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DISTINGUISHABLE CHARACTERISTICS AND EARLY GROWTH OF PIGLETS FROM LITHUANIAN INDIGENOUS PIGS AND WILD BOAR INTERCROSS AND BACKCROSS

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The objective of the study was to examine distinguishable characteristics between Lithuanian indigenous pigs and their hybrids through the presence of wattles, coat coloration patterns of newborn piglets and their early growth. Introgression of wild boar into Lithuanian indigenous pigs reduced the number of stillborn and dead piglets until 3 weeks of age ($0.1<p\leq0.05$). Negative correlations between the number and weight of piglets at birth were found. The highest portion of low weight piglets and the lowest mean weight at birth was found for 1/4 WB piglets ($p<0.05$) but their early growth rates were higher than those of 1/2 WB piglets. However, the highest growth rates were determined for purebred Lithuanian indigenous pigs ($p<0.05$). The weight at birth of male piglets was higher ($p<0.05$) than that of female piglets in all studied groups. The higher weight of male piglets from birth until weaning ($p<0.05$) was only in 1/2 WB genotype. 71.7% of 1/4 WB and 31.6% of 1/2 WB piglets inherited wattles, a morphological feature of Lithuanian indigenous pigs. The striped pattern was found in all 1/2 WB piglets and in 32.1% of 1/4 WB piglets. The portion of wild boar had a significant effect on piglet coat coloration.

Key words: swine, hybrids, early growth, wattles, coat coloration patterns

INTRODUCTION

Wild mammals have long been associated closely with the human food chain, being the source for domesticated animals and considered to provide wild harvests (Macmillan and Phillip, 2008; White and Lowe, 2008). Archaeological evidence indicates that during the medieval times wild mammals were consumed primarily by the governing elites (Vitkunas, 2006; Macmillan and Phillip, 2008). Nowadays wild meat consumption is lower than at any other time and it is estimated that it accounts for less than 1% of all meat consumed (Macmillan and Phillip, 2008). Of yore in Lithuania wild boar meat was highly appreciated. Although wild boar in Lithuania has never been extinct, there is growing interest

for hobby activities and a new alternative for diversification of pork products on small family farms both in captive breeding of wild boar and crossbreeding with domestic pigs. This alternative, as well as the search for the possibilities of adaptation of conserved Lithuanian indigenous pigs to production niches, encouraged Lithuanian indigenous wattle x wild boar intercross. Lithuanian indigenous pigs are less demanding in terms of feeding and keeping conditions. Their coat color range is wide: white, black, brownish, but in most cases – spotted, both long- and short-eared, because previously no breeding-selective work had been performed. Wild boar produces less juveniles and has a slower growth in comparison with domestic pigs (Kontrimavičius, 1988; Náhlik and Sándor, 2003; Gethöffer *et al*., 2007; Servanty *et al*., 2007). Reproduction and litter traits, including pre-weaning mortality and low piglet weight at weaning, are significant to breeders because these traits are very important on both economic and animal welfare grounds (Johansen *et al*., 2004; Casellas *et al*., 2008). Therefore, the objective of the present study was to examine distinguishable characteristics between Lithuanian indigenous pigs and their different wild boar genotype hybrids through the presence of wattles, coat coloration patterns of newborn piglets and their early growth.

MATERIALS AND METHODS

This study included 24 litters from purebred Lithuanian indigenous wattle pigs (LIW) and from two combinations of wild boar genotype: Lithuanian indigenous wattle x wild boar intercross (1/2 WB genotype) and their backcross (Lithuanian indigenous wattle x wild boar) x: Lithuanian indigenous wattle (1/4 WB genotype). All animals were born at the Institute of Animal Science of Lithuanian Veterinary Academy. The litters came from 24 sows and 9 boars. The animals were reared indoors. The number of piglets born alive, stillborn, the number of piglets at 3 weeks and at 2 months (weaned) of age was recorded for each litter. The presence of wattles, a distinctive morphological feature of Lithuanian indigenous pigs, and the coat color were recorded for each piglet. All piglets were weighed at birth (within the first few hours after farrowing, at 3 weeks and 2 months of age. The data consisted of 197 piglets. No cross-fostering was used.

Statistical analysis was performed in MINITAB release 14.20. ANOVA model included genotype (Lithuanian indigenous, 1/4 WB and 1/2 WB) and gender as a fixed factor for the weight of piglets. Second ANOVA model included genotype and the presence of wattles as a fixed factor for the weight of piglets. One-way ANOVA included genotype as fixed factor for the litter size traits. LSD (Least Significant Difference) test (α=5%) was used to ascertain the existence of significant differences between the traits. Due to a small number of litters (24 litters), also non-parametric analysis was performed for the litter size traits. Mann-Whitney-Wilcoxon and Kruskal-Wallis tests were used to ascertain the existence of significant differences between the traits where they occurred. Chi-square test was performed for the coloration patterns and the presence of wattles. Pairwise correlation (Spearman's correlation coefficients) was calculated.

RESULTS

Mann-Whitney-Wilcoxon test showed that introgression of wild boar into Lithuanian indigenous pigs reduced the number of stillborn ($0.1<p\leq0.05$) piglets until 3 weeks (Table 1). Lower number of dead piglets in 1/2 WB genotype ($0.1<p\leq0.05$) was estimated by both Mann-Whitney-Wilcoxon test and LSD test. 86.7%, 50% and 33.3% of deaths of the studied piglets during the first 3 weeks of age occurred, respectively, in purebred Lithuanian indigenous, 1/4 WB and 1/2 WB genotypes. After three weeks, the percentage of the reduction of the observed survivability in purebreds became lower. However, the deaths in 1/4 WB were distributed throughout all pre-weaning period, until piglets reached 2 months of age. The survivability of 1/2 WB piglets decreased after the three weeks of their age. The weight at birth of 1/2 WB genotype was more homogenous than that of the piglets from other genotypes, and there was the lowest portion of piglets classified as having very low (<1.0 kg) and low (<1.2 kg) weight (Figure 1). The highest portion of low weight piglets and the lowest mean weight at birth was for 1/4 WB piglets ($p<0.05$), but their early growth rates were higher than for 1/2 WB piglets (Table 2). However, the highest growth rates were for purebred Lithuanian indigenous piglets ($p<0.05$).

Table 1. Means and standard errors for piglet numbers from the litters of different genotypes

Variables	Genotype		
	LW	1/4 WB	1/2 WB
n	12	7	5
Number of piglets born total	8.83±0.57	7.57±1.11	7.6±1.60
Number of piglets born alive	7.42±0.63	7.29±1.06	7.40±1.57
Number of stillborn piglets	1.42 ± 0.50^{C}	0.29 ± 0.18^{D}	0.20 ± 0.20^{D}
Number dead until 3 weeks	1.08 ± 0.29^{cC}	0.71±0.36	0.20 ± 0.20^{dD}
Number dead until 2 months	1.17±0.30	1.14±0.34	0.40±0.40
Number of piglets with wattles	7.17 ± 0.63^{aA}	5.71±1.54	3.00 ± 0.89^{bB}
Number of piglets without wattles	1.67 ± 0.45^{aC}	1.43 ± 0.57^{aC}	4.60 ± 1.72^{bD}

Different letters within the row indicate significant difference: a and b ($p<0.05$) for LSD test; A and B ($p<0.05$) for Mann-Whitney-Wilcoxon test; c and d ($0.05\leq p0.10$) for LSD test; C and D ($0.05\leq p<0.10$) for Mann-Whitney-Wilcoxon test

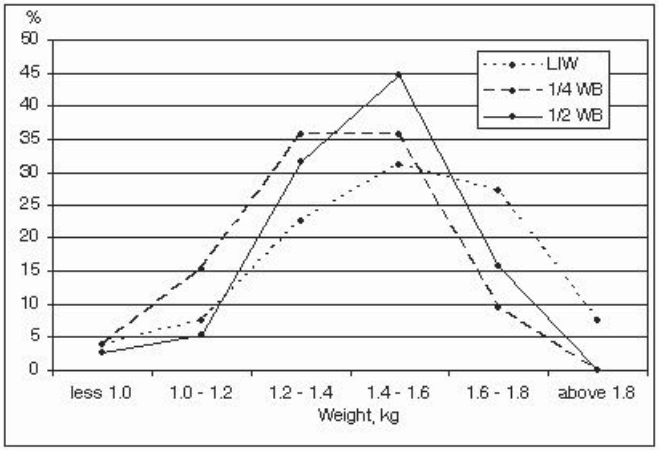

Figure 1. Distribution of piglets by weight at birth from the studied genotypes

Table 2. Early growth of piglets from different genotypes

Variables	Genotypes					
	LIW		1/4 WB		1/2 WB	
	n	Mean ± se	n	Mean ± se	n	Mean ± se
Weight at birth (kg)	106	1.50 ± 0.02^{a}	53	1.36 ± 0.03^{b}	38	1.45 ± 0.03^{a}
Weight at 3 weeks (kg)	93	4.90 ± 0.13^{a}	49	4.10 ± 0.14^{b}	37	3.80 ± 0.17^{b}
Weight at 2 months (kg)	91	13.9 ± 0.38^{a}	45	11.7 ± 0.56^{c}	36	8.40 ± 0.55^{b}

Different letters within the row indicate significant difference: a and b ($p<0.05$) for LSD test

The gender ratio in the litters decreased as the litter size increased (Figure 2). Gender ratio was male based in small litters and female based in larger ones. However, there were no differences in gender ratio in the litters from different genotypes. The weight at birth of male piglets was higher ($p<0.05$) than that of female piglets in all studied groups, but the weight difference between genders in 1/4 WB genotype was insignificant (Table 3). The higher weight of male piglets from birth until weaning ($p<0.05$) was only in 1/2 WB genotype. The effect of litter size estimated by ANOVA and by Kruskal-Wallis test on the weight at birth was lowest for purebred piglets 13.8% ($p<0.05$) ($\chi^2=15.9$, df=6, $p<0.05$) and increased with the higher portion of wild boar 21.3% ($p<0.05$) ($\chi^2=11.7$, df=4, $p<0.05$ for 1/2 WB). The effect of litter size on body weight also increased with the

age of the piglets from 15.5% ($p<0.05$) ($\chi^2=15.9$, df=6, $p<0.05$) at 3 weeks of age and 21.3% ($p<0.01$) ($\chi^2=20.3$, df=6, $p<0.01$) at 2 months of age for purebred piglets; to 45.7% ($p<0.001$) ($\chi^2=13.8$, df=4, $p<0.01$) at 3 weeks of age and 62.5% ($p<0.01$) ($\chi^2=14.4$, df=4, $p<0.01$) at 2 months of age for 1/2 WB piglets. Negative correlations between the number and body weight of piglets support the estimated effect of litter size on weight (Table 4). Correlations between the number of piglets and the weight were found to be low for Lithuanian indigenous. However, correlations between these traits for hybrid piglets were higher. About 89% of newborn piglets in the current population of Lithuanian indigenous pigs have wattles under the neck. Even 71.7% of 1/4 WB and 31.6% of 1/2 WB piglets inherited wattles, a morphological feature of Lithuanian indigenous pigs, therefore the difference in the numbers of piglets with wattles was significant ($p<0.05$) only between purebred Lithuanian indigenous and 1/2 WB genotype. The weight of piglets without wattles from purebred group was insignificantly higher than that of the piglets with wattles. While the weight at 3 weeks and at 2 months of piglets without wattles from 1/4 WB was higher ($p<0.05$), the weight of piglets without wattles from 1/2 WB, conversely, was insignificantly lower (Table 5). The striped pattern was found in 32.1% of 1/4 WB and in all 1/2 WB piglets. Most of striped piglets (92.1% from 1/2 WB and 70.6% from 1/4 WB genotypes) were born with yellowish-brown coats and dark stripes along the body. The rest part of these piglets was with grey-yellowish-brown coats among dark stripes. The portion of wild boar had a significant effect on the piglet coat coloration ($\chi^2=51.2$, df=4, $p<0.001$) but the coat color was not associated with gender ($\chi^2=3.9$, df=4, $p=0.4$) in 1/4 WB genotype and ($\chi^2=0.6$, df=1, $p=0.4$) in 1/2 WB genotype. However, the wattle presence and coat color are dependent traits ($\chi^2=20.1$, df=4, $p<0.001$).

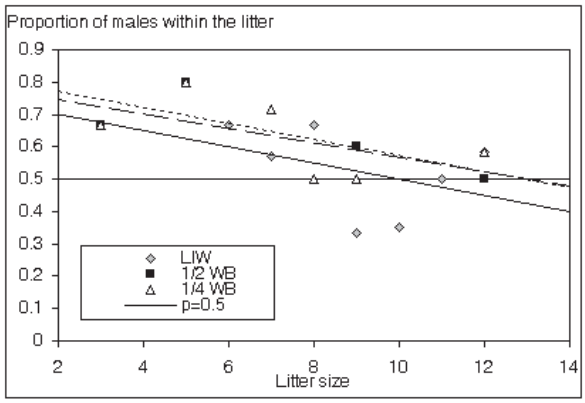

Figure 2. Distribution of male-based gender ratio in the litters from the studied genotypes

Table 3. Early growth of piglets from different genotypes by gender

Trait	LIW		1/4 WB		1/2 WB	
	Females	Males	Females	Males	Females	Males
n	50	56	22	31	17	21
Weight at birth (kg)	1.44±0.03[a]	1.55±0.03[b]	1.35±0.03	1.37±0.04	1.37±0.04[a]	1.51±0.03[b]
n	44	49	20	29	16	21
Weight at 3 weeks (kg)	4.88±0.18	4.97±0.19	3.87±0.20	4.23±0.18	3.33±0.28[a]	4.17±0.17[b]
n	42	49	18	27	15	21
Weight at 2 months (kg)	14.19±0.51	13.62±0.56	11.42±0.78	11.95±0.79	6.99±0.76[a]	9.47±0.71[b]

Different letters within the row indicate significant difference: a and b ($p<0.05$), for LSD test

Table 4. Correlations (Spearmen) between the weight and number of piglets

Variables	Weight at birth			Weight at 3 weeks			Weight at 2 months		
	LIW	1/4 WB	1/2 WB	LIW	1/4 WB	1/2 WB	LIW	1/4 WB	1/2 WB
Number of piglets total born	-.29**	-.23	-.41*	-.23*	-.52**	-.48**	-.28*	-.46**	-.47**
Number of piglets born alive	-.25**	-.16	-.43**	-.08	-.46**	-.38*	-.16	-.36*	-.47**

*– $p<0.05$; **– $p<0.01$

Table 5. Early growth of piglets from different genotypes by wattle presence

Variables	LIW		1/2 WB		1/4 WB	
	Without wattles	With wattles	Without wattles	With wattles	Without wattles	With wattles
n	19	86	23	12	10	38
Weight at birth, kg	1.52±0.06	1.49±0.02	1.43±0.03	1.46±0.05	1.33±0.10	1.36±0.02
n	17	75	23	11	8	36
Weight at 3 weeks, kg	5.16±0.34	4.87±0.14	3.79±0.20	3.62±0.35	4.70±0.51[a]	3.9±0.13[b]
n	16	74	22	11	8	32
Weight at 2 months, kg	14.58±0.95	13.68±0.42	8.22±0.65	8.35±1.11	15.13±1.60[a]	10.88±0.54[b]

Different letters within the row indicate significant difference: a and b ($p<0.05$), for LSD test

DISCUSSION

In this study no significant differences were found between the total number of born piglets and the number of piglets born alive, but the introgression of wild boar into Lithuanian indigenous wattle pigs influenced the number of stillborn and dead piglets, as well as the growth of piglets. The highest mortality rates occurred in the first weeks of the piglets' lives both in free-ranging wild boar and domestic pigs (Náhlik and Sándor, 2003; Casellas *et al*., 2004). However, in the present study this was supported only by the purebred Lithuanian indigenous piglets. The survivability of 1/2 WB piglets decreased after three weeks of age and was in contrast with the data of these authors. Baubet *et al*. (1995) have reported a high variation of the growth rate in wild boar, but have not found any relationship between growth and survival of wild piglets. On the other hand, the influence of weight at birth on the survivability of domestic piglets was reported by many authors (Tuchscherer *et al*., 2000; Quiniou *et al*., 2002; Damgaard *et al*., 2003; Casellas *et al*., 2004; English and Bilkei, 2004; Arango *et al*., 2006; Wolf *et al*., 2008). In our study the highest portion of low weight piglets was in 1/4 WB genotype. Although the loss of piglets from 1/4 WB genotype before 3 weeks of the age was lower than of purebred piglets, but the loss of piglets during the whole weaning period became almost equal to that of Lithuanian indigenous piglets. However, Knol *et al*. (2002) have found that genetic differences between piglets in survivability will be reflected in differences in body composition rather than in differences in body weight at birth. These findings were supported by experimental work with Meishan pigs and could be supported by the results of this study with wild boar hybrids. Le Cozler *et al*. (2002) have reported that good supervision with a human presence during parturition decreased stillbirth. The presence of the technical staff during parturition of Lithuanian indigenous pigs allows decrease of the loss of piglets during the first hours, but assistance for hybrid piglets was unnecessary. Vitality of hybrid piglets at birth was higher and the time elapsed between birth and the first udder contact and suckle was shorter for hybrid than for purebred piglets, and this is in agreement with the authors who have noted a positive relationship between the piglet's survival and the first udder contact and suckle (Herpin *et al*.1996; Tuchscherer *et al*., 2000). Estimated negative correlations between body weight at birth and the number of piglets born are consistent with the findings of other authors (Kaufmann *et al*., 2000; Wolf *et al*., 2008) including the effect of litter size (Knol *et al*., 2002; English and Bilkei, 2004; Wolf *et al*., 2008). Although among piglets from 1/2 WB genotype the portion of low weight piglets at birth was the lowest, their slow growth did not support the findings of other authors (Quiniou *et al*., 2002; Damgaard *et al*., 2003; Gondret *et al*., 2005) in domestic piglets that higher weight at birth is associated with higher daily gain. The growth rates of Lithuanian indigenous x wild boar hybrids differed from the results of Müller *et al*. (2000) who have detected higher early growth rate in wild boar x Meishan than in purebred Meishan. In our study, the negative wild boar effect on the growth of hybrid piglets may be the result of a limited genetic growth capacity of the wild boar and that was increased with the higher portion of WB and the age of hybrids. This may be partly confirmed by the results of Solanes

et al. (2004) who have found that piglet body weight before weaning was influenced more by environmental and maternal genetic effects than by direct genetic effects, and after weaning the genes of the piglets are of higher importance. In our study all the piglets were weaned later (at 2 months of age) than in the study of Solanes *et al*. (2004), and the genes of the piglets obtained from wild boar showed the influence on growth earlier. During the pre-weaning period, the gender influence, as well as the wattle presence, were different in separate groups and periods and indicated that there was contrast with the results of other authors who did not detect sexual dimorphism in the growth rate of wild boar between 0.5 and 6 months of age (Gaillard *et al*., 1992) or who conversely indicated that daily gain per day before weaning for domestic males compared to females was 4 g lower (Johansen *et al*., 2004).

The distinctive morphological feature of Lithuanian indigenous pigs - a pair of wattles is a highly inherited feature. Comparison of the wattle presence in crossbreds from Lithuanian indigenous crosses with different breeds observed in our previous studies (Razmaite, 2002; 2004) indicated that in this study the portion of 1/2 WB hybrids with wattles (31.6%) was much lower than the portion of F^1 crossbreds from Lithuanian indigenous x Duroc (53.6%) and Lithuanian indigenous x Danish Landrace (56.7%). The wattle presence in wild boar hybrids was observed by Mayer and Brisbin (1991) who have reported that only wild boar hybrids and feral/domestic pigs are having this structure.

The literature survey regarding sex ratio theory indicates that genetic variance for sex ratio exists (Toro, 2006). A negative relationship between litter size and gender ratio (male based for small and female based for larger litters) has been observed by Gorecki (2003) in domestic pigs and by Servanty *et al*. (2007) in wild boar. Gorecki (2003), also, have found the effect of sire breed on the offspring sex ratio. However, Alfonso (2005) indicated that sex seems to follow a binomial distribution, but sex probability is not the same for all the farms. Whereas castration of male piglets is a controversial issue within Europe, distribution of sex, particularly in wild boar hybrids is important. In the present study sex ratio was male based and was decreasing when the litter size increased and this was in agreement with the mentioned studies. However, low number of litters in our study could account for the absence of a significant relationship between sex ratio and litter size in different genotypes.

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KARAKTERISTIČNE RAZLIKE I RANI PORAST PRASADI DOBIJENE UKRŠTANJEM I POVRATNIM UKRŠTANJEM DOMAĆIH LITVANSKIH SVINJA I DIVLJIH NERASTOVA

RAZMAITE VIOLETA i KERZIENE SIGITA

SADRŽAJ

Cilj ovih ispitivanja je bio utvrđivanje karakterističnih razlika između domaćih Litvanskih svinja i njenih hibrida na osnovu boje dlake i prisustva "minđuša" kod novorođene prasadi. Ukrštanje sa divljim nerastovima, imalo je za posledicu smanjenje broja avitalne prasadi i broja uginule prasadi do treće nedelje života ($0,1<p\leq0,05$). Dokazana je negativna korelacija između broja prasadi i njihove prosečne mase pri rođenju. Najveći procenat prasadi sa malom masom i najmanja srednja telesna masa su utvrđene kod genotipa 1/4 WB ($p<0,05$), ali je njihov rani prirast bio veći nego kod genotipa 1/2 WB. Najveći prirasti su registrovani kod čistokrvne domaće Litvanske prasadi ($p<0,05$). U svim posmatranim grupama, masa muške prasadi je bila veća ($p<0,05$) u odnosu na ženske jedinke. Veća masa muške prasadi od rođenja do zalučenja je dokazana samo za genotip ($p<0,05$) 1/2 WB. Kod genotipa 1/4 WB, "minđuše" je nasleđivalo 71,7% prasadi a kod genotipa 1/2 WB je taj procenat iznosio 31,6. Ovo je inače morfološka karakteristika domaće Litvanske svinje. Pruge na dlaci (livreja) su postojale kod svih jedinki genotipa 1/2 WB i kod 32,1% jedinki genotipa 1/4 WB. Učešće genoma divljeg vepra je imalo značajan uticaj na obojenost dlake.