

**BIOCHEMICAL AND MINERAL PARAMETERS IN PIGS OF TWO BREEDS REARED IN LARGE INDUSTRIAL COMPLEXES OF WESTERN SIBERIA**

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**Abstract**

Pig farming has a long tradition in Russian agriculture. The objectives of the present study were to investigate some indicators of blood biochemistry and hematology, and mineral metabolism in pigs (aged 6 months) of Landrace and Kemerovskaya breeds reared and kept in large industrial complexes named “Chistogorsky” and “Altai-myasoprom” (250 thousand heads in each) and to determine differences between two breeds in biochemical, hematological and mineral parameters. The Kemerovskaya breed belonged to local one but the Landrace breed was introduced from Ireland 3 generations ago. Concentrations of albumins, urea and phosphorus were higher in the Landrace breed than in the Kemerovskaya breed. In contrast, there was increased concentration of globulins and AST activity in animals of the Kemerovskaya breed in comparison with the Landrace breed. In addition, there were differences between breeds in some hematological indices and mineral metabolism parameters excluding phosphorus. The average population levels of the parameters investigated in two pig breeds could be used as reference values to evaluate animal’s interior at other pig farms in Western Siberia. The selected biochemical indices are recommended to farmers to assess the physiological status of animals in large industrial pig-raising plants.

**Keywords:** animal breeding, animal biochemistry, breed, pig raising plants.

**Introduction**

The study of continuously varying traits, which include hematological and biochemical parameters, makes a huge contribution to animal and plant breeding (Mazer & Dzinks, 1985). Along with this, the establishment and evaluation of genetic and paratypic variability lead to complexity. In this regard, there is an increase in the number of studies whose purpose is to evaluate genotype-environment interaction. This allows making adjustments in the characteristics of genetic and evolutionary factors (Solbrig & Solbrig, 1982). Thus, the accuracy of the evaluation of gene and phene pool impact is increased for farm animals to obtain high productivity, adaptability to severe environmental conditions (Glazko, Zubets, Kushnir, Tarasyuk, & Glazko, 2005) and resistance to dangerous diseases (Petukhov, 1981, 1989). At the present stage of livestock development, a large number of different breeds of animals of different species have been created, but the uniqueness of their gene and phene pools have yet to be fully appreciated (Moiseeva et al., 2006; Ukhanov et al., 1993). In this regard, the biochemical indices are of particular interest, since they are the result from multilevel interactions and are under control of complex interacting systems of genes (Lande, 1981; Zeng, Houle, & Cockerham, 1990). In turn, such systems can have some of their copies - polymers of polygenes, which can be significantly affected by a large number of fixed and random factors (Bliznyuchenko, 2010). In many scientific papers assessments of the phene pool of animal breeds of different species have been carrying out. In this regard, the indigenous and disappearing Kemerovo pig breed are of particular interest. It is important to compare some interior parameters of this

breed with the recently introduced population of the Landras pigs bred in the conditions of large pig raising plant for 3 generations. An assessment of the gene pool should be carried out taking into account environmental conditions and, in particular, in the sharply continental climate of Western Siberia. The aim of the research was to evaluate the Kemerovskaya and Landrace pig breed gene pool using some hematological and biochemical blood parameters at the conditions of large pig raising plants.

### **Material and methods**

The research was conducted on the populations of Kemerovo and Landrace pigs, bred at two large industrial complexes (pig raising plants) of Kemerovo and Altai regions of Russia. Some indicators of protein and mineral metabolism in slaughtered animals reaching 100 kg (age 6 months) were used to make comparisons. In our and other studies have found that the content of heavy metals and other pollutants in organs, tissues, soil, water, feed, organs and tissues of animals of different species did not exceed the maximum permitted concentrations (MPC). The territory on which these animals are bred is therefore suitable for obtaining healthy products. Hematological parameters were quantified using the hematological analyzer PCE-90VET. Biochemical indices were determined by means of Vector-Best reagent's kits and a semi-automatic "Photometer-5010" analyzer manufactured by Robert Riele GmbH & CoKG. The statistical analysis was performed using the statistical environment "R". The distribution was assessed using the Anderson-Darling and Shapiro-Wilk criteria. The comparison of the groups was carried out using the Welch and Mann-Whitney tests.

### **Results and discussion**

In many scientific publications, reference values of haematological and biochemical indices for farm animals are usually given without taking into account the direction of productivity, pedigree and environmental conditions and other factors. Here we intended to compare local and introduced pig breeds on haematological and biochemical parameters (protein and mineral metabolism are of great importance to the meat production). It was important to show the real situation at the conditions of large pig raising plants with population of more than 200 thousand animals. In fact, many farmers in Russia do not always perform haematological and biochemical analysis for all the animals they keep. It leads to the appearance of weak animals that look like apparently healthy ones. On the one hand, the problem is that the animals are slaughtered when they reach 100 kg (6 months) and we do not know completely whether the animals were healthy or not but are used as food. On the other hand, perhaps, there is breed difference in the haematological and biochemical parameters. For that reason, some haematological and biochemical indices were used to assess possible distinction between the breeds. More than 60 haematological and biochemical parameters were determined initially and only several of biochemical indices were selected to recommend farmers. These parameters are quite stable and easy to determine at reasonable price. No significant differences were found between the breeds for a number of hematological indices. The intrabreed similarity among some biochemical parameters associated with protein and mineral metabolism was identified (table).

There were no significant differences in the content of total serum protein, albumins/globulins ratio, ALT activity, Ca, Ca/P, Mg and K levels in blood. However, differentiation of the two breeds based on the rest of the parameters was observed. The level of albumin in Kemerovo pigs was 1.5 times lower than in Landrace pigs. At the same time, the globulins content in the Kemerovo pig breed significantly higher in comparison with the Landrace breed. This can be indicators of adaptive ability of the indigenous Kemerovo population of pigs to the ecological conditions of Siberia. The activity of aspartate aminotransferase in pigs of the Kemerovo breed was significantly higher than that of the Landrace subpopulation and less variable. In most indices of mineral metabolism, the animals of the two breeds did not differ from each other. However, the phosphorus content in the blood serum was twice as high as that of another breed. It was associated with highest variability of these parameters in comparison with those assessed previously. A comparatively higher variability in the

majority of parameters of protein metabolism in Kemerovo pig breed in contrast to Landrace was observed. To assess possible difference in variability of the biochemical indices the interquartile range levels were visualized in the same scale (% , fig 1.).

Table 1. Intra-breed differences on selected biochemical parameters of swine blood

Biochemical parameter	Landrace breed			Kemerovskaya breed			Reference values
	$\bar{x} \pm s_{\bar{x}}$	Me	IQR	$\bar{x} \pm s_{\bar{x}}$	Me	IQR	
Protein (total), g/l	80.7±19.7	84.5	8.25	79.6±3.25	79.1	23.0	55-86
Albumins, g/l	49.6±1.35	50.0	5.25	32.2±2.35***	29.2	18.3	35-50
Globulins, g/l	31.1±1.88	31.5	6.25	47.4±4.82**	52.3	38.7	53-64
Albumins/Globulins ratio	1.68±0.151	1.50	0.487	1.16±0.263•	0.475	1.04	0.3-0.6
Urea, mmol/l	10.3±0.75	10.5	2.73	7.32±0.453**	6.78	3.34	3-8
Alanine transaminase activity (ALT), U/l	10.2±1.22	8.77	3.08	10.9±1.04	9.16	5.06	0.5-41
Aspartate transaminase activity (AST), U/l	5.81±1.06	5.69	5.69	10.2±0.694**	8.99	3.19	0.6-38
de Ritis coefficient	0.58±0.098	0.525	0.36	0.99±0.04***	0.985	0.275	1.33
Ca, mmol/l	4.14±0.671	5.43	3.44	3.43±0.478	2.50	1.65	2.4-3
P, mmol/l	5.22±0.596	4.60	2.50	2.40±0.124***	2.56	0.71	1.3-3.3
Ca/P ratio	0.877±0.18	0.790	0.668	1.58±0.239	0.945	1.24	1-1.5
Mg, mmol/l	1.99±0.814	1.15	0.85	1.11±0.103	0.740	0.90	0.9-1.7
K, mmol/l	6.51±0.302	6.45	1.46	7.08±1.27	4.75	6.40	4-5

Note: significant differences at • –  $\alpha < 0.10$ , \*\* –  $\alpha < 0.01$  and \*\*\* –  $\alpha < 0.01$

The lowest variability in most of the traits was observed in Landrace pigs (lower than 30% - globulins, K, albumins and total protein). On the contrary, the only P content had low variability level in Kemerovskaya breed. This can be considered as unique variability profile of the breeds reared in large industrial complexes of Western Siberia. Obtaining high quality and safe livestock products is one of the most important tasks in field of animal husbandry. To accomplish this task, the content of heavy metals and other pollutants in the water, soil, plants and animals is constantly monitored (Konovalova et al., 2017; Korotkevich, Petukhov, Sebezko, Barinov, & Konovalova, 2014; Marmuleva, Barinov, & Petukhov, 2003; Miller, Petukhov, Korotkevich, Korotkova, & Konovalov, 2013; Miller et al., 2013; Narozhnykh et al., 2016, 2016; Narozhnykh et al., 2017; Osadchuk et al., 2017; Syso et al., 2017).

All these factors can affect the quality of animal husbandry products. Without limiting the preceding, within the large pigs raising complexes, animal health problems are not completely observed. Among such diseases, liver diseases are prominent. This is clearly evidenced by the ALT/AST ratio. This is due to the intensification of pork production negatively affecting the physiological state of the animal's organism. Our research has shown that the local Kemerovo breed pigs are better adapted to the conditions of large industrial complex with presence of many stress factors. This is demonstrated by such indicators as: urea, ACT activity, de Ritis coefficient and phosphorus content. Thus, intra-breed difference of the level of phenotypic variability on some biochemical parameters was revealed. The selected biochemical parameters can be used to assess the interior of animals, the phenotypic similarity of breeds, can be taken into account in environmental studies and recommended to farmers as biochemical parameters used to assess the physiological status of animals in large industrial pig raising complexes. The data presented are part of a comprehensive

study of the gene pool- and phene pool of porcine breeds in Western Siberia by molecular genetics, immunogenetic, cytological, cytochemical, immunological and zootechnical parameters (Kamaldinov, 2013; Petukhov et al., 2012).

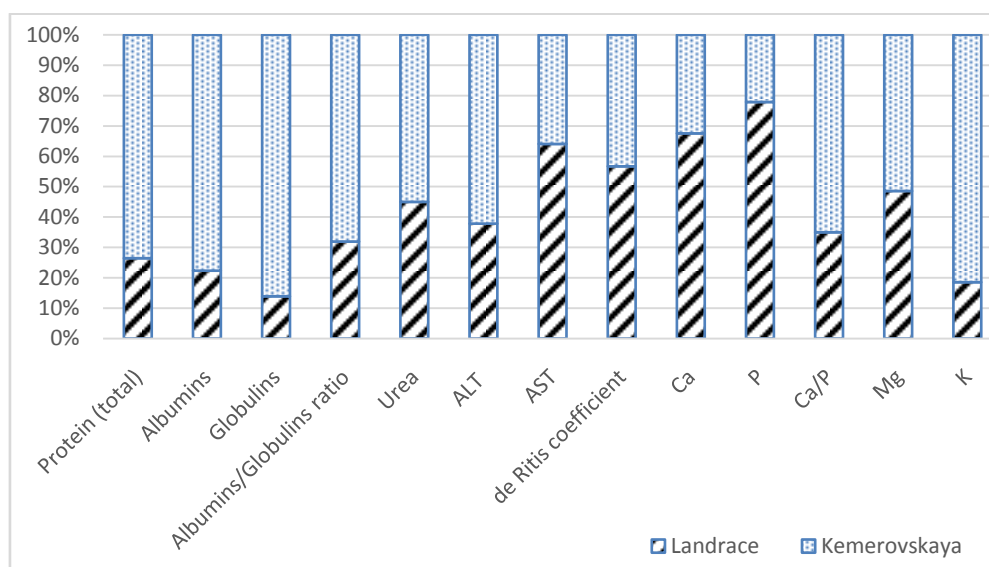


Figure 1 Variability of the biochemical indices in relation to Landrace and Kemerovskaya pig breeds

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