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# Features of the adaptive response of the blood system of boars of Poltava meaty breed of various genotypes in conditions of negative metabolic manifestations

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**Abstract.** The article discusses the issues of the adaptive response of the blood system, namely, the indicators characterizing protein metabolism with negative metabolic manifestations (hyperproteinuria). We studied purebred main boars of the Poltava meat breed of different genotypes: group I - individuals obtained without using the introductory crossing, group II - individuals obtained by the method of introductory crossing using the blood of the Finnish Landrace. Each group was divided into control animals (with a serum protein level of 70-92 g / l) and experimental (the amount of protein in the serum is more than 92 g / l). It was found that only in control animals of "pure" genotypes, all the studied parameters corresponded to the reference values. In control animals with Finnish Landrace blood, the ALT level was increased. These animals were significantly different only in higher protein levels and lower urea levels. The animals of the experimental groups did not differ significantly from each other. Their high serum protein levels were due to increased globulins. According to the Cv analysis, adaptive changes in the blood system in animals were multidirectional depending on the genotype. Animals of "pure" genotypes were more adaptable to these natural and technological conditions.

## 1. Introduction

Proteins are the structural and functional basis for the existence of any living organism. Even minor changes in them lead to the transformation of the viability of the cell, tissue and organism as a whole. Changes in the amount of protein in the serum and blood plasma of farm animals are of greatest interest from the point of view of health monitoring [1-2], predicting and improving the body's protective functions and productivity [3].

The genotype of an animal determines its ability to biosynthesize proteins and the potential for its growth, development and productivity. It has long been known that there are breed differences in the level of protein metabolism [3-4], including in pigs [5], which are associated with individual genetic variability [6], and can also be caused by the action of various breeding programs to which the breeds were subjected.

However, there are a number of factors, especially the environment, that also affect the metabolism of proteins in the body. For a correct interpretation of the level of protein metabolism in the body, according to the literature, non-genetic factors should also be taken into account [6]: the conditions of



feeding and keeping animals, climate, season [3; 7], the age of the animal [8], the physiological state [7; 9].

In recent years in pig breeding, the goal of breeding programs has been to produce and breed healthier and more efficient animals for a variety of environmental conditions. This implies the development of an appropriate strategy for managing the interaction "genotype x environment" [10]. As a result of the action of various factors with intensive livestock production technology, there is often a discrepancy between the interaction "genotype x environment". Under these conditions, the body's systems experience a great functional load, which is manifested, as a rule, primarily by a change in the level of metabolic processes of protein metabolism in the body.

It is known that individuals close to the population average are the most resistant to various fluctuations of environmental factors. However, in the literature, there is no uniform data on the reference values of protein metabolism in pigs. Therefore, given that protein metabolism is characterized by a high level of variability, both depending on genetic and nongenetic factors, it may be necessary to determine separate reference values for breeds, breed groups of pigs in specific natural and technological breeding conditions to assess both the health level and potential possibilities of productive and breeding qualities of animals.

The purpose of this work is to study the features of the adaptive response of the blood system of breeding boars of the Poltava meat breed in conditions of negative metabolic manifestations.

## 2. Materials and methods

The studies were carried out in the conditions of LLC Breeding factory "Belovodskiy" (Lugansk region, Ukraine) on a purebred livestock of the main boars of the Poltava meat breed. All animals belonged to the elite and first classes.

Poltava meat breed of pigs is a breed of meat productivity direction. Pigs of this breed are characterized by better adaptability to local feeding and housing conditions, higher reproductive qualities and better resistance. In order to improve meat qualities and create new genotypes in the breed, introductory crossing with pigs of the Finnish Landrace breed is used. Clinically healthy animals were selected for the study on the principle of analog pairs: Group I - boars obtained in "pure" without bleeding ( $n = 12$ ), Group II - boars, with a Finnish Landrace blood share of 12.5% ( $n = 8$ ). In each group, subgroups were distinguished: control - individuals close to the population average in terms of total protein in the blood (70-92 g / l, according to the literature) and experimental - individuals with hyperproteinemia (with a total protein level in the blood of more than 92 g / l). Hyperproteinemia occurs quite often in conditions of intensive livestock farming and is a consequence of protein overfeeding [11].

All boars received the same diet under the same conditions. The feeding conditions and maintenance of all groups corresponded to the feeding standards of the Institute of Pig Breeding and Agroindustrial Production of the National Academy of Sciences of Ukraine, taking into account age, live weight and physiological state. Feeding type - concentrate with the use of our own feed. The keeping of animals is free-range.

Blood sampling was performed in the morning, before feeding the animals, by puncture of the ear vein into vacuum tubes. In boars, the amount of total protein, the amount of albumin, globulins, protein coefficient, urea content, aminotransferase activity (ALT and ASAT), and de Ritis coefficient were determined in the blood serum. Biochemical parameters were determined using the kits of the firm "Phylcit Diagnostics" (Ukraine): total protein - by biuret reaction (g / l), albumin - by reaction with bromocresol green (g / l), urea - by color reaction with diacetyl monooxime (mmol / k), the activity of ALT and ASAT was determined by the dinitrophenylhydrazine method according to Reitman-Frenkel (mmol / (h × l)) [11].

The data obtained were processed by the methods of variation statistics using the Statistika-6 software package with the assumption of a probability of  $\leq 0.05$ .

### 3. Results

The data obtained for the indicators of the biochemical blood picture of the main boars of the Poltava meat breed of various genotypes are shown in table 1.

**Table 1.** Blood biochemical parameters of the main boars of the Poltava meat breed of various genotypes, (M±m).

Index	Animals obtained in "purity" (group I) (n = 12)		Animals with Finnish Landrace blood (group II) (n = 8)		Reference values
	I control	I experimental	II control	II experimental	
Total protein, g / l	73.8±1.7*	97.26±0.97*	81.4±1.6*	98.08±1.18*	70-92
Cv,%	4.59	2.64	13.2	2.68	-
Albumin, g / l	34.15±1.65	39.17±2.75	36.15±2.15	36.06±2.49	28-47
Cv,%	9.66	18.58	8.4	15.42	-
Globulin, g / l	39.65±2.94	58.09±3.38**	45.25±5.45	62.12±3.48*	36-64.3
Cv,%	14.82	15.37	17.01	12.5	-
A / G	0.86±0.1	0.67±0.09	0.8±0.04	0.58±0.074*	0.7-1
Cv,%	22.72	32.39	7.9	27.96	-
Urea, mmol / l	5.48±0.76*	5.21±1.28	2.37±0.13*	4.38±1.34	3.3-5.8
Cv,%	27.37	65.06	7.59	68.61	-
ALAT, mmol / (h × l)	1.45±0.26	2.31±0.26*	1.6±0.2	2.96±0.89	1.02-1.48
Cv,%	35.86	29.43	17.5	67.23	-
AsAT, mmol / (h × l)	1.6±0.55	2.06±0.49	1.2±0.6	3.08±0.95	0.72-1.76
Cv,%	68.12	62.13	70.83	68.83	-
De Ritis coefficient	1.1±0.63	0.9±0.17	0.75±0.16	1.13±0.26	0.23-1.32
Cv,%	96.18	48.89	83.95	50.35	-

Note: \* - the probability of a difference between the groups  $p \leq 0.05$ ; \*\* - the probability of a difference between the groups  $p \leq 0.01$ .

As a result of the study, it was found that in boars of the Poltava meat breed, obtained "clean" (control group I), all biochemical parameters were within the reference values. They had significantly lower values of total blood protein (by 9.33% ( $p \leq 0.05$ )) and a higher level of urea (by 56.75% ( $p \leq 0.05$ )) than in the control group II. At the same time, in animals with Finnish Landrace blood (control group II), non-compliance with the reference values was established only in terms of the ALT activity indicator, which was 7.5% higher than the upper permissible value of the norm. Boars of this group were distinguished by the least variability in terms of albumin in the blood, the A / G ratio and the level of urea, which can be considered as a favorable factor for a more intensive formation of meat productivity.

The animals of both experimental groups, having a significantly higher protein level than the control groups, were also distinguished by a significantly higher level of globulins in the blood serum, i.e. the total protein concentration increased, mainly due to the increase in globulin concentration. At the same time, no significant difference was found for other investigated indicators.

According to Chorfi et al. (2004) [12] the concentration of total globulin can be considered as an indicator of the immune response of an animal, and it is possible that this increase is associated with a large number of contacts with pathogens and with an increase in their antibodies [6]. The level of albumin and globulins in the blood serum of the animals of the experimental groups corresponded to the reference values, but the ratio of albumin to globulin did not. In experimental group I, the indicator was lower than the lower limit of the norm by 4.29%, and in II - 17.14%. Piccinini et al. (2004) [9] suggests using the ratio of albumin and globulins as a marker for assessing the immune status. An analysis of the coefficient of variation of all protein fractions indicates an increase in the "voltage" of

protein metabolism in animals, regardless of the genotype, as evidenced by an increase in the Cv value. However, it should be noted that an increase in the level of globulins in boars with Finnish Landrace blood leads to a greater resistance of the organism to external factors (Cv decreases), but in general, to lower adaptive abilities of this genotype.

The urea level in the studied individuals corresponds to the reference values, but varies in different directions depending on the genotype, with an increase in the amount of protein in the blood serum. The variability of the indicator also increases, which seems to be of an adaptive nature and is associated with a high concentration and the need for protein utilization.

A change in the level of protein in the blood serum also leads to an increase in the activity of the level of aminotransferase enzymes (ALT and ASAT), the activity of which in animals of the experimental groups was higher in comparison with the control ones and exceeded the values of the reference values. However, a significant increase was noted only in boars of "pure" genotype in ALT activity and amounted to 37.23% ( $p \leq 0.05$ ). The de Ritis coefficient corresponded to the values of the reference values in animals of all groups. The level of variability of indicators characterizing the activity of transaminases with an increase in the amount of protein decreased, with the exception of the activity of ALT in animals with the blood of the Finnish Landrace.

#### 4. Discussion

The study was conducted to assess the effect of the level of protein in the blood serum on other parameters of the blood system of the main boars of the Poltava meat breed of different genotypes.

The infusion of the blood of the Finnish Landrace, to improve the meat qualities of animals in individuals of the control groups, led to significant shifts in protein metabolism, which are the basis for the formation of better meat productivity. However, in these animals, the highest indicators of protein metabolism, on the one hand, will ensure better productivity of boars, and on the other hand, the infusion of blood increases the "tension" of the body's defense systems. The indices of animals of "pure genotypes" fully corresponded to the reference values; felt comfortable in these natural and technological conditions.

It was found that the adaptive response of the blood system, caused by an increase in the level of protein in the serum, is determined by the genotype and is compensated by multidirectional changes in the use of excess protein. At the same time, the animals of the experimental groups did not significantly differ from each other in the studied parameters. There was no negative effect of an increased amount of proteins in the blood serum on the indices of the amount of albumin, globulins, urea and the de Ritis coefficient. The instability of metabolic processes in animals of the experimental groups was manifested by the lability of the biochemical parameters of proteinases and the ratio of albumin and globulins. In addition, in many of the studied biochemical parameters, an increase in the serum protein level caused a decrease in the variability, i.e. increasing the adaptability of the organism to the action of external factors

#### 5. Conclusion

Bleeding of the Finnish Landrace's blood to the boars of the Poltava meat breed leads to the formation of a genetically determined higher level of biosynthetic processes in the body, but only if adequate full-fledged detailed feeding is used, taking into account the genotype. In conditions of negative metabolic manifestations, the difference between genotypes is leveled. Animals of "pure" genotypes are more preferable in these natural and technological conditions, since have a sufficient level of adaptability. The established features of the metabolic status of boars of the Poltava meat breed must be taken into account in further selection and breeding work with these genotypes.

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