealed a fairly high degree of influence of biological activity of pre-probiotic Biokoretron-Forte in the diet of breeding pigs on the concentration of silicon, Vitamin A, protein and fat in the liver and rib eye of young pigs with a low level of arbitrary factors (Table 4). The power of influence of institutional factors on the concentration of silicon, protein and fat in the livers of newly-born pigs was 98.08%, 96.74% and 90.17%, respectively, with a correlation ratio measuring 0.990; 0.984; 0.950; the silicon and fat concentration in the muscle tissue of 35-day –old weaned pigs was 98.73% and 78.74%, respectively; the silicon and fat concentration in the liver was 71.97% and 68.84%, with a correlation ratio of 0.994 and 0.887 and 0.848 and 0.830, respectively. That is evidence of considerable and statistically trustworthy impact of the factor under study.

Table: 4 Dispersive analysis of Biokoretron-forte pre-probiotic and arbitrary factors influencing the protein, fat, silicon and Vitamin A content in the liver and muscles

Measures	Factor			
	Institutional %	Arbitrary %	Probability (according to Fischer)	Correlation ratio
Newborn pigs				
Protein in liver of day-old pigs	96.74	3.26	1.000	0.984
Fat in the liver of day-old pigs	90.17	9.83	1.000	0.950
Silicon in the liver of day-old pigs	46.52	53.48	0.938	0.682
Vitamin A in the liver of day-old pigs	96.08	3.92	1.000	0.980
Protein in the muscles of day-old pigs	98.26	1.74	1.000	0.991
Fat in the muscles of day-old pigs	84.9	15.1	0.999	0.921
Silicon in the muscles of day-old pigs	98.08	1.92	1.000	0.990
Vitamin A in the muscles of day-old pigs	96.16	3.84	1.000	1.981
35-day-old and one-day old pigs				
Fat in the liver of weaned pigs	68.84	31.16	0.989	0.830
Silicon in the liver of weaned pigs	71.97	28.03	0.992	0.848
Vitamin A in the liver of weaned pigs	74.31	25.69	0.994	0.862
Protein in the muscles of weaned pigs	45.77	54.23	0.935	0.677
Fat in the muscles of weaned pigs	78.74	21.26	0.997	0.887
Silicon in the muscles of weaned pigs	98.73	1.27	1.000	0.994
Vitamin A in the muscles of weaned pigs	54.88	45.12	0.965	0.741

The degree of influence of institutional factors on the Vitamin A content in the liver and muscles of day-old pigs equals 96.08% and 96.16% with a correlation ratio measuring 0.980% and 0.981%. Similar patterns were revealed in defining the degree of impact of the said biology on the Vitamin A concentration in the liver and rib eye of weaned pigs. This factor confirms that the enrichment of the diet of breeding pigs with Biokoretron-forte has a strong impact on all the aspects of physiological and immunological processes in the organisms of breeding pigs and their offspring. Consequently, the inclusion of the sorbing pre-probiotic Biokoretron-forte in the diet of breeding pigs increases the accumulation of Vitamin A and Silicon in the liver and muscles. That, in turn, has a beneficial impact on the measures of their multiple pregnancy, the live weight of young pigs at birth, the vitality and safety of young pigs at the age of 21 and 35 days.

CONCLUSIONS

1. The inclusion of the Biokoretron-forte pre-probiotic with sorbing properties (30g/per animal) in the daily diet of breeding pigs has a positive impact on the embryonic growth of their litter which is revealed in the large weight of pigs at birth, their well-developed internal organs and tissues with a better chemical composition.
2. In the suckling period, young pigs born from the breeding pigs in the experimental group grow and develop better and reach a huge body weight; the mass of internal organs and a better chemical composition of the liver and muscle tissues than the young pigs produced by the breeding pigs in the control group.

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