ISSN: 0975-8585

Research Journal of Pharmaceutical, Biological and Chemical Sciences

Peculiarities Of Metabolism In Young Pigs When Using Zeolite-Containing Additives.

Talyzina Tatyana L*, Gamko Leonid N., Talyzin Viktor V, and Podolnikov Valery E.

Bryansk State Agrarian University, p. Kokino, Vygonichsky district, Bryansk region, Russia, 243365.

ABSTRACT

The article presents the results of studies of two experiments on young pigs when fed in the composition of the feed mixture of zeolite (clinoptilolite) and zeolite-whey additives. The intake of metabolizable energy and digestible protein with feed rations in the first and second experiments corresponded to the physiological norm. It was established that when fed to the experimental group 6% of the dry matter of the diet of natural zeolite contributed to an increase in the average daily gain of 7.46%, an increase in the amount of muscle tissue by 3.5% due to protein and a decrease in fatty tissue by 5.6% and. When fed to young pigs of the experimental group in the composition of the diet of 3% zeolite-serum supplement, the average daily gain was higher by 25.5% (P<0,05) in comparison with the control group. The studied additives contributed to the change in the micromineral composition of tissues in experimental animals in comparison with the control ones. So, with the introduction of a zeolite-serum additive in the diet at a dose of 3% in the liver of young pigs, the concentration of zinc increased by 17.9% (P<0,05), while reducing chromium by 55.9% (p <0, 05); in muscle tissue, the copper content increased by 31.9% (P<0,05. When feeding 6% of the zeolite additive, an increase in copper concentration by 12.5% (P<0,05) was found in the liver, and lead level decreased by 10, 94% (P<0,05) and cadmium by 20.9% (P<0,05); cobalt concentration in muscle tissue increased by 33.3% (P<0,05), and manganese increased by 70.0 % (P<0,05) while reducing nickel by 25.2% (P<0,05), lead by 72.4% (P<0,01), and cadmium by 53.3% (p <0 , 01) in comparison with similar indicators in the control group of animals.

Keywords: zeolite (clinoptilolite), zeolite-whey additives, young pigs, productivity, mineral elements

https://doi.org/10.33887/rjpbcs/2019.10.3.43

Corresponding author

ISSN: 0975-8585

INTRODUCTION

One of the reasons for the low productivity of animals is the violation of biochemical processes in the body, in particular the exchange of mineral substances. Mineral elements are involved in maintaining osmotic pressure, creating buffer systems, enzymatic catalysis, it regulates the metabolism of proteins, nucleic acids, carbohydrates, lipids. The availability of animals with minerals depends on their content in the diet in optimal amounts and in a bioavailable form. Under production conditions, such an "ideal" ration is almost impossible to form [1]. A deficiency or excess of mineral elements entails a metabolic disorder, which causes inhibition of the growth and development of animals, therefore natural mineral additives with ion-exchange properties, in particular, zeolites, are introduced into the compound feed. Zeolites are minerals with such interesting properties as water absorption, ionic adsorption and cation-exchange ability. In this regard, zeolite-containing additives can be in animals as sources of mineral elements [2], sorbents of ammonium ions [3], cations of heavy metals [4-8], they are recommended to be used for the prevention of metabolic disorders, increasing resistance [9-11] productivity and product quality [12-17].

The purpose of the research was to study the possibility of using natural zeolite and zeolite-whey additives in diets of young pigs to optimize metabolism.

MATERIALS AND METHODS OF RESEARCH

We have carried out two scientific and business experiences in the conditions of educational and experimental farm "Kokino" (Russia, Bryansk region). The materials of the study were additives based on natural zeolites with a clinoptilolite content of 60%. In the first experiment, zeolite additive was used in a dose of 6% of the dry matter of the ration, in the second experiment, zeolite-serum additive developed by us in a dose of 3%. In each experiment, 2 groups of animals (control and experimental) of 11–12 animals each were studied, which were formed on the principle of pair-analogues, taking into account the breed, age and body weight. The average live weight of the piglets in the first experiment was 18,98 ± 0.2 kg, in the second 25,89 ± 0.05 kg.

The control group of animals received a basic diet, balanced nutritionally [18]. With the basic ration, the animals received on average 2,2 and 2,35 energy feed units (ECE), 1,53 and 1,83 kg of dry matter, 218g and 234g of digestible protein in the first and second experiments, respectively. Animals of the experimental groups were fed, in addition to the basic diet, the studied supplements in the morning feeding. Zeolite-whey additive was prepared from 4 parts of zeolite and 1 part of condensed milk hydrolyzed whey, enriched with lactates. Studies were conducted for 120 and 180 days. At the end of the study conducted control slaughter. Weight gains were established by individual weighing before the morning feeding monthly. Based on the results of weighing, gross and average daily increment was calculated. Costs per 1 kg of growth were calculated based on the nutritional data of average daily rations. Meat productivity was studied according to the results of the control slaughter of animals. The concentration of heavy metals was determined in samples of the liver and muscle tissue of animals after control slaughter by atomic absorption photometry on a Perkin-Elmer spectrophotometer [19]. Statistical processing of the experiment materials was performed using the IBM PC/XP Excel software package. In determining the reliability of the difference between the indicators of the control and experimental groups, the argument of Student was used. The results were considered as reliable, starting with a value of $P<0,05$ [20].

RESEARCH RESULTS AND THEIR DISCUSSION

Research has shown that the average daily gain in live weight in young pigs from the experimental group (experiment 1), which received 6% of the dry matter of natural zeolite in addition to the basic ration, was 499,92 ± 20.43 g, which is higher than in the control group 7.46%. The cost of feed, ECE, digestible protein per 1 kg increase on average for the experience decreased by 7,0%.

The results of the control slaughter showed a positive effect of 6% of the zeolite additive on the qualitative composition of carcasses of young pigs from the experimental group compared to the control: there was an increase in the amount of muscle tissue by 3.5% ($P<0,05$), a decrease in fat tissue by 5.6% ($P<0.001$); at the same time, the protein content in the muscle tissue increased by 17.86% ($P<0,01$) and decreased in fat - by 28.5% ($P<0,05$).

When a 2,5-month-old zeolite supplement was introduced into the piglets for 180 days at a dose of 3% of the dry matter of the diet (experiment 2), the average daily weight gain was increased by 25,5 (P<0,05) relation to a similar indicator in the control group of pigs, which reduced the cost of energy and protein by 20%.

No reliable indicators of control slaughter were found, but it should be noted that in the experimental group of young pigs, relative to the control, the level of mineral substances (raw ash) increased by 25,5%.

The increase in the productivity of experimental animals fed with zeolite-based feed additives is regular and due to the ion-exchange properties of the zeolite, which made it possible to optimize the mineral composition of the cells and the additional nutritional components contained in whey.

Since the studied additives contain mineral elements and have sorption properties, we studied the levels of mineral elements in the liver and muscle tissue, where metabolic processes are most intensive. The results are presented in tables 1 and 2.

1. Changes in the level of mineral elements in the liver and muscle tissue of young pigs when feeding supplements of zeolite

Mineral element	Groups			
	I (control) (n=4)	II (experienced) (n=4)	I (control) (n=4)	II (experienced) (n=4)
	Liver		Muscle	
Copper, mmol/kg	0,247 ± 0,002	0,278 ± 0,005*	0,111 ± 0,011	0,096 ± 0,004
Zinc, mmol/kg	2,043 ±0,078	2,281 ± 0,180	0,802 ± 0,042	0,751 ± 0,027
Manganese, mmol/kg	0,153 ± 0,006	0,147 ± 1,292	0,040 + 0,005	0,068 ± 0,005
Cobalt, mmol kg	0,010±0,001	0,009 ± 0,001	0,006 + 0,000	0,008 ± 0,001*
Chrome mmol/kg	0,284 ± 0,023	0,274 ± 0,053	0,405 ± 0,008	0,351 ± 0,050
Nickel, mmol/kg	0,064 ± 0,003	0,075 ± 0,007	0,135 ± 0,006	0,101 ± 0,008*
Lead, µmol/kg	7,343 ± 0,232	6,540 ± 0,042*	5,714 ± 0,311	1,576±0,270**
Cadmium, mmol/kg	1,788±0,060	1,414 ±0,04*	0,930 ± 0,031	0,434±0,055**

* - P<0,05, ** - P<0,01,

Introduction to the diet of young pigs supplements of natural zeolite caused a change in the level and distribution of the studied mineral elements by the organs and tissues.

So, in the pigs liver of the experimental group, which in addition to the basic ration received the additive of zeolite in the amount of 6% of the dry matter of the diet, an increase in copper concentration by 12,5% (P<0,05) and zinc - by 11,6% and nickel - by 17,2% and lead level decrease by 10,94% (P<0,05) and cadmium by 20,9% (P<0,05) in comparison with the same indicators in the control group of animals.

The trace element composition of the muscle tissue of young pigs has also changed under the influence of zeolite. The cobalt concentration in the experimental animals versus the control ones increased by 33,3% (P<0,05), and that of manganese increased by 70,0% (P<0,05) while reducing nickel by 25,2% (p <0, 05), lead by 72,4% (P<0,01), and cadmium by 53,3% (P<0,01).

ISSN: 0975-8585

2. The effect of zeolite-serum supplements on the level of mineral elements in the liver and muscle tissue of young pigs

Mineral element	Groups			
	I (control) (n=4)	II (experienced) (n=4)	I (control) (n=4)	II (experienced) (n=4)
	Liver		Muscle	
Copper, mmol/kg	0,198±0,016	0,230±0,012	0,044±0,003	0,058±0,003*
Zinc, mmol/kg	2,002±0,053	2,360±0,091*	0,997±0,179	1,185±0,216
Manganese, mmol/kg	0,046±0,011	0,044±0,004	0,013±0,005	0,013±0,001
Cobalt, mmol kg	0,005±0,000	0,007±0,001	0,003±0,000	0,004± 0,000
Chrome mmol/kg	0,034±0,006	0,015±0,001*	0,070±0,028	0,044±0,001
Nickel, mmol/kg	0,002±0,000	0,004±0,001	0,024±0,001	0,023±0,004
Lead, µmol/kg	7,352±0,717	7,432±0,243	4,746±0,143	5,824±0,808
Cadmium, mmol/kg	0,649±0,191	0,474±0,072	0,199±0,077	0,240±0,050

* - P<0,05

When feeding a zeolite-whey additive at a dose of 3% of the dry matter of the ration in pig liver, the concentration of copper increased by 16,2%, zinc - by 17,9% (P<0,05), cobalt 40.0% and nickel by 50 % while reducing chromium by 55,9% (P<0,05) and cadmium by 27.0% .

In the muscle tissue of young pigs, the level of trace elements in control animals was 2-4 times lower than in the liver. When feeding a zeolite-whey additive, a similar liver-like increase in copper content by 31,9% (P<0,05), zinc - by 18.9%, lead and cadmium by 21-23% was observed in the experimental group, while reducing chromium by 37,1%.

Experimental data obtained in two experiments on the content of mineral elements in the liver and muscle tissue using feed additives based on zeolite indicate a similar change in the concentration of copper, zinc, nickel and chromium. It should be noted that when using in the composition of feed mixtures of young pigs, zeolite supplements in a dose of 6%, the level of toxic metals - lead and cadmium decreased, and when fed, zeolite-whey additives increased. The decrease in the concentration of toxicants is probably due to the sorption properties of the zeolite, and when fed with a zeolite whey supplement containing zeolite, sorption activity against lead did not manifest itself, probably due to the "employment" of the zeolite microtubules by the constituent elements of the whey.

CONCLUSION

Studies have shown the positive effect of zeolite-containing additives in the rations of animals from experimental groups and the possibility of their use to stimulate metabolism. This is confirmed by an increase in average daily gains of live weight by 7,5% when feeding the zeolite supplement at a dose of 6% of the dry matter of the diet and by 25,5% when using 3% zeolite-serum supplement, normalization of mineral metabolism due to an increase in the liver and muscle tissue essential micronutrients and toxic reduction. It is necessary to pay attention to the content of toxic elements in zeolite and whey, which must meet the maximum allowable concentrations, which will allow to obtain high-quality products.

REFERENCES

[1] Samokhin V.T. Prevention of microelement metabolism disorders in animals of Dubrovitsy: Russian Training Center for Environmentally Safe Livestock Technologies, 2007: 136.
[2] Kuznetsov S.G., Skurikhina O.D. Bioavailability of mineral elements for young pigs from natural zeolites. Sb. tr. VNIIFBiP. Borovsk, 1999; 38: 313-322.
[3] Xue Li, Cong Lin, Yang Wang, Ming Zhao, Yu Hou Clinoptilolite Adsorption Capacity of Ammonia in Pig Farm, Environmental Sciences, 2010; 2: 1598-1612

[4] Ustenko V.V., Vedmitsky V.A., Gorokhov V.K. and others. The possibility of cumulation of some toxic trace elements when feeding natural zeolites. // Natural zeolites in the national economy. Novosibirsk, 1990: 201-202.
[5] Talyzina T.L. Natural zeolite as an adsorbent of heavy metals in the body of pigs. Zootechny, 1997; 2: 14-16.
[6] Ulitko V.E. Efficiency of using zeolite-containing rocks to reduce the level of heavy metals in the body of cows. Zootechny, 2007; 11: 14-15.
[7] Tanka P. Prasai, Kerry B. Walsh, Surya P. Bhattarai, David J. Midmore, Thi T.H. Van, Robert J. Moore, Dragana Stanley Zeolite Food Supplement Reduces the Enterobacteria. Microbiological Research, 2017; 195: 24-30.
[8] Menyakina A.G., Gamko L.N. The use of natural sorbent additives in the diets of young pigs and their effect on the content of heavy metals in organs and tissues. Zootechny, 2018; 3: 14-16.
[9] Belkin B. L. The effect of zeolites on the resistance and productivity of pigs. Veterinary Medicine, 2002; 3: 45-47.
[10] Martínez, Mayuly; Castro, M .; Hidalgo, Katia; Ayala, Lázara; Pérez, R .; Hernández, L .; Báez, L. La utilización efectiva de la zeolita para el control de las diarreas. Revista Cubana de Ciencia Agrícola, 2004; 38 (4): 395-398
[11] Jung BC, Toan NT, Cho SJ, Ko JH, Jung YK, Leung diet pigs. Veterinary Microbiology, 2010; 143: 117–125.
[12] Talyzina T.L. The effect of zeolite additives on productivity and the content of trace elements in the organs and tissues of young pigs. Abstract of dissertation. M., 1995: 18.
[13] Zeolites: efficiency and application in agriculture / edited by G.A. Romanov. M.: FGNU "Rosinformagrotekh", 2000; Part II: 336 p.
[14] Gamko L., Shpadarev A., Podolnikov V., Shepelev S. Metabolism in young pigs when fed zeolites from different deposits. Pig breeding, 2006; 6: 16-18.
[15] Kazakova N.V., Satkeeva A.B., Pak V. Zeolite in the diets of young fattening pigs. Agrarian Bulletin of the Urals, 2007; 6: 65-67.
[16] Papunidi E.K., Korostyleva V.P. The use of zeolite for the correction of metabolism in piglets and increase their productivity. BIO, 2010; 6: 13-14.
[17] Uchasov D.S., Yarovan N.I., Litovchenko D.V. The effect of natural zeolites and their combinations with biologically active additives on the metabolic status of farm animals in industrial complexes. Biology in agriculture, 2016; 4 (13): 17-21.
[18] Norms and rations for feeding farm animals. Reference book / Ed. A.P. Kalashikova, V.I. Fisinina, V.V. Scheglova, N.I. Kleimenov. Moscow, 2003: 456 p.
[19] GOST 30178-96. Raw material and food stuffs. Atomic absorption method
[20] Plokhinsky N.A. Algorithms of biometrics M .: Moscow State University, 1980: 150 p.