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EFFICIENCY OF USING OF THE ORGANIC MINERAL MIXED LIGAND CUPRUM IN THE PIG FEEDING

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Abstract: The value of mineral substances for the normal life of the organism is very difficult to overestimate. However, inorganic salts of transition metals (Zinc, Cuprum, Ferrum, Manganum) due to low digestibility transit and in combination with the concomitant salts of heavy metals pollute the environment. So, traditional approaches to mineral nutrition of farm animals require substantial revision. The analysis of publications confidently attests about the benefits of using microelements from organic compounds in fodder production. This is related primarily with higher bioavailability, which reduces significantly their introduction in the feed mixtures. Experimental materials with justification of expediency of complex organic mineral mixed ligand Cuprum using in young pigs rations are presented. Positive effect for the putting of this complex into compound feed of crossbreed young pigs (Large White Landrace pig x Duroc pig) is established, which helps the metabolism and assimilation of nutrients, increases nutritional value of rations, average daily growth of animal and animal productivity.
Keywords: complex organic mineral mixed ligand Cu, crossbreed young pigs, quality of meat

1. INTRODUCTION

Particular attention is being paid to the problem of increasing the production of competitive meat products with the improvement of quality indexes (Bagchi Debasis, Swaroop Anand, Bagchi Manashi 2015). Modern animal breeds and crosses require increased macro- and micro- elements in mixed fodders due to a significant increase in growth and productivity (Gonzales-Eguia A., Fu C.-M., Lu F.-Y., & Lien, T.-F. (2009), Khalak V. I., Lunyk Yu. M., 2015). It is believed that protein, energy, and minerals should be digested in a more accessible form (Dyachenko L. S., Syvyc T. L., Tytariova O. M., Kuzmenko O. A., Bilkevich V. V. 2017).

The value of mineral substances for the normal life of the organism is very difficult to overestimate. However, inorganic salts of transition metals (Zinc, Cuprum, Ferrum, Manganum) due to low digestibility transit and in combination with the concomitant salts of heavy metals pollute the environment (Huang, Y., Zhou, T., Lee, J., Jang, H., Park, J., & Kim, I,. 2010;. Khavturina A. V.,Bomko V.S., 2015; Bomko V.S.,Dolid S.V., 2015). So, traditional approaches to mineral nutrition of farm animals require substantial revision. The analysis of publications confidently attests about the benefits of using microelements from organic compounds in fodder production. This is related primarily with higher bioavailability, which reduces significantly their introduction in the feed mixtures (Merzlov S. V., 2009; Marshalok V. A., Bomko V. S., 2012; Huang, Y. L., Ashwell, M. S., Fry, R. S., Lloyd, K. E., Flowers, W. L., & Spears, J. W., 2015).

Significant reduction of the level of microelements in organic forms of mixed fodders greatly reduces access to heavy metals and improves the quality of livestock products (Liao P., Li M., Li Y., Tan X., Zhao F., Shu X., & Yin Y., 2017).

Cuprum is an important part of the metal proteins which regulates oxidative and reconstructive processes of cellular respiration, photosynthesis, assimilation of molecular nitrogen. As part of hormones Cuprum affects growth and development, reproduction, metabolism in general, processes of gamma globulin formation, promotes the transformation of reticulocytes into mature erythrocytes. Cuprum is required for the formation of melanin pigment, affects the development of bones, and increases the content of vitamins B_{12} and C in the liver.

The purpose of the research was to study the effectiveness of using the complex organic mineral mixed ligand Cuprum on the quality of pig meat (Sologub L. I., Antonyak H. L., Stefanyshyn O. M., 2004).

2. MATERIAL AND METHOD

Scientific and economic research about the effectiveness of using the complex organic mineral mixed ligand Cuprum in rations of crossbreed young pigs (Large White Landrace pig x Duroc pig) on their meat productivity and qualitative indexes of meat were carried out in the private limited company "Agrofirma named after Horkii" in Dnipropetrovsk region.

To formulate the experiment on the principle of pair-analogues 3 groups of young pigs of 10 heads in each aged 60 days were formed. Animals of the 1st control group received a general diet, which contained of Cuprum in sulfate form. Young pigs of the 2nd experimental group received Cuprum in sulfate form as a part of the general food ration, which was replaced on mixed ligand complex only in 50% and animals of the 3d experimental group received feeding where Cu sulfate was completely replaced by a complex organic mineral mixed ligand Cu. Duration of the experiment was 150 days. Animals of all experimental groups were kept in the same room and served by one operator. Keeping of pigs were in groups without walking. All experimental animals were clinically healthy. The parameters of the microclimate in the

building were supported by the combined extract and input ventilation and conformed to the norms. The animals were fed twice a day, and the drinking was carried out using automatic drinking system.

Ration for young pigs were adjusted depending on age, live weight and intensity of growth and were calculated to obtain average daily increments within 650-700 g. The fodder was of a full value (Petukhova E. A., Bessarabova R. F., Khaleneva L. D., Antonova O. A., 2010).

3. RESULTS

The influence of organic mineral mixed ligand complex on dynamics of live weight of pigs is established. The conducted researches on using in ration of feeding of young pigs the complex organic mineral mixed ligand Cuprum showed that it influenced positively on the live weight of pigs on fattening (Figure 1), (Melnichenko O. P., Yakymenko I. L., Shevchenko R. L., 2006).

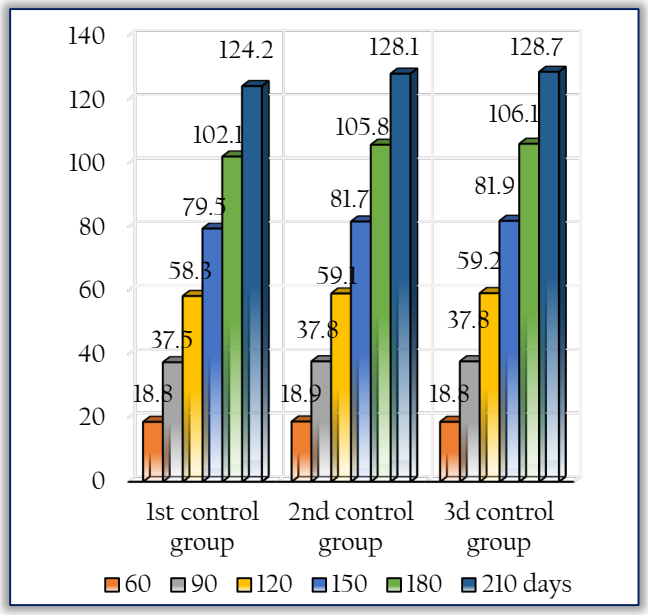

Figure 1. Dynamics of live weight of experimental pigs, kg

Throughout the period of fattening, the animals of experimental groups exceeded the weight of peers from the control group. By the end of the experiment, the difference in live weight of animals in the 2nd and 3rd experimental groups compared to the control group was 3,9 and 4,5 kg, or 3,14 % (P<0,05) and 3,63 % (P<0,01).

The absolute growth of live weight as a whole during the experimental period in young pigs exceeded control and was in the 2nd experimental group 109.2 kg, in the 3rd experimental group 109.9 kg, which is 3.6% (P <0.01) and 4.2% (P <0.001) higher than control.

During growing, the highest absolute growth of live weight was recorded in experimental groups pigs in the period from 151 to 180 days, which was 24,1 kg in the 2nd experimental group, 24,2 in the 3d experimental group against 22,6 in control. However, it should be noted that in the period from 91-120 days of fattening there was a significant increasing in the absolute growth in live weight of young pigs of experimental groups.

This indicates a high bioavailability of organic mineral mixed ligand Cu, which activated metabolic processes in the pig's body. And, as a result, the animals of experimental groups exceeded the analogues from the control group for the average daily gain of live weight.

During the experiment, the average daily increment of pigs in the 2nd experimental group exceeded the control on 18,7 g (2,63 %); P<0,05, 3d on 23,4 g (3,29 %); P<0,01. Higher intensity of live weight gain of animals in the experimental groups relative to control was observed throughout the fattening period.

Animals of experimental groups in indexes of relative growth exceeded the analogues from the control group throughout the entire period of breeding. Pigs' growth rates in experimental groups also were higher and made up 6.78 in the 2nd experimental group, 6.85 in the third experimental group, 6.61 in the control group.

Replacing the sulfate compound of Cu in rations of feeding pigs on organic mineral mixed ligand Cu had a positive effect on the growth rate of animals of experimental 2nd and 3rd groups.

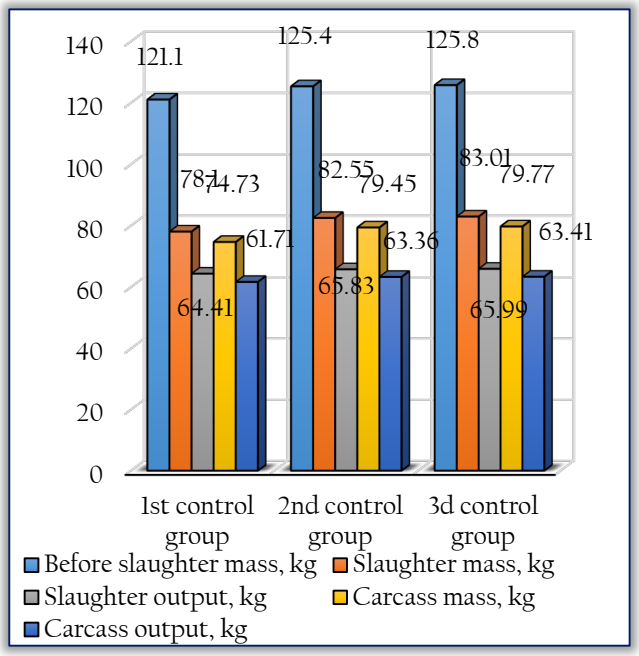

Figure 2 - Slaughter and meat qualities of experimental animals

The most important indicators of meat productivity are slaughter weight and mass of carcasses. The results of slaughter control showed a positive effect of organic mineral mixed ligand Cu on growth, development and meat productivity of pigs. Before slaughter pigs mass of experimental groups exceeded control on 4,3 kg (3,55 %), P<0,05 and 4,7 kg (3,88 %), P<0,01; mass of carcass on 4,72 kg (6,32 %), P<0,01 and 5,04 kg (6,74 %), P<0,001; slaughter output on 1,42 % (P<0,05) and 1,58 % (P<0,05), and carcass output on 1,65 and 1,7 (Figure 2).

The most important method of evaluation, which gives the most complete description of the quality of meat, of its physiological maturity, energetic and biological value, is an analysis of its chemical composition.

The results of a chemical analysis of the average muscle test of carcass found that in comparison with the control dry substance contained in pig meat in 2nd and 3d experimental groups was more on 0,52 (P<0,05) and 0,54 (P<0,05), protein on 0,46 (P<0,05) and 0,48 (P<0,05).

The content of fat in the animals average sample meat compared with control animals revealed no significant differences. Thus, according to the indexes of the chemical composition of the average sample of meat from the pigs back longest muscle of the carcasses in the experimental groups which received organic mineral mixed ligand Cu in the ration differed profitably from the animals of the control group.

Deeper and more objective information on the meat and lard rates of pigs can be obtained by analyzing the morphological composition of carcasses (table 1). In the first 6 months after birth, the pigs' muscles form in the most intensive way and, accordingly, their relative weight in the body increases. Later, the growth of muscles slows down and fat deposition increases. Therefore, the age of pigs is one of the decisive factors that determines the type of feeding and its success.

The data of experimental butchering of carcasses show that the using the general food ration in fattening pigs in the 1st control group containing Cu all in sulfate form, in pigs feeding of the 2nd experimental group with the general food ration where Cu sulfate was replaced by only 50% on the mixed ligand complex Cu and animals of the 3rd experimental group, where Cu sulfate was replaced completely by the organic mineral mixed ligand compound of this metal generally contributed an increase in the total amount of lard in carcasses by 0,8-2,2%, and meat - by 0,9-2,8%.

Table 1. Morphological composition of carcasses of experimental animals

Group	Amount of heads	Morphological composition, %			The ratio of meat and lard in the carcass	Coefficient of meatiness
		meat	lard	bones		
1 control	4	61,58	27,34	11,08	1:0,44	5,56
2 experimental	4	60,68	28,11	11,21	1:0,46	5,41
3 experimental	4	58,73	29,59	11,68	1:0,50	5,03

Accordingly, a general tendency was observed for reducing the meatiness coefficient by 0.15 and 0.50 units in accordance with control. Thus, summing up the obtained material, it can be stated that the using of the mixed ligand complex Cu contributed to a steady tendency to increase the slaughtered yield of carcasses and increased the general fattiness of animals, the effect of the mixed ligand complex Cu was most tangible in increasing these parameters in animals of the 3rd experimental group, however the difference in these indicators was not probable.

Replacement in the diet of fattening pigs Cu sulfate, which has an inorganic origin, on organic origin mixed ligand complex Cu had a positive effect on the growth and development of internal organs (table 2).

Table 2. Mass of internal organs of experimental pigs

Index	Groups		
	1 control	2 experimental	3 experimental
Internal fat, kg	1,05±0,12	0,92±0,1	0,82±0,04
Mass of head, kg	5,10±0,34	5,37±0,22	5,75±0,47
Mass of legs, kg	0,84±0,05	0,88±0,03	0,74±0,03
Mass of skin, kg	5,85±0,2	5,38±0,28	5,73±0,26
Liver, kg	1,93±0,11	1,62±0,11	1,78±0,1
Heart, kg	0,25±0,04	0,25±0,02	0,22±0,01
Lungs, kg	0,34±0,05	0,43±0,02	0,37±0,01
Spleen, kg	0,13±0,01	0,11±0,01	0,11±0,01
Stomach, kg	0,73±0,05	0,85±0,02	0,82±0,07

The results of the experiment on replacing Cu sulfate with Cu chelation showed that these drugs have a positive effect on hematopoiesis and biochemical parameters of metabolism, which leads to increasing of animal productivity and in a certain way affects the mass of individual internal organs. Given that the liver performs functions of secretion of bile, metabolic, antibacterial, anti-toxic, regenerative and other, changes in the mass of this organ of the pigs in the control and experimental groups fluctuated at the level of 0.7-4.4%. There is no reliable difference between the animals.

The results of the analysis of heart mass indexes indicate that significant differences between animals in control and experimental groups have not been established. The results of the determination of the lungs and kidneys mass indicate that there were no significant deviations of the pigs in the control and experimental groups.

It is known that the mass of the spleen increases with increasing of hematopoiesis cells death, and decreases - with the death of cells of the lymph and erythropoiesis. The obtained results of spleen weighing indicate that the average weight of the spleen was the highest in pigs of the 1st group. According to the indicator of the animals of this group, 2.8% of the pigs of the control group prevailed, but this difference was not reliable. Animals of the 2nd and 3rd experimental groups did not differ from the control analogs by the mass of the spleen.

The results of weighing of internal fat showed that its largest mass was fixed in pigs of the 1st group. The weight of the internal organs of the pigs in the experimental groups was at the control level, the difference was not probable.

Thus, the feeding of the organic-mineral additive of Cu in fattening of pigs for meat contributed positively to the slaughter rates of these animals. However, the best slaughter qualities were noted in those animals which diets contained of 100% of mixed ligand complex Cu. By weight of the internal organs of pigs between all groups difference is not observed.

It is known that young pigs produce meat carcasses with less amount of fat than adults. The level and quality of feeding determines the speed of reaching the necessary condition of fattening pigs, feed costs and quality of pork. The more intense the feeding, the faster the fattening ends and the lower feed expense per unit of output is. High levels of protein

contribute to the formation of muscles, and significant levels of energy - deposition of fat in the pigs' bodies. The quality of the lard depends on the fat content of the feed. The consumption of significant quantities of vegetable fats by pigs is responsible for the decline in the quality of pork. The fat of such pigs is mild and fusible, unsuitable for smoking. Data on measurements of the subcutaneous layers of fat thickness are given in Table 3.

Table 3. The thickness of the subcutaneous fat, sm

Index	Groups		
	1 control	2 experimental	3 experimental
On the neck	3,12±0,11	3,37±0,12	3,17±0,31
On the withers	4,87±0,11	5,92±0,45*	6,1±0,58*
On the 6-7 ribs	3,3±1,12	3,75±0,38	4,07±0,41
On sacrum	3,6±0,3	3,57±0,28	4,25±0,43
On the back	3,12±0,11	3,65±0,18	4,22±0,44
Average	3,6±0,15	4,05±0,28	4,36±0,43

From the data of the table it can be seen that the replacement of sulfur Cu with organic and mineral mixed ligand Cu in feed on 50% and 100% leads to a tendency of increasing the average thickness of lard in pigs of the 2nd group by 12.5%, and the third - by 21.1%, which has a direct correlation with the increasing in the mass of internal fat in carcasses of pigs of experimental groups. The tendency to thicken the lard in the experimental groups occurs at practically all measuring points. A probable difference is observed only on the withers ($P < 0.05$). The obtained data show that the diets with a mixed ligand complex cause the intensification of fat deposition in carcasses.

4. CONCLUSIONS

Thus, in the results of the control slaughter, the chemical composition of meat, the morphological composition of carcasses, the mass of the internal organs and the thickness of the lard indicate that the young pigs of the 3rd experimental group which received a complex of organic mineral mixed ligand complex Cu had precedence in our studies.

Note: This paper is based on the paper presented at ISB-INMA TEH' 2018 International Symposium (Agricultural and Mechanical Engineering), organized by Politehnica University of Bucharest – Faculty of Biotechnical Systems Engineering (ISB), National Institute of Research-Development for Machines and Installations Designed to Agriculture and Food Industry (INMA) Bucharest, The European Society of Agricultural Engineers (EurAgEng), Society of Agricultural Mechanical Engineers from Romania (SIMAR), National Research & Development Institute For Food Bioresources (IBA), University of Agronomic Sciences and Veterinary Medicine Of Bucharest (UASVMB), Research-Development Institute for Plant Protection (ICDPP), Hydraulics and Pneumatics Research Institute (INOE 2000 IHP), National Institute for Research and Development in Environmental Protection (INCDPM), in Bucharest, ROMANIA, between 01–03 November, 2018

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