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Development of Technology for Producing Organic Pork With the Introduce of Probiotics, Prebiotics and Synbiotics into the Diet

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Abstract*: *As a result of the work, adequately new data were obtained on the change in the intestinal microbiocenosis of pigs during their entire life. The degree of influence of the probiotic, prebiotic and synbiotic on the change in the microbiocenosis of the intestines of pigs is determined. A scheme for the introduction of lactic starter cultures, "Baliz-V" and lactic starter cultures and "Baliz-V" together. The effect of the new diet on growth indicators, microbiocenosis, immunity and the quality of raw meat was studied. The positive effect of the synbiotic effect on the quantitative composition of lactic acid bacteria in the intestines of young pigs was 3-4 orders of magnitude higher than in the control. The use of a probiotic, prebiotic and synbiotic led to an improvement in intestinal microbiocenosis, strengthening the body's resistance, and an increase in live weight gain, respectively, by 8.4; 9.6 and 10.7%.

Keywords* : *Pigs, Probiotic, Prebiotic, Synbiotic, Immunity, Quality and Safety of Raw Meat.

I. INTRODUCTION

One of the safest and cheapest methods to improve the quality of raw meat is the use of probiotics (living microorganisms) and prebiotics (oligosaccharides, organic acids, etc.) that have beneficial effects on the vital activity of the intestinal microflora of the animal host by correcting and activating the vital functions of the microflora of its digestive tract [6 ,nine]. In connection with the rapid development of agricultural biotechnology, interest in the use of probiotic microorganisms, prebiotics, and their complexes (synbiotic) in animal husbandry has increased [7, 10, 14, 15]. Microorganisms and their metabolic products are widely used as bioprotectors for the prevention and treatment of gastrointestinal diseases. Probiotics are considered as the most promising antibiotic substitutes in agriculture [2, 12, 13].

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The maximum amount of normoflora is found in the lower intestine, primarily useful include lactobacilli of the genus Lactobacillus (L. Acidophilus) and bifidobacteria of the genus Bifidobacterium (B. lactis, B. breve, B. bifidum and others). Bifidobacteria are mainly found in the colon . It is thanks to bifidobacteria and lactobacilli that the optimal immune status is maintained. They affect the body's immune system through activation of monocyte migration, activation of phagocytic activity. Bifidobacteria serve as a protective barrier against pathogenic microorganisms, activate the digestion of feed, the absorption of amino acids, vitamins, trace elements. Lactobacilli are natural antibiotics for the body. In the process of metabolism, lactobacilli produce organic acids, including lactic acid, antibiotics, bacteriocins. The main ones are the protective and immunoprotective functions of lactobacilli. In order to fully activate the work of beneficial microorganisms, prebiotics such as Baliz-B (veterinary) containing organic acids are necessary [5, 11]. Normoflora, which inhabits a healthy intestine, produces B vitamins and nicotinic acid, due to which the body's cells are enriched with calcium and iron from fodder products. Disruption of the normal intestinal microflora can occur for various reasons. As a result of failures, beneficial bacteria die, and pathogenic bacteria, on the contrary, multiply more actively.

Probiotics are living microorganisms and preparations based on them that have beneficial effects on the body of an animal host [4, 8]. Positive effects are manifested both at the local level through the normalization of the microbial ecology of the digestive tract, and systemically [3]. The basis of most modern probiotics are lactic acid microorganisms isolated from the luminal microflora of warm-blooded animals. These are bacteria of the genera Bifidobacterium, Lactobacillus, Lactococcus, Streptococcus, etc. Probiotics are able to suppress the vital activity of pathogenic microorganisms, improve the physiological state of the animal and increase its productive qualities [1, 3]. The probiotic MKZ was developed at the SKNIIZH FSBI. Its activity is determined by the bacteria contained in it, which, having a high antagonistic activity to a wide range of pathogenic and conditionally pathogenic microorganisms, improve feed absorption, stimulate metabolic processes, and prevent the development of dysbacteriosis. Baliz-B obtained by biotechnological method.

The mechanism of action of organic acids of such prebiotics as “Baliz-2” and “Baliz-B” (veterinary) is associated with a decrease in pH in the intestine and a positive effect on the host through selective stimulation of growth or enhancement of the metabolic activity of normal intestinal microflora. “Baliz-B” is a filtered culture fluid formed as a result of the metabolism of an aerobic gluconobacter containing gluconic acids (gluconic, 2,5-diketogluconic, 5-ketogluconic, 2-ketogluconic and kamenovo). The authors found that "Baliz-V" has no inhibitory effect on lactic acid bacteria [5].

Synbiotics are a combination of prebiotics and probiotics, which have a positive effect on the health of animals and humans. In our studies, the complex of the MKZ probiotic and the Baliz-V prebiotic was studied as a synbiotic.

II. MATERIAL AND METHODS

The purpose of the research was to study the effect of probiotic lactic acid starter culture (“MKZ”) based on propionic acid and lactobacilli produced by LLC NPF Biovet (Moscow); veterinary prebiotic "Baliz-V" containing Kamenovo and other organic acids produced by Baliz-Pharm (Krasnodar); synbiotic (“MKZ” + “Baliz-V”) on the microbiocenosis of the large intestine and the productivity of young pigs raised to produce organic pork.

The experiment was carried out in the FSUE OPH Leninsky Put in the Novokubansky District of the Krasnodar Territory. For the experiment, 40 weaning piglets of 24 days of age with an average live weight of 9.0 ± 0.5 kg were selected, formed in 4 groups of analogues (n = 10). Animals were in similar conditions of keeping and feeding. The first group is the control on the main diet (RR), balanced by nutrition (table. 1).

Table - I: Nutritional ration by age of growing and fattening experienced pigs (n = 10)

1 kg content	Growing and fattening period (months)		
	start (0-2)	height (2-4)	finish (4-6)
Feed units	1,27	1,20	1,16
Dry matter, g	880,0	865,0	860,0
Crude fiber, g	40,0	48,0	54,7
Exchange energy, MJ	13,6	13,3	13,2
Crude protein, g	171,2	169,0	156,0
Lysine, g	11,0	10,0	8,8
Methionine + cystine, g	5,8	5,6	5,3
Threonine, g	6,3	5,9	5,6
Tryptophan, g	2,0	1,8	1,8
Crude Fat, g	43,0	32,0	39,0
Table salt, g	4,0	4,0	5,0
Calcium g	8,0	10,0	10
Phosphorus, g	6,0	8,0	8,0
Iron mg	80,0	70,0	60,0
Zinc mg	45,0	40,0	35,0
Copper mg	15,0	9,5	8,0
Cobalt, mg	1,25	0,15	0,10
Manganese, mg	40,0	40,0	35,0
Selenium mg	0,3	0,3	0,2
Iodine, mg	0,5	0,5	0,25
Vitamin A, mg	0,1	1,0	1,5
Vitamin D3, thousand IU	100,0	500,0	600,0
Vitamin B12, mg	0,032	0,030	0,024

The second, third and fourth groups of piglets additionally with the main diet (MD) received the probiotic MKZ and the prebiotic Baliz-V in accordance with the experimental scheme (Table 2). The duration of the experiment was 180 days.

Table - II: Scheme of experience in studying the effect of probiotic agents on the age-related dynamics of pig intestinal microbiocenosis (n = 10)

Group	Features of feeding, per head per day			
1	Control MD	age period		
		up to 2 months	2 - 3 months	3-6 months
2	MD + MKZ	10 ml	20 ml	10 ml
3	MD + Baliz-V	10 ml	20 ml	10 ml
4	MD + MKZ + Baliz-V	10 + 10 ml	20 + 20 ml	10 + 10 ml

Dosage of probiotic and prebiotic after 3 months. reduced due to the fact that in our previous studies it was proved that in piglets older than 3 months. beneficial intestinal microflora has already been adjusted and requires maintenance at the same level [1]. In the experiment, we studied zootechnical indices, intestinal microbiocenosis, hematologic (red blood cell count, color index, hemoglobin concentration, leukocyte formula) and immune status (lymphocyte population composition, phagocytosis indices: phagocytic number, phagocytic index, etc.).

To assess the microbial colonization of the contents of the large intestine, microbiological studies of faeces (excrement) of piglets were carried out by dilution in sterile saline and plating on nutrient media. The study of intestinal microbiocenosis of animals was carried out at the age of 30, 60, 180 days. Intestinal microflora was studied by its identification by birth: Lactobacillus spp .; Bifidobacterium spp .; Clostridium spp .; Staphylococcus spp .; Enterococcus spp.; Enterobacteriaceae genn, as well as yeast and mold microscopic fungi. The number of microorganisms in the colony forming units (CFU) located in 1 g of the contents of the large intestine was determined.

III. RESULTS AND DISCUSSION

It was established that in piglets at the age of one month, the number of microorganisms in the intestinal contents of piglets was several orders of magnitude smaller compared to subsequent periods. Their number increased significantly by the age of 60 (table 3). It should be noted that the number of lactobacilli and bifidobacteria in piglets at the age of 60 days was an order of magnitude higher compared to monthly animals, and at 180 days it was two orders of magnitude higher. When probiotic (group 2), prebiotic (group 3) and synbiotic (group 4) are introduced into the diet, there is a significant change in the intestinal microbiocenosis indicators in the direction of an increase in useful normoflora. Differences in the quantitative composition of the intestinal microflora of animals of various groups were revealed.

Since the additives used in feeding animals of groups 2 and 4 included lactic acid bacteria and a prebiotic, the content of microorganisms of the genera Lactobacillus and Bifidobacterium was the most indicative parameter of the effect of the additives used on the quantitative composition of the intestinal microbiocenosis of experimental animals.

Table - III: Qualitative and quantitative composition of the intestinal microbiocenosis of experimental pigs (n = 10)

№	Microorganisms	Group	Age days		
			30	60	180
			Amount, lg CFU / g		
1	Lactobacillus (Lactobacillus spp.)	1	5,0±0,09	6,9±0,08	7,5±0,05
		2	7,0±0,12	7,8±0,09	8,8±0,11
		3	7,0±0,22	7,7±0,26	8,7±0,25
		4	8,5±0,18	8,8±0,16	9,0±0,14
2	Bifidobacteria (Bifidobacterium spp.)	1	6,0±0,28	7,0±0,29	7,5±0,18
		2	7,3±0,31	9,8±0,31	9,2±0,31
		3	7,4±0,31	9,8±0,25	9,5±0,22
		4	9,0±0,23	9,7±0,31	9,8±0,31
3	Clostridia (Clostridium spp.)	1	1,0±0,08	3,4±0,08	3,6±0,09
		2	-	2,5±0,06	3,3±0,07
		3	-	1,6±0,07	3,3±0,08
		4	-	-	1,2±0,23
4	Enterococci (Enterococcus spp.)	1	6,8±0,22	7,0±0,24	6,1±0,11
		2	6,0±0,21	7,7±0,15	7,3±0,17
		3	6,5±0,11	7,5±0,13	6,5±0,14
		4	6,0±0,31	7,0±0,31	6,0±0,31
5	Staphylococci (Staphylococcus spp.)	1	2,7±0,31	4,4±0,34	5,1±0,43
		2	1,5±0,22	1,9±0,23	1,9±0,13
		3	1,9±0,08	1,4±0,07	1,3±0,08
		4	1,0±0,13	1,2±0,12	1,3±0,15
6	Enterobacteriaceae (Enterobacteriacea e genn.)	1	6,2±0,34	6,9±0,30	7,8±0,32
		2	5,8±0,32	6,0±0,33	7,0±0,34
		3	6,0±0,13	6,6±0,11	6,8±0,22
		4	5,5±0,59	5,8±0,18	6,0±0,24
7	Candida yeast	1	2,4±0,13	2,7±0,12	2,6±0,12
		2	0,4±0,06	0,5±0,07	0,5±0,06
		3	0,4±0,07	0,5±0,08	0,5±0,07
		4	0,4±0,06	0,5±0,07	0,5±0,06
8	Mold mushrooms	1	-	1,3±0,11	2,5±0,16
		2	-	2,2±0,17	2,3±0,13
		3	-	1,3±0,09	2,0±0,11
		4	-	-	-

The addition of a synbiotic group 4 to the diet (MKZ together with Baliz-B) gave the best results in terms of a positive effect on intestinal microbiocenosis. So, the content of lactobacilli in the intestines of piglets in 30 days was 8.5 lg CFU / g, in 60 days - 8.8 lg CFU / g, in 180 days - 9.0 lg CFU / g, which is significantly higher compared to the control ($p < 0.001$). the content of bifidobacteria in the intestines of piglets in 30 days was 9.0 lg CFU / g, in 60 days - 9.7 lg CFU / g, in 180 days - 9.8 lg CFU / g, which is also significantly higher compared to the control ($p < 0.001$).

Thus, the use of the probiotic MKZ and the prebiotic Baliz-B had a positive effect on the composition of the luminal microflora of the intestines of animals of the second and third groups. And the positive effect of the synbiotic effect on the quantitative composition of lactic acid bacteria in the intestines of young pigs was the highest (3-4 orders of magnitude higher than in the control).

Observations of the growth of animals showed that the introduction of probiotic, prebiotic and synbiotic supplements into their diet had a positive effect on the average daily gain in live weight over the entire growing period. It was found that in 2-4 experimental groups, compared with the control, the average daily gain in live weight was significantly higher, respectively, by 60.9; 69.3 and 77.1 g (table 4).

During the growing and fattening period, the indicators of gain in live weight in relation to the control were higher in animals of 2-4 experimental groups, respectively 8.4; 9.6 and 10.7%. A study of peripheral blood revealed a significant ($P < 0.01$) increase in the number of red blood cells in animals of the experimental groups. In addition, in animals of these groups, there was a significant 9, 10 and 15%, respectively, increase in hemoglobin concentration compared with the control. The number of leukocytes in animals of the experimental groups was also significantly (10-18%) higher compared to the control, due to an increase in the content of segmented against the background of a decrease in the number of stab neutrophils, eosinophils and lymphocytes.

Table - IV: Effect of lactic starter cultures on animal growth rates (n = 10)

Indicators	Group	Рацион	Age days	
			24	180
Live weight kg	1	Control	9,0±0,5	121,9
	2	MKZ	9,0±0,5	131,4
	3	Baliz-V	9,0±0,5	133,9
	4	MKZ + Baliz-V	9,0±0,5	135,2
The average daily gain in live weight, g	1	Control		723,7
	2	MKZ		784,6
	3	Baliz-V		793,0
	4	MKZ + Baliz-V		800,8
The average daily gain,% of control	1	Control		100,0
	2	MKZ		108,4
	3	Baliz-V		109,6
	4	MKZ + Baliz-V		110,7

These data indicate a significant strengthening of the resistance of the body of experienced pigs to the negative effects of the external environment and infectious diseases.

IV. CONCLUSION

Studies have shown that the use of probiotic, prebiotic and synbiotic led to an improvement in intestinal microbiocenosis, an increase in live weight gain, respectively, by 8.4; 9.6 and 10.7%, improved blood biochemical parameters.

REFERENCES

1. E.A. Denisenko, T.K. Kuznetsova, N.N. Zabashta, N.E. Skoblikov, E.N. Golovko, O.A. Polezhaeva A.F. Eyes. Probiotics for pigs. Proceedings of the Kuban GAU, 2011; # 4 (31): 224-228.
2. N.I. Malik, A.N. Panin. Veterinary probiotic preparations. Veterinary Medicine, 2001; # 1: 46-50.
3. N.I. Malik, A.N. Panin. Probiotics: theoretical and practical aspects. Veterinary agriculture animals, 2006; # 6: 48-50.
4. B.A. Shenderov, 1998. Medical microbial ecology and functional nutrition. M. Russia: GRANT.
5. N.N. Zabashta, E.N. Golovko. The effectiveness of the use of lactic acid probiotics to obtain organic meat raw materials. Effective livestock, 2018; # 9 (148): 88-90.

6. R. Fuller. Probiotics in man and animals. J. Appl. Bacteriol., 1989; # 66: 365-378.
7. Guidelines for the Evaluation of Probiotics in Food. Report of a Joint FAO / WHO Working Group on Drafting Guidelines for the Evaluation of Probiotics in Food, London, Ontario, Canada, April 30 - May 1, 2002. P.176-187.
8. Health and Nutritional Properties of Probiotics in Food including Powder Milk with Live Lactic Acid Bacteria. FAO / WHO report, Cordoba, Argentina, 1-4 October 2001. P. 131-149.
9. R.B. Parker. Probiotics, the other half of the antibiotic story. An..N.H., 1974; # 29: 4-8 ,.
10. Probiotics and prebiotics. World Gastroenterology Organization Practice Guideline, 2008 .-- 22 p.
11. V.G. Semenov, D.A. Nikitin, A.V. Volkov, V.G. Tyurin, A.G. Koshchaev, A.A. Nesterenko, S.V. Shabunin. Preventing shipping stress in imported heifers with the use of immunocorrection. International Journal of Engineering and Advanced Technology, 2019; 8 (5): 1591-1595.
12. A. Luneva, Y. Lysenko, A. Koshchaev, A. Nesterenko, V. Guzenko Comprehensive biosafety assessment of additives based on live microorganisms. International Journal of Engineering and Advanced Technology, 2019; 9 (1): 2477-2483.
13. A.G. Koshchaev, Y.A. Lysenko, A.V. Luneva, A.N. Gneush, M.V. Aniskina, V.I. Fisinin, I.P. Saleeva. Studying biological activity of lactobacillus hydrolysates. Journal of Pharmaceutical Sciences and Research, 2018; 10 (10): 2475-2479.
14. A.G. Koshchaev, T.A. Inyukina, N.N. Guguchvili, Y.A. Makarov, A.M. Gulyukin, O.P. Neverova, V.N. Shevkopljas. The influence of metabolic products of Echinococcus granulosus on the oxidation processes in the organism of pigs. Journal of Pharmaceutical Sciences and Research, 2018; 10 (9): 2317-2325.
15. M.B. Rebezov Ecological problems of the Southern Urals. International Research Journal, 2015; 4-1 (35): 25-28.

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