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## The use of soy okara in feeding of pigs.

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### ABSTRACT

The aim of the research was to examine indices of protein metabolism, concentration of ferrum and copper in tissues of suckling piglets when lactating sows are fed with soy okara. It is proved that the use of soy okara as a feeding increases the intensity of biosynthesis of tissue proteins in the body of suckling piglets. At the same time there is decrease in the transport and oxidation of trivalent ferrum and increase in the mobilization of bivalent ferrum through the copper transport system.

**Keywords:** feed additive, piglets, soy okara, ferrum, total protein, globulins, amino acids.

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## INTRODUCTION

The primary source of protein and minerals for pigs is feed. Protein deficiency in the feed is compensated, at first time, due to the proteins of organs and tissues, especially liver. Then the process involves the blood proteins and, later, proteins of muscles and other tissues, synthesis of hormones is disrupted. Protein deficiency in the organism of young animals leads to disruption of nitrogen metabolism, delay in growth and development [1, 2].

In case of violation of protein metabolism mineral nutrition does not give the desired effect. Minerals have a great influence on the processes of digestion, absorption and assimilation of nutrients, providing an environment for the action of enzymes and hormones [3, 4]. In animals the deficiency of minerals is determined by their digestibility. The iron of the feed is absorbed in the small intestine better, if you stay in bivalent form ( $\text{Fe}^{2+}$ ), nontransferrin-bound ferrum is highly toxic and can be deposited in body tissues (heart, liver, etc.) [5]. In the neonatal period minerals are particularly important for the normal development of piglets. Ferrum deficiency is accompanied by delay in their growth, decrease of the level of blood hemoglobin, anemia, reduced resistance to diseases [6, 7].

The establishment, in the Volga region of Russia, of new varieties of soybeans that can steadily grow where before it seemed impossible, extends its introduction, including the use of soybean products as additional reserve of livestock forage [8, 9]. Among soy products the protein-containing soy pulp - okara holds a special place, it is the only known plant source of bio absorbable bivalent ferrum ( $\text{Fe}^{2+}$ ) whose concentration is 20 times higher than the similar content of low-fat cheese [10].

## OBJECTS AND METHODS OF RESEARCH

The object of the study were sows and their piglets. For physiological experience groups of 5 animals each were formed. The first group (control) gained balanced on all major nutrients diet (OR), the second one - supplementary feeding with soy okara. In the diet of sows soy Okara in an amount of 200 g for gestating and 300 g for lactating were injected once a day. Suckling piglets received a supplement consume from the mother's milk. Supplement was fed to sows a month before farrowing. Lactating sows with piglets were kept in individual cages.

Soy okara for our research was obtained from soybean variety USKh1 6, released in Middle Volga region of the Russian Federation (8). Laboratory studies have shown that 1 kg of soy okara (grown on the fields of Ulyanovsk region farms) contains 107 g of crude protein, 91 g of digestible protein, the level of digestible ferrum was up to 200 mg.

The study of physiological and biochemical parameters was carried out according to modern techniques, using the following instruments: acoustic analyzer AKBa-01-BIOM" of the firm "BIOM" (Russia), amino acid analyzer LKB-4101" (Sweden), the analyzer "Stat Fax 1904 Plus» of the company "Awareness Technology" (USA) and the sets of reagents of the firm "Lachema" (Czech Republic), «Bio-LA-Test" - spectrophotometer of the company Perkin Elmer (USA). Dynamics of growth of young animals was estimated with verification checks. Correlation and biometric data processing were performed using computer programs Statgraphics and Statistika.

## THE RESEARCH RESULTS

In the course of the experiment it was found out that in the blood serum of piglets of the experimental group the content of total protein increased by 4,7 % ( $P < 0,05$ ) and albumin by 4,8 % ( $P < 0,02$ ) compared to the control. Against this background, there was increase of fractions:  $\alpha_1$ - by 16,3 % and  $\gamma$ -globulins - by 19,5 %, reduction of the level  $\alpha_2$ - by 15,6 % ( $P < 0,001$ ) and  $\beta$ -globulins - by 14,5 % ( $P < 0,05$ ). to ferrous  $\text{Fe}^{2+}$ , carried out transferrin and copper-containing proteins - ceruloplasmin. This shows a reduction of the transport processes and oxidation of trivalent  $\text{Fe}^{3+}$  into bivalent  $\text{Fe}^{2+}$ , carried out by transferrin proteins and copper-containing - ceruloplasmin.

Biochemical studies of liver tissues of the experimental piglets of the 2nd group confirmed this regularity, which is manifested by increase in the concentration of total protein in the liver by 5.0 % ( $P < 0.05$ ) compared with the control. Correlation between total protein level and concentration of copper (Cu) in the liver of piglets of the experimental group is calculated. The inverse dependence of high level (correlation coefficient amounted to  $r = -0.80$ ,  $P < 0.001$ ) is established, the linear regression equation:  $y = 26.87 - 0.58x$  ( $x$  is the number of total protein in liver,  $y$  - the level of Cu in the liver). At the same time in the group of animals analogues, direct average dependence ( $r = +0.50$ ) is noted.

Therefore, under the influence of the soy okara in the body of a suckling piglet there is reduction of copper-containing protein transportation and mobilization of Fe is enhanced through the copper transport system.

The results showed that reserved Fe is deposited in the liver of piglets of the experimental group. Its concentration has increased by 12.4 % ( $P < 0.01$ ) compared to the index of peers of the 1st group (figure 1). The content of Cu in liver tissues of animals of the 2nd group, on the contrary, under the influence of soya okara decreased significantly by 11.6 %, which indicates the intensive use of Cu in metabolic processes (figure 2).

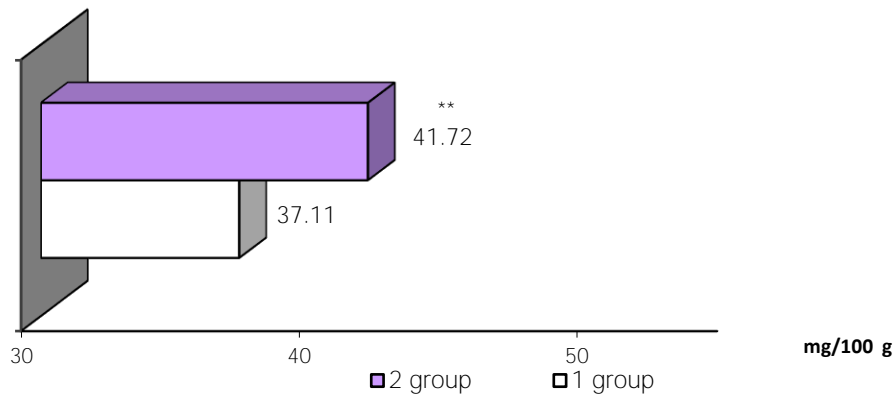


Fig 1. The total ferrum content in the liver of piglets with the use of soy okara

Remark: \*\* - ( $p < 0.01$ ), compared to the same index in the control

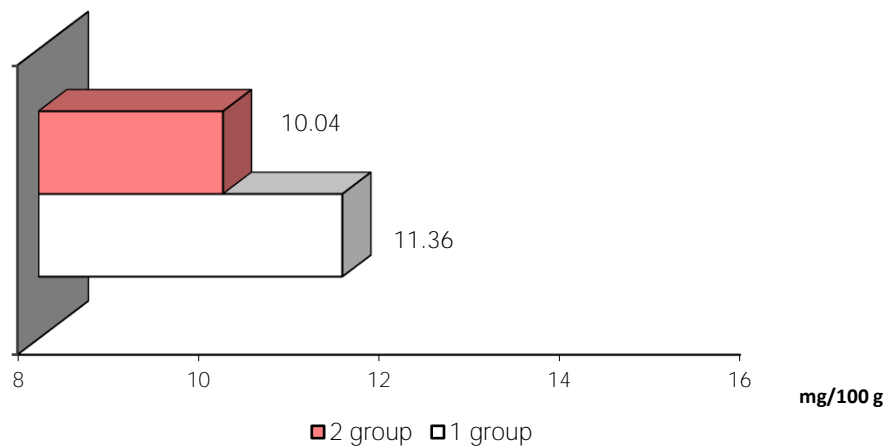


Fig 2. The total copper content in liver of piglets with the use of soy okara

The study of the amino acid spectrum of liver tissue of the piglets showed that total content of free amino acids in the liver of animals of the 2nd group within the physiological range decreased by 2.9 % ( $P < 0.001$ ), including limiting amino acids by 3.6 % ( $P < 0.01$ ), with the ratio of amino acids - 0.93. At the same time, under the rules, the level of amino acids decreased: glutamic acid by 9.8 % ( $P < 0.02$ ), indicating the formation of amides (glutamine) - the source of nitrogen for synthesis of amino acids, and the concentration of

threonine decreased by 4,1 % showing the normal course of protein metabolism. Of the essential amino acids the concentration decreased: valine by 9,0 % ( $P<0,01$ ), methionine - by 9,1 % ( $P<0,01$ ), leucine - by 8,5 % ( $P<0,01$ ), lysine - by 6,2 % ( $P<0,01$ ) and tryptophan - by 7,7 %. All data is given in comparison with the control and indicates the effective use of amino acids in the processes of biosynthesis of new tissue protein, increasing the growth rate of piglets.

The analysis of the activity of aminotransferase in blood serum and in liver tissues of suckling piglets under the influence of the soya okara allowed to note the high intensity of the reactions of reamination. In the experimental group of animals it was revealed a decrease in the activity of aspartate aminotransferase (AST) by 10,6 % ( $P<0,01$ ) and alanine aminotransferase (ALT) by 10,1 % ( $P<0,001$ ) compared to control. In the liver of piglets of the 2nd group, on the contrary, the activity of these enzymes increased by respectively 15,83 and 19,4 % in comparison with these indicators in analogues of the 1st group. This indicates a stimulation of the synthesis of new tissue protein and productive use of nitrogen.

The proof of this was the decline in the standards of non-protein nitrogenous substances in the blood serum of piglets of the 2nd group, in particular the main end product of nitrogen metabolism - urea concentration by 20,0 % ( $P<0,05$ ), at the same time, there was a decrease in the level of total bilirubin by 24,9 % ( $P<0,05$ ) compared to control. This indicates a positive nitrogen balance in the organism of piglets and reduction of percentage of nitrogen utilization. While in their blood creatinine increased by 17,2 % ( $P<0,01$ ) compared to this indicator in their peers of the 1st group, indicating the growth of muscle mass.

The revealed changes were accompanied by an increase in the absolute gain in live weight of piglets to the 21st day of life by 13,25% compared to control.

### CONCLUSION

The study of parameters of protein metabolism, concentration of ferrum and copper in tissues of suckling piglets with the use of soy okara revealed the following regularities: increase in the level of total protein in the blood and liver; decrease in blood fractions of  $\alpha_2$ - and  $\beta$ -globulins; high negative correlation level between concentrations of total protein and copper in the liver; ferrum deposit reserve in the liver; increase of efficient use of amino acids in the biosynthesis of tissue proteins; decrease of nitrogen utilization; reinforcement of anabolic processes.

It is proved that the use of soy okara as a feeding for sows during gestation and suckling has a beneficial effect on the organism of piglets. This manifests itself: strengthening of the processes of reamination and productive utilization of amino acids; positive nitrogen balance; stimulation of biosynthesis of tissue protein; decrease in transport and oxidation of trivalent ferrum, due to the supply of digestible iron of soy okara in their organism; localization of iron in the liver tissue of pigs.

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