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Production Testing Of Amivit In Combination With Succinic Acid On Fattening Pigs.

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ABSTRACT

The article presents the results of studies on the use of vitamin-amino acid complex "Amivit" in combination with succinic acid on the physiological state, indicators of natural resistance and productivity of fattening pigs. The positive effect of the mentioned preparation on the clinical status, morphological and biochemical parameters of blood, natural resistance and growth of live weight of piglets, histostructure of immunocompetent organs and quality of meat is shown.

Keywords: "Amivit", fattening pigs, productivity, morphological and biochemical parameters of blood, natural resistance, histostructure, mesenteric lymph nodes, liver, meat quality.

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INTRODUCTION

One of the main problems for the pig industry in Russia is to increase the production of environmentally friendly and high quality pork.

In the conditions of industrial production of pork, long-term exposure to adverse environmental factors lead to massive severe metabolic disorders, pathology of organs and systems of the body, the birth of piglets-dystrophs, premature selection of animals, especially young animals (Yu.N. Brigadirov, A.I., Anufriev, V.M. Aslamov, 1997 [3]; A.G. Shakhov, N.M. Sukhov, V.I. Bolgova, 1981[22]).

The lack of a balanced diets with amino acid composition, vitamins and mineral substances is a serious obstacle for the normal development of animal husbandry (A.W. Jongbloed et al., 2002 [26]; S.N. Alexandrov, T.I. Kosova, V.L. Dudinskiy, 2008 [1]; V.A. Alekseev, 2008 [2]; Yu.A. Kurlykova, 2009 [9]), etc.

Most often, the unbalance of the diets with nutrients leads to a decrease in the natural resistance of the body of the animals, and as a result, the disease and the deterioration of the quality of the meat (E.L. Macy, H.D. Naumann, M.E. Bailey, 1964 [28]; C. Mackay, B. Imhof, 1993 [28], L.Toporova, M. Borovko, S. Melnikova, 2011 [21]).

Numerous researchers have proven that for the metabolic processes in pigs and the formation of desirable productive characteristics in their diets all kinds of biologically active substances: vitamins and minerals, enzymes and synthetic amino acids, antibiotics, hormonal and tissue preparations, pre -, pro -, and probiotics, feed additives of natural, semi-synthetic and synthetic origin are implemented. This diversity not only has a positive effect on the animal organism, improves metabolic processes, physiological and biochemical characteristics and productivity, but sometimes excludes products of slaughter-free from drugs and other stimulants (T.C. Wang, M.F. Fuller, 1989 [32]; A. Shakhov, A. Anufriev, P. Anufriev, 2004 [23]; R. Volobuev, V. Volobueva, 2004 [4]; R.A. Merzlenko et al, 2004 [11]; L.I., Podobed, 2004 [14]; Yu.V. Starodubova, 2011 [19]; D.G. Gubanov, N.M. Altukhov, S.N. Semenov, 2012 [6]; D.G. Gubanov, 2013 [7]; R.N. Tikshaikin, 2012 [20]; T.V. Slaschivina, O.M. Marmurova, 2015 [17]).

Thus, the use of protein-vitamin-mineral supplements in the cultivation of pigs after weaning allows increasing the average daily growth and live weight by 12-15%, while reducing feed costs per unit of growth (Yu.N. Petrushenko, 2009 [13]; L.V. Reznichenko et al., 2014 [15]).

There are reports that the use of the feed additive MRKD-1 in the diets of fattening pigs provides an advantage over the control group by sensory parameters – by 2.75 %, by morphological and physiological characteristics – from 3.11 to 17.45 %, and by biotechnological parameters from 2.86 to 14.25 % (G.V. Parfenov, 2017 [12]).

It is also proved that the productivity of animals by more than 60% depends on the balance of the diet with protein, amount of energy, vitamins and minerals (R. Volobuev, V. Volobueva, 2004 [4]; L.I. Podobed, 2004 [14]), etc.

The literature sources available to us have insufficient and sometimes contradictory information on the complex effects of amino acid, vitamin and mineral preparations and succinic acid on the clinical status, morphobiochemical parameters of blood, morphological and functional characteristics of organs and tissues and productive indicators of fattening pigs.

In connection with the above, the problem of using drugs aimed at increasing resistance, normalization of metabolic processes in animals, improving the quality of pork is relevant, and has scientific and practical value.

PURPOSE AND OBJECTIVES OF THE RESEARCH

The purpose of the research – to conduct a comprehensive assessment of the effect of vitamin-amino acid supplement “Amivit” in combination with succinic acid on the physiological state of fattening pigs.

To achieve this goal, the following **objectives** were defined:

- to study the productivity and safety of piglets using a complex vitamin-amino acid preparation;
- to determine the nature of morphological and biochemical changes in the blood of fattening pigs;
- to study the degree of activation of natural resistance factors in piglets at the application of complex vitamin and amino acid supplement;
- to reveal the nature of histomorphological changes in mesenteric lymph nodes and liver of fattening pigs, reflecting their functional state after application of amivitamin in combination with succinic acid;
- to carry out physical-chemical and commercial evaluation of meat of pigs that received the drugs.

MATERIALS AND METHODS

To study the effect of vitamin-amino acid complex "Amivitamin" in combination with succinic acid on the physiological state, indicators of natural resistance and productivity of fattening piglets we conducted scientific and economic experience in a specialized pig farm – LLC "Belgorod bacon" f/c "Sirovino" Belgorod region.

According to the principle of analogues (taking into account age, clinical condition and live weight) 3 groups of piglets breed Landras X Yorkshire 76-day age were formed: control, 1st and 2nd experienced 60 heads in each. The main diet consisted of complete feed SK 5-351, manufactured according to GOST R 52255-2004. Piglets in the control group received the basic diet, the 1st and 2nd experimental group – with drinking water additionally "Amivitamin" in doses of 1.2 and 1.4 ml / 10 kg of live weight and succinic acid at a dose of 10 mg per 1 kg of body weight, respectively courses of once a day for 3 days in a row with 7 daily breaks. The duration of the experiment is 70 days.

The experience took into account:

1. Live weight of piglets by individual weighing at the beginning and at the end of the experiment;
2. Feed costs per unit of live weight gain, by daily recording of eaten feed;
3. The safety of livestock through daily records of dead animals;
4. Morphological and biochemical parameters of blood (amount of hemoglobin, erythrocytes, leukocytes with leukogram excretion, content of total protein and protein fractions, urea, aspartate aminotransferase (AsAT), alanine aminotransferase (AlAT), total calcium, inorganic phosphorus using conventional methods;
5. Indicators of nonspecific resistance: the amount of immunoglobulins (zinc-sulphate method), lysozyme activity of blood serum (photoelectrocolorimetry method using the test-culture), bactericidal activity of blood serum (photoelectrocolorimetry method), phagocytic activity of leukocytes (photoelectrocolorimetry method using the test-culture of *Staphylococcus. Albus*), phagocytic index – by calculation method, phagocytic number – by calculation method;
6. Histological studies after the control slaughter of pigs (3 heads from the group) at the end of the experiment. For morphological study, mesenteric lymph nodes and liver were selected from experimental pigs of the control, 1st and 2nd experimental groups. The material was fixed in 10% formalin solution. Histological preparations were prepared according to conventional methods, histosresis was prepared and after staining with hematoxylin-eosin under the scanning microscope "Mikmed-2" of the "Video test" setting (N.P. Roldugina, V.E. Nikitchenko, V.V. Yaglov, 2004 [16]);
7. Carrying out veterinary and sanitary examination of carcasses in accordance with the "Rules of veterinary and sanitary inspection of slaughter animals and veterinary and sanitary examination of meat and meat products";
8. Results of the study of the chemical composition of muscle tissue using liquid chromatograph AAA 400.

Statistical processing of the research results was carried out using Microsoft Excel 2010 spreadsheets on a personal computer using the Student's criterion.

RESEARCH RESULTS AND THEIR DISCUSSION

The results of these studies are presented in tables 1-4.

It is known that the mass of animals is one of the main indicators of physiological flow of metabolic processes in their organism (T.P. Sokolova, 1968[18]).

As a result of researches some differences on intensity of growth of young pigs of experimental groups were revealed, caused, in our opinion, by the best balance and a ratio of nutrients in fodder diets at use of vitamin and amino acid additive and succinic acid (tab. 1).

Table 1: Productivity, safety of pigs and feed costs per 1 kg of live weight gain

Indicator	group		
	Control	1 st experimental	2 nd experimental
Live weight of piglet, kg: in 76 days	25,0± 0,4	24,2± 0,2	25,3± 0,3
in 146 days	70,4± 0,8	71,8 ± 0,8	72,2 ± 0,9
Absolute gain, kg	43,6± 0,5	47,6± 0,6	46,9± 0,4
Average daily gain, g	622,4± 23,7	679,4± 24,5	670,1± 25,2
Feedcosts per 1 kg gain, number of units	3,81	3,72	3,74
Safety, %	98,2	98,6	98,3

The data of table 1 show that at the end of the experiment (age 146 days) live weight of piglets of the control group was 70.4± 0.8 kg, 1st and 2nd experimental groups – respectively 71.8 ± 0.8 and 72.2 ± 0.9 kg or higher by 2.0 and 2.6% (at p >0.05 in both cases) in comparison with the control. At the same time, during the accounting period of experience, there was a tendency to increase the average daily gain of live weight of piglets of the experimental groups relative to the control, respectively, by 9.2 and 7.7% (p>0.05) with a decrease in feed costs per 1 kg of gain by 2.4 and 1.8 %. The safety of piglets in all groups remained almost the same and quite high (98.2-98.6%).

The morphological and biochemical parameters of the blood reflect the intensity of metabolic processes in the body of the animal and are inextricably linked to the growth, development, or productivity of the animal (E.A. Ganzenko, A.V.Petrenkov [5]). However, the metabolic processes in the body are complex and depend on various factors (the content of proteins, fats, various vitamin and mineral supplements, etc.), so in most cases, the results of biochemical studies are uniquely problematic to interpret (Z. Usyudus, 2005 [30]; Z. Zraly et al., 2006 [34]; D. Kornewicz, et al., 2007 [27]; J.P. Wang, J.S. Yoo, I. H. Kim, 2009 [33]).

Analysis of hematological studies (tab. 2) showed that the use of vitamin and amino acid supplements in combination with succinic acid does not have a negative impact on the morphological parameters of the blood, thereby contributing to the maintenance of homeostasis in animals. It is known that the intensity of redox processes in animals is closely related to the amount of hemoglobin in their blood (S.A. Lugovskaya, M.E. Pochtar, 2001[10]).

Table 2: Morphological parameters of blood of piglets at the age of 146 days

Indicator	Group		
	Control	1st experimental	2nd experimental
Hemoglobin, g/l	98,42±0,81	104,19±0,85**	104,64±0,92**
Erythrocytes, 10 ¹² /l	5,92±0,23	6,74±0,28*	6,77±0,25*
Leukocytes, 10 ⁹ /l	14,34±0,25	14,49±0,20	14,07±0,16
Leukogram, %			
Eosinophils	5,03±0,35	4,47±0,40	4,81±0,32
Rodneutrophils	4,60±0,48	4,82±0,50	4,87±0,51
Segmentedneutrophils	40,27±1,07	36,47±1,03	36,35±1,10
Lymphocytes	46,80±1,20	49,17±1,03	48,78±1,10
Monocytes	3,30±0,26	5,07±0,22	5,19±0,25

In our studies, the level of hemoglobin in the 1st and 2nd experimental groups in animals aged 146 days was significantly higher by 5.9 and 5.3 % ($p < 0.01$ in both cases), respectively, compared with the control, indicating an increase in metabolic processes in their body.

The concentration of red blood cells in all experimental pigs was at a relatively stable level and corresponded to the physiological norm, according to their age. However, by the end of the experiment, the number of pigs in the 1st experimental group increased by 13.9%, in the 2nd – by 14.3 % ($p < 0.05$ in both cases). The marked tendency to increase the number of shaped elements and, accordingly, the saturation of red blood cells with hemoglobin during the period of intensive growth of fattening piglets, indicates the strengthening of the respiratory function of the blood, and, consequently, the activation of metabolic processes and energy.

During the experimental period, the content of leukocytes in piglets of experimental groups was within their physiological and age norms and had minor fluctuations.

The stable quantitative content of leukocytes in the blood of the studied animals indicates that the inclusion of amivit and succinic acid in the diet of piglets in general provides a sufficiently high resistance of their organism throughout the experimental period.

In the white blood cell population, the proportion of segmented forms decreased in piglets of both experimental groups (to 36.47 and 36.35%, respectively). There was a tendency to increase the proportion of lymphocytes and monocytes.

Biochemical studies of blood serum of experimental animals are presented in the table 3.

Table 3: Biochemical parameters of blood serum of piglets at the age of 146 days

Indicator	Group		
	Control	1st experimental	2nd experimental
Total protein, g/l	66,40±1,40	75,00±1,85**	75,24±1,72**
Albumins, g/l	23,24±0,93	30,45±1,17**	30,01±1,21**
Globulins, g/l	43,16±0,95	44,55±1,06	45,23±1,12
A/G, units	0,54±0,02	0,68±0,04	0,66±0,04
Urea, mmol/l	4,44±0,08	4,12±0,06*	4,19±0,05*
AlAT, mmol / HL	0,79±0,09	0,69±0,08	0,67±0,09
AsAT, mmol / HL	0,92±0,07	0,76±0,05	0,75±0,03
DeRitisratio	0,86	0,91	0,89
Totalcalcium, mmol/l	3,50±0,18	3,73±0,17	3,90±0,16
Inorganicphosphorus, mmol/ l	2,60±0,11	2,44±0,12	2,61±0,10

The concentration of total protein in the blood serum is one of the integral indicators of the growth rate of animals (I.M. Karput, 1986 [8]) and indicates the availability of the necessary amino acids of the body. Our studies found that the presence of a significant difference ($p < 0.01$) in terms of total protein and protein fractions in piglets of experimental groups in relation to the control indicates a positive effect of amivit and succinic acid on protein metabolism. During the period of the experiment, the amount of total protein in the blood serum of piglets of both experimental groups increased by 13.0 and 13.3%, respectively, compared with the control.

The share of albumins in the total protein was significantly increased by 31.0 and 29.1% compared to the control.

To identify differences in metabolic biochemical reactions in control and experimental pigs, the protein index of blood serum was calculated. Our studies have shown that the protein index of blood serum of piglets of both experimental groups exceeded the control by 25.9 and 22.2 %, which also indicates an increase in the intensity of metabolic processes occurring in their body.

The amount of urea in the blood serum of piglets of both experimental groups decreased respectively by 7.2 and 5.6% relative to control ($p < 0.05$ in both cases).

The tendency of decrease of activity of enzymes ALAT and ASAT in blood serum of experimental groups of animals in relation to control is noted, however the difference was doubtful ($p > 0.05$).

There were no significant differences in calcium and phosphorus content between the groups.

Improving the functions of the blood had a positive impact on the level of natural resistance of piglets receiving "Amivit" and succinic acid (tab. 4).

Thus, in the blood serum of animals of the 1st and 2nd experimental groups there was a significant ($p < 0.05$) increase in the amount of immunoglobulins by 42.0 and 40.5%. Lysozyme activity, bactericidal activity of blood serum, phagocytic activity of neutrophils, phagocytic index and phagocytic number also significantly ($p < 0.01$) increased in both experimental groups against the control, respectively, 23.6 and 24.7, of 8.7 and 8.5, compared to 24.4 and 26.0 38.1 and 42.5 and 44.9 and 50.7%.

Increase of nonspecific resistance indices in piglets of experimental groups indicates activation of both humoral and cellular immunity. These animals were more resistant to gastrointestinal and pulmonary diseases, and recovery occurred on average 4-5 days faster.

Table 4: Indicators of natural resistance of piglets at the age of 146 days

Indicator	Group		
	Control	1st experimental	2nd experimental
The amount of immunoglobulins, units of CST	17,52±1,44	24,88±1,34*	24,62±1,28*
LASK, %	20,47±0,59	25,30±1,02**	25,52±0,90**
BASK, %	46,23±0,57	50,25±1,03**	50,16±0,79**
FA, %	38,84±1,44	48,32±2,02**	48,94±2,19**
PHI	3,02±0,10	4,17±0,18**	4,30±0,25**
FC	1,78±0,14	2,58±0,22**	2,68±0,33**

The results of our studies on the effect of vitamin and amino acid supplements in combination with succinic acid on the metabolism and physiological state of piglets are consistent with those of other authors, when feeding pigs with biologically active additives (R. Volobuev, V. Volobueva, 2004 [4]; Yu.A. Kurlykova, 2009 [9]; Yu.N.Petrushenko, 2009 [13]; R.N. Tikshaikin, 2012 [20]; Yu.N.Shumsky, I.A. Nikulin, N.I. Shumsky, 2012 [24]), etc.

Lymph nodes belong to the organs of immunological protection and contribute to the provision of immunological homeostasis, the deterioration of which reduces resistance to disease, leads to metabolic disorders and productivity of animals.

The liver is a large stagnant digestive gland, one of the central organs that performs a huge number of functions aimed at protecting and maintaining the body's chemical homeostasis. The main functions of the liver include – metabolism of fats, proteins, carbohydrates, enzymes, vitamins, macro - and microelements, bile secretion. But only the morphological picture of the organ can give an objective assessment of the impact of various substances on the body of animals (B. Fromenty, D. Pessayre, 1995 [31]).

Conducted histological examination of the mesenteric lymph nodes and liver of fattening pigs at the end of experiment (70 days) allowed determining their immunological status and the effect from vitamin-amino acid complex "Amivit" in combination with succinic acid (Fig. 1-6).

Mesenteric lymph nodes: In the control group of pigs who did not receive amivit, the blood vessels of the capsule and the parenchyma of the lymph nodes are expanded and filled with blood, the phenomena of

erythrodyapedesis are visualized. The boundaries of the lymph nodes are expressed. Regional and cerebral sinuses filled with macrophages_

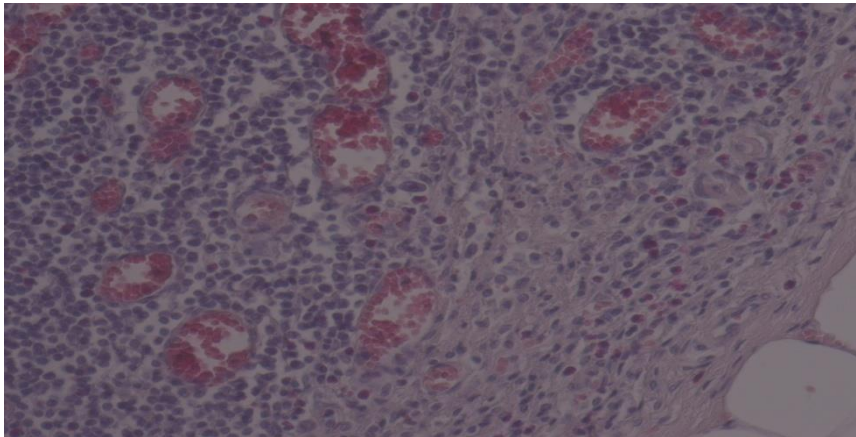


Fig 1: Section of the mesenteric lymph node of piglets of the control group.Sur. G+E. Exp. 40x16

In the 1st and 2nd experimental groups lymph nodes had a typical structure with clearly defined boundaries. Eosinophils are visualized in the cellular composition of stroma and parenchyma.

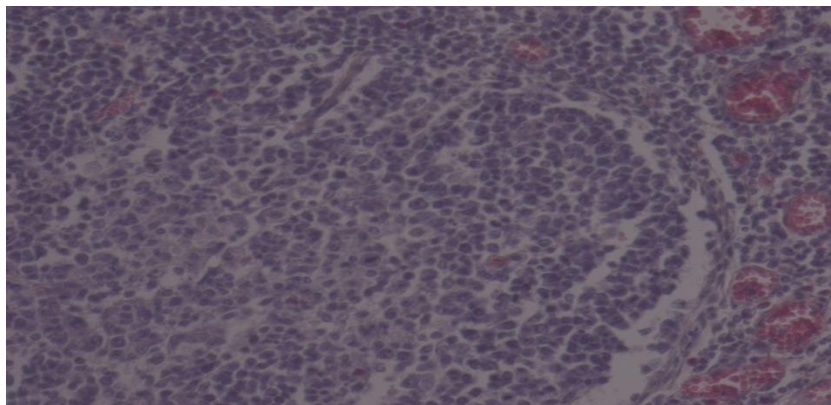


Fig 2: Section of the mesenteric lymph node of piglets of the 1st experimental group.Sur. G+E. Exp. 40x16

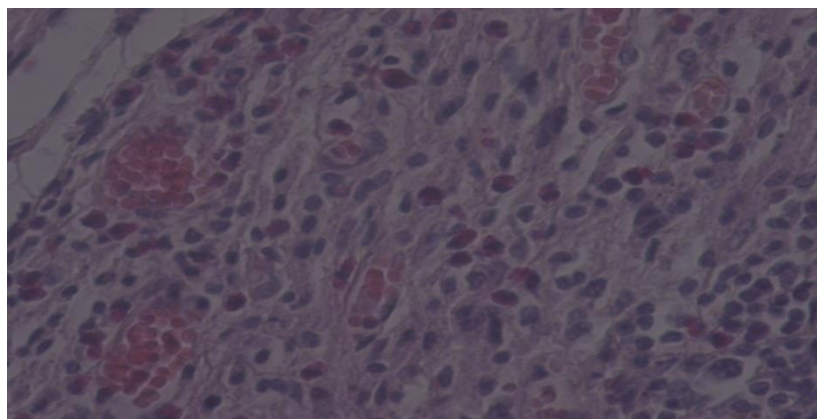


Fig 3: Section of the mesenteric lymph node of piglets of the 2nd experimental group. Sur. G+E. Exp. 40x20

Liver: The general morphological structure of the liver in the pigs of all groups studied by us did not differ significantly and did not deviate from the physiological norm, according to their age. But at the same time, in

animals of experimental groups there were some differences in the morphological structure of the organ in relation to the control.

In piglets who did not receive the drug (control), on liver sections, the beam structure of hepatocytes is traced. In some slices instead of regular rows of hepatic beams are detected weaker dyed disorderly groups adjacent to each other in liver cells. Sinusoidal capillaries, central and portal veins are unevenly full-blooded with a predominance of increased full-blood. The nuclei of hepatocytes are pale colored; there are foci of necrobiosis, where the cell is represented by a nuclear-free dim formation. There are large hepatocytes, cells with two nuclei or hyperchromic colored nuclei.

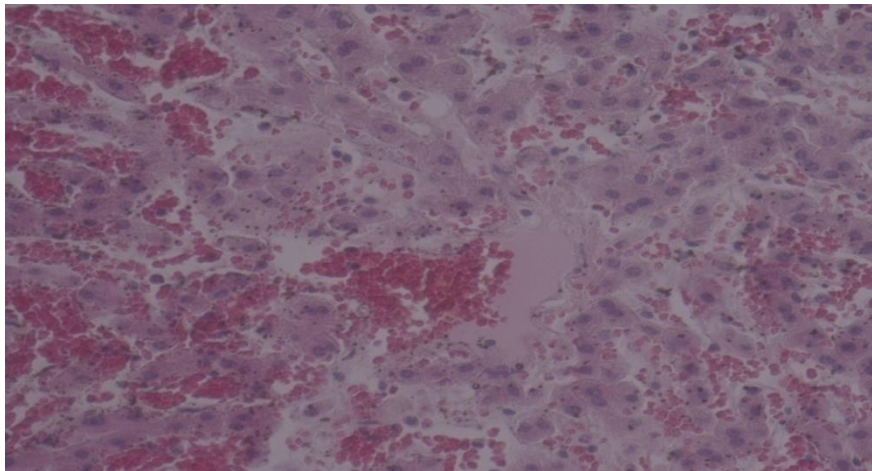


Fig 4: Section of the liver of piglets of the control group. Sur. G+E. Exp. 40x16

Piglets from the 1st and 2nd groups receiving amivit and succinic acid have in the liver good liver slices that are distinguishable with severe hepatic beams. Hepatocytes are of their multi-faceted or cubic shape. Between the hepatocytes, bile capillaries are seen. There are hepatocytes, having two nuclei, as well as light and dark hepatocytes, containing large and small vacuoles. Cytoplasm is oxyphilic, fine-grained with occasional vacuoles.

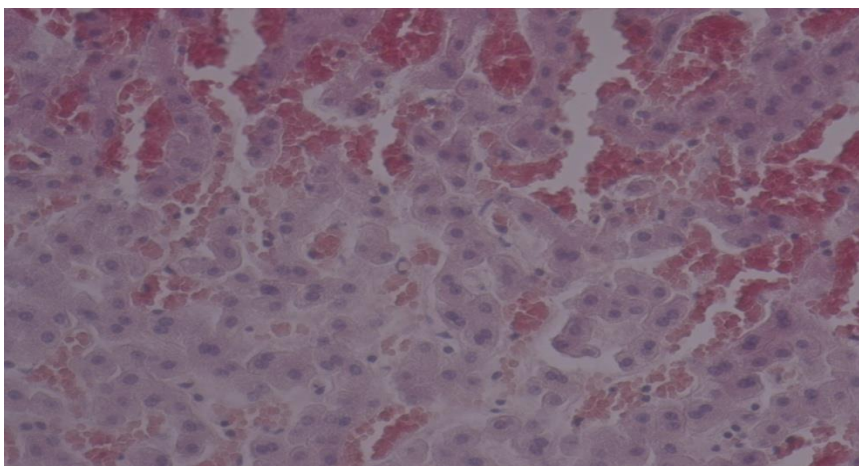


Fig 5: Section of the liver of piglets of the 1st experimental group. Sur. G+E. Exp. 40x16

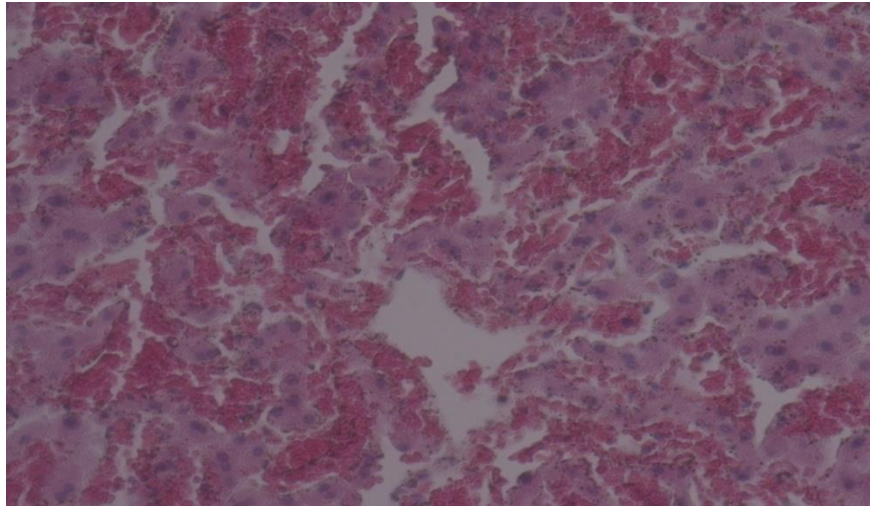


Fig 6: Section of the liver of piglets of the 2nd experimental group. Sur. G+E. Exp. 40x16

Thus, the noted histological changes in the tissues of the examined fattening piglets showed that in mesenteric lymph nodes of all groups there are diffuse lymphoid cell infiltrations, which are absent or less expressed in the 1st and 2nd experimental groups.

In the liver of piglets of the control group there are foci of necrobiosis, where the cell is represented by a nuclear-free dim formation. There are large hepatocytes, cells with two nuclei or hyperchromic colored nuclei. Compared with the control in the 1st and 2nd experimental groups, the structure of the liver corresponds to the norm.

At the end of production tests of the effectiveness of vitamin-amino acid complex “Amivit” in combination with succinic acid slaughtering pigs was made (3 heads from the group). At veterinary and sanitary examination of carcasses and internal organs no pathological changes were revealed. Carcasses of pigs of all groups are well bloodless, muscles of elastic consistence, pale pink color, on a cut slightly damp, a smell rather specific, characteristic for fresh meat of pigs. When pressed with a finger, the resulting hole is easily aligned. After maturation of the meat on the surface the pale pink dry crust is formed.

Further the meat of slaughter animals was subjected to chemical study.

The results of the studies are shown in table 5.

Table 5: Chemical composition and biological value of pork meat

Indicator	Control group	1 experimental group	2 experimental group
Dry matter,%	34,04±0,53	33,09±0,51	33,67±0,55
Ash, %	1,21±0,10	1,21±0,12	1,20±0,10
Fat,%	4,43±0,18	4,15±0,17	4,17±0,10
Total nitrogen, %	3,76±0,10	3,90±0,10	3,85±0,12
Nitrogennon-protein, %	0,34±0,02	0,37±0,02	0,38±0,03
Protein, %	23,72±0,93	24,23±0,89	24,20±0,97
Nitrogen protein, %	3,39±0,10	3,47±0,11	3,41±0,13
Albumen, %	20,50±0,29	21,69±0,27*	21,34±0,30
Oxyproline,%	0,29±0,05	0,24±0,03	0,25±0,04
Tryptophan,%	1,08±0,04	1,14±0,03	1,11±0,04
BAP	3,72± 0,14	4,22± 0,13*	3,96± 0,17

Moisture capacity by meat weight, %	49,33±0,97	53,72±0,94*	53,07±0,89*
Caloric value, kJ	838,04±6,52	871,25±6,75*	853,64±5,93

The data of table 5 show that after the use of drugs in the chemical composition of meat there were some changes. In the meat of the pigs of the 1st and 2nd experimental groups after application of the preparations the total nitrogen, protein tended to increase. In the 1st experimental group protein content increased significantly by 5.8 % ($p < 0.05$). The meat protein of experimental pigs contained less hydroxyproline and more tryptophan, and therefore BAP increased in the carcasses of both experimental groups, but statistically significant only in the first experimental group (by 13.4% at $p < 0.05$).

Our studies also revealed significant differences in moisture capacity in animals of all experimental groups. Thus, in the meat of animals of the control group the analyzed index was 49.33 %, in the pigs of the 1st and 2nd experimental groups – 53.72 and 53.07 % respectively (at $p < 0.05$ in both cases). The higher the moisture capacity of meat, the more it is able to bind water, and, consequently, at the same time, less to lose it already during cooking or heat treatment, which also contributes to the extension of shelf life in the cooled state and obtain a better product after processing.

On caloric content meat of pigs of the 1st and 2nd experimental groups surpassed control by 4.0 % ($p < 0.05$) and 2.1% ($p > 0.05$).

However, even these small changes are indicators of improved meat quality.

Thus, the introduction of a water-soluble vitamin-amino acid complex “Amivit” in doses of 1.2 and 1.4 ml per 10 kg of live weight in combination with succinic acid in a dose of 10 mg per 1 kg of body weight into the diet of fattening pigs has almost the same positive stimulating effect on their natural resistance, physiological state, productivity and quality of meat. Therefore, it is more economically feasible to use a dose of 1.2 ml.

CONCLUSIONS

1. The optimal dose of vitamin-amino acid additive “Amivit” was determined – 1.2 ml per 10 kg of live weight in combination with succinic acid in a dose of 10 mg per 1 kg of body weight (1st experimental group) in the diets of fattening pigs, which contributed to an increase in the average daily gain of their live weight by 9.2% and a decrease in feed costs per 1 kg of growth by 2.4% compared to the animals of the control group.

2. During the whole experimental period, the positive dynamics of the main morphobiochemical and immunological parameters was observed with the implementation of vitamin-amino acid complex into the diet of pigs. At the age of 146 days in the pigs of the 1st experimental group we noted: a significant increase in indicators compared with control animals-hemoglobin level by 5.9 % ($p < 0.01$); - the number of red blood cells by 13.9 % ($p < 0.05$); - total protein by 13.0 % ($p < 0.01$); - albumins by 31.0 % ($p < 0.01$); - the amount of immunoglobulins by 42.0 % ($p < 0.05$); - indicators of lysozyme activity, bactericidal activity of blood serum, phagocytic activity of neutrophils, phagocytic index and phagocytic number, respectively 23.6; 8.7; 24.4; 38.1; 44.9 % and lowering the urea content of 7.2 % ($p < 0.05$).

3. Histomorphological changes in mesenteric lymph nodes and liver of pigs after application of amivit and succinic acid indicate the presence of more expressed protective and adaptive changes, characterized by the absence or less expressed lymphoid and inflammatory infiltration, that are in intact animals of the control group.

4. The use of vitamin-amino acid complex “Amivit” in the diet in combination with succinic acid in these doses contributed to the improvement of the chemical composition and biological value of the meat of pigs, compared with the control group: a significant increase ($p < 0.05$) of protein content by 5.8 %, BAP – by 13.4 %; moisture content by 8.9 %; caloric content by 4.0 %.

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