

Efficiency of complex feed hydrolysate on piglets of the rearing group

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Abstract. The authors carried out researches to study the effect of complex feed hydrolysate on the zootechnical parameters of piglets of the rearing group. As a result of the experiment, it was found that the productivity of piglets in the experimental group was higher than in the control group by 1.07 kg (3.61 %), 1.45 kg (4.90 %) and 2.10 kg (7.09 %). When analyzing the weight gain of piglets, an increase in this parameter was also found in the experimental groups. Thus, in the 1st experimental group, the weight gain of piglets during the study period was 4.42% higher than in the control group, 6.72 % higher in the 2nd experimental group and 7.87% higher in the 3rd group. The results of calculating feed costs per 1 kg of animal weight gain showed that in the 1st, 2nd and 3rd experimental groups, the conversion of compound feed was 1.88 kg, 1.82 kg and 1.81 kg, which is respectively lower than in the control group by 4.09 %, 6.65 % and 7.16 %. The results of the general and biochemical analysis of piglets' blood, reflecting metabolic processes and the state of internal organs, showed the absence of a negative effect of the feed additive on the animals' body, the studied parameters were within the limits of intraspecific norms. The results of physiological experiments showed that the use of feed additives in the diet of pigs contributed to a positive effect on the level of digestibility of individual nutrients in the diet.

1 Introduction

Pig breeding is an industry that occupies the second place in animal husbandry and is currently on the rise. Pig breeding remains a profitable trade, as these animals are prolific and unpretentious in keeping. The productivity of pigs depends, to a greater extent, on high-quality and full-fledged feeding [5].

As a result of the intensity of piglets growth, the need for macro- and microelements is much higher in them than in young animals of other animal species, for example, with a lack of zinc, manganese, vitamins A, B12, E, etc., there are factors that reduce the resistance of the body. The nervous system also reacts acutely, the synthesis of mediators is disrupted with insufficient intake of the trace element iodine, which contributes to the development of a secondary form of vitamin deficiency of group A, C and group B [1, 2, 6].

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Currently, an effective way to stimulate the functional reserves of the pigs body is considered to be feeding them biologically active additives, immunomodulators and adaptogens that are part of the diets in small quantities, but are very vital, contributing to the formation of persistent immunity, improving the physiological state and increasing the productivity of animals [4, 7].

Only a complete balance of diets and compound feeds for all elements of nutrition – energy, protein, amino acids, minerals, vitamins, antioxidants and other biologically active substances guarantee high productivity of animals and low feed costs for the production of livestock products [3, 7].

In this regard, the purpose of our work was to determine the safety and effectiveness of a complex feed additive based on hydrolysate of plant origin when introduced into the main diet of piglets.

2 Materials and methods

The object of research is a feed additive, which is a multicomponent preparation based on a group of vitamins A, D3, E, C, B1, B2, B6, B9, PP, zinc, manganese, calcium pantothenate, enzymatic hydrolysate of vegetable protein, potassium sorbate, sodium selenite, L-3,5 diiodothyrosine. It is designed to enrich the balancing of the diets of farm animals and poultry, effectively increase and reliably maintain a high level of productivity and preservation.

Studies on the safety and effectiveness of feed additives in the diet of piglets of the rearing group were carried out on the basis of the TPC "Piglet" of the Kuban educational and experimental farm, laboratory blood tests were carried out on the basis of the scientific and testing center of toxico-pharmacological research and development of veterinary medicines, feed additives and disinfectants (SIC Vetfarmbiocentr), feed analyses and the isolation products of target animals were carried out in the research laboratory of the Department of Biotechnology, Biochemistry and Biophysics are structural divisions of Kuban State Agrarian University named after I. T. Trubilin.

Experiments to determine the safety and effectiveness of feed additives in pig feeding were carried out on 240 piglets of the rearing group at the age of 30 days, with a live body weight, on average, 8.01 kg. During the experiment, the dynamics of live weight was recorded at the beginning and at the end of the experiment, by individually weighing piglets of each group. Based on the live weight parameters, the average increase per head was calculated. The consumption and feed costs for the live weight gain of piglets were recorded for the entire experiment, by taking into account the amount of prepared and eaten compound feed for the entire period of research.

The safety of animals and the causes of plague were taken into account throughout the experiment. A physical clinical examination was performed daily, which included an assessment of appetite (decrease, increase or physiological norm), feed intake, motor activity.

Morphological and biochemical parameters of blood of laboratory and target animals were studied.

3 Results of research

As a result of the experiments conducted to study the safety and effectiveness of feed additives when introduced into the diet of piglets during the rearing period, based on the results of control weighings, the productivity of experimental animals was determined –

live weight at the beginning and at the end of the experiment, as well as their safety and feed costs per unit of production (Table 1).

Table 1. Parameters of productivity, safety and conversion of compound feed for piglets of experimental and control groups when introducing a feed additive into the diet

Parameter	Group			
	Control	1 st experimental	2 nd experimental	3 rd experimental
Average age at check-in, day	30	30	30	30
Average age at transfer, day	80	80	80	80
Growing period, day	50	50	50	50
Number of heads during the production	60	60	60	60
Number of the transfer, heads	60	60	60	60
Weight at check-in, total, kg	473,3	480,1	472,6	496,9
Weight at the end of the experiment, total, kg	1777,3	1841,6	1864,4	1902,9
Average weight at check-in 1 head, kg	7,89±0,04	8,00±0,04	7,88±0,053	8,28±0,04
Average weight of 1 head at the end of the experiment, kg	29,62±0,22	30,69±0,31	31,07±0,25	31,72±0,31
Increase of 1 head during the research period, kg	21,73	22,69	23,19	23,44
Amount of feed consumed during the period, kg	2550	2560	2540	2550
Feed conversion, kg	1,96	1,88	1,82	1,81
Dead animals, heads	0	0	0	0
Plague, %	0	0	0	0
Culling, heads	0	0	0	0
Culling, %	0	0	0	0
Total waste, %	0	0	0	0
Preservation, %	100	100	100	100

Daily inspection and observation of piglets of experimental groups demonstrated that during the entire period of the experiments, the appetite and motor activity of the animals of the experimental and control groups did not differ, they satisfactorily consumed feed and water.

The results of taking into account the productive parameters of piglets during rearing showed that at the end of the experiment, the live body weight of one head, on average, in the 1st experimental group was 30.69 ± 0.31 kg, in the 2nd experimental group - 31.07 ± 0.25 kg and in the 3rd experimental group - 31.72 ± 0.31 kg, respectively higher than in the control group by 1.07 kg (3.61 %), 1.45 kg (4.90 %) and 2.10 kg (7.09 %). When analyzing the weight gain of piglets, an increase in this parameter was also found in the experimental groups compared with the control group of pigs. Thus, in the 1st experimental group, the weight gain of piglets during the study period was 4.42 % higher than in the control group, 6.72 % higher in the 2nd experimental group and 7.87 % higher in the 3rd group.

The results of calculating feed costs per 1 kg of animal weight gain (conversion) showed that in the 1st, 2nd and 3rd experimental groups, the conversion of compound feed was 1.88 kg, 1.82 kg and 1.81 kg, which is respectively lower than in the control group by 4.09 %, 6.65 % and 7.16 %.

During the study period, no plague and forced culling were registered in the control group, thus, the safety of livestock by the end of the experiment was 100.0 %.

Blood was taken for general and biochemical blood analysis (Table 2) at the end of the experiment.

Table 2. Changes in biochemical and morphological parameters of the rearing group piglets blood ($n = 10$)

Parameter	Group				Norm
	Control	1st experimental	2 nd experimental	3rd experimental	
<i>General blood test</i>					
Red blood cells, 10 ¹² /l	7,10±0,14	7,39±0,17	7,63±0,14**	6,92±0,20	5,5–9,0
Hemoglobin, g/l	116,70±2,91	123,3±2,103	127,40±3,40*	136,10±3,28***	100,0–160,0
Hematocrit, %	39,40±1,43	42,95±1,42	42,88±1,50	41,44±1,83	33,0–52,0
ESR, mm/hour	5,00±0,30	3,80±0,42*	3,90±0,88	3,30±0,60*	2,0–9,0
Leukocytes, 10 ⁹ /l	15,79±1,12	22,05±1,20***	19,68±1,34*	23,82±0,67***	10,2–30,0
Lymphocytes, %	55,26±2,21	53,31±1,71	58,91±2,28	62,11±1,19**	40–70
Monocytes, %	9,37±0,37	8,09±0,20**	9,51±0,260	8,87±0,40	1–12
Neutrophils, %	32,00±2,17	33,75±1,62	27,45±2,480	22,97±1,19***	20–60
Eosinophils, %	2,72±0,52	4,09±0,56	3,48±0,44	5,41±0,590***	0–8,9
Basophils, %	0,66±0,09	0,75±0,15	0,64±0,09	0,64±0,09	0–2
<i>Biochemical blood analysis</i>					
AST, Units/l	41,35±2,41	40,93±1,72	45,78±2,41	44,18±1,68	15,3–55,3
ALT, Units/l	34,40±2,76	37,65±2,15	36,69±1,38	40,00±1,22	21,7–46,5
Alkaline phosphatase, Units/l	156,79±3,15	167,28±2,89*	171,45±5,01*	179,39±3,38***	140,0–200,0
Cholesterol, mmol/l	1,97±0,15	1,84±0,17	1,80±0,1	1,63±0,12	0,2–3,3
Triglycerides, mmol/l	0,43±0,02	0,38±0,03	0,38±0,03	0,40±0,03	0,2–0,5
Total bilirubin, mmol/l	2,19±0,12	2,44±0,13	2,22±0,13	2,24±0,13	1,7–3,4
Direct bilirubin, mmol/l	1,54±0,14	1,63±0,12	1,65±0,14	1,53±0,17	0,1–2,1
Urea, mmol/l	5,03±0,18	4,90±0,19	5,30±0,16	4,97±0,18	3,7–6,4
Creatinine, mmol/l	119,60±4,55	128,90±3,99	129,60±4,97	121,80±5,88	69,6–207,7
Total protein, g/l	68,17±1,42	72,24±0,99*	74,78±0,91***	75,67±0,82***	58,3–83,2
Albumin, g/l	26,80±0,83	28,38±0,71	28,97±0,61*	30,20±0,53***	19,0–33,0
Glucose, mmol/l	5,76±0,09	5,23±0,13**	5,13±0,10***	5,10±0,15***	4,0–6,4
LDG, Unit/l	339,87±9,33	319,28±13,08	323,28±8,25	326,48±8,83	159,6–424,7
Calcium, mmol/l	2,57±0,09	2,69±0,06	2,77±0,09	2,76±0,09	2,5–3,5
Phosphorus, mmol/l	1,43±0,04	1,53±0,05	1,67±0,05***	1,73±0,04***	1,4–1,9

Note: the differences are reliable (* $p \leq 0.05$; ** $p \leq 0.01$; *** $p \leq 0.001$) in comparison with the control

The results of the general blood analysis of piglets obtained during the studies on the rearing of the control and experimental groups were within the reference values for this type of animal. The following significant differences were noted in the studied parameters: the number of erythrocytes in piglets of the 3rd experimental group was 10.26 % higher than the control indicators. The saturation of hemoglobin in erythrocytes in piglets of the control group was 116.70 ± 2.91 g/l, which is lower than similar indicators of the 1st experimental group by 5.65 % (without statistical reliability), by 9.17 % and 16.62 % in comparison with the values

obtained in the 2nd and 3rd experimental groups (at $p \leq 0.05$ and $p \leq 0.001$, respectively). The erythrocyte sedimentation rate (ESR) in the control group was 5.00 ± 0.30 mm/hour, in the 1st experimental group – 3.80 ± 0.42 mm /hour, in the 2nd – 3.90 ± 0.88 mm /hour, in the 3rd – 3.30 ± 0.60 mm /hour, a significant difference in these parameters was noted between the control and the 1st and 3rd experimental groups, amounting to 24.0 and 34.0 %, respectively. There was a tendency of a significant increase in the leukocyte content in the blood of the tested piglets in comparison with the control by 24.64 %, 39.65 % and 50.86 %, respectively, groups. In the parameters of the leukocyte formula, there are also reliable changes in the parameters of the content of lymphocytes, monocytes, neutrophils and eosinophils between the experimental and control groups, however, all changes reflect the correlation of changes in the total composition of whole blood, having no diagnostic significance from the administered feed additive. Thus, the reflected changes in the total blood count of the tested piglets demonstrate an improvement in erythropoiesis, an associated increase in oxygen transport and an increase in the immune response in the body of experimental animals, due to the complex influence of the components that make up the feed additive.

The results of the biochemical analysis of piglets' blood, reflecting metabolic processes and the state of internal organs, showed that there was no negative effect of the feed additive on the animals' body. The studied parameters were within the limits of intraspecific norms. It should be noted a significant trend in the growth of the level of alkaline phosphatase: in the 1st, 2nd and 3rd experimental groups, this indicator was higher than the control indicator by 6.69 %, 9.35 % and 14.41 %, respectively, which indicates a more active growth in the animals of the experimental groups. The same difference is noted in the parameters of total protein, which amounted to 68.17 ± 1.42 g/l in the control group and was significantly lower by 6.20 %, 9.70 % and 11.00 %, respectively, in the 1st, 2nd and 3rd experimental groups. The albumin level in the control group was 26.80 ± 0.83 g/l, in the 1st group - 28.38 ± 0.71 g/l, in the 2nd – 28.97 ± 0.61 g/l, in the 3rd - 30.20 ± 0.53 g/l, however, statistical reliability in favor of the experimental groups was noted only the 2nd and 3rd groups. There was a trend towards a decrease in glucose levels: the difference between the control and the 1st group was 9.20 %, the 2nd group - 10.94 %, the 3rd group – 11.46 %. It is worth paying attention to the increased metabolism of calcium and phosphorus in the body of the experimental piglets of the rearing group: for example, the calcium level in the 1st experimental group was higher than the same parameter in the control by 7.00 % (without correlation coefficient), in the 2nd experimental group there was a difference of 16.78 % compared with the control at the level of reliability $p \leq 0.001$, in the 3rd group by 20.98 %. The difference in serum calcium in the tested animals had no statistical significance, however, its level in the experimental groups was higher than the control parameter by 4.67 % (group 1), 7.78 % (group 2) and 7.39 % (group 3).

On the basis of individual accounting of the consumed feed and excreted feces, as well as data on their chemical composition, the coefficients of digestibility and use of nutrients of the diets were determined (Table 3).

Table 3. Results of the coefficient of digestibility and use of nutrients of compound feed by pigs on rearing, $n = 4$

Parameter	Group			
	Control	1 st experimental	2 nd experimental	3 rd experientnal
<i>Coefficient of digestibility of nutrients</i>				
Dry matter, %	79,70±0,24	79,95±0,75	81,68±0,47***	82,98±0,21***
Ash, %	47,35±0,94	48,48±0,48	48,28±0,54	49,58±0,35*
Raw protein, %	72,83±0,36	73,05±0,47	73,73±0,56	74,65±0,43**
Raw fat, %	58,65±1,00	59,23±0,55	59,93±0,52	60,43±0,34
Raw fiber, %	41,93±0,61	41,80±0,70	43,50±0,70	43,95±0,37**
BEV, %	88,70±0,51	89,20±0,87	89,23±1,17	88,90±1,11
Organic substance, %	81,54±0,36	81,95±0,68	82,24±0,73	82,26±0,65
<i>The coefficient of use of mineral substances from taken with feed</i>				
Nitrogen, %	30,13±1,67	31,45±1,23	32,38±0,91	33,85±0,56*
Calcium, %	43,23±1,03	42,95±0,81	44,60±0,50	45,678±0,81
Phosphorus, %	44,45±0,21	43,73±0,42	44,85±0,49	46,38±0,55**

Note: the differences are reliable (* $p \leq 0.05$; ** $p \leq 0.01$; *** $p \leq 0.001$) in comparison with the control

The results of physiological experiments showed that the use of feed additives in the diet of pigs contributed to a positive effect on the level of digestibility of individual nutrients of the diet, especially in the 3rd experimental group. It was found that the digestibility of dry matter in the 3rd experimental group was significantly higher than in the control group by 4.12 %, crude ash – 4.71 %, crude protein – 2.50 %, crude fat – 3.04 % (without significant meaning), crude fiber – 4.82 %. There were no significant shifts in the digestibility of nitrogen-free extractives and organic matter.

When analyzing the balance of mineral substances, significant changes in comparison with the control group were also revealed in the parameters of the 3rd experimental group: the nitrogen content in the control was 30.13 ± 1.67 % versus 33.85 ± 0.56 % in the experiment (a statistically significant difference was 12.35 %), the phosphorus content in the 3rd group was higher than the control parameter by 4.34 %.

4 Conclusion

When studying the safety and effectiveness of target animal species, it was found that the introduction of the studied complex feed additive into the main diet of piglets of the rearing group at a dose of 500.0 ml, 1000.0 ml and 1500.0 ml per 1 ton of compound feed contributes to an increase in live weight by 3.61–7.09 %, an increase in live weight by 4.42–7.87 %, a decrease in the conversion of compound feed by 4.09–7.16 %, as well as increased digestibility.

The beneficial effect of the feed additive on the piglets' body is due to the complex stimulating effect of its components: a complex of vitamins is a catalyst for metabolic processes, amino acids are structural units of tissue proteins, enzymes, peptide hormones and other biologically active compounds. Thus, the investigated complex feed additive normalizes protein and general metabolism, which contributes to the increase in live weight and productivity in animals.

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