The effect of non-traditional feed additives on the metabolism of young pigs in Yakutia

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Abstract. The results of the study on the effect of zeolite feed additives on digestibility of fodder and metabolism of young white pigs in Yakutia are presented in the article. Three groups of pigs with 15 animals each were formed for the experiment. The formation of groups was produced by the method of analogues. The control group consumed a ration, the experimental groups additionally received Hongurin’s zeolite at the rate of 0.15 g/kg of body weight with 5 g of Kempendiai salt, and in the second experimental group pigs received 0.18 g/kg of Hongurin’s zeolite and 6 g of Kempendiai salt. The grinding class of zeolite flour is 1 mm. Feed additives have affected the rate of digestion and metabolism. So the experimental groups digested the nutrients better than the control group in dry matter by 0.22% and 0.91%, in organic matter by 0.55% and 1.28%, in protein by 2.16% and 2.96%, in fat by 3.83% and 4.45%, in fiber by 7.96% and 8.21%. When studying metabolism in terms of deposition of nitrogen, calcium and phosphorus in experimental groups of pigs, superiority over animals in the control group was observed. The best metabolism was observed in animals of the experimental groups that exceeded their analogues in nitrogen by 0.56% and 4.93%, in calcium by 2.18% and 20.06%, in phosphorus by 11.43% and 20.15%. Thus, the use of non-traditional feed additives zeolite hongurin in feeding pigs provides the intensity of digestion of feed and improves the metabolism of animals in Yakutia.

1. Introduction
It is known that intensification of the livestock industry and realization of the potential of animals as a result of achieving high profitability of livestock production depend on the organization of the most complete and balanced feeding of animals (P.N. Prokhorenko, 2008; V.I. Volgin, L.V. Romanenko, A. S. Bibikova, 2009; V.E. Ulitiko, 2014; S.I. Kononenko, 2016) [1, 2, 3, 4].

In turn, the organization of full-fledged animal feeding is based on knowledge about the animal's needs for various nutrient, mineral, biologically active substances and the value of a particular diet component (L.V. Toporova, A.V. Arkhipov, R.F. Bessarabova, 2004; N. G. Makartsev, 2007) [5, 6].

Food processes include food intake, its chemical composition, metabolism, assimilation, assimilation and isolation of the body’s vital products (N.I. Shtanenko, G.A. Medvedeva, 2015) [7].

An extensive domestic experience has been accumulated and the need to regulate trace elements in animal diets such as iron, copper, zinc, iodine, manganese, molybdenum, cobalt, selenium and chromium has been convincingly proven (V.A. Medvedsky, M.V. Rubina, M.V. Bazylev, 2004; O.P.
Zeolites are of particular importance in the feeding of farm animals and birds, as their inclusion in the diets contributes to the enrichment of the mineral composition. Zeolites also contribute to a more active assimilation of nutrient and mineral elements, have ion-exchange and bactericidal properties (V. Demircan, 2008; G.M. Shkuratova, V.A. Soloshenko; 2015; I.M. Donnik, O.P. Neverova, O.V. Gorelik, 2016) [11, 12, 13].

The gross chemical composition of the zeolite rocks of the Khongurin deposit in Yakutia is represented by oxides of silicon, aluminum, iron, manganese, calcium, sodium, potassium, copper, molybdenum, cobalt, and other impurities. Hongurin is a crushed rock, the main components of which are a mixture of non-metallic minerals: clinoptilolite and heylandite (K.E. Kolodeznikov, 2004) [14]. In hongurin, quartz, feldspars, and other micro and macro elements, which are vital for farm animals and birds, are also present as impurities.

Today, there is insufficient information on the effect of zeolite hongurin on the digestibility and metabolism of young pigs in Yakutia.

Therefore, the aim of the research was to study the influence of the Suntar zeolite on the digestibility and metabolism of young pigs in Yakutia.

The objectives of the research are the following:

- to study the digestibility of nutrients rations in young pigs of large white breed;
- to study metabolism in young pigs of large white breed.

2. Material and research methods

Studies on the possibility of including hongurin and Kempendiai salt in the diets of 4-month-old piglets were organized in 3 groups, 15 animals each selected according to the principle of analogues taking into account live weight, age and growth energy (table 1).

| Experimental groups | Number of animal units | Conditions of feeding |
|---------------------|------------------------|-----------------------|
| Control             | 15                     | MD                    |
| I experimental      | 15                     | MD + X 0.15 g/kg of live weight + K 5 g |
| II experimental     | 15                     | MD + X 0.18 g/kg of live weight + K 6 g |

Notes: MD is a main diet, X is zeolite hongurin, K is Kempendiai salt.

The microclimate of the room where the animals were kept met the following requirements: the room temperature ranged from 15 to 25°C. The concentration of CO₂ was ranged from 0.15 to 0.20%; the concentration of ammonia was 0.0055; hydrogen sulfide was ranged from 0.05 to 0.09%. Illumination was normal.

3. Research results and discussion

Researches were conducted to determine the effectiveness of the use of zeolite hongurin as a feed additive for fattening weaned piglets of large white breed. When growing piglets, a characteristic feature of their feeding is an unlimited supply of feed to ensure intensive growth.

The composition, nutritional value and average daily diet of young pigs are presented in table 2.

The analysis of the feeding of experimental young pigs of large white breed found that all feed and nutrient requirements at different periods of their growth corresponded to feeding standards, and were eaten well and completely.
Table 2. Composition and nutritional average daily diet of large white pigs.

| Type of fodder, kg | Rate | Norm | Actual |
|-------------------|------|------|--------|
| Complete feed, kg | 2.6  | 2.6  |        |
| Hongurin, g       | 11   | 11   |        |
| Salt, g           | 10   | 10   |        |

A daily diet contains:

|                | Rate | Norm | Actual |
|----------------|------|------|--------|
| EFU            | 2.5  | 2.6  |        |
| Metabolic energy, mJ | 25.0 | 26.0 |        |
| Dry basis, kg  | 1.9  | 2.2  |        |
| Crude protein, g | 315.5 | 382.0 |       |
| Digested protein | 230.0 | 268.0 |       |
| Lysin, g       | 13.3 | 12.1 |        |
| Threonine, g   | 8.6  | 7.8  |        |
| Methionine + cystine, g | 8.3 | 7.9  |        |
| Crude fibre, g | 130.0 | 128.0 |       |
| Calcium, g     | 16.0 | 19.0 |        |
| Phosphorus, g  | 13.0 | 16.0 |        |
| Ferrum, mg     | 162.0 | 130.0 |       |
| Copper, mg     | 23.0 | 12.0 |        |
| Zink, mg       | 110.0 | 235.0 |       |
| Cobalt, mg     | 2.3  | 1.2  |        |
| Manganese, mg  | 90.0 | 43.0 |        |
| Iodine, mg     | 0.5  | 0.3  |        |
| Carotin, mg    | 10.8 | -    |        |
| Vitamin A, ths. MU | 5.4 | -    |        |
| Vitamin D, ths. MU | 0.54 | -     |        |
| Vitamin E (tocopherol), mg | 5.5 | -    |        |
| Vitamin B1, mg | 4.2  | -    |        |
| Vitamin B2, mg | 5.7  | -    |        |
| Vitamin B3, mg | 27.7 | -    |        |
| Vitamin B4, mg | 1.9  | -    |        |
| Vitamin B5, mg | 110.0 | -   |        |
| Vitamin B12, mk | 44.0 |       |        |

Experiments to determine the digestibility of feed nutrients, as well as metabolism in young pigs of large white breed, were carried out in the middle of the experiment at the age of 5 months. The physiological experience was organized on three heads from each group of animals according to the generally accepted zootechnical technique.

Digestibility of nutrients of feed rations in young pigs of large white breed when using local non-traditional feed additives in their daily diet is presented in table 3.

Table 3. Digestibility of nutrients rations in young pigs of large white breed (M ± m, n = 3).

| Group of pigs | Dry basis | Organic matter | Protein | Fat | Fibre | Nitrogen-free extractive substances |
|---------------|-----------|----------------|---------|-----|-------|-----------------------------------|
|               |           |                |         |     |       | Excreted in feces, g              |
It should be noted that the experimental animals had a good appetite and had a slightly smooth reddish skin and shiny bristles.

Analyzing the obtained data on nutrient digestibility, it was found that young pigs of the control group lost to experimental groups I and II of animals in terms of digestibility coefficients by dry matter by 0.22% and 0.91%, by organic matter by 0.55% and 1.28%, by protein by 2.16% and 2.96%, by fat by 3.83% and 4.45%, by fibre by 7.96% and 8.21% and by nitrogen-free extractive substances by 0.89% and 1.31%. It was previously associated with the best process of digestion of the digestive system of animals, due to the influence of local non-traditional feed additives, which provides higher absorption of nutrients and minerals in the intestines and their deposition in the body of animals.

Thus, the inclusion of unconventional feed additives in the daily diet, hongurin in the amount of 0.15 and 0.18 g per kg of live weight of the animal and 5-6 g of Kempendiai salt provided an additional increase of 7.42-14.17%, as well as contributed to an increase in the digestibility of nutrients in the diet of animals. It is known that the level of feeding and the composition of feeds differently affect the digestibility of nutrients in the diet, but also the balance of nitrogen, calcium and phosphorus, respectively. The nitrogen balance in piglets of large white breed when local non-traditional feed additives included in their diet are presented in table 4.

**Table 4.** Nitrogen balance in young pigs of large white breed, (M ± m, n = 3).

| Rate                     | Control          | Group of animals I experimental | Group of animals II experimental |
|--------------------------|------------------|---------------------------------|---------------------------------|
| Taken with food, g       | 73.52±0.00       | 73.52±0.00                      | 73.52±0.00                      |
| Excreted in feces, g     | 15.35±0.81       | 14.66±0.11                      | 13.72±0.16                      |
| Digested, g              | 58.16±0.81       | 58.86±0.11                      | 59.80±0.16                      |
| Excreted in urine, g     | 22.47±1.07       | 22.97±1.05                      | 22.34±0.61                      |
| Delayed: (+), (-)        | +35.69±0.28      | +35.89±0.94                     | +37.45±0.69                     |
| Used, %:                 |                  |                                 |                                 |
| From taken               | 48.55±0.38       | 48.82±1.28                      | 50.94±0.94                      |
| From digested            | 61.41±1.33       | 61.00±1.70                      | 62.63±1.06                      |

It was established that in all experimental animals the nitrogen balance was positive. The control group of young pigs lost to the experimental groups of animals in terms of nitrogen balance by 0.56%
and 4.93%. We note that the intake of nutrient and biologically active substances with food in all groups of pigs was almost the same and practically did not have any significant differences in the groups.

Thus, the inclusion of local non-traditional feed additives in the main diet of experimental young pigs of large white breed positively affected the balance of nitrogen in the body.

The use and exchange of calcium by young pigs of large white breed when local non-traditional feed additives included in their diet are presented in Table 5.

**Table 5. Calcium balance in young pigs of large white breed, (M ± m, n = 3).**

| Rate                      | Control        | Group of animals |         |         |
|---------------------------|----------------|------------------|---------|---------|
|                           | Taken with food, g | I experimental   | II experimental |
| Taken with food, g        | 24.18±0.00     | 24.18±0.00      | 24.18±0.00 |
| Excreted in feces, g      | 17.47±1.17     | 17.31±0.75      | 16.17±0.26 |
| Excreted in urine, g      | 0.28±0.02      | 0.29±0.02       | 0.28±0.02 |
| Total excreted            | 17.75±1.15     | 17.61±0.78      | 16.46±0.24 |
| Delayed: (+), (-)         | +6.43±1.15     | +6.57±0.78      | +7.72±0.24 |
| Used, % from taken        | 26.59±4.77     | 27.18±3.21      | 31.95±0.99 |

The calcium balance showed that in all groups it was positive but differed in its content in the body. So the control group lost to the experimental groups of animals in the balance of calcium by 2.18% and 20.06%. The difference between the experimental groups is 17.50% in favor of the II experimental group.

The exchange of phosphorus and the use of it by young pigs of large white breed when local non-traditional feed additives included in their diets are presented in Table 6.

**Table 6. Phosphorus balance in young pigs of large white breed, (M ± m, n = 3).**

| Rate                      | Control        | Group of animals |         |         |
|---------------------------|----------------|------------------|---------|---------|
|                           | Taken with food, g | I experimental   | II experimental |
| Taken with food, g        | 23.66±0.00     | 23.66±0.00      | 23.66±0.00 |
| Excreted in feces, g      | 11.40±2.12     | 10.22±0.80      | 9.25±0.57 |
| Excreted in urine, g      | 1.58±0.01      | 1.54±0.04       | 1.57±0.13 |
| Total excreted            | 12.98±2.11     | 11.76±0.84      | 10.83±0.44 |
| Delayed: (+), (-)         | 10.67±2.11     | 11.89±0.84      | 12.82±0.44 |
| Used, % from taken        | 45.11±8.91     | 50.27±3.57      | 54.20±1.88 |

The phosphorus balance was positive in all experimental groups. The phosphorus balance was positive in all experimental groups of pigs; it is evidence of the fact that the diets of animals in the content of this element were complete and balanced.

The inclusion in the diet of local non-traditional feed additives for young large white breed at the rate of 0.15 and 0.18 g per kg of live weight of the animal from 5-6 g of Kempendiai salt increases the live weight by 3.02% and 6.68% higher compared to analogues of the control group and reduces feed consumption, and also affects the deposition of phosphorus in the body by 11.43% and 20.15%, respectively. It should be noted that the balance of nitrogen, calcium and phosphorus in experimental groups of young pigs of large white breed was in accordance with their growth and development during these age periods.

**4. Conclusion**

The use of non-traditional feed additives influenced the digestibility of nutrients in fattening young large white pigs, and were higher than in analogues from the control group: by dry matter by 0.22% and 0.91%, by organic matter by 0.55% and 1.28%, by protein by 2.16% and 2.96%, by fat by 3.83% and 4.45%, by fibre by 7.96% and 8.21%, and by nitrogen-free extractive substances by 0.89% and 1.31%.
The best metabolism for nitrogen, calcium and phosphorus was characterized by pigs from experimental groups that exceeded the control group by 0.56-4.93%, 2.18-20.06%, 11.43-20.15%.

Thus, the conducted researches prove the effectiveness of unconventional feed additives in feeding young pigs in the conditions of Yakutia.

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