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Chemical Composition, Biological Values And Processing Properties Of Meat From Pigs Fed With A New Biologically Active Supplement In Their Rations.

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ABSTRACT

The research reflects the influence of biologically active substances contained in the "MegaStimImmuno" feed supplement on the meat productivity and physicochemical properties of meat from pigsof French selection "Large White x Landras x Duroc." It has been found that the studied supplement in the amount of 2 kg/ton of feed from Day 5 to 28 and 1 kg/ton of feed from Day 29 to 77 positively influenced the productivity of young pigs. A significant difference in the live weight in favor of the pigs inTest group was observed from the age of 56 days to the end of fattening. Higher slaughter yield and optimal ratio between meat, fat and bones has testifiedof the activation of metabolic processes in the animals bodies under the influence of the biologically active substances of the feedsupplement proposed. The chemical composition of the Longissimus muscle of the pigs inTest groupwas studied, i.e., their content of protein, fat, ash, moisture capacity, protein-quality and culinary-technological indicators, as well as the amino acid and mineral compositions. The research results have proven, that the "MegaStimImmuno"feed supplement contributed to the improvement of the biological value and processing properties of meat.

Keywords: pig raising, feeding, biologically active supplement, young pigs, growth rate, quality of pork.

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INTRODUCTION

Without addressing the issues of balanced feeding, other measures for the development of livestock will not produce the effectdesired. One of the promising ways to increase the productivity of pigs and improve the processing quality of pork is the use of a number of biologically active feed substances that promote the blood circulation, metabolism, an increase in resistance of the body and improvement of the feed taste [1, 2, 3, 4 and 5].

In this regard, we have studied the impact of the innovative “MegaStimImmuno”feed supplement on the growth rate of young pigs from birth to slaughter, as well as the physicochemical properties of pork.

MATERIAL AND METHODS

Experimental studies were carried out in conditions of the Vishnevsky Hybrid Selection Center in the Orenburg Region. The objects of the research were three-breed cross piglets of French selection (Large White xLandrasx Duroc). For the experiment, 2 groups of piglets at the age of 5 days were formed, 36 heads each. The pigs inControl group received a general diet, in Test group they were fed with the “MegaStimImmuno”feed supplement in the amount of 2 kg/ton of feed from Day 5 to 28 and 1 kg/ton of feed from Day 29 to 77. The conditions of keeping the pigs were the same.

The active feed supplement conveniently named “Mega Stim Immuno” was developed by the scientists of the Volga Region Research Institute of Manufacture and Processing of Meat-and-Milk Production and OOO Mega Mix.

The composition of the supplement includes egg powder, the biological properties of which are conditioned by the presence of natural egg immunoglobulins, promoting the normalization of metabolism, productivity of farm animals and increase in resistance of their or ganisms; cinnamal dehyde and thymol promote the stimulation of antioxidant processes in the animals bodies, improve the taste of the feed and stimulate its consumption; L-Carnitine base 50% is an important component of the energy metabolism in the body, is involved in the metabolism of fatty acids and enhances their oxidation and transfer to the mitochondria; MegalipaseHC 200 TS improves the digestibility of fats of animal and vegetable origins, which are parts of the compound feed and promotes the assimilation of vitamins A, E, D, K and polyunsaturated fatty acids.

Diatomite was used as a fillerthat is a source of water-soluble silicon (34.2 mg/g) required for the stable functioning of the smooth muscles of the intestine and stomach of animals and improvement of the absorption of calcium; adsorbs and removes mycotoxins (the sorption capacity of aflotoxin B1 is 42.0 and zearalenone 99.0) from the body; and has insecticidal properties.

In the course of the study, the growth rate of the experimental young pigs was studied by weekly weighing and calculations of the overall and average daily weight gain and relative growth rate in certain age periods according to the Brody’s formula.

The meat production and morphological composition of pig carcasses were determined in accordance with the “Methodological recommendations of the All-Union Academy of Agricultural Sciences on meat productivity evaluation, quality of meat and subcutaneous fat of pigs” (Moscow, 1987) and “Method for the integrated assessment of meat productivity and quality of meat from pigs of different genotypes” developed in the V.M. Gorbatov Federal Research Center for Food Systems of Russian Academy of Sciences (2000) according to the following parameters: weight of carcass,kg; yield of carcass,%; slaughter yield, %; length of halfcarcass, cm; thickness of fat over the sixth and seventh thoracic vertebrae,mm; andloin eye area, cm^2.

The chemical composition of meat was examined in accordance with the GOST 9793-74 Meat products. Methods for determination of moisture content; GOST 25011-81 Meat and meat products. Methods of protein determination; and GOST 23042-86Meat and meat products. Methods of fat determination.

The pH value was measured with a portable pH meter directly in the muscle tissue according to the GOST R 51478-99 (ISO 2917-74).

The water-retaining capacity of porkwas determined with a planimetric press method (Grau&Hamm) in Volovinsky- Kelman's modification.

The content of hydroxyproline in meat was determined by the Neuman and Logan method in the Werbicki and Deatherage's modification, tryptophan content by the method proposed by C.E. Gyrehem, E.P. Smithm, S.W. Hier and D.L. Klein, using the alkaline hydrolysis procedure according toE.Werbicki and F.F. Deatherage.

The amino acid composition was determined on the amino acid analyzer Aracus (Germany). The mineral composition of pectoral muscles was foundby the method of inversion volt-ampere measurement (GOST R 8.563-96 and GOST ISO R 5725-2002) and on the atomic adsorption spectrometer KVANT-2A (GOST R ISO 5725-2002).

RESULTS AND DISCUSSION

Nutritious diet of the pig populationwas balanced in all nutrients and enriched with biologically active feed supplements, which ensuredthe animals fattened to have high energy of growth and effective use of feed.

The research results have shown that the biologically active substances of the studied feed supplement positively influenced the growth and development of the piglets in the suckling period and the periods of nursery and fattening. The dynamics of the live weight and average daily weight gain of the experimental animals in different age periods are presented in Table 1.

Table 1: Values of live weight and average daily weight gain of piglets in the age aspect (n=36)

Ageperiods, days	Group			
	Control		Test	
	Liveweight, kg	Averagedailygain, g	Liveweight, kg	Averagedailygain, g
Sucklingperiod				
At birth	1.595±0.07	–	1.600±0.07	–
7	2.72±0.09	160.7±5.37	2.76±0.08	165.7±4.67
14	4.25±0.86	218.6±11.97	4.34±0.71	225.7±12.34
21	6.14±0.25	270.0±8.80	6.29±0.19	278.6±10.03
28	8.16±0.84	288.6±11.30	8.41±0.53	302.9±12.17
Nurseryperiod				
35	9.48±0.48	188.6±4.97	9.88±0.57	210.0±5.63*
42	11.46±0.92	282.9±15.39	12.10±0.74	317.1±13.19
49	14.04±0.39	368.6±7.07	14.83±0.87	390.0±9.08
56	17.41±0.34	481.4±9.04	18.41±0.21*	511.4±8.12*
63	21.55±0.34	591.4±11.57	22.82±0.32*	630.0±9.67*
70	26.16±0.25	658.6±12.15	27.72±0.29***	700.0±9.13**
77	31.06±0.40	700.0±12.38	33.28±0.35***	794.3±11.46***
Fatteningperiod				
107	54.33±0.64	775.7±6.47	58.19±0.59***	830.3±6.88***
137	79.98±0.59	855.0±8.84	86.17±0.71***	932.7±8.19***
167	106.66±0.59	889.3±8.56	114.96±0.83***	959.7±10.11***

The analysis of the research results has indicated that the live weight of the piglets inTest group exceeded the Control group starting from the age of 14 days, although the difference was statistically unreliable. In the beginning ofnursery, at the age of 28 days, the difference in live weight between the animals inTest and Control groups was 250 grams, later this difference increased and reached 790 gramsby the 49thday of age.

With respect to the live weight, a significant difference was observedin favor of the pigs in Test group from the age of 56days to the end of fattening. By the end of fattening, at the age of 167 days, the live weight

of the animals inTest group reached 114.96 kg, which was higher than in Control group by 8.3 kg (7.78%, P<0.001). The analysis of the obtained data on the growth rate in terms of indicators of the average daily gainof young pigs confirmed the pattern established. Over the entire period of growing and fattening the animals (from Day 1 to 167), the average dailyweight gain in Test group was 678.8 g, which was by49.7 g (7.90%, P<0.001) higher than in Control group.

One of the specific features of the growth of pigs was a large duration of growth combined with its exceptionally high rate in the postembryonic period [6].

Proceeding from the data obtained,it can be concluded that the relative growth rate of animals in Test group exceeded the parameter in Control group both in individual age periods and during the whole experiment.

An important condition for obtaining high quality products is rapid growth of animals. The pigs' relative development intensity of the adipose tissue was 2.5-3.0 times higher than the relative development intensity of the muscle tissue, so the delay in growth at an early age could subsequently cause a change in the ratio between the muscle and adipose tissues in the carcass towards an increase in the latter [7 and 8].

The control slaughter results showed that the slaughter yield was higher in the animals inTest group and amounted to 72.71%, which was higher than in Control group by 0.87% (P<0.005) (Table 2).

Table 2: Slaughter and meat qualities of pigs carcasses (n=30)

Parameters under study	Group	
	Control	Test
Weight, kg:		
Pre-slaughter	104.26±1.29	112.66±1.47***
Slaughter	74.90±1.18	81.91±1.23***
Fresh carcass	71.93±1.21	78.68±1.39***
Internalfat	1.52±0.12	1.53±0.11
Slaughter yield, %	71.84±0.20	72.71±0.31*
Fresh carcass yield, %	69.00±0.53	69.84±0.49
Thickness of fat over the 6th-7th thoracic vertebrae, mm	24.73±0.29	24.21±0.41
Loin eye area, mm^2	29.57±0.41	31.93±0.28***
Weight of chilled carcass, kg	70.19±1.11	76.53±1.14***
Flesh weight, kg	40.30±0.87	45.21±0.59***
Flesh yield, %	57.41±0.42	59.07±0.47
Weight of fat, kg	22.14±0.21	22.66±0.31
Fat yield, %	31.54±0.24	29.61±0.23
Weight of bones, kg	7.48±0.43	8.12±0.52
Bone yield, %	10.65±0.19	10.61±0.14
Fleshingindex	5.39	5.57

A higher value of the loin eye area was found in the pigs in Test group,andit exceeded the Control values by 2.36mm^2 (7.98%, P<0.001), which indicated a change in the composition of carcasses towards fleshing. It should be noted that the animals inControl group also corresponded to the meat category.

Boning of the carcasses of pigs in Test group made it possible to establish the absolute and relative number of basic tissues.

The study of the morphological composition of the carcasses of the experimental pigs revealed a difference in the weight and yield of meat, fat and bones between the groups. The Test group pigs fed with the studied supplement in their dietwere established to exceedtheir analogs in Control group in terms ofthe flesh weightby 4.91 kg (12.18%, P<0.001). The meat yield in Test group was 59.07%, which was higher than in Control group by 1.66%. The weight of fat and bones was almost at the level of the Control. The fleshing index was 5.57 in Test group and 5.39 in the Controlone.

In comparison with beef and mutton,porkis distinguished by high energy and nutritional value due to its higher content of dry matter and fat.

The studyresults of the Longissimus muscleproved the physiological maturity of porkin Test group (Table 3).

Table 3: Physico-chemical properties of the Longissimus muscle

Parameters under study	Group	
	Control	Test
Drymatter	25.47±0.08	26.05±0.09**
Protein, %	20.34±0.13	21.02±0.08**
Intramuscularfat, %	3.59±0.07	3.52±0.09
Ash, %	1.54±0.03	1.51±0.02
Tryptophan, mg%	407.48±1.18	431.18±1.49***
Oxyproline, mg%	49.81±0.37	47.25±0.31
Proteinqualityindex(PQI)	8.18	9.13
Water-retentioncapacity(WRC), %	61.54±0.13	62.83±0.19**
Abilitytocookdown, %	39.29±0.19	38.92±0.27**
Culinary-technologicalindicator	1.57	1.61
Hydrogenionconcentration(pH)	5.86±0.03	5.98±0.03

The Longissimus muscle of the animals in Test group was found to contain more dry matter by 0.58% (P<0.01) and protein by 0.68% (P<0.01), against the background of a decrease in fat and ash.

In assessing the nutritional value of pork, the protein-quality index is very important. According to the A. Polivoda's classification (1981), the ratio between tryptophan and hydroxyproline (protein-quality index) is more than 13 in high-quality meat,from 8 to 13 in good-quality meat and less than 8 in low-quality meat.

In our studies, the PQIof the Longissimus muscle was establishedto be 9.13 in Test group versus 8.18 in Control group, i.e. the meat in both groups was of good quality.

The hydrogen ions (pH) concentration, characterizing the level of active acidity of meat and depending on the amount of lactic acid, is formed from glycogen after slaughter of animals and closely related to the water-retention capacity and ability to cook down during the heat treatment.

The active pH acidity level of the Longissimus muscle was found to be within the limits characterizing the standardmeat quality (NOR).

The pigs in Test group had higher magnitude of the culinary-technological indicator (the ratio between thewater retention capacity and ability to cook down) than in Control group by 0.04.

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The biological value and taste of pork is largely dependent on the amino acid and mineral compositions of muscle tissue.

The study of the amino acid composition of muscle tissue is important, since it is a mobile reserve of plastic material necessary for the metabolic processes [9].

The study of the amino acid composition of the Longissimus muscle proteins in Test animals showed that the amount of essential amino acids in Test group exceeded the Control by 5.37% (P<0.01), and the nonessential ones by 3.84% (P<0.01). So, the value of the amino acid index in Test group was higher by 0.03 and made 1.18 (Table 4).

Table 4: Amino acid composition of proteins of the Longissimus muscles in Test animals (% to protein)

Amino acids	Group	
	Control	Test
Arginine(Arg)	5.03±0.27	6.81±0.21**
Histidine(His)	3.23±0.11	3.87±0.17
Lysine (Lys)	6.12±0.19	7.43±0.23**
Methionine (Met)	3.61±0.22	3.99±0.21
Valine (Val)	3.27±0.18	3.69±0.14
Threonine (Thr)	3.85±0.13	4.09±0.09
Leucine (Leu)	5.21±0.12	5.29±0.15
Ioleucine(Ile)	2.89±0.10	3.37±0.09*
Phenylalanine (Phe)	3.02±0.08	3.07±0.11
Amount of essential amino acids	36.23±0.61	41.6±0.73**
Glutamicacid(Glu)	10.73±0.43	11.87±0.51
Serin(Ser)	2.39±0.14	2.43±0.11
Glycine (Gly)	2.68±0.08	2.84±0.07
Proline (Pro)	2.64±0.09	3.39±0.10**
Alanine (Ala)	3.51±0.16	4.81±0.19**
Asparticacid(Asp)	6.98±0.31	7.25±0.43
Tyrosine (Tyr)	2.53±0.17	2.71±0.15
Amount of nonessential amino acids	31.46±0.55	35.30±0.49**
Aminoacidindex	1.15	1.18

When usinga feed supplementthat contains water-soluble silicon, contributing to the stable functioning of smooth muscles of the intestine and improvement of calcium absorption, we studied the mineral composition of the Longissimus muscle of Test animals (Table 5).

Table 5: Mineral content in the Longissimus muscle of pigs

Mineralelements	Group	
	Control	Control
Calcium, g/kg	0.91±0.07	1.19±0.05*
Phosphorus, g/kg	1.87±0.06	2.17±0.08*
Iron, mg/kg	19.11±0.18	20.44±0.15**
Zinc, mg/kg	20.54±0.47	23.67±0.29**
Copper, mg/kg	0.97±0.08	1.03±0.07
Silicon, mg/kg	83.69±5.57	107.49±4.61***
Manganese, mg/kg	1.78±0.07	1.81±0.08
Selenium, µg/kg	168.19±2.14	177.12±1.63*
Iodine, µg/kg	141.64±1.95	157.84±2.07**

The determination of the mineral composition of the Longissimus muscle of the animals in Test group showed that the calcium content in the muscle tissue inTest group exceeded the Control valuesby 30.77% ($P<0.05$), phosphorus by 16.04% ($P<0.05$), iron by 6.96% ($P<0.01$), zinc by 15.24% ($P<0.01$), silicon by 28.44% ($P<0.001$), selenium by 5.31% ($P<0.05$) and iodine by 11.44% ($P<0.001$).

CONCLUSIONS

Biologically active substances that are part of the "MegaStimImmuno" feed supplement in the rations of young pigs activated metabolic processes in their bodies, which allowed to increase the live weight gain and improve the morphological composition of carcasses and the physicochemical properties of meat.

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