Morphobiochemical indicators of vietnamese pot-bellied pigs with concentrate type of feeding

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***Abstract*—Small forms of economic activity have been actively developing in the Russian Federation in recent years. Novice farmers choose animals to achieve payback and profit. One of these breeds in the pig industry is the Vietnamese pot-bellied pigs. This breed appeared and began to spread in Russia not long ago. The article describes the morphological and biochemical studies of peripheral blood. There are described macro- and microstructural changes in the liver of piglets of the Vietnamese pot-bellied breed with a concentrated type of feeding. Moreover, there were determined the biochemical parameters that reflect liver functional deficiency, confirmed by histological studies. Analysis of the obtained data showed that during the first 5 months there was the highest average daily increase, and then there was observed a decrease in the dynamics of weight gain. According to the average daily weight gain, it can be concluded that, after 5-6 months the experimental piglets begin to develop not muscle, but fatty tissue, which is confirmed by literary data.**

Keywords—Vietnamese pot-bellied pigs breed, piglets, hematological indices, biochemical indices, morphology, liver

I. INTRODUCTION

According to the program of strategic development of agriculture until 2025, small forms of enterprises are actively developing, such as personal subsidiary farms and peasant farms. For start-up entrepreneurs in the field of agriculture, the choice of early breeds with a high yield, good adaptation indicators and quick payback is important. One of these breeds in the pig breeding is theVietnamese pot-bellied pigs breed. This breed appeared and began to spread in Russia not long ago [1,2]. Animals of this breed have differences not only in the exterior, but also in physiological features, in terms of feeding and housing [3, 4]. Pigs of the Vietnamese pot-bellied pigs breed have good adaptive qualities, high fecundity, precocity, which explains their relevance in small farms[5, 6, 7].

A. The goal and objectives of research

Goal of the study - to study the morphological changes in the liver and the morphofunctional parameters of the peripheral blood of pot-bellied pigs with a concentrated type of diet.

To achieve the goal of the study there were set the following tasks:

- to determine the morphological parameters of the blood and the breed characteristics of Vietnamese pot-bellied pigs;
- to determine the features of the biochemical status of peripheral blood in the dynamics of the pot-bellied pigs growth;
- to evaluate the morphological features of one of the central organs of metabolic processes - the liver.

B. Object of research

The object for the study were piglets of the Vietnamese pot-bellied pigs breed at the age from birth to 7 months in the amount of 30 heads.

II. MATERIAL AND METHODS OF RESEARCH

Studies on the keeping and feeding of animals were carried out in a scientific- experimental farm of Ural state agrarian university, hematological, biochemical and histological studies - in the laboratory of the Department of Infectious and Non-communicable Pathology of USAU and in the accredited laboratories of the Ural Federal Agrarian research Center of Ural Department of Russian Academy of Sciences. The results of biochemical parameters were compared with standard intervals of landrace pigs of this age and sex group.

Hematological parameters were determined on an Abacus Junior Vet analyzer from Diatron (Austria) using standard Diatron reagents (Austria); leukocyte count was calculated in blood smears stained by Romanovsky-Giemsa. The results were recorded visually on a Micros microscope (Austria).

Biochemical studies of blood serum were made on modern equipment using diagnostic achievements in clinical biochemistry using kinetic, colorimetric and turbimetric methods. Laboratory equipment: automatic chemochemical analyzer Chem Well-2910 Combi from Awaveness Technology, USA using standard reagent kits from Vital Diagnostics Spb (Russia), DIALAB GmbH (Austria). The reliability of the measurements was confirmed by control materials recommended by reagent manufacturers.

It was loafing using the walking area. To made research on the principle of analogues pairs there were selected young Vietnamese pigs and divided into 3 groups of 10 animals each. They were provided with a three-time concentrate

feeding with plenty of water. The composition of the diet consisted of 73% concentrated and 27% succulent feed. Used mixed fodder concentrate SCC-55 for meat-fed pigs. The conditions of keeping and feeding of animals of all groups during the period of the research were the same.

The dynamics of the relative and absolute growth rates were monitored by monthly weighing, and the condition of the animals was assessed daily using a clinical examination. At the same time, attention was paid to the condition of the skin, temperature and physical activity. Slaughter of piglets was carried out at 7 months of age, after which carcasses and offal were weighed to account for the slaughter yield of meat products. There was determined the ratio of fat and muscle tissues and were evaluated the meat qualities of the carcass. [3]

After slaughter, material for histological examination was selected from internal organs and skeletal muscles. The selected material was fixed in 10% neutral formalin, then dehydrated in alcohols of increasing concentration and embedded in paraffin. Sections were prepared on a sledge microtome. Staining was done with hematoxylin-eosin. Preparation of paraffin blocks, sections and staining of histological sections were carried out according to standard techniques. The study of microscopic specimens was performed using a Micro-Micro P-1 light microscope; photographing microscopic specimens was performed using a digital camera for a Levenhuk C-Series microscope.

III. THE RESULTS OF THEIR OWN RESEARCH

During the study, it was noted that throughout the entire study period, pigs actively ate feed and moved around the sites.

The results of the dynamics of the weight gain rate and the growth rate are presented in table 1.

Analysis of the data presented in Table 1 showed that during the first 5 months there was the highest average daily gain, and then there was a decrease in the dynamics of weight gain.

According to the average daily weight gain, it can be concluded that, after 5-6 months of age, the experimental piglets begin to develop not muscle, but adipose tissue, which is confirmed by literary data (A. Kokosinska and others). [8]

TABLE I. DYNAMICS OF THE WEIGHT GAIN RATE OF PIGLETS

Age	3 months	4 months	5 months	6 months	7 months
Live weight, kg	12,5±2,5	26,45±2,6	38,03±2,2	48,8±2,5	56,93±2,5
Average daily gain, g	-	465±25	386±20	360±30	271±15

During the entire study period, no clinical signs of disease were observed in animals. The cellular composition and biochemical parameters of peripheral blood are shown in Tables 2, 3.

TABLE II. HEMATOLOGICAL STATUS OF PIGLETS, M±M

Indicators	unit of measurement	Standard spacing	3 months	5 months	7 months
leukocyte	10^9/л	8-16	23,4±0,4	21,7±0,5	19,7±1,7*
Lymphocytes	10^9/л	3,2-8	14,8±0,8	12,6±0,6*	10,8±0,9**
erythrocyte	10^{12}/л	6-7,5	9,5±0,5	9,2±0,2	8,8±0,5
Hemoglobin	г/л	90-110	145,7±0,5	136,0±2,0	127,0±4,0*
ESR	мм/ч	4-6	6,7±0,7	8,0±0,5*	5,5±0,5*
Leukocyte formula,					
Basophils	%	0-1	0±0	0±0	0±0
Eosinophils	%	1-4	2,5±0,1	2,5±0,1	3,0±0,05*
immature neutrophil	%	0-2	0±0	0±0	0±0
banded neutrophil	%	2-4	0±0	1±0,5*	1±0,5*
segmented neutrophil	%	40-48	36,8±1,5	38,5±2,5	39,5±2,5
Lymphocytes	%	40-50	60,7±2,7	57±1,5	54,5±1,5*
Monocytes	%	2-6	0,00±0	1±0,5**	3±0,5**

[a.] * P ⩽0,05; ** P ⩽0,01; *** P ⩽0,001 compared to control

The result of studies, according to Table 2, indicated that leukocyte level was on 31%, lymphocyte level was on 28%, red blood cells on 31% and hemoglobin level on 36% higher than the standard interval, however, when observed over time, there was a tendency for these values to decrease indicators. They were at the top of the reference values. In terms of leukogram, also there was noted synchronous decrease in lymphocytes. In parallel with the described shifts, there was noted an increase in the concentration of monocytes, eosinophils, banded and segmented neutrophils within the standard interval. At the same time, the percentage of segmented neutrophils did not reach the lower limit of the physiological norm. The revealed changes characterize the process of active hematopoiesis in the body of piglets, as confirmed by the research of Semenova I.D. (Altai State Agrarian University, 2013). An increase in the level of leukocytes and lymphocytes relative to the species norm may indicate a characteristic feature of the Vietnamese pot-bellied pigs as a fast-growing breed. [9]

TABLE III. PIGLETS BIOCHEMICAL STATUS, M±M

№	Indicators	unit of measurement	Standard spacing	3 months	5 months	7 months
1	glucose	mmol / l	3,6-5,3	6,0±0,5	5,1±0,2	4,6±0,5
2	crude protein	g / l	65-85	53,0±0,8	54,3±0,3	53,4±1,5
3	albumen	g / l	19-24	35,2±1,2**	31,8±0,5**	39,5±1,0**

4	creatinin	μmol / l	90-240	103,8±3.8	100,1±2,2	106,5±3,0
5	ureas	mmol / l	3,0-8,5	2,4±0,4	1,9±0,1	2,3±0,1
6	alanine transaminase	U / l	31-58	213,5±0,5***	176,9±4,5***	05,8±2,5***
7	aspartate transaminase	U / l	32-84	165,7±2,7***	107,6±3,5***	124,0±1,0***
8	alkaline phosphatase	U / l	1-117	242,3±10,1***	158,7±14,7***	242,9±5,5***
9	total bilirubin	μmol / l	0-17,1	3,1±0,1	1,0±0,1	2,2±0,2
10	conjugated bilirubin	μmol / l	0-5,1	1,7±0,2	0,7±0,1	0,2±0,1
11	cholesterol	mmol / l	3,02-3,1	2,8±0,5	2,5±0,1	3,6±0,2
12	triglycerides	mmol / l	0-2,3	1,0±0,1	0,4±0,1	0,6±0,1
13	gamma-glutamyltranspeptidase	U / l	10-60	69,0±1,5	39,3±1,3	109,5±1,0**
14	lactic dehydrogenase	U / l	5-480	972,3±11,0***	726,1±11,5***	712,3±10,5***
15	hydroxybutyrate dehydrogenase	U / l	3-182	489,7±11,5***	367,0±10,5***	314,2±7,5***
16	calcium	mmol / l	1,78-2,9	2,7±0,2	2,5±0,1	2,7±0,1
17	phosphorus	mmol / l	1,3-3,55	2,7±0,2	2,5±0,2	2,3±0,1
18	Ca/P		1,5:1	1±0,2**	1±0,2**	1,2±0,1*8
19	potassium	mmol / l	4,7-7,1	5,2±0,2	5,2±0,1	7,2±0,3
20	sodium	mmol / l	140-150	-	142,5±1,5	143,0±1,0
21	chloride	mmol / l	94-103	96,3±1,5	102,5±1,0	96,5±1,5
22	ferrum	μmol / l	8,8-30	43,3±1,0**	48,7±0,5**	57,5±1,0**

b. * P ≤0,05; ** P ≤0,01; *** P ≤0,001 compared to control

From the data of table 3 it can be seen that piglets throughout the whole period of the study had an increased level of albumin in 0.6 times, hydroxybutyrate dehydrogenase exceeded 4.2 times and an increased number of white blood cells (from table 2) may indicate intensive metabolism. Decrease in the level of total protein by 18%, urea by 34%, cholesterol by 5%, could characterize the insufficiency of the protein-synthesizing function of the liver. At the same time, increased levels of alanine transaminase by 3.7 times, aspartate transaminase by 2.3 times, lactic dehydrogenase by 3.3 times, alkaline phosphatase by 3.6 times and gamma-glutamyltranspeptidase at 7 months of age, regarding species norms, also indicated functional impairment in the liver. In addition, an elevated level of alkaline phosphatase could indicate active bone formation, since this breed belongs to the early maturity, she noted an active set of live weight, the active growth of muscle tissue and bones. The decrease in the ratio of calcium to phosphorus is also associated with the active growth of bones and muscles [10,11].

Elevated levels of ferrum, red blood cells and hemoglobin can be considered a sign of active erythro and hemopoiesis [12]. An increase in cholesterol levels of 5% over the age of 5 months is likely due to protein overfeeding associated with concentrate feeding.

At slaughter, according to measurements of the ratio of back fat to muscle mass in the back, averaged 4 to 6.5 cm (Fig. 1, 2)

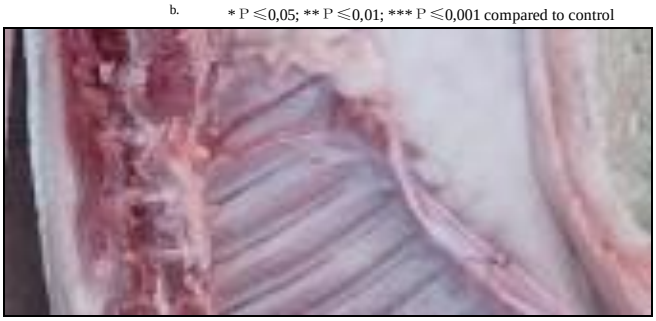

Fig. 1. The carcass on the sagittal section in the back (last ribs)

Fig. 2. The carcass on the sagittal section in the back (last ribs)

There is uneven liver staining from pale cherry, to a darker color when macroscopic examination of the liver. The capsule can be removed easily. The edge of the body is sharp (Fig. 3). Scraping is moderate on the incision. The macrostructure is saved. The plethora of the body is normal

Fig. 3. Liver macroscopic

During the histological study, it was established that the histostructure corresponds to the typical structure, the beam structure is visible, the connective tissue capillaries are slightly filled with blood (Fig. 4). There is a cluster of lymphocytes in the central part of the lobule (Fig. 8, 9). In some hapatocytes, fatty degeneration is noted (Fig. 6, 7), the cytoplasm occupies a significant area. The nuclei of hepatocytes are in a functionally active state (Fig. 4–9). In some segments, fatty degeneration of hepatocytes and lymphoid cell infiltration are noted in the center.

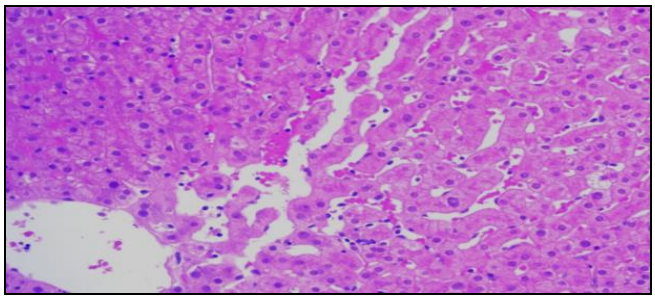

Fig. 4. The structure of the liver. Stained with hematoxylin and eosin. Uv.kh400

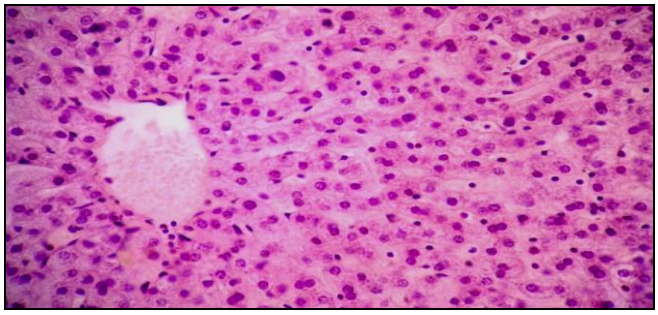

Fig. 5. Minor lymphoid cell infiltration. Stained with hematoxylin and eosin. Uv.kh400

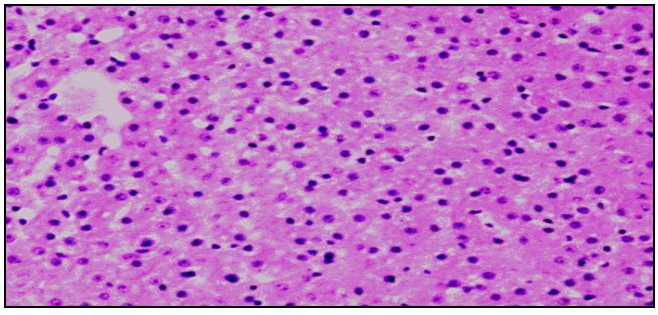

Fig. 6. Minor lymphoid cell infiltration and signs of fatty degeneration of hepatocytes. Stained with hematoxylin and eosin. Uv.kh400

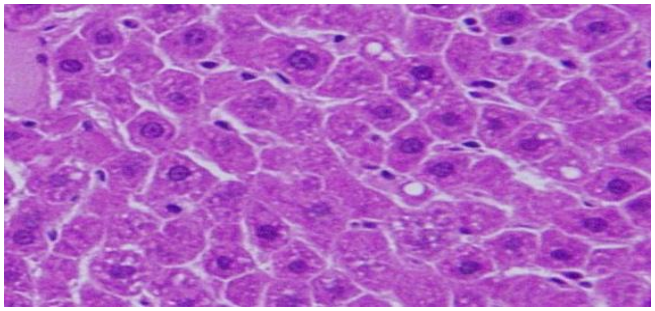

Fig. 7. The initial stage of hepatic dystrophy of hepatocytes. Stained with hematoxylin and eosin. Uv.h900

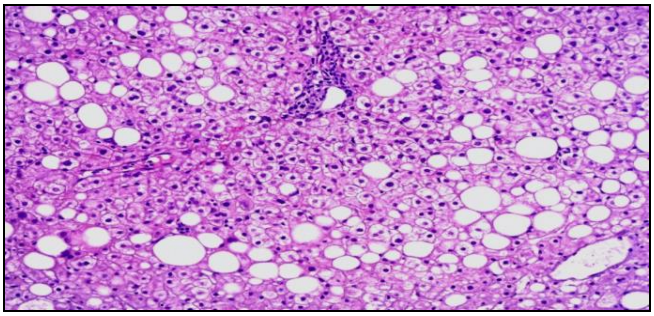

Fig. 8. The structure of individual lobules with signs of fatty degeneration of hepatocytes. Stained with hematoxylin and eosin.

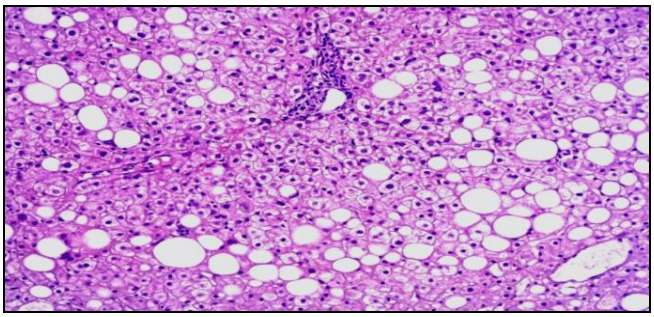

Fig. 9. Lymphoid cell infiltration and signs of fatty degeneration of hepatocytes. Stained with hematoxylin and eosin. Uv.kh400

IV. Conclusion

After analyzing the results we can draw the following conclusions:

- According to hematological and biochemical studies of peripheral venous blood in the body of piglets up to 7 months of age, active erythro- and hemopoiesis is taking place, accompanied by the activation of hemo- and erythroposis.
- Throughout the entire period of observation and fattening, piglets were noted to have leukocytosis that is not associated with infectious and inflammatory processes in the body, which can be attributed to the interior features of the breed or to the features of fattening with a concentrated type of feeding.
- According to the results of biochemical blood tests in the case of a concentrated type of feeding piglets of Vietnamese pot-bellied pigs, there is a deficiency of the protein-forming function of the liver.
- According to the results of morphological studies with a concentrated type of feeding piglets of the

Vietnamese pot-bellied pigs breed, fatty degeneration of the liver is observed.

- On the basis of literature data and studied morphobiochemical parameters of peripheral blood of pigs of Vietnamese pot-bellied pigs breed, it can be concluded that with the concentrated type of feeding and in, the standard indicators of pigs of the Landrace breed are not reference, as clinical manifestations of the disease have not been identified.

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