

## DYNAMICS IN CERTAIN BLOOD INDICATORS OF LIVER AND KIDNEY FUNCTION AT TERMINAL BOARS (PRELIMINARY ANALYSIS)

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### Abstract

*The aim of the study was to follow the dynamics in certain blood indicators of liver and kidney function in terminal boars (Large White x Pietrain). We observed the changes in Cholinesterase U/L; Lipase U/L; ALT U/L; AST U/L; Alkaline phosphatase U/L; Creatinine  $\mu\text{mol/L}$  and Bilirubin  $\mu\text{mol/L}$ . In this study we found that the lipase and alkaline phosphatase tend to decrease with age. AST, ALT and creatinine are higher in older boars. Cholinesterase and bilirubin age changes are too small and are close to 5% variation. The first cluster includes individuals with higher cholinesterase, lipase and ALF ( $P < 0.01$ ), but considerably lower for creatinine ( $P < 0.01$ ). The second cluster includes thirteen-month-old boars with higher AST, ALT, bilirubin and creatinine ( $P < 0.01$ ) and respectively lower ALF ( $P < 0.01$ ).*

**Key words:** boars, blood indicator, liver and kidney function, clusters

### INTRODUCTION

Productivity of pigs is defined not only by their genotype, feeding level and breeding conditions, but also by the health status of the animals. The disturbed metabolism in the organism is a factor which leads to a number of problems – the productivity of the animals decreases, the expenses on veterinary services increase, the economic efficiency of breeding decreases. The analysis of the parameters of the blood count is a basic way of revealing the metabolic status and an important indicator for the health condition of the organism, even when there are no visible symptoms [1]. A number of authors find a connection between the values of serum metabolites, the enzyme activity, and the blood parameters with the genotype of the animals, with their age and sex, and with the management [4], [8], [15], [17] by [2].

All this gives us a reason to follow the dynamics of some indicators of liver and kidney function in the blood serum of terminal boars.

### MATERIAL AND METHODS

The study included three breeding boars imported from France (Large White x

Pietrain), bred in a farm in the region of the town of Plovdiv. A detailed description of the microclimate and the hygiene and energy features and efficiency of the premises where the boars are bred was made in our previous studies [6], [7].

Blood samples were taken from the orbital sinus, in the morning before eating and before the acquisition of sperm for artificial insemination, in sterile tubes, individual for each animal. The blood serum was separated through centrifugation under room temperature (1.800xg, 15 min). Two different months were covered, at different age of the boars (November, 2013, which matches the age of 11 months, and February 2014, when the animals were 13 months old).

The boars were bred and fed under identical regimen, in accordance with the regulations. The boars had a 24-hour free access to the walking yards with a total area for each one of 17 m<sup>2</sup>, and 6 m<sup>2</sup> each of the building area. The experimental animals were fed with nourishing combined fodder containing 17.0 % raw protein, 3218.0 kcal ME for pigs, calcium – 0.95%, phosphorus - 0.62%.

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The following indicators of the liver and kidney function in the blood serum were analyzed: Cholinesterases, U/L; Lipase, U/L; Aspartate aminotransferase, U/L (AST); Alanine aminotransferase, U/L (ALT); Alkaline phosphatase, U/L (ALP); Bilirubin,  $\mu\text{mol/L}$ ; Creatinine,  $\mu\text{mol/L}$ ; with control tests of BIOMED company.

We used the K-Means Cluster analysis to form the groups on the basis of the specified features. The Euclidean inter-group distance was used as a similarity measure.

Shapes which graphically present the grouping under the studied indicators within the clusters were built.

The performed study is a part of a series of experiments aimed to a detailed study of the productivity and the reproduction qualities of the boars and sows imported from France and put under the conditions of extensive breeding.

The statistical processing was performed with software product SPSS version 24.

## RESULTS AND DISCUSSION

The biochemical blood testing is widely used in veterinary medical practice. This trend is dictated by the necessity to learn more about

some of the metabolic processes of the organism of the animals and of the diseases connected to them. The external influences, like the environmental temperature changes, the change of seasons, the change of the physiological condition, as well as the dietary regimen, have influence on metabolism, and this, for its part, influences the processes of homeostasis. The persistence of the internal atmosphere is maintained through a number of invertible metabolic processes unlocked by the adaptive mechanisms as a response to the external influences. Learning the specifics and dynamics of the biochemical indicators in the blood helps for the creation of great opportunities for assessing the condition of the specimen [19].

Table 1 shows the average values ( $LS \pm SE$ ) of the studied indicators of the blood serum of boars. The value of cholinesterase enzyme is  $270.58 \pm 9.08$  U/L, which is within the physiological range of the indicator (200-400 U/L). This parameter does not exceed the reference range in all the analyzed blood samples. Regarding the age dynamics, practically, the values of both age groups are equal, as the value is slightly higher with younger animals (Figure 1).

Table 1 Blood serum characteristics ( $LS \pm SE$ ) of terminal boars

Traits	LS	$\pm SE$	Cv,%
Cholinesterase, U/L	270.58	9.08	7.94
Lipase, U/L	15.17	1.83	33.49
ALT, U/L	15.98	1.06	15.58
AST, U/L	12.83	0.83	14.65
Alkaline phosphatase, U/L	210.83	3.93	12.06
Creatinine, $\mu\text{mol/L}$	183.33	3.98	23.55
Bilirubin, $\mu\text{mol/L}$	1.28	0.03	6.25

The average value of lipase indicator is  $15.17 \pm 1.83$  U/L, but within a too wide variation (Table 1). The conditions of this experiment tend to a decrease of the studied indicator with age (Figure 1). The brood

animal, whose lipase value is the largest – 995 (24 U/L) and achieved at the age of 11 months (Figure 2), does not exceed the biological reference range of the indicator (0-44 U/L).

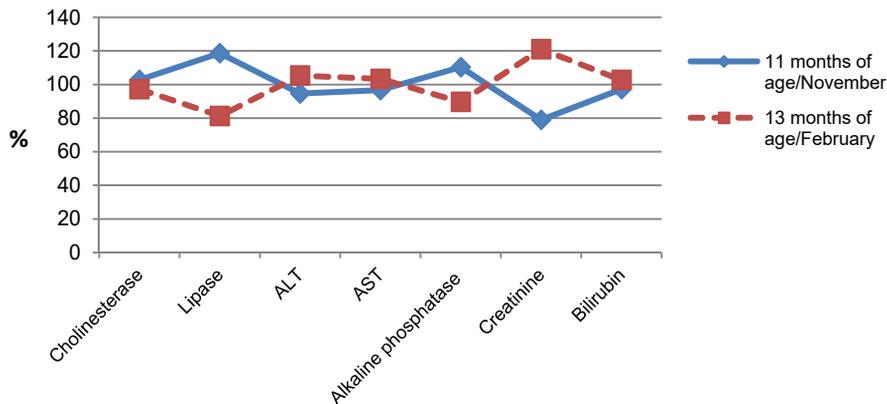


Fig. 1 Age dynamic of blood serum characteristics of terminal boars (as deviation of mean, %)

Under the conditions of permanent increase of the productivity of pigs, the parameters which help for the prediction of productivity qualities are a question of present interest of discussion. According to [10], such parameters are some ferments in the blood serum which stimulate the metabolic processes in the organism, like aspartate aminotransferase (AST) and Alanine aminotransferase (ALT). The same authors come to the conclusion that the activity of those enzymes is genetically defined and is closely connected to the productivity of the animals, and they establish greater values of both enzymes in hybrid pigs compared to purebred animals. Under the conditions of our experiment, the average values of AST (15.98 U/L) and ALT (12.83 U/L) are within the reference range for the indicators – 8-25 U/L and, respectively, 10-18 U/L (Table 1).

The change of the plasma levels of ALT and AST is also connected to degenerative changes in the histological structure of the liver [13]. Figure 1 shows that, with age, the enzyme activity of ALT is increased with nearly 7%, and of AST – with 11%. The results show that, regardless of the increase of the enzyme activity of older animals, the average values of both indicators is within the physiological range, so it is not a matter of structural and functional changes of the liver with age.

Regarding the individual variation, we ascertain the fact that the value of ALT is lowest with specimen 982 – 10.8 U/L, and the highest with breed animal 995 -16.2 U/L. The

last commented animal has the lowest value – 11.9 U/L of AST, and boar number 985 measures the highest one (18.8 U/L) for the AST indicator (Figure 2).

The level of creatinine in blood is an important indicator for the condition and function of the kidneys. Creatinine is a waste product of muscle metabolism, which is released unchanged through the kidneys, and usually has a permanent value [11]. The average value of this indicator under the conditions of our study is  $183.33 \pm 3.98$   $\mu\text{mol/L}$ , which is within the reference range of 141-239  $\mu\text{mol/L}$  (Table 1). In November, when the experimental animals were at the age of 11 months, this indicator was 21% less than the average for the extract. With age, we detect an increase of the values of creatinine in the blood serum (Figure 1). In all the taken blood samples, the one taken from breed animal 982 has both the highest value of the studied indicator – 232.6  $\mu\text{mol/L}$  at the age of 13 months, and the lowest one (140.9  $\mu\text{mol/L}$ ), but in the previous age period.

Enzymes are a specific protein group which aim is to accelerate chemical reactions of organisms. There are several enzymes which help to follow the function of the liver, like alanine aminotransferase, aspartate aminotransferase, lactate dehydrogenase, etc. ALP is a biochemical indicator to diagnose osteoporosis [3], liver and gallbladder diseases. The values of ALP in our study (Table 1) are within the physiological range (92-294 U/L).

Moreover, the average values of this indicator decrease with the increased age of the boars (Figure 1). The analysis of the seasonal dynamics of hematologic and biochemical parameters in autochthonous breeds of pigs [12] establish that the activity of ALP is lower with age for all the seasons. The authors explain this drop with the decrease in the needs of the enzyme for skeletal growth with age [16]. Boar 995 is with the lowest value of ALP (175 U/L),

and the highest (238 U/L) – is for breed animal 982.

For all the processed blood samples, the bilirubin is the indicator with the smallest variation (Table 1), and its value does not exceed the reference range in any of the animals (up to 1.7  $\mu\text{mol/L}$ ), (Figure 2). This result can be assessed as a successful transformation of bilirubin in a conjugated form from hepatocytes [9].

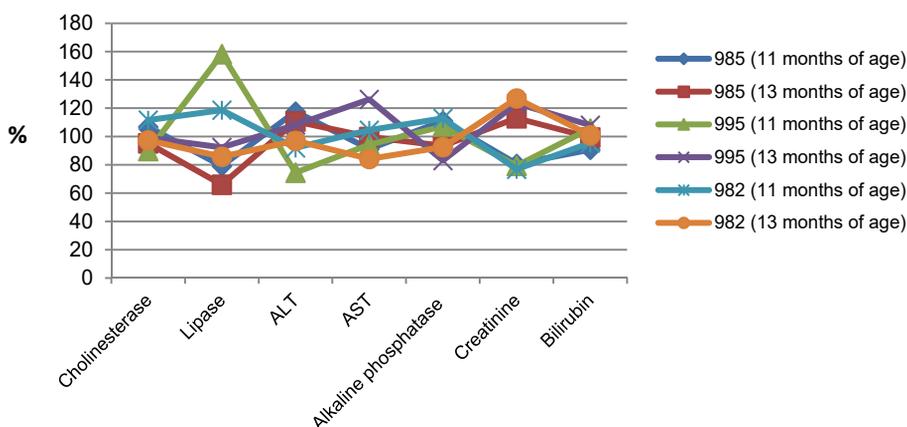


Fig. 2 Individual dynamic of blood serum characteristics of terminal boars (as deviation of mean, %)

In his publications [14] emphasizes on the advantages and disadvantages of cluster analysis by stressing on the fact that it is rather appropriate for the initial stages of the analysis, while there are not any hypotheses formed [18].

During the analysis, we agreed that the data be divided in two clusters, which is enough for this volume of the extract. While forming the

clusters of the studied indicators, the values of the ALP and creatinine are of greatest importance (Table 2). Figure 3 a, b shows the clear distribution of the animals with their individual indicators according to the age – the first group includes the values of eleven-month-old breed animals, and the second one – the thirteen-month-old ones.

Table 2 F-criterion and degree of reliability (ANOVA table)

	F-criterion and degree of reliability
1. Cholinesterase, U/L	0.668
2. Lipase, U/L	2.388
3. AST, U/L	0.646
4. ALT, U/L	0.273
5. Alkaline phosphatase, U/L	30.865**
6. Creatinine, $\mu\text{mol/L}$	94.184**
7. Bilirubin, $\mu\text{mol/L}$	1.142
***P<0.001; **P<0.01; *P<0.05	
The F-criterion was used for the purposes of the description only, without having to consider hypotheses [5]	

Table 3 shows the final cluster centers of our groups. The first cluster includes the individuals whose blood count detects higher

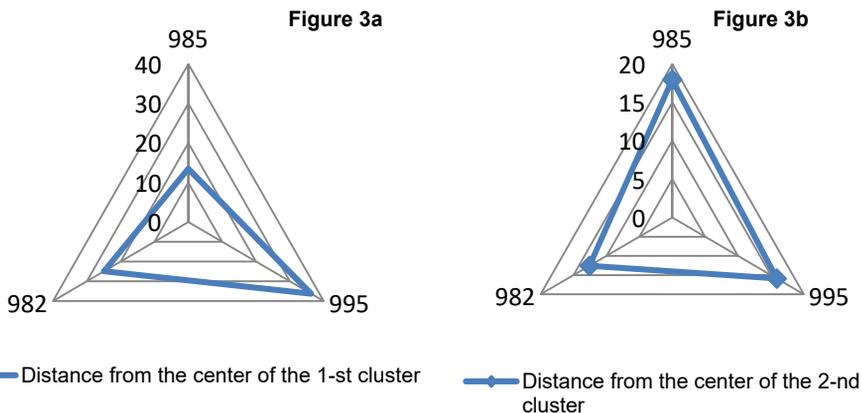
values of cholinesterase, lipase, and ALP ( $P < 0.01$ ), but reliably lower values of creatinine ( $P < 0.01$ ).

Table 3 Final cluster centres

	Cluster 1	Cluster 2
1. Cholinesterase, U/L	278.00	263.17
2. Lipase, U/L	18.00	12.33
3. AST, U/L	15.13	16.83
4. ALT, U/L	12.40	13.27
5. Alkaline phosphatase, U/L	232.67	189.00
6. Creatinine, $\mu\text{mol/L}$	144.73	221.93
7. Bilirubin, $\mu\text{mol/L}$	1.24	1.31

The second cluster is formed by the thirteen-month-old boars with higher values of

AST, ALT, bilirubin, and creatinine ( $P < 0.01$ ), and, respectively, lower proven ALP ( $P < 0.01$ ).



## CONCLUSIONS

1. Under the conditions of the conducted experiment, there is a tendency of reduction of the indicators of lipase and alkaline phosphatase with age. The values of AST, ALT, and creatinine are higher with older boars. The age differences with cholinesterase and bilirubin are rather small and within the range of almost 5%.

2. The first cluster includes the specimens whose blood count read higher values of cholinesterase, lipase, and ALP ( $P < 0.01$ ), but reliably lower for creatinine ( $P < 0.01$ ). The second cluster is formed by the thirteen-month-old boars with higher values of AST, ALT, bilirubin, and creatinine ( $P < 0.01$ ), and, respectively, lower proven ALP ( $P < 0.01$ ).

3. Additional studies are necessary for differentiation and proving the effect of

multiple factors which have influence on the indicators of liver and kidney functions in blood serum of terminal boars.

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