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THE STATE OF PROTEIN AND MINERAL METABOLISM OF CROSSBRED PIGS FOR THE ACTION OF BETAINE

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Abstract

The effect of feed additive betaine on the content of macro- and microelements, as well as the number of amino acids in the liver of piglets is studied experimentally. It has been found that the additional consumption of feed additive betaine by crossbred piglets keeping for fattening has a positive effect on amino acid composition of the liver.

Using betaine we observe the highest content of arginine by 0.96% ($p<0.01$), methionine by 1.08% ($p\leq0.001$), threonine by 0.52% ($p\leq0.001$) and phenylalanine by 0.85% ($p\leq0.001$) in the liver of animals of the 3rd group compared to the control group. It is recorded the highest level of histidine in the liver of animals of the 4th group, it is by 0.13% ($p\leq0.001$) more than in the control group.

It is established that the consumption of feed additive by animals of the 2nd group increases the amount of calcium in the liver by 4.3% ($p\leq0.001$) compared to the control group. It is found that the feeding factor in the diet of crossbred piglets increases the amount of zinc by 17.9% ($p\leq0.001$) and of manganese by 16.7% ($p\leq0.001$) in the liver of animals of the 4th group compared to the control one.

Keywords: feed additive betaine, feeding, fattening, crossbred piglets, liver, complete feed.

Topicality. Improving the consumption, increasing the efficiency of feed application, and obtaining maximum livestock productivity is ensured by a high level of balanced feeding with various feed additives application.

Feed additives are used to improve the nutritional value of basic feed. Nowadays the list of feed additives includes hundreds of different feeds, it is constantly updated. Betaine (Betafin) occupies an important place among the protein supplements; it is a substance from sugar beet molasses [4].

Betaine is a natural sugar beet extract used in animal nutrition to improve performance. It maintains water balance in cells, the function of ion pumps and improves liver function by promoting homeostasis [1, 6].

The liver is the largest internal organ performing a metabolic function; it is involved in the metabolism of proteins, carbohydrates, fats, hormones, and vitamins; it is also involved in neutralization and detoxification of many endogenous and exogenous substances.

The liver is involved in the regulation of all types of metabolism due to anatomical and biochemical features. Participating in protein metabolism, the liver destroys and rebuilds blood proteins, it converts amino acids into a reserve source of energy and material for the synthesis of its own proteins in the body [2, 7].

The aim of these studies was to determine the amino acid and mineral content of the liver of crossbred piglets fed by betaine supplement in different proportions; we also researched the optimal amount of betaine in the diet.

Materials and methods of research. We have conducted a scientific experiment with crossbred piglets F1 (Big White x Landrace) at a nucleus farm Servolux Genetic LLC in Orativ district of Vinnytsia region to achieve the goal of research. The experiment was performed on four groups of young pigs selected by the principle of analogous groups according to the following scheme [5] (table 1).

We took into account sex, age, origin, live weight and growth intensity for the previous period (growth) forming analogous groups for scientific experiment. All animals were clinically healthy and suitable for research. 68 piglets were selected for the equalization period of the experiment, four 12 head groups were formed. During the equalization and the main periods, the control group received the basic ration (BR), i.e. complete ration feed TM Trouw Nutrition International (the Netherlands). Experimental groups were also fed by betaine feed additive according to the experimental scheme.

The duration of the equalization and main research periods was 15 and 72 days.

Biometric processing of digital material is processed by the method of M. Plokhinskyi [3].

Table 1

Scheme of Experiment

Group	Duration of the experiment, days		Number of animals in group, heads	Feeding characteristics
	Compared	Main		
1-control	15	72	12	BD (complete feeds)
2-experimental	15	72	12	BD + 0.5 kg of Betaine per 1 t of complete feeds
3-experimental	15	72	12	BD + 1 kg of Betaine per 1 t of complete feeds
4-experimental	15	72	12	OP + 1.5 kg of Betaine per 1 t of complete feeds

* BD – basic diet

Results of research. The role of the liver in protein metabolism is the hydrolysis and rearrangement of amino acids, their deamination.

Additional consumption of feed supplement betaine by crossbred piglets at fattening has a positive effect on the amino acid composition of the liver (Table 2).

The liver of animals of the 3rd group had the higher content of arginine by 0.96% (p≤0.01), methionine by 1.08% (p≤0.001), threonine by 0.52% (p≤0.001), and phenylalanine by 0.85% (p≤0.001) than in the control group under the action of the feed additive.

It was found that the feeding of animals by the researched additive increases the amount of valine by 1.97% (p≤0.001), isoleucine by 1.85% (p≤0.001) and leucine by 4.29% (p≤0.001) in the liver of the 2nd pig group.

Table 2

Amino acid content in pig liver, % (M ± m, n=4)

Amino acid	Group			
	1-control	2- experimental	3- experimental	4- experimental
Arginine	5.54±0.162	5.78 ± 0.055	6.50 ± 0.028**	5.99 ± 0.017*
Methionine	2.31±0.014	2.53 ± 0.027***	3.39 ± 0.002***	3.03 ± 0.010***
Threonine	4.19±0.031	3.47±0.004***	4.71±0.005***	4.59±0.015***
Valine	3.94±0.018	5.91 ± 0.021***	3.46 ± 0.007	3.71 ± 0.004***
Isoleucine	3.16±0.16	5.01 ± 0.008***	3.16 ± 0.008	3.39 ± 0.017
Leucine	7.45±0.013	11.74±0.064***	9.00 ± 0.010***	8.41 ± 0.042***
Histidine	3.31±0.053	2.53±0.044***	3.16 ± 0.012*	3.44 ± 0.004*
Phenylalanine	3.54±0.021	3.04 ± 0.044***	4.39 ± 0.007***	3.99 ± 0.007***
Lysine	10.46±0.021	9.19±0.026***	9.40 ± 0.017***	9.84±0.052***
Serine	4.32±0.008	3.30±0.007***	4.65±0.005***	4.63±0.014***
Tyrosine	3.32±0.008	1.80 ± 0.012***	3.59 ± 0.007***	3.53 ± 0.002***
Proline	3.52±0.177	3.34 ± 0.091	3.79 ± 0.085	5.10 ± 0.033***
Glycine	4.92±0.002	5.59 ± 0.029***	4.85 ± 0.005***	4.77 ± 0.009***
Alanine	8.37±0.019	10.63±0.058***	8.75 ± 0.007***	8.45 ± 0.011*
Cystine	0.89±0.035	0.95 ± 0.006	0.89 ± 0.003	0.91 ± 0.016
Aspartic acid	9.41±0.032	7.88±0.030***	7.88±0.011***	7.63±0.040***
Glutamic acid	21.28±0.117	17.26±0.071***	18.36±0.021***	18.52±0.127***

The highest level of histidine is recorded in the liver of animals of the 4th group; it is by 0.13% (p≤0.001) more than in the control sample. However, the content of this amino acid decreases by 0.78% (p≤0.001) and 0.15% (p≤0.05), respectively in the 2nd and 3rd groups.

However, the amount of lysine decreases in all experimental groups; the 2nd group had the its lowest amount, it is less by 1.27% (p≤0.001) than in the control group.

The use of betaine helps to increase the content of serine by 0.33% (p≤0.001) and tyrosine by 0.27% (p≤0.001) in the liver of the animals from the 3rd samples.

Additional consumption of feed additives increases the proportion of glycine by 0.67% (p≤0.001) and alanine by 2.26% (p≤0.001) in the liver of animals of the second group compared with control analogues.

The highest amount of proline was recorded in the liver of animals of the 4th group of pigs, it is by 1.58% (p≤0.001) more than in the control group.

There is also a tendency to increase the level of cystine in all experimental groups, but no significant difference with the control was found.

However, there is a decrease in the content of aspartic and glutamic acids in the liver of animals of experimental groups. The lowest level of aspartic acid is observed in the liver of animals of the 4th group, it is by 1.78% (p≤0.001) less than in the control. In the 2nd group the level of glutamic acid is by 4.02% (p≤0.001) less than in the control.

The effect of the studied additive on the content of

macronutrients in the liver of pigs was researched (Table 3).

Table 3

The content of macronutrients in the liver of pigs (M ± m, n=4)

Indicator	Group			
	1-control	2-experimental	3-experimental	4-experimental
Calcium, g / kg	0.091±0.0009	0.095±0.0009*	0.067±0.0010***	0.078±0.0014***
Phosphorus, g / kg	29.4±0.01	26.75±0.014***	29.32±0.009***	27.14±0.019***
Magnesium, g / kg	1.019±0.0009	1.051±0.0014***	1.047±0.0017***	1.452±0.0009***

It was found that the consumption of feed additives increased the amount of calcium by 4.3% ($p \leq 0.001$) in the liver of animals of the 2nd group of pigs.

However, there is a decrease in the level of phosphorus in the liver of the experimental groups under the action of drug. Thus, the 2nd sample has its lowest content, it is by 9.0% ($p \leq 0.001$) less than in the control indicator.

The effect of betaine on the content of trace elements in liver of pig for fattening was also investigated (table 4).

The application of the studied feed additive increases the amount of zinc by 17.9% ($p \leq 0.001$) and manganese by 16.7% ($p \leq 0.001$) in the liver of animals of the 4th group.

Table 4

Вміст мікроелементів у печінці свиней (M ± m, n=4)

Indicator	Group			
	1-control	2-experimental	3-experimental	4-experimental
Zinc, mg / kg	293.4±0.01	300.08±0.007***	298.52±0.012***	345.92±0.024***
Manganese, mg / kg	9.14±0.011	9.56±0.012***	8.58±0.009***	10.67±0.028***
Copper, mg / kg	683.22±0.009	236.9±0.02***	852.81±0.009***	291.08±0.004***
Cobalt, mg / kg	1.35±0.007	1.56±0.014***	1.76±0.017***	1.42±0.017**
Ferum, mg / kg	62.43±0.022	84.26±0.009***	193.67±0.005***	77.12±0.010***

It should be noted that there is an increase in magnesium and iron levels by 34.9% ($p \leq 0.001$) in the 2nd group, by 2.7% ($p \leq 0.001$) in the 3rd group; and by 23.5% ($p \leq 0.001$) in the 4th group under the influence of the researched feed factor compared to the control sample.

The level of copper increased by 24.8% ($p \leq 0.001$) and cobalt increased by 30.3% ($p \leq 0.001$) in animals of the 3rd experimental group under the influence of betaine.

Conclusions:

1. The higher content of arginine by 0.96% ($p \leq 0.01$), methionine by 1.08% ($p \leq 0.001$), threonine by 0.52% ($p \leq 0.01$), and phenylalanine by 0.85% ($p \leq 0.001$) when feeding the betaine in the amount of 1 kg per 1 ton of feed.
2. There was an increase in the level of magnesium and iron in the liver of all experimental groups of pigs, respectively, by 3.1 and 34.9% ($p \leq 0.001$) in the 2nd group, by 2.7% ($p \leq 0.001$) in the 3rd group, and ($p \leq 0,001$), and by 42.4 and 23.5% ($p \leq 0,001$) in the 4th group.

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