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The Effect of Feed Supplement Energosil on the Metabolism and Productivity of Young Pigs

Djunaidi Sharamazanovich Gayirbegov, Alexander Anatolievich Suvorov, Alexander Sergeevich Fedin, Alexander Ivanovich Andreev, Gennady Gennadievich Bragin

Abstract*: *The possibility of using the complex silicon-containing preparation Energosil as a new feed additive for replacement gilts has been scientifically substantiated. The influence of various dosages of Energosil on the digestibility and utilization of nutrients, as well as the growth of replacement gilts and the biochemical status of their blood has been studied. The most optimal dosage of the new feed additive in their diets has been determined, which is 5 mg/kg of the live weight of the animal. It has been found that gilts from the first experimental group that received the silicon-containing feed additive in these quantities grew better, and digested all nutrients in the diet, compared to their counterparts from other groups. Young replacement gilts from the first experimental group that in addition to the main diet received Energosil in the amount of 5 mg per kilogram of live weight retained in the organism 17.1% more nitrogen, 55.9 % more calcium, 69.7 % more phosphorus, compared to their counterparts from the reference group. Blood indicators of the gilts in the first group were also more favorable than those in other groups.

Index Terms*: *replacement gilts, groups, diet, supplement, Energosil, nutrients, digestibility, body weight, gain, blood.

I. INTRODUCTION

An important factor that determines the usefulness of feeding agricultural animals and poultry is enriching their diets with various safe to humans and animals and environmentally clean feed additives of domestic and foreign production. According to [1, 2], depending on the dosage, they have a positive effect on the productivity of animals and poultry and increase their resistance to diseases. One of such universal biologically active silicon-containing feed additives of the new generation is Energosil. This is a domestic two-component supplement that consists of a synthetic analog to phytohormones – Trekrezan, silatranemival, and a ballast binder [3, 4]. Analysis of the literature data shows that currently there is no uniform opinion about the advisability and the efficacy of using this feed supplement in the diet of replacement gilts.

Therefore, studying the influence of Energosil on the metabolism in their organisms and their productivity is a relevant task with certain scientific and practical value. Given these circumstances, this work was aimed at finding a scientific and production substantiation for the possibility of using and establishing the optimal dosage of the bioactive silicon-containing feed supplement of new generation Energosil in the combined feeds for replacement gilts, the energy of replacement gilts' growth, and the biochemical status of their blood.

II. METHODS

For reaching this goal, in the conditions of a pig-breeding complex at the Center for Practical Training of Agricultural Specialist in the Republic of Mordovia, the following scientific-economical experiment was held. For the experiment, 40 gilts were chosen with the same age and live weight, which were divided into four groups, 10 animals in each. The hygienic conditions of keeping animals in all groups were the same. Young animals were kept in group pens. The experimental gilts were also fed in groups in accordance with the norms of RAAS (2003) [5].In terms of the content of essential nutrients, the diets were the same and differed between the groups only in the amount of the Energosil feed supplement. The gilts in the reference group 30 to 42 days of age received the main diet from the full-fledged combined feed – PKS-3; 42 to 60 days of age – SPK-4; 61 to 104 days of age – SPK-5, and 104 to 240 days of age – SPK-6. The diets of the gilts, depending on their age, contained 1.5 to 4.65 energy feed units, 413.38 to 3,700 g of dry matter, and 77.26 to 387.37 g of digestible protein. Their counterparts from the first experimental group, in addition to the main diet, received Energosil during the seven months of the experiment in the amount of 5 mg per each kilogram of live weight, and animals in the second and the third experimental groups – 7.5 and 10 mg per kilogram of live weight, respectively. Against the background of the scientific and economic experiment, for identifying the effect of the studied factor on the digestibility and utilization of nutrients upon reaching the age of six months, a digestion trial was performed.

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* Correspondence Author
Djunaidi Sharamazanovich Gayirbegov*, National Research Ogarev Mordovia State University, Saransk, Russia.
Alexander Anatolievich Suvorov, National Research Ogarev Mordovia State University, Saransk, Russia.
Alexander Sergeevich Fedin, National Research Ogarev Mordovia State University, Saransk, Russia.
Alexander Ivanovich Andreev, National Research Ogarev Mordovia State University, Saransk, Russia.
Gennady Gennadievich Bragin, National Research Ogarev Mordovia State University, Saransk, Russia.

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For this purpose, three similar animals were chosen from each group.During the digestion trial, the conditions of keeping, feeding and care similar to those in the scientific and economic experiment were maintained.

The duration of the preparatory period was eight days, and that of the accounting period – 10 days. During the preparatory and accounting periods, the gilts were fed and watered individually, with daily accounting for the feed and its remainders.

After thorough mixing with the full-fledged combined feed, the preparation was given to young animals on a daily basis, in the scientific and economic experiment – to the whole group, and in the digestion trial – individually to each animal.

On the day of completing the digestion trial, with the aim of studying the effect of the Energosil feed supplement on the health of the gilts, the authors studied the blood of three animals – counterparts from each group, taken in the morning before feeding.

The obtained digital material was processed on a PC with the use of the Statistica application ver. 2.6. The obtained results were studied and compared using the method of groups. The difference between the groups by the average indicators was considered veracious with the probability level of (P = 0.05) determined by the Student's t-test according to E. K. Merkurieva [6].

III. RESULTS AND DISCUSSION

The results of the digestion trial have shown that adding the silicon-containing preparation to the diet of the gilts in the amount of 5 mg per kilogram of body weight significantly increased the digestibility of dry matter by 3.62 % ($p<0.05$), organic matter – by 3.29 % ($p<0.01$), crude protein – by 4.09% ($p<0.001$), fat – by 4.30 % ($p<0.01$), fiber – by 3.79 % ($p<0.01$), and nitrogen-free extractives – by 2.03% ($p>0.05$), compared to the reference counterparts. However, the pigs from the first experimental group also digested all nutrients better by the statistically significant difference except for the nitrogen-free extractives, compared to the animals in the second and the third experimental groups that received increased (7.5 and 10 mg/kg of live weight) dosages of Energosil in the diet.

It should also be noted that the animals in the second experimental group that received the feed additive in the amount of 7.5 mg/kg of live weight also digested all nutrients, except for the nitrogen-free extractives, better, compared to their counterparts in the reference group (Table 1).

Table 1. Digestibility and utilization of nutrients from the diet (n = 3)

Indicators	Groups			
	Reference	Experimental 1	Experimental 2	Experimental 3
Digestibility coefficients % :				
Dry matter	69.28±0.35	72.90±0.40*	71.07±0.34*	70.65±0.21
Organic matter	72.00±0.36	75.29±0.36**	73.83±0.14**	73.12±0.45
Crude protein	63.60±0.33	67.69±0.20***	65.25±0.41*	64.80±0.29
Crude fat	48.59±0.40	52.89±0.38**	50.70±0.38*	49.94±0.31
Crude fiber	31.06±0.47	34.85±0.47**	33.18±0.31*	32.02±0.57
Nitrogen-free extractives	79.11±0.89	81.14±0.77	81.30±0.45	79.72±0.55
Nitrogen digestion, g	29.70±0.79	34.80±0.40**	32.81±0.43	31.30±0.43
% from received	49.96±0.97	58.38±0.98**	54.17±0.48	52.22±0.40
% from digested	78.55±1.25	86.24±1.17**	89.33±2.94	80.58±0.99
Use of calcium, g	7.08±0.48	11.04±0.48**	8.80±0.41	7.68±0.20
% from received	35.88±2.24	56.03±2.56	44.59±1.94	38.70±1.30
Use of phosphorus, g	4.13±0.29	7.01±0.22**	5.12±0.21	4.70±0.15
% from received	24.49±1.89	41.48±0.99	30.38±1.60	27.67±1.16

*p<0.05; **p<0.01; ***p<0.001

The research aimed at determining the amount of digested nitrogen has shown that the balance of this element in young gilts in all groups was positive; at the same time, there were differences in the degree of its retention in the organism, depending on the amount of the Energosil supplement added to the diet. For instance, the gilts in the first experimental group that, in addition to the main diet, received Energosil in the amount of 5 mg/kg of live weight retained nitrogen in the organism by 5.1 grams, or 17.1% ($p<0.01$) more than their counterparts in the reference group, by 2 g, or 6 % ($p<0.05$) more than those in the second group, and by 3.5 g, or 11.1 % ($p<0.01$) more than those in the third experimental group.

It should also be noted that in terms of the increased dosages of Energosil, the best effect on nitrogen digestion from the diet was observed for the dosage of 7.5 mg/kg of body weight of the animal. The young animals that received Energosil in this amount digested nitrogen better by 3.11 g, or 10.4 % ($p<0.05$)

than their counterparts from the reference group, and by 1.51 g, or 4.8 % (p>0.05) than the counterparts from the third experimental group. The degree of absorbing the element from the eaten amount, in the first experimental group, compared to the reference counterparts, was higher by 8.42 % (p<0.01), compared to the second group – by 4.21 % (p<0.05), and to the third group – by 6.16 % (p<0.01). As to the degree of nitrogen assimilation from the digested amount, it was higherby 7.69 % (p < 0.01) in the first experimental group, compared to the reference, higher by 5.66 % (p < 0.01), compared to the third experimental group, and lower by 3.09 % (p>0.05), compared to the second experimental group. Studying the utilization of calcium and phosphorus has shown that the new feed supplement Energosil also had a certain effect on the degree of retaining these elements in the organisms of replacement gilts. For instance, when comparing the data by the groups, one can see that the best utilization of calcium and phosphorus both in the absolute and relative terms was observed in the animals from the first experimental group that received the feed supplement in the amount of 5 mg/kg of live weight a day. In the animals from this group, the retention of calcium in the organism was higher by 3.96 g, or 55.9 % (P<0.01), of phosphorus – higher by 2.88 g, or 69.7 %, compared to their counterparts in the reference group (P<0.01). Increasing the dosage of Energosil in the diets of the young gilts in the second and third experimental groups contributed to a certain decrease in the content of calcium and phosphorus in the organisms, compared to the first group; however, these indicators were higher than those in the reference group.

Monthly weighing of all experimental livestock in the groups has helped trace the dynamics of the gilts' growth in the period of monitoring (Table 2). For instance, over the 210 days of observation, the live weight of young animals in the first experimental group that received Energosil with the diet in the amount of 5 mg/kg of live weight, compared to the reference group, increased by 13.86 kg, or 10.8 % (p<0.001), compared to the second group – by 7.65 kg, or 5.7 % (p < 0.01), and, compared to the third experimental group – by 12.05 kg, or 9.2 % (p<0.001).

Table 2. The dynamics of replacement gilts' live weight growth, kg (n = 10)

Gilts' age, days	Groups			
	Reference	Experimental 1	Experimental 2	Experimental 3
30	8.30±0.16	8.00±0.18	8.20±0.17	8.10±0.17
60	24.11±0.28	24.70±0.34	24.50±0.56	24.50±0.37
90	38.20±0.28	40.40±0.52	39.20±0.84	38.70±0.55
120	54.30±0.27	58.80±0.52	56.30±0.81	55.00±0.64
150	73.00±0.34	79.80±0.80	75.70±0.94	74.20±0.51
180	92.00±0.45	100.20±0.87	96.20±0.85	93.30±0.51
210	111.65±0.53	123.30±0.98	117.55±0.95	113.40±0.67
240	128.34±0.60	142.20±0.89***	134.55±1.01**	130.15±0.88

** p <0.01*** p <0.001,

Increasing the amount of feed supplement in the diet to 7.5 mg/kg of live weight of the animal did not result in similar growth;however the weight of the animals in the second experimental group was by 6.21 kg, or 4.8 % higher than that in the reference (p<0.01), and by 4.4 kg, or 3.4% (p>0.05) higher than that in the third experimental group.

Increasing the share of Energosil in the combined feed to 10 mg/kg of body weight increased the body weight of the gilts in the third experimental group, compared to the reference counterparts, by 1.81 kg, or 1.4 % (p>0.05).

Over the period of growing the replacement gilts, the introduction of the feed supplement into the combined feed in the optimal amount (5 mg/kg of body weight) allowed increasing the average daily gain by 67.43 g, compared to the reference group, by 37.38 g compared to the secondgroup, and by 57.85 g, compared to the third experimental group (Table 3).

Table 3. The average daily weight gain by replacement gilts, g (n = 10)

Age, days	Groups			
	Reference	Experimental 1	Experimental 2	Experimental 3
30 – 60	527.00±5.56	556.66±6.05	543.33±13.37	546.66±7.80
60 – 90	469.66±6.56	523.30±7.92	490.00±24.30	473.33±10.90
90 – 120	536.67±3.26	613.33±7.02	570.00±13.54	543.33±6.68
120 – 150	623.33±3.06	700.00±13.17	646.66±5.47	640.00±18.44
150 – 180	633.30±6.52	680.00±5.47	683.33±8.99	636.66±17.95

180 – 210	655.00±12.34	770.00±16.02	711.66±8.79	670.00±25.55
210 – 240	556.33±8.17	630.00±15.27	566.67±13.12	558.33±15.96
Average for the experiment	571.61	639.04	601.66	581.19

Blood tests have shown that all studied blood parameters are within the limits of physiologically acceptable norms, which fact is the evidence of normal development and physiological state of the experimental animals. However, it should be noted that in the blood of the young gilts from the first experimental group that received the Energosil supplement in the amount of 5 mg/kg of live weight, a significant increase in the number of erythrocytes by7.7 % ($p<0.05$)was observed, compared to the counterparts from the reference group; by 3 % ($p>0.05$), compared to the counterparts in the second experimental group, and by 6.7 % ($p<0.05$), compared to the counterparts in third experimental group. In the blood of the gilts from the first experimental group, the amount of hemoglobin was higher, compared to the reference counterparts, by 12.4 %, to the counterparts from the second experimental group – by 5.2 %, and to the counterparts from the third experimental group – by 10.2 % ($p<0.001$).

The optimal dosage of Energosil in the diets of the young gilts from the first experimental group also contributed to reducing the concentration of leukocytes, compared to the counterparts from the reference group, by 4.6 % ($p<0.05$), to the counterparts from the second experimental group – by 2.8 % ($p>0.05$), and to the counterparts from the third experimental group – by 2.4 % ($p>0.05$).

Analysis of the action of various dosages of Energosil on the protein composition of blood has shown that the total protein concentration under the influence of the optimal amount of this feed supplement (5 mg/kg of body weight) in the first experimental groupincreased, compared with the reference counterparts, by 5.3 % ($p<0.05$),compared to the counterparts from the second experimental group – by 3.4 % ($p<0.05$), and compared to the counterparts from the third experimental group – by 5.2 % ($p<0.05$).

IV. CONCLUSION

Thus, based on the data obtained during the scientific and economic experiment, a conclusion can be made that the most favorable conditions for the best digestion of nutrients, digestion of nitrogen, utilization of calcium and phosphorus from the diet, increasing the growth energy of the gilts, as well as normalization of their blood composition are obtained upon the introduction of the new silicon-containing organic preparation Energosil in the amount of 5 mg/kg of body weight of the animal.

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