

Effect of blood serum enzymes on meat qualities of piglet productivity

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The article presents the results of studies of fattening and meat qualities of young white pigs of different white breeds of different intensity of formation (Δt) in early ontogeny, biochemical parameters of blood serum (aspartate aminotransferase activity, alanine aminotransferase, alkaline transferase, alkaline phosphatase). It is established that according to the main indicators of fattening and meat qualities (age of reaching live weight of 100 kg, days; thickness of the sleeve at the level of 6-7 thoracic vertebrae, mm; length of chilled carcass, mm) young pigs of the controlled herd belong to the first class and class elite, and serum biochemical parameters are consistent with the physiological norm of clinically healthy animals. Taking into account the class of distribution by intensity of formation (Δt), a significant difference was established between animals of I ($\Delta t = 0.795-0.832$) and III ($\Delta t = 0.660-0.703$) groups on the average daily gain of live weight and age of reaching live weight of 100 kg. The relationship between the biochemical parameters of serum, fattening and meat characteristics of young pigs ranges from -0.250 to $+0.385$ and is unlikely. We offer in breeding and breeding work, along with the traditional methods of evaluation and selection of high-yielding animals use the method of evaluation and breeding indices.

Keywords: Young pigs; Breed; Ontogeny; Intensity of formation; Fattening and meat quality; Biochemical parameters of blood serum; Variability; Correlation

Introduction

The analysis of the results of studies of domestic and foreign scientists, as well as the experience of modern agro-formations show that important indicators, along with the reproductive capacity of sows and boars, are offspring and meat qualities of their offspring (Birta & Burhu, 2012; Berezovskyi, 2014; Bankovska & Voloshchuk, 2015; Agapova & Susol, 2015; Berezovskyi et al., 2016; Bankovska, 2016; Vashchenko, 2016; Khalak et al., 2019). However, these groups of features in domestic animals do not provide a high level of profitability of the industry as a whole. This is due to the lack of adequate conditions for the keeping and feeding of animals of different sex age groups, uncontrolled import of foreign livestock, lack of regional pig breeding and hybridization programs and other factors (Orzechowski et al., 2006; Koval, 2014; Susol, 2013; 2014).

An important issue is the study of the nature of inheritance of the main quantitative traits of young pigs, taking into account the growth rates in early ontogeny and interior (Jejdridgevich & Raevskaja, 1966; Shejko et al., 2013; Povod, 2014; Loban & Shejko, 2015). The aim of the study is to investigate the fattening and meat qualities of young white pigs of different breeding intensity (Δt) in early ontogeny, serum biochemical parameters (aspartate aminotransferase (AST) activity, alanine aminotransferase (ALT), alkaline phosphatase (alkaline phosphatase) pair correlation coefficients between traits.

Material and Methods

The study was conducted under the conditions of a breeding reproducer for breeding pigs of large white breed LLC "AF "Dzerzhynets" of Dnipropetrovsk region, research center of biosafety and environmental control of APC resources of Dnepropetrovsk State Agrarian and Economic University, meat-packing plant "Globinsky Meat Combine" LLC and livestock laboratories of the State Institution "Institute of Crops of NAAS". The subject of the study was young pigs of large white breed. Control fattening of animals was carried out in the conditions of the economy in accordance with conventional methods (Berezovskyi & Khatko, 2005). The following absolute and integrated indicators were taken into account for estimation of young pigs for fattening and meat qualities: "average daily weight gain for the period of control fattening, g", "age of reaching live weight of 100 kg, days", meat quality of young pigs was investigated for the thickness of the pelvis at the level of 6-7 thoracic vertebrae (mm) and the length of the cooled carcass (cm). Integrated assessment of growth, fattening and meat quality of pigs was performed using the following mathematical models:

$$\Delta t = \frac{W_3 - W_0}{0,5 \times (W_3 + W_0)} - \frac{W_6 - W_3}{0,5 \times (W_6 + W_0)}, \quad (1)$$

where: Δt – index “intensity of formation”, score; W_0 , W_3 , W_6 – live weight of young pigs at the appropriate age – at birth, at 3 and 6 months of age, kg. (Svechin, 1985);

$$I_e = 100 + (242 \times K) - (4,13 \times L), \quad (2)$$

where: I_e – complex index of fattening and meat quality, points (index of B. Taylor, 1996); K is the average daily increase in live weight, kg; L – thickness of the sleeve at the level of 6–7 thoracic vertebrae, mm; 242; 4.13 – constant coefficients (Berezovskyi, 1999). Blood samples were taken at 5 months of age. Blood biochemical studies were performed using the sets of reagents of the firm “Phyllis-Diagnostics” (Ukraine, Dnipro). The activity of aspartate aminotransferase (AST), alanine aminotransferase (ALT) and alkaline phosphatase was investigated in the blood serum of pigs (Vlizlo et al., 2012). Biometric processing of research results was carried out according to the method of G.F. Lakin (Lakin, 1985) using the programmatic module “Data Analysis” in Microsoft Excel.

Results and Discussion

It is established that young pigs of large white breed of the controlled herd are characterized by sufficiently high indicators of fattening and meat qualities. Thus, the average daily gain of live weight during the period of control fattening was 805.3 ± 6.15 g ($S_v \pm S_{Cv} = 3.82 \pm 0.493\%$), the age of reaching the live weight of 100 kg – 175.8 ± 1.15 days ($S_v \pm S_{Cv} = 3.28 \pm 0.423\%$), the thickness of the sleeve at the level of 6–7 thoracic vertebrae, mm – 22.3 ± 0.47 mm ($C_v \pm S_{Cv} = 10.64 \pm 1.374\%$), the length of the cooled carcass is 96.3 ± 0.31 cm ($C_v \pm S_{Cv} = 1.63 \pm 0.210\%$). Integrated growth (Δt), fattening and meat (I_e) values are 0.748 ± 0.010 ($S_v \pm S_{Cv} = 7.23 \pm 0.934\%$) and 202.55 ± 2.231 points ($S_v \pm S_{Cv} = 5.51 \pm 0.711\%$) respectively. Biochemical parameters of blood serum correspond to the physiological norm of clinically healthy animals: aspartate aminotransferase (AST) activity was 1.33 ± 0.074 mmol/h/l ($S_v \pm S_{Cv} = 27.65 \pm 3.722\%$), alanine aminotransferase (ALT) – 1.87 ± 0.063 mmol/h/l ($S_v \pm S_{Cv} = 17.03 \pm 2.201\%$), alkaline phosphatase – 291.99 ± 12.517 u/l ($S_v \pm S_{Cv} = 21.43 \pm 2.768\%$). The results of studies of biochemical parameters of serum, fattening and meat characteristics of young white pigs of different growth rates in early ontogeny are given in Tables 1 and 2.

Table 1. Biochemical parameters of blood serum of young white pigs of different growth rates in early ontogenesis, $n = 10$

Indicators, units	Biometric indicators	Formation intensity (Δt), score		
		0.795–0.832	0.713–0.769	0.660–0.703
		I	II	III
AST activity, mmol/h/L	$\bar{X} \pm S_{\bar{x}}$	1.21 ± 0.107	1.43 ± 0.142	1.32 ± 0.073
	$C_v \pm S_{C_v}, \%$	25.1 ± 5.62	33.0 ± 7.38	13.6 ± 3.04
ALT activity, mmol/h/L	$\bar{X} \pm S_{\bar{x}}$	1.80 ± 0.119	1.96 ± 0.104	1.79 ± 0.095
	$C_v \pm S_{C_v}, \%$	18.7 ± 4.19	17.6 ± 3.95	13.0 ± 2.91
Index de Ritis (AST/ALT ratio)	$\bar{X} \pm S_{\bar{x}}$	0.68 ± 0.081	0.73 ± 0.063	0.74 ± 0.045
	$C_v \pm S_{C_v}, \%$	33.4 ± 7.47	28.6 ± 6.39	14.9 ± 3.34
Activity of alkaline phosphatase, units/L.	$\bar{X} \pm S_{\bar{x}}$	296.1 ± 28.46	288.3 ± 12.73	293.1 ± 31.89
	$C_v \pm S_{C_v}, \%$	27.18 ± 6.080	14.64 ± 3.275	26.64 ± 5.959

Table 2. Breeding and meat characteristics of pigs of white big breed at different intensity of early ontogenesis forming, $n = 10$.

Indicators, units	Biometric indicators	Formation intensity (Δt), score		
		0.795–0.832	0.713–0.769	0.660–0.703
		I	II	III
Average daily increase in live weight during the period of control fattening, g	$\bar{X} \pm S_{\bar{x}}$	812.6 ± 5.30	804.5 ± 10.41	779.1 ± 12.73
	$C_v \pm S_{C_v}, \%$	1.84 ± 0.411	4.29 ± 0.959	4.85 ± 1.085
Age of live weight 100 kg, days	$\bar{X} \pm S_{\bar{x}}$	171.2 ± 0.87	176.7 ± 1.62	178.7 ± 1.79
	$C_v \pm S_{C_v}, \%$	1.43 ± 0.319	3.05 ± 0.682	3.24 ± 0.724
Thickness at 6-7 thoracic vertebrae, mm	$\bar{X} \pm S_{\bar{x}}$	21.2 ± 0.95	23.0 ± 0.64	22.6 ± 0.88
	$C_v \pm S_{C_v}, \%$	12.76 ± 2.854	9.32 ± 2.085	9.53 ± 4.545
The length of the cooled carcass, cm	$\bar{X} \pm S_{\bar{x}}$	96.2 ± 0.70	96.2 ± 0.42	96.3 ± 0.61
	$C_v \pm S_{C_v}, \%$	2.05 ± 0.458	1.47 ± 0.328	1.56 ± 0.348
Comprehensive index of fattening and meat quality, points	\bar{X}	208.95	199.57	195.18

Note: * – $P < 0.05$; ** – $P < 0.001$

The difference between the de Ritis groups (AST/ALT) and the alkaline phosphatase activity ranged from 0.98 to 8.11% and is unlikely. Studies of the fattening and meat characteristics of young white pigs of different intensities of early ontogeny formation indicate that animals of group I were characterized by higher rates of average daily live weight gain and complex index of fattening and meat characteristics. According to these indicators, they outperformed peers of II and III groups by 8.1 (td = 0.69; $P > 0.05$) and 33.5 g (td = 2.43; $P < 0.05$), 9.18 and 10.6 points. Higher daily average weight gain contributed to a reduction in age of 100 kg live weight by 5.5 (td = 1.83; $P > 0.05$) – 7.5 days (td = 3.76; $P < 0.001$). The thickness of the pelvis at the level of 6–7 thoracic vertebrae and the complex index of fattening qualities the difference between the animals of these groups was 1.8 (td = 1.57; $P > 0.05$) – 1.4 mm (td = 1.08; $P > 0.05$), 9.38 – 13.77 points. The length of the chilled carcass in animals of the I–III groups ranged from 96.2 to 96.3 cm, which corresponds to the elite class, according to the Instruction on pig testing.

The results of the calculation of the pair correlation coefficients between the interior, fattening and meat qualities showed that the number of direct and feedback relationships is 40.0 and 60.0% (Table 3).

Table 3. The coefficient of paired correlation between biochemical parameters of blood serum, fattening and meat characteristics of large white breed, $n = 25$.

Indicator	Biometric indicators			
	x	y	$r \pm S_r$	t_r
Average daily increase in live weight during the period of control fattening, g		a	0.239 ± 0.2015	1.18
		b	0.385 ± 0.1924	2.00
		c	-0.150 ± 0.2062	0.73
Age of live weight 100 kg obtaining, days		a	-0.004 ± 0.2085	0.02
		b	-0.250 ± 0.2019	1.24
		c	-0.017 ± 0.2085	0.08
Thickness at 6-7 thoracic vertebrae, mm		a	-0.053 ± 0.2082	0.25
		b	-0.069 ± 0.2080	0.33
		c	-0.002 ± 0.2085	0.01
The length of the cooled carcass, cm		a	0.090 ± 0.2077	0.43
		b	0.338 ± 0.1962	1.72
		c	-0.039 ± 0.2084	0.19
Comprehensive index of fattening and meat quality		a	0.207 ± 0.2040	1.01
		b	0.318 ± 0.1977	1.61
		c	-0.099 ± 0.2075	0.48

Note: a – activity of AST, mmol/h/L, b – activity of ALT, mmol/h/L, c – activity of alkaline phosphatase, units/l, * – $P > 0.95$

They range from -0.250 ± 0.2019 (100 kg live weight × ALT activity to 0.385 ± 0.1924 (mean daily live weight gain during control fattening × ALT activity).

Conclusion

Biochemical parameters of blood serum of young pigs correspond to the physiological norm of clinically healthy animals, fattening and meat quality – class and class elite. The probable difference between the animals of the first and third groups is set according to the indicators of “average daily weight gain for the period of control fattening, g” and “age of reaching the live weight of 100 kg, days”. The coefficients of paired correlation between biochemical parameters of blood serum, fattening and meat characteristics of large white breed range from -0.250 to +0.385. We offer in breeding and breeding work, along with traditional methods of evaluation and selection of high-performance animals to use the method of evaluation and breeding indices.

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