MEAT QUALITY VALUES IN DIFFERENT MUSCLES BY GENOTYPE AND GENDER FROM HYBRID PIGS

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Summary. The aim of the study was to examine the effect of genotype (terminal breed), muscle and gender on the meat quality of hybrids from Lithuanian indigenous wattle pig and wild boar backcross to lean pig breeds. The animals used were females and castrated males from domestic Lithuanian indigenous wattle and wild boar hybrid backcross to domestic lean breeds (Norwegian Landrace and Yorkshire). The terminal breed influenced the growth rate and carcass fatness. The age at slaughter of hybrids from terminal Norwegian Landrace breed was 69.5 days lower, their backfat thickness at the 10 rib was 5.56 mm lower compared with the hybrids from terminal Yorkshire breed. However, Norwegian Landrace as a terminal breed showed a tendency towards lower meat quality traits, such as pH value in the longissimus and semimembranosus muscles and an increased thawing loss in the semimembranosus muscle. Gilts tended to have relatively 4.7% higher amount of dry matter and 0.7% lower pH value in longissimus muscle and relatively 3.6% lower content of dry matter and 4.0% higher content of protein than barrows in the semimembranosus muscle. However, the barrows had relatively 98.2% higher level of intramuscular fat in *M. semimembranosus* compared with gilts. The main differences between the muscle type were related to the differences in water holding capacity, cooking loss, colour and pH. Colour intensity and water holding capacity relatively 4.3% were higher, and pH value had a tendency to be higher in the semimembranosus muscle. Cooking loss had a tendency to be relatively 4.7% higher in the longissimus muscle. This study also identified several phenotypic correlations between the age, body weight and carcass fatness of hybrid pigs and meat quality traits, such as pH and water holding capacity.
Keywords: meat quality, genotype, gender, pigs, wild boar, hybrids.

SKIRTINGO GENOTIPO IR LYTIES HIBRIDŲ RAUMENŲ KOKYBĖ

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Santrauka. Tyrimų tikslas buvo įvertinti genotipo, kurį apsprendžia paskutinė kryžminimui naudojama veislė, ir lyties įtaką hibridų, gautų taikant grįžtamąjį kryžminimą, skirtingų raumenų kokybei. Atlikti Lietuvos vietinių kiaulių su šernais grįžtamojo kryžminimo su raumeningomis Jorkšyro ir Norvegijos landrasų veislėmis gautų hibridų ilgiausiojo nugaros raumens ir pusplėvinio raumenų cheminės sudėties bei technologinių savybių tyrimai. Buvo tiriamos kiaulaičių ir kastratų raumenų savybės. Hibridų genotipas pagal paskutinę kryžminimui naudotą veislę turėjo įtakos hibridų augimo spartai ir skerdenų riebumui. Hibridai, gauti Lietuvos vietinių ir šernų hibridus toliau kryžminant su Norvegijos landrasais, užaugo 69,5 dienomis greičiau, o jų skerdenos buvo liesesnės (lašiniai ties 10 šonkauliu buvo 5,56 mm plonesni) negu baigiamajam kryžminimui naudojant jorkšyrus. Tačiau hibridų, gautų panaudojus landrasus, kai kurie mėsos kokybės rodikliai, tokie kaip pH abejuose tirtuose raumenyse ir defrostavimo nuostoliai pusplėviniame raumenyje, buvo prastesni. Kiaulaičių ilgiausiajame nugaros raumenyje buvo santykinai 4,7 proc. daugiau sausųjų medžiagų ir 0,7 proc. mažesnė pH reikšmė, bet pusplėviniame raumenyje buvo santykinai 3,6 proc. mažiau sausųjų medžiagų ir 4,0 proc. daugiau baltymų negu atitinkamuose kastratų raumenyse. Tačiau kastratų pusplėviniame raumenyje buvo santykinai net 98,2 proc. daugiau riebalų negu kiaulaičių raumenyje. Pusplėvinio raumens buvo santykinai 4,3 proc. didesnis vandens rišlumas, intensyvesnė spalva ir didesnis pH. Ilgiausiojo nugaros raumens virimo nuostoliai buvo santykinai 4,7 proc. didesni. Nustatyta fenotipinė koreliacija tarp hibridų amžiaus, svorio ir skerdenų riebumo su tokiais mėsos kokybės rodikliais kaip pH ir vandens rišlumas.
Raktažodžiai: mėsos kokybė, genotipas, lytis, kiaulės, šernai, hibridai.

Introduction. The food quality is presented as a system of product requirements both material and immaterial, related to the product in itself, the production context, the product-packaging system, and the product-market system. The dynamics of the quality system also include a relationship between product characteristics, product performance and consumer requirements. Thus quality can be described as the requirements necessary to satisfy the needs and expectations of the consumer (Peri, 2006). There is a whole range of pig production systems having a claim on higher quality of meat, from much differentiated ones relying on local breeds and extensive rearing conditions to systems using conventional breeds in intensive conditions (Krystallis et al., 2009; Bonneau and Lebret, 2010). Slow growing and fat, local breeds are used in one third of the differentiated European systems.

Most often their meat is found to be of higher eating quality compared to conventional European genotypes (Bonneau and Lebret, 2010; Stimbirys and Jukna, 2010). Current pig production system has provided pork at a reasonable price and quality for consumer, and pork produced in Lithuania is found to be of higher quality compared to imported meats (Garmienė et al., 2010). However, public concerns on animal welfare, environmental pollution and safety of meat products have grown up (Dransfield et al., 2005; Krystallis et al., 2009). In recent years, organic animal and wild animal products have received a significant attention in most developed countries, as the products are considered to be healthier and safer than those produced by intensive production systems (Gongora et al., 2003; Dransfield et al., 2005; Li et al., 2005; Randi, 2005). Wild mammals represent only 2% of the herbivore biomass (Gorman and Raffaelli, 2008), therefore an alternative to increase the amount of relatively "wild" meat could be captive rearing of wild species or their crossbreeding with domestic animals. Although currently in Lithuania domestic pig and wild boar crossbreeding is warrantable only for research, in this respect, the public interest for wild boar introgression into domestic pigs has been increased. Previous research studies showed that some increase of loin area in hybrid genotypes with increasing wild boar portion could be noticed. Crossing of wild boar with Lithuanian indigenous pigs decreased the growth rate, carcass length and increased backfat thickness in 1/2 wild boar hybrids (Razmaitė et al. 2009). Furthermore, the increase of wild boar portion in hybrids increased the difference of backfat thickness between the genders and castrates were found to be very fat (Razmaitė and Kerzienė, 2009). Therefore, it was expedient to evaluate backcross to lean domestic pigs. The aim of the present study was to examine the effect of genotype (terminal breed), muscle and gender on the meat quality of hybrids from Lithuanian indigenous wattle pig and wild boar backcross to lean pig breeds.

Materials and Methods. Thirteen animals used were females and castrated males from domestic Lithuanian indigenous wattle and wild boar hybrid backcross to domestic lean breeds (Norwegian Landrace and Yorkshire). The hybrids were reared indoors in mixed-gender groups from birth to slaughter consuming twice a day the same standard concentrate feed, containing 12.28 MJ metabolisable energy and 14.49% crude protein balanced with lysine (0.80%/kg feed). The animals were slaughtered when they reached approximately 90 kg weight**.** The slaughtering was conducted in the abattoir for control slaughtering of the state pig breeding station immediately with minimum handling stress after 5 km transportation. The pigs were stunned with electricity and were bled within 15 s of stunning. Afterwards, the carcasses were scalded in a Hubert H_{AAS} scalder for 5 min. at 64ºC and dehaired. The head was removed and the carcass was split longitudinally on the midline. Eviscerated carcasses were weighed to determine warm carcass weight and chilled for 24 h at +2-4ºC. Carcass weight was measured without head and feet. Dressing percentage was calculated as percentage of carcass weight 0.5 h after slaughtering on live weight before slaughter. After twenty-four hours post-mortem, carcasses were weighed again to determine cold carcass weight. Cooling loss was calculated as difference between warm and chilled carcass weight in percentage. Measurements of backfat thickness were taken with a ruler on the left side of carcasses at the dorsal line of mid back at the 10 rib. The photo was taken to measure the area of *M. longissimus dorsi* at 1/2 lumbar vertebra by digital camera EX-Z110 (Casio). Afterwards, loin area was planimetrically measured by means of the "SCAN-STAR K" planimetrical system (Germany) (Razmaitė et al., 2009). Samples of *M. longissimus dorsi* (LD) and *M. semimembranosus (SM)* were collected, respectively, from the loin and from the ham of the left side of carcasses.

Technological meat quality was determined approximately 24 h post mortem. Meat pH was measured by using Knick pH-766 meter (CALIMATIC, Berlin, Germany). Colour intensity was determined by the method of Khornsi's modification with a spectrophotometer СФ-46 (LOMO, Russia), as described in the methodological guidelines (Misik, 1978). Cooking loss was found according to meat weight differences before and after cooking. Water holding capacity of LD and SM was determined by the method of Grau and Hamm (1953) and as the thawing loss of these muscles. Samples for determination of thawing loss were frozen for 5 days at -20ºC. After thawing at ambient temperature, the thawing loss of LD and SM was determined as weight difference of frozen and defrosted muscles (Heyer et al., 2004).

Chemical composition analysis was performed on defrosted LD and SM muscles after determination of thawing loss. Dry matter content was determined by drying sample in an oven at 105˚C until a constant weight was obtained (method No 950.46B; AOAC, 1990). Crude protein content was determined by the Kjeldahl method using the Kjeltec system 1002 apparatus (Foss-Tecator AB), and a conversion factor of 6.25 was used to convert total nitrogen to crude protein (method No 981.10; AOAC, 1990). Intramuscular fat was determined by the Soxhlet extraction method (method No 960.39; AOAC, 1990). Ash was determined by incineration in a muffle furnace at 550˚C for 24 h (method No 920.153; AOAC, 1990). The content of protein, intramuscular fat and ash was expressed as the weight percentage of dry matter from muscle tissues. The samples were analysed at least in duplicate for all analytes.

Statistical analysis was performed with the general linear model (GLM) procedure in Minitab. The age and carcass data and meat quality parameters within muscles were analysed using a model that included the fixed effects of gender (females or barrows) and genotype (terminal breed). The meat quality parameters were also analysed using a model that included the fixed effect of the muscle. Tukey`s HSD significance test was used to ascertain the existence of significant differences between the traits and where they occurred. Significance was determined at $P<0.05$, but differences of $0.05\leq P<0.10$

would be considered as trends. Pairwise correlation (Pearson`s correlation coefficients) was calculated.

Results. The live weight at slaughter in the subgroups was similar, with the largest difference of 2.8 kg ($P>0.10$) between the genotypes (Table 1), but the age at slaughter of the genotype from the terminal Norwegian Landrace breed [(LIW x WB) x NL] or 1/2 NL was by 69.5 days ($P<0.001$) lower compared with the genotype from the terminal Yorkshire breed [(LIW x WB) x Y] or 1/2 Y.

Table 1 **Least square means and standard errors of differences for age and carcass data by gender and genotype of hybrid pigs**

Variables	Gender			Genotype		
	Gilts	Barrows	SED	(LIWxWB)x Y	(LIWxWB)x NL	SED
Age, days	224.3	222.8	14.71	258.3	188.8	15.07***
Live weight, kg	92.5	93.5	2.61	94.4	91.6	2.68
Hot carcass weight, kg	59.9	61.5	1.87	61.9	59.5	1.91
Dressing percentage, %	64.75	65.78	0.70	65.61	64.91	0.72
Cold carcass weight, kg	58.5	60.1	1.85	60.5	58.1	1.89
Cooling loss, %	2.34	2.24	0.22	2.29	2.28	0.22
Backfat thickness of mid back at the 10 rib, mm	20.00	22.95	3.48	24.26	18.70	3.56
Loin area, cm^2	33.02	32.87	1.10	33.34	32.55	1.12

Significance level: ***$P<0.001$

Table 2 **Least square means and standard errors of differences for chemical composition and technological quality of different muscles from hybrid pigs**

Variables	*M .longissimus dorsi*	*M. semimembranosus*	SED
Dry matter, %	27.02	26.39	0.40
Protein,%	89.55	88.88	1.26
IMF, %	6.35	6.78	1.29
Ash,%	3.76	3.86	0.15
pH	5.46	5.52	0.03^t
Colour	70.51	81.66	2.41***
Cooking loss,%	41.11	39.27	0.97^t
WHC,%	53.48	55.76	1.03*
Thawing loss,%	9.99	10.73	0.81

Significance levels: $^t0.05\leq P<0.10$; *$P<0.05$; *** $P<0.001$

Table 3 **Least square means and standard errors of differences for chemical composition and technological meat quality of longissimus muscle from hybrid pigs by gender and genotype**

Variables	Gender			Genotype		
	Gilts	Barrows	SED	LIWxWBxY	LIWxWBxNL	SED
Dry matter, %	27.75	26.50	0.60^t	27.90	26.35	0.62*
Protein, %	88.95	91.60	2.36	89.44	91.10	2.41^t
Fat, %	7.06	3.99	2.56	6.083	4.964	2.62
Ash, %	3.58	3.97	0.22	3.65	3.89	0.22
pH	5.42	5.46	0.06^t	5.50	5.38	0.07^t
Colour	70.42	71.87	3.84	75.44	66.85	3.94^t
Cooking loss¸%	41.31	40.86	1.54	41.84	40.33	1.58
WHC, %	50.59	54.55	2.87	50.10	55.04	2.94
Thawing loss, %	11.27	10.54	2.15	10.47	11.34	2.20

Significance levels: $^t0.05\leq P<0.10$; *$P<0.05$

Table 4 **Least square means and standard errors of differences for chemical composition and technological meat quality of semimembranosus muscle from hybrid pigs by gender and genotype**

Variables	Gender			Genotype		
	Gilts	Barrows	SED	LIWxWBxY	LIWxWBxNL	SED
Dry matter, %	26.08	27.03	0.52^{t}	26.71	26.39	0.53
Protein, %	91.43	87.91	1.65^{t}	89.60	89.74	1.69
Fat, %	3.96	7.85	1.70*	5.50	6.31	1.74
Ash, %	4.00	3.74	0.20	3.87	3.87	0.20
pH	5.51	5.50	0.04	5.58	5.43	0.04**
Colour	82.08	84.13	3.83	83.81	82.40	3.93
Cooking loss, %	40.18	39.14	1.91	38.69	40.63	1.96
WHC, %	53.82	54.56	2.27	54.64	53.75	2.30
Thawing loss, %	11.76	12.23	1.67	9.86	14.12	1.71*

Significance levels: ^{t}0.05≤P<0.10; **P*<0.05; ** *P*<0.01

Although 1/2 Y hybrids and castrated males had higher backfat thickness of the mid back at the 10 rib, respectively, differences of carcass characteristics between the genotypes and genders were statistically insignificant. There were no statistically significant differences between the chemical composition of the longissimus and semimembranosus muscles (Table 2). However, colour intensity (P<0.001) and water holding capacity relatively 4.3% (P<0.05) were higher, and pH value had a tendency to be 1.1% higher (0.05≤P<0.10) in the semimembranosus muscle. Cooking loss was relatively 4.7% higher (0.05≤P<0.10 in the longissimus muscle. Hybrids from 1/2 Y genotype had relatively 5.9% more dry matter in the longissimus muscle (P<0.05) than the hybrids from 1/2 NL genotype (Table3). However, the hybrids from 1/2 NL genotype tended to have relatively by 1.9% more protein (0.05≤P<0.10) compared with the hybrids from 1/2 Y genotype. The hybrids from 1/2 Y also tended to have 2.2% higher pH and 12.8% higher colour intensity (0.05≤P<0.10) of *M. longissimus dorsi* than the hybrids from 1/2 NL. Gilts tended to have relatively 4.7% higher amount of dry matter in *M. longissimus dorsi* and 0.7% lower pH value of this muscle (0.05≤P<0.10) compared to barrows. In contrast to the proportion of dry matter between the genders in the longissimus muscle, gilts tended to have relatively 3.6% lower content of dry matter and relatively 4.0% higher content of protein than barrows (0.05≤P<0.10) in the semimembranosus muscle (Table 4). The barrows had relatively 98.2% higher level (P<0.05) of intramuscular fat in *M. semimembranosus* compared with gilts. There was no effect of the genotype on the chemical composition of *M. semimembranosus.* However, the hybrids from 1/2 NL genotype had lower pH (P<0.01) and relatively 43.2% (P<0.05) higher thawing loss than the hybrids from 1/2 Y of *M. semimembranosus.*

The correlation between meat quality and carcass traits was performed for the two muscles. In general the correlation values were low and only a few were higher than 0.5. Negative correlation (r = -0.58; P<0.05) was found between the carcass cooling loss and loin area, and no statistically significant correlation was found between the cooling loss and other carcass related parameters (Table 5).

Table 5 **Correlation coefficients between cooling loss and age and carcass data for hybrid pigs**

	Cooling loss
Age	0.17
Weight	-0.25
Backfat thickness of mid back at the 10 rib	-0.15
Loin area	-0.58*

Significance level: **P*<0.05

Table 6 **Correlation coefficients between age and carcass data and meat quality within two muscles**

	M. longissimus dorsi				*M. semimembranosus*			
	Age	Weight	Loin area	Backfat	Age	Weight	Loin area	Backfat
pH	0.76**	-0.25	0.07	-0.02	0.47	0.33	0.36	0.44
Colour	0.27	0.38	0.48^{t}	0.51^{t}	0.03	-0.34	0.33	-0.21
Cooking loss	0.06	0.14	0.07	0.24	-0.27	-0.52^{t}	-0.11	-0.32
WHC	-0.02	-0.65*	-0.30	-0.62*	0.44	-0.64*	-0.16	-0.65*
Thawing loss	-0.55^{t}	0.17	0.29	0.02	-0.60*	-0.12	-0.13	-0.42
IMF	0.27	0.07	-0.15	0.25	0.32	-0.16	-0.28	0.15
Dry matter	0.21	0.57*	0.21	0.61*	0.11	0.16	-0.01	0.04

Significance levels: ^{t}0.05≤P<0.10; **P*<0.05; ** *P*<0.010

Pearson's correlation coefficients between the age, weight, loin area**,** backfat thickness and the main parameters of muscles quality are presented in Table 6. The pH showed positive correlations with the age for both muscles, however, only the correlation (r = 0.76) between the age and pH for *M. longissimus dorsi* was statistically significant (P<0.05). The colour of LD muscle tended positively to correlate (r = 0.48) with the loin area and backfat thickness (0.05≤P<0.10). The cooking loss showed the trend of negative correlation (r = -0.52) with the body weight for SM muscle. Negative quite equal correlation (r = -0.64 and -0.65) was found between water holding capacity and weight and backfat thickness of hybrids for both studied muscles (P<0.05). Thawing loss showed negative correlation (r = -0.60) with age for SM muscle (P<0.05) and tended to correlate (r = -0.55) for LD muscle (0.05≤P<0.10). Dry matter positively correlated with weight (r = 0.57) and backfat thickness (r = 0.61) only for LD muscle (P<0.05).

Discussion and conclusions. In developing strategies for pork production diversification, information on the effects of production factors (genotype) and inherent factors (gender and muscle type) on meat quality traits is needed. This study indicated an important effect of the genotype (terminal breed) on the growth rate. The hybrid pigs from the terminal Norwegian Landrace breed (LIW x WB) x NL genotype) grew much faster than the pigs from the terminal Yorkshire breed (LIW x WB) x Y genotype), and their carcasses contained less fat. These results were not unexpected since Landrace pigs of Norsvin selection in Lithuania are the leanest pigs, characterised by very fast growth (Lundeheim and Razmaitė, 2005). In accordance with Latorre et al. (2004) the barrows in the present study produced insignificantly heavier carcasses than the gilts. However, contrary to the results of Latorre et al. (2004) the dressing percentage of barrows was insignificantly higher. Intramuscular fat is important in assessing meat quality, but the terminal breed and muscle in the present study had no effects on intramuscular fat levels. Higher IMF content was observed in the semimembranosus muscle of barrows and this is in agreement with Lebret et al. (2001) and Correa et al. (2006), and in disagreement with Latorre et al. (2004) and Lo Fiego et al. (2010). The colour of muscles represent important criteria for the consumer, however, pH measurements are often used to predict other pork quality traits (Ramos et al., 2007). In the present study, Norwegian Landrace as a terminal breed showed a tendency towards lower colour intensity and pH value in the longissimus muscle, and lower pH value and thawing loss in the semimembranosus muscle. The comparison between the characteristics of the longissimus and semimembranosus muscles showed significant differences between the two muscles for two of the variables studied and this is somewhat in disagreement with the findings of Gil et al. (2008) who reported significant differences between the muscles for all of the variables studied and the importance of the muscle type on the metabolic properties. The correlation between meat quality traits, such as water holding capacity, pH value, cooking loss, reflectance, etc. is existent as predictable (Huff-Lonergan, 2002; Jennen et al., 2007). In this study correlations between the cooling loss and age and carcass traits, and also correlations between the age, weight and carcass fatness and meat quality traits within two muscles were presented. Bertram et al., (2007) have noted that the perceived juiciness of the meat is believed to be linked to the water in the meat. The amount and distribution of water within the meat has a considerable influence on its nutritional value, consumer appeal and technological properties. Pronounced effects of slaughter age on water mobility and distribution in the muscles have been revealed. Bertram et al., (2007) reported about a significant effect of slaughter age on juiciness, as juiciness increased with decreasing age. In this study juiciness was not evaluated, however, it is noteworthy that the negative correlation between the backfat thickness and water holding capacity, and negative correlation between the age and thawing loss in both studied muscles should possibly be ascribed to the associations between water mobility and distribution and age of pigs and their carcass fatness. The negative correlation between the cooling loss and loin area was unexpected and this was in disagreement with the results of Müller et al. (2000) who reported that the cooling loss positively correlated with the meat amount in carcass. The reason for that different correlation might be the difference in the genetic background and carcass fatness between the reported examinations. Although the negative correlation between the cooling loss and backfat thickness was low, backfat thickness correlated negatively with water holding capacity. Otto et al. (2004) reported that correlations observed between the carcass traits, such as lean content and drip loss were low or not significant but they are undesirable in particular with regards to loin area what was in agreement with the results in this study.

In conclusion, hybrids in the same environment and production regime and low pre-slaughter stress of the present study permitted the expression of the phenotypic characteristics of the two genotypes designed from different terminal breeds. The terminal breed influenced the growth rate and carcass fatness. The hybrids from the terminal Norwegian Landrace grew faster and had less fatty carcasses than the hybrids from terminal Yorkshire. However, Norwegian Landrace as a terminal breed showed a tendency towards lower meat quality traits, such as pH value in the longissimus and semimembranosus muscles and increasing thawing loss in semimembranosus muscle. The gender showed higher effects on the chemical composition of the muscles. The main differences between the muscle type were related to the differences in water holding capacity, colour and pH (higher in the semimembranosus muscle) and cooking loss (higher in the longissimus muscle). This study also identified several phenotypic correlations between the age, body weight and carcass fatness of hybrid pigs and meat quality traits, such as pH and water holding capacity.

References

1. AOAC. Official methods of analysis (15th ed.). Arlington, VA, 1990. Association of Official Analytical Chemists.

2. Bertram H. C., Straadt I. K., Jensen J. A., Aaslyng M. D. Relationship between water mobility and distribution and sensory attributes in pork slaughtered at an age between 90 and 180 days. Meat Science., 2007. Vol. 77. P. 190–195.

3. Bonneau M., Lebret B. Production systems and influence on eating quality of pork. Meat Science., 2010. Vol. 84. P. 293–300.

4. Dransfield E., Ngapo T. M., Nielsen N.A., Bredahl L., Sjöden P. O., Magnuson M., Campo M. M., Nute G. R. Consumer choice and suggested price for pork as influenced by its appearance, taste and information concerning country of origin and organic pig production. Meat Science., 2005. Vol. 69. P. 61–70.

5. Correa J. A., Faucitano L., Laforest J. P., Rivest J., Marcoux M., Gariépy C. Effects of slaughter weight on carcass composition and meat quality in pigs of two growth rates. Meat Science., 2006. Vol. 72. P. 91–99.

6. Garmienė G., Jasutienė I., Zaborskienė G., Mieželienė A. Lietuvos rinkoje parduodamos kiaulienos nugarinės kai kurių rodiklių palyginimas. Veterinarija ir Zootechnika., 2010. T. 52 (74). P. 21–28.

7. Gil M., Delday M. I., Gispert M., Font i Furnols M., Maltin C. M., Plastow G. S., Klont R., Sosnicki A. A., Carrión D. Relationships between biochemical characteristics and meat quality of Longissimus thoracis and Semimembranosus muscles in five porcine lines. Meat Science., 2008. Vol. 80. P. 927–933.

8. Gongora, R. J., Peltoniemi, O. A. T., Tammen, I., Raadsma, H. & Moran C. 2003. Analyses of possible domestic pig contribution in two populations of Finnish farmed Wild Boar. Acta Agriculturae Scandinavica Sect. A, Animal Science., 2003. Vol. 53. P. 161–165.

9. Gorman M. L. and Raffaelli D. The functional role of wild mammals in agricultural ecosystems. Mammal Review., 2008. Vol. 38. P. 220–230.

10. Grau, R., Hamm, R. 1953. Eine einfasche methode zur bestimmung des wasserbindung in muskel. Freischwirtschaf., 1953. Vol. 4. P. 295–297.

11. Heyer A., Andesson H.K., Rydhmer L., Lundström K. Carcass quality and technological and sensory meat quality of once-bred gilts in a seasonal outdoor rearing system. Acta Agriculturae Scandinavica Sect. A, Animal Science., 2004. Vol. 54. P. 103–111.

12. Huff-Lonergan E., Baas T. J., Malek M., Dekkers J. C. M., Prusa K. and Rothshild M. F. Correlations among selected pork quality traits. Journal of Animal Science., 2002. Vol. 80. P. 617–627.

13. Jennen D. G. J., Brings A. D., Liu G., Jüngst H., Tholen E., Jonas E., Tesfaye D., Schellander K. and Phatsara C. Genetic aspects concerning drip loss and water-holding capacity of porcine meat. Journal of Animal Breeding and Genetics., 2007. Vol. 124 (Suppl. 1). P. 2–11.

14. Krystallis A., De Barcellos A. D., Kügler J. O., Werbeke W., Grunert K. G. Attitudes of European citizens towards pig production systems. Livestock Science., 2009. Vol. 126. P. 46–56.

15. Latore M. A., Lázaro R., Valencia D. G., Medel P. and Mateos G. G. The effects of gender and slaughter weight on the growth performance, carcass traits, and meat quality characteristics of heavy pigs. Journal of Animal Science., 2004. Vol. 82. P. 526–533.

16. Lebret B., Juin H., Noblet J. and Bonneau M. The effects of two methods of increasing age at slaughter on carcass and muscle traits and meat sensory quality in pigs. Animal Science., 2001. Vol.72. P.87–94.

17. Li D., Siriamornpun S., Wahlqvist M. L., Mann N. J. and Sinclair A. J. Lean meat and heart health. Asia Pacific Journal of Clinical Nutrition., 2005. Vol. 14. P. 113–119.

18. Lo Fiego D. P., Macchioni P., Minelli G., Santoro P. Lipid composition of covering and intramuscular fat in pigs at different slaughter age. Italian Journal of Animal Science., 2010. Vol. 9:e39. P. 200–205.

19. Lundeheim N., Razmaitė V. Evaluation of Lithuanian pig breeds and breed combinations. Proc. of the 11th Baltic Animal Breeding and Genetics Conference. Palanga. 2005. P. 121–124.

20. Misik A. T. Methodological guidelines for assay of quality of carcass, meat and subcutaneous fat of slaughtered pigs. Moscow, VASHNIL, 1978. 43 (in Russian).

21. Müller E**.,** Moser G., Bartenschlager H. and Geldermann H. Trait values of growth, carcass and meat quality in wild boar, Meishan and Pietrain pigs as well as their crossbred generations. Journal of Animal Breeding and Genetics., 2000. Vol. 117. P. 189–202.

22. Otto G., Roehe R., Looft H., Thoelking L. and Kalm E. Comparison of different methods for determination of drip loss and their relationships to meat quality and carcass characteristics in pigs. Meat Science., 2004. Vol. 68. P. 401–409.

23. Peri C. The universe of food quality. Food Quality and Preference., 2006. Vol. 17. P. 3–8.

24. Ramos A. M., Serenius T. V., Stalder K. J., Rothschild M. F. Phenotypic correlations among quality traits of fresh and dry-cured hams. Meat Science., 2007. Vol. 77. P. 182–189.

25. Randi E. Management of wild ungulate

populations in Italy: Captive-breeding, hybridisation and genetic consequences of translocations. Veterinary Research Communications., 2005. Vol. 29. (Suppl. 2). P. 71–75.

26. Razmaitė V., Kerzienė S., Jatkauskienė V. Body and carcass measurements and organ weights of Lithuanian indigenous pigs and their wild boar hybrids. Animal Science Papers and Reports., 2009. Vol. 27(4). P. 331–342.

27. Razmaitė V., Kerzienė S. Lyties įtaka skirtingo genotipo kiaulių skerdenų rodikliams. *Veterinarija ir Zootechnika*., 2009. T. 45 (67). P. 41–46.

28. Stimbirys A., Jukna V. Lietuvoje auginamų kiaulių veislių penėjimosi, skerdenos ir mėsos kokybės įvertinimas. Veterinarija ir Zootechnika., 2010. T. 52(74). P. 73–78.

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