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HERITABILITY AND CORRELATION OF MEAT AND FERTILITY TRAITS IN PIGS IN ESTONIA

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Abstract

In Estonian pig breeding the importance of fertility traits has decreased during the years, whereas meat traits have become more and more superior. To get better meat quality and maintain good fertility of Estonian pigs, breeders should take heritability and relationships between the traits into account. Therefore it is of utmost importance to study heritability of the traits considered in selection. Data of 6601 sows and 1015 boars with 10 411 litters, obtained from database of Animal Recording Centre in 1999...2001, was used to analyze heritability of litter size and meat traits. The following breed combinations were investigated: Estonian Landrace (EL), Estonian Large White (ELW), Hampshire (H), Piatrain (Pi), EL↵xELW↯, ELW↵xEL↯ and Pi↵xH↯. Meat traits were measured by ultrasonic equipment Piglog 105. Average heritability of backfat and lean meat percentage was high, being h^2=0.68 and h^2=0.66 respectively, on the other hand the heritability of loin eye diameter was lower (h^2=0.30). Among breeds heritability differed largely. Heritability of lean meat percentage was higher in EL and Pi breeds (h^2=0.73 and h^2=0.62), which are both well known for their good meat quality. Lower heritability of lean meat percentage was found in ELxELW and ELWxEL crossbred breeds (h^2=0.49 and h^2=0.54). Average heritability of litter size at birth was h^2=0.08, being lower in ELxELW (h^2=0) and EL (h^2=0.03), higher in ELW (h^2=0.09) and ELWxEL (h^2=0.12). These results show highly significant effect of a boar on litter size and of a sow on meat traits. Correlations between meat traits and fertility were generally low.

Introduction

The importance of fertility traits has decreased during the years, whereas meat traits have become more and more superior in Estonian pig breeding. Local pig breeds have had high fertility as a result of selection of breeding animals by fertility. Advisors have actively estimated live pigs' meat traits with ultrasonic equipment Piglog-105 in Estonia and more attention has been paid also to improve slaughter pigs' meat quality by crossbreeding. Therefore great success has been achieved during last years (Tänavots, 1998, Tänavots *et al*., 2001). To get better meat quality and maintain good fertility of Estonian pigs, breeders should take heritability and relationships between the traits into account. Therefore it is of utmost importance to study heritability of the traits considered in selection.

Material and Methods

Data analysed comprised 6601 sows and 1015 boars with 10 411 litters from 39 farms throughout Estonia; obtained from database of Animal Recording Centre in 1999...2001. Completed dataset included breed, farm, parity, insemination method, season of birth and year of birth, litter size at birth and at weaning, which was collected by PC program DB-Planer. Meat traits were measured by ultrasonic equipment Piglog 105. Meat traits recorded were: backfat thickness at last (x1) and 11...12th (x3) rib, 7 cm from midline (mm), and diameter of loin eye (x2), 7 cm from midline (mm) (PÕMm RTL, 1998). Lean meat percentage (y) was calculated using the formula (Piglog 105, 1991).

The following breed (litter) combinations were investigated: Estonian Landrace (EL), Estonian Large White (ELW), Hampshire (H), Piatrain (Pi), EP↵xELW♂, ELW↵xEP♂ and Pi↵xH♂. The testing year was divided into four parts: spring - March, April, May; summer - June, July, August, fall - September, October, November and winter - December, January, February.

Heritability coefficients were estimated by sire model, where boar (n=1...1015), birth season (n=1...4), farm (n=1...38), birth year (n=1...3), insemination method (n=1...2), breed (n=1...7) were taken into account (SAS Inst. Inc., 1991).

The results are given as least-square means (Parring *et al.*, 1997). Level of significances expressed conventionally: *** - P<0.001, ** - P<0.01, * - P<0.05, # - P<0.1.

Results and Discussion

Average heritability of backfat and lean meat percentage was high, being h^2=0.68 and h^2=0.66 respectively (Table 1), on the other hand the heritability of loin eye diameter was lower (h^2=0.30).

Table 1. Heritability of meat traits

Breed	n	Backfat	Diameter of loin eye	Average lean meat %
EL	3428	0.77	0.20	0.73
ELW	4654	0.60	0.34	0.59
H	37	NE	NE	NE
Pi	69	0.69	0.16	0.62
EL↵xELW♂	1515	0.55	0.19	0.49
ELW↵xEP♂	682	0.79	0.28	0.54
Pi↵xH♂	26	NE	NE	NE
Average	10 411	0.68	0.30	0.66

NE – not estimated

Backfat thickness was better inherited in purebred EL (h^2=0.77) and crossbred ELWxEL (h^2=0.79) breeds. Average backfat heritability was exceeded also by Pi (h^2=0.69). Contemporary, low heritability of backfat thickness (h^2=0.36) in Large White pigs was found by Johnson, *et. al*., 2000. Diameter of loin eye had low heritability, being highest (h^2=0.34) in ELW pigs. Among breeds heritability of meat traits differed largely. Highest heritability of lean meat percentage was observed in EL and Pi breeds (h^2=0.73 and h^2=0.62), which are both well known for their good meat quality. Lower heritability of lean meat percentage was found in ELxELW and ELWxEL crossbred breeds (h^2=0.49 and h^2=0.54).

Table 2. Heritability of fertility traits

Breed	n	Litter size at birth	Litter size at weaning
EL	3428	0.03	0.13
ELW	4654	0.09	0.13
H	37	NE	NE
Pi	69	NE	NE
EL↵xELW♂	1515	0	0.03
ELW↵xEP♂	682	0.12	0.27
Pi↵xH♂	26	NE	NE
Average	10 411	0.08	0.14

NE – not estimated

Average heritability of litter size at birth was h^2=0.08, being lower in ELxELW (h^2=0) and EL (h^2=0.03), higher in ELW (h^2=0.09) and ELWxEL (h^2=0.12) (Table 2).

Heritability of litter size differed largely among breeds, being h^2=0...0.12 at birth and h^2=0.03...0.27 at weaning. Thorough studies have found heritability for litter size about h^2=0.11 (Hill & Webb, 1982; Johansson, 1981; Haley *et al*., 1988; Lamberson *et al*., 1991) (Table 3).

Table 3. Overview of heritability of litter size

Author	Litter size		
	born alive	at the age of 3 weeks	at the age of 8 weeks
Urban *et al.* (1966)	0.08	-	0,13
Legault (1970)	0.07[1]	0.01	-
	0.11[2]	0.09	-
Strang ja King (1970)			
Large White	0.07[2]	0.07	0.09
Strang ja Smith (1979)			
Large White	0.04[1]	0.03	0.05
Landrace	0.09[2]	0.10	0.06
	0.07[1]	-0.02	0.00
Johansson (1981)			
1. litter	0.18[1]	0.16	-
2. litter	0.15[1]	0.15	-
Hill and Webb (1982)	0.12	-	-
Haley *et al.* (1988)	0.09	-	-
Lamberson *et al.* (1991)	0.07	-	-
Rydhmer(1993)	0.13	-	-

[1] – half sibs analysis

[2] - daughter - mother analysis

These results show highly significant effect of a boar on litter size and of a sow on meat traits.

Correlations between meat traits and fertility were generally low. High and significant correlation was found between backfat thickness and lean meat percentage (r=-0.943; P<0.001); lean meat percentage and diameter of loin eye (r=0.477; P<0.001); litter size at birth and at weaning (r=0.696; P<0.001). There were only slight differences among breeds.

Table 4. Correlations between meat and fertility traits (above breed's average & below Estonian Landrace)

Traits	Backfat thickness	Diameter of loin eye	Lean meat %	Litter size at birth	Litter size at weaning
Backfat thickness		-0.176***	-0.943***	-0.002	-0.029
Diameter of loin eye	-0.217***		0.477***	0.017**	0.018**
Lean meat %	-0.932***	0.537***		0.005	0.030***
Litter size at birth	-0.029**	0.032**	0.035***		0.696***
Litter size at weaning	-0.021	0.018**	0.030***	0.696***	

Table 5. Correlations between meat and fertility traits (above Estonian Large White & below Hampshire)

Traits	Backfat thickness	Diameter of loin eye	Lean meat %	Litter size at birth	Litter size at weaning
Backfat thickness		-0.200***	-0.953***	-0.019*	-0.084***
Diameter of loin eye	0.117		0.474***	0.011	0.036***
Lean meat %	-0.931***	0.236**		0.017*	0.084***
Litter size at birth	-0.068	-0.106	0.003		0.696***
Litter size at weaning	-0.021	-0.062	-0.028	0.823***	

Table 6. Correlations between meat and fertility traits (above Pietrain & below ELxELW)

Traits	Backfat thickness	Diameter of loin eye	Lean meat %	Litter size at birth	Litter size at weaning
Backfat thickness		-0.180**	-0.912***	0.084	0.023
Diameter of loin eye	-0.034*		0.545***	-0.075	0.055
Lean meat %	-0.946***	0.338***		-0.092	0.006
Litter size at birth	0.018	-0.024	-0.026#		0.678***
Litter size at weaning	0.023	-0.031*	-0.033*	0.536***	

Table 7. Correlations between meat and fertility traits (above ELWxEL & below PxH)

Traits	Backfat thickness	Diameter of loin eye	Lean meat %	Litter size at birth	Litter size at weaning
Backfat thickness		-0.100***	-0.907***	-0.011	-0.023
Diameter of loin eye	-0.009		0.488***	0.027	0.069**
Lean meat %	-0.887***	0.440***		0.017	0.048
Litter size at birth	-0.101	-0.077	0.088		0.511***
Litter size at weaning	-0.068	0.048	0.119	0.712***	

To select pigs for breeding, more attention should be turned to meat traits in ELW pigs and to fertility traits in EL pigs, as heritability of these traits is lower. To improve slaughter pigs' meat quality, it is important to take into account meat traits of EL sows. To improve fertility, information about litter size of ELW boars should be considered.

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