Influence of feed additives on sows' reproductive functions

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Abstract. One of the radical ways to prevent and reduce mycotoxicosis on the animal body is the use of adsorbing feed additives in the diet. Inclusion of complex mineral and vegetable complex additive Nabikat at 0,20% dose and mineral - dry content of Glaukonit substance of 0.25% in enceinte and nursing sows' full-fledged combined fodder composition showed that they increase the digestibility of crude fiber in the uterus during deep pregnancy by 4.97 and 4.07%, as well as the digestibility of crude fat by 5.24 and 1.71% and deposit nitrogen in it. They amount to 2.54 g and 1.24 g respectively. Compared to Glaukonit, Nabikat has a more positive effect on the anabolic properties of metabolic body processes. As a result, sows' diversity in this group was 17.3% higher than in the control group, reaching 0.4% in the lazurite group. The difference in piglets' preservation amounted to 10.9% and 2.2%, as well as in the weight of the litter when weaning. The age amounted to 26.5 and 0.9, respectively.%. Nabikat addition to sows' diet reduced feed costs per piglet by 19.1 - 30.4%, using Glaukonit - by 4.7 -5.8%.

1 Introduction

Today in the Russian Federation, poultry and pig farming are the main sectors of animal husbandry, which has allowed to significantly increase the meat production in the country and reduce the share of imported products for the last decade. In 2016 alone, the increase in the number of pigs in the Russian Federation amounted to 4.2%, and the number that reached slaughter weight - 6.5% [5,13]. At the same time, the main pork production is concentrated on industrial complexes with modern technological equipment, feeding animals with dry full-fledged combined fodder. However, no matter how the diet is balanced by the normalized nutritional elements, their conversion into products largely depends on many factors, including the technology of grain feed harvesting - the most affected by mold fungi mycotoxins. Most often, contamination by mycotoxins occurs during the feed preparation period and their storage, less often - during transportation. Moisture of source material is the main reason for the favorable mold development on grain feed. The only way to prevent their development is to quickly remove excess moisture by drying, which is not always possible. That's why up to 70% of all harvested grain forages in

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the world contain mycotoxins, the diversity of which has over 300 species and, as a rule, their full determination is simply impossible [2,10].

A great breakthrough in the fight against mycotoxins was the organization of their determination at feed mills by ELISA method, allowing to establish the toxin class and its concentration. But even in the presence of the latter at MPC level, toxins can be cumulated in the body in parenchymal organs, negatively affect metabolism, growth and development of the body, disturb the fetuses' trophics and their viability in both ontogenetic and postnatal development periods.

To date, producers are offered various feed additives of sorption action, which can reduce the toxic load on the body, normalize the bacterial composition of the gastro-intestinal tract, replenish the host organism due to desorption by certain biogenic nutrients.

The most widespread sorption action feed additive in the diets of farm animals and poultry was shivyrtuin zeolite from the Chitinsky deposit, but later aluminosilicates of new deposits were used: sakhaptin, Sibaysky zeolite, silica deposits of Sverdlovsk region, Glaukonit and others [9].

If earlier aluminosilicates were included in the diet of farm animals in its pure form, today they have become used as carriers of prebiotics, probiotic cultures, vitamins, and other biologically active substances. Passing through the acidic reaction of the stomach medium, sorbents deliver dietary supplements to the small intestine, where they exhibit their biological effect. First of all, they normalize bacterial composition of intestinal microflora [3], reproduction functions of animals [8], increase the digestibility and use of nutrients of the diet [1,6], stimulate immune system of the body [7,11,15], growth and development [12,14], increase the indicators of meat productivity [1]. However, new feed additives based on aluminosilicates appearing on the domestic market require a wide approval in production conditions. The producers' recommendations not always correspond to the expected results, which can be influenced by the ingredients of the diet, the quality of feed, the availability of mineral and extra biologically active additives [4].

The main goal of our study was to compare the reproductive function of sows when using adsorption feed additives of Glaukonit and Nabikat in the diet. At the same time, tasks were established to study the uterus weight during pregnancy and lactation, productivity, dynamics of large-fetal piglets, growth during feeding milking cows, safety of livestock and economic efficiency of computational research.

Scientific and economic experiment was conducted in the conditions of "Uralbroiler" JSC on Rodnikovsky pig complex of Krasnoarmeysky district of Chelyabinsk region. For study, 3 groups of sows of 19 heads each were selected. When grouping, the animal's breed, age, live weight and physiological state were considered. Scientific and economic experiment was based on the scheme presented in Table 1.

Table 1. Experimental scheme

Group	Quantity, heads	Features of feeding
I control	19	Basic feeding diet (BD)
Experimental II	19	BD + Nabikat 0.20% from dry diet substances
Experimental III	19	BD + Glaukonit 0.25% from dry diet substances

Nabikat feed additive (manufacturer - Center of Implementation Technologies, Novosibirsk) is a set of plant-origin gallocatechins and a water-soluble monomolecular form of silicon; Glaukonit (manufacturer - Glaukonit LLC, Kunashak village of Chelyabinsk region) — natural aluminosilicate of Karinsky deposit, composition is presented by Al_2O_3up to 10.0% and SiO_2- up to 47 - 50.5%.

The feed additives tested were introduced into full-fledged combined fodder by step mixing. Sows' live weight control was carried out by individual weighing of animals during the period of pregnancy and nursing, piglets - at birth and weaning. In sows with deep pregnancy, a balance experiment was conducted to study digestibility and nutrient application in the diet. To control sows'metabolic status, blood was taken from 5 animals in each group during the preparation phase, the last third of pregnancy, and the nursing phase to determine morphological, physiological, and biochemical indicators.
Depending on the actual feed and the number of piglets received during weaning, the cost of feed per piglet was calculated. Digital materials undergo biometric processing, and the difference is considered significant at $P \leq 0.05$.

2 Material and methodology

Feeding sows during the period of pregnancy and nursing was carried out by full-fledged combined fodder SK-1 and SK-2, piglets - SK-4 in accordance with the detailed system of normed feeding. The studied feed additives had certain actions on the dynamics of experimental animals' live weight (Table 2).

Table 2. Change in the live weight of sows during the period of pregnancy and nursing ($X \pm S_x$, n=19)

Indicator	Group		
	I	II	III
Live weight, kg: - when set for the experiment	126.6±2.76	126.1±2.92	125.0±3.02
- 84 days of pregnancy	168.4±3.34	181.6±4.26	169.0±3.01
- 112 days of pregnancy	186.4 ±3.27	201.9±3.26**	189.0±2.82
Absolute gain of live weight, kg	59.8	75.8	64.0
Average daily gain, g	609±16	673±23*	651±11
in% to group I	100.0	110.5	106.9
Live weight, kg: - 5 day of lactation	167.4±2.57	182.8±3.79	168.0±3.02
- weaning piglets	150.95±2.61	157.8±3.04	145.6±2.51
Loss of body weight per lactation, kg	16.45	25.00	22.40
in% to group	100.0	151.3	136.2

Here and further: *) R≤0.05; **) R≤0.01; ***) R≤0.001.

If the average daily weight gain in the first control group was 609 g, then in the II experimental group the average daily weight gain was 10.5% ($P \leq 0.05$), and in the III group - 6.9%. During this period, the weight loss of these groups exceeded the loss of the control group by 51.3% and 36.2%, reaching 25.00 kg and 22.40 kg respectively. The feed supplement Nabikat had a more positive effect on sows' lactescence in comparison to Glaukonit. Whenever possible, this was combined with a difference in the digestibility and consumption of diet's nutrients.

The consequence of the balance experiment conducted on deeply pregnant sows (Table 3) showed that both Glaukonit and Nabikat have a positive effect on the digestibility of dry and organic matter of the diet.

Table 3. Nutrient digestibility coefficients of sows' diet, % ($X \pm S_x$, n=3)

Indicator	Group		
	I	II	III
DM	69.23±0.61	73.89±0.42***	72.92±0.25**

TM	73.43±0.81	75.81±0.59***	75.51±0.39**
CP	74.05±0.72	75.46±0.57	74.57±0.18
CF	36.12±0.78	41.09±0.90***	40.21±0.37***
CF	55.23±1.29	60.47±0.51**	56.94±0.57
NFES	78.88±0.32	81.57±0.56	79.89±0.65

At the same time, in the organic feed part Nabikat raised the digestibility of CF by 4.97% (P≤0.001), CF - by 5.24% (P≤0.01), and Glaukonit significantly increased the digestibility of CF by 4.07%. In the digestibility of CP and NFES, there is only a tendency to increase these indicators in the experimental groups in comparison with the control group. Whenever possible, these differences were combined with the more effective influence of silicon's biophilic configuration on metabolism compared to its presence in Glaukonit as an oxide.

Despite a slight difference in CP digestibility in the diet of sows of experimental groups, their loss of nitrogenous substances with the final products of metabolism - urine was lower than the control group, resulting in nitrogen deposition in the body of animals of II and III groups was superior to the analogues of I control by 2.54 g (P≤0.001) and 1.24 g (Figure 1).

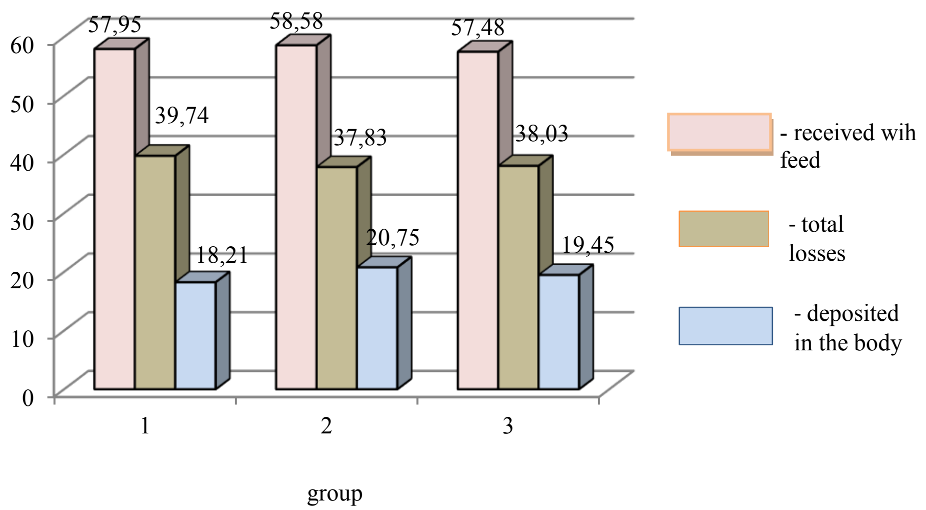

Fig. 1. Intake and deposition of nitrogen in sows' body, g/head per day

Existing differences in nutrient digestibility of experimental animals' diet showed that both Nabikat and Glaukonit during the entire period of pregnancy and nursing influenced on metabolic effects process in sows. At the same time, there were no reliable differences in the content of red blood cells and hemoglobin, calcium, phosphorus, and magnesium in all groups of animals. Although the concentration of total protein and total lipid in sows' blood was the same, these metabolites in the experimental group of animals are better used as plastic materials for anabolic processes, as evidenced by the data on urea and β-lipoproteins concentration. (Figure 2-3).

Compared to the control group, a significant difference in metabolism in the experimental group can be explained by the biological action of biophilic silicon and chelate plant form of some Nabikat micronutrients, which accelerate the metabolism of lipids and proteins. Aluminum and silicon oxide contained in mayenite have little effect on the anabolic process in animals.

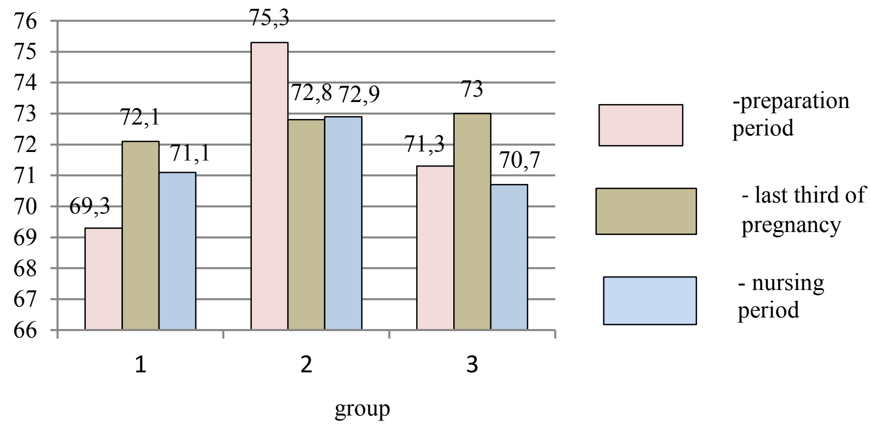

Fig. 2. Total protein content in the blood serum of sows, g/l

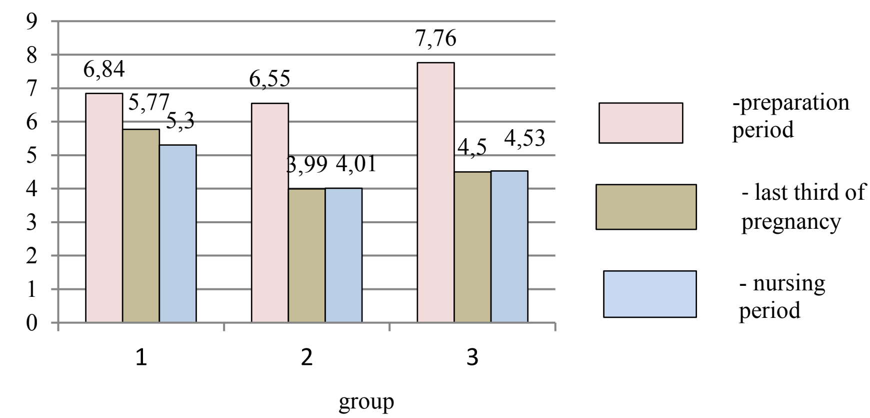

Fig. 3. Urea content in sows' serum, mmol/l

A more significant metabolic process in the body of experimental groups' sows in comparison to the control was seen on the reproduction functions of animals (Table 4).

Table 4. Reproductive functions of sows (X±S, n=19)

Indicator	Group		
	I	II	III
Multifertility, heads	10.11±0.46	11.86±0.40*	10.15±0.56
Large-fetal, g	1082±12	1050±23	1030±16
Gain of live weight, kg	8.00±0.21	8.69±0.35	8.02±0.21
Average daily gain, g	223±7	247±5	231±9
Seat live weight, kg:			
- at 30 days	89.48±2.72	113.20±3.55**	90.27±3.82
Number of piglets in a group, heads:			
- at birth	220	256	229
- at weaning	192	249	203
Preservation,%	86.4	97.3	88.6

Nabikat feed additive increased sows' multifertility by 17.3% ($P \leq 0.05$), with the use of Glaukonit - by 0.4%. With equal large-fetal piglets of all groups at the time of birth, their live weight in Group I and III was equal to weaning, and in group II - higher by 8.6%. In comparison with the control group, both Nabikat and Glaukonit raised the piglet stock preservation in the group by 10.9 and 2.2%, and the seat weight at a weaning age - by 26.5 ($P \leq 0.01$) and 0.9%.

Difference in reproducible functions of sows under the influence of studied feed additives and increased piglets' preservation by weaning allowed to reduce feed costs by 1 good piglet (Table 5).

Table 5. Cost effectiveness of conducted research (per head)

Indicator	Group		
	I	II	III
Fed:			
Combined fodder, kg	431.32	445.32	435.61
EFU	522.31	538.72	524.31
CP, kg	62.95	65.51	62.99
DP, kg	46.61	49.43	46.97
Piglets per 1 sow, heads	10.1	13.1	10.7
Spent per 1 weaning piglet:			
combined fodder	42.70	33.99	40.70
in% to group I	100.0	79.6	95.3
EFU	51.71	41.12	49.00
in% to group I	100.0	79.5	94.8
DP, kg	4.66	3.77	4.39
in% to group I	100.0	80.9	94.2

In sows' diet, Nabikat feed additive reduced the cost of fodder per 1 piglet by 30.4%, CFU and DP - by 19.1 -20.5%, using Glaukonit - by 4.7%, 5.2 -5.8%.

4 Conclusion

Similarly, to improve sows' reproductive function and the safety of sucking piglets during feeding, the most sensible approach is to increase the dry matter content in feed additive Nabikat up to 0.20%.

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