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 higher. 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 from 1999 to 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 a litter size and of a sow on meat traits. Correlations between meat traits and fertility were generally low.
Keywords: pigmeat, fertility, ultrasonic, heritabilities, correlations, breed differences.

ESTIJOS KIAULIŲ MĖSINGUMO IR VISLUMO POŽYMIŲ KORELIACIJA BEI PAVELDIMUMAS

Santrauka. Pastaraisiais metais, veisiant kiaules Estijoje, mažiau kreipiama dėmesio į vislumo požymius. Vis svarbesnis tampa mėsingumas. Norint gauti geresnės kokybės mėsą ir išlaikyti gerą Estijos kiaulių vislumą, veisėjai turėtų atsižvelgti į naudingų požymių ir paveldimumo tarpusavio ryšį. Todėl, vykdant selekciją, labai svarbu įvertinti su selekcija susijusių požymių paveldimumą. 6601 kiaulės ir 1015 kuilių su 10 411 vadų duomenys, gauti iš Gyvulių registravimo centro duomenų bazės 1999–2001 m. laikotarpiu, buvo panaudoti vados dydžio ir mėsos savybių paveldimumo analizei. Tirti tokie veislių deriniai: Estijos landrasų, (EL), Estijos didžiųjų baltųjų (ELW), Hempšyrų (H), Pjetrenų (Pi), EL♂xELW♀, ELW♂xEL♀ and Pi♂xH♀. Mėsos savybės tirtos ultragarso aparatūra *Piglog* 105. Paaiškėjo, kad vidutinis nugaros lašinių ir liesos mėsos paveldimumas yra didelis – atitinkamai h^2=0,68 ir h^2=0,66, o nugarinės skersmens paveldimumas – mažesnis (h^2=0,30). Atskirų veislių paveldimumo požymiai labai skyrėsi. Liesos mėsos paveldimumas didesnis EL ir Pi veislių (h^2=0,73 ir h^2=0,62), kurios pasižymi gera mėsos kokybe. Mažesnis liesos mėsos paveldimumas nustatytas ELxELW ir ELWxEL sukryžmintų veislių (h^2=0,49 ir h^2=0,54). Vidutinis vados dydžio paveldimumas paršiavimosi metu buvo h^2=0,08: ELxELW ir EL – mažesnis (h^2=0 ir h^2=0,03), ELW ir ELWxEL – didesnis (h^2=0,09 ir h^2=0,12). Šie rezultatai rodo, kad kuilių įtaka svarbi vados dydžiui, o kiaulių – mėsos požymiams. Mėsingumo ir vislumo požymių koreliacija buvo maža.
Raktažodžiai: kiauliena, vislumas, ultragarsas, paveldimumas, koreliacija, tarpveisliniai skirtumai.

Introduction. The importance of fertility traits has decreased during the years, whereas meat traits have become higher 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 also paid 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. Analysed data comprised 6601 sows and 1015 boars with 10 411 litters from 39 farms throughout Estonia (obtained from database of Animal Recording Centre from 1999 to 2001). Completed dataset included breed, farm, parity, insemination method, season from 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. Recorded meat traits 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), EL♂xELW♀, ELW♂xEL♀ 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 is 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♂xEL♀	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 the highest (h^2=0.34) in ELW pigs. Among breeds heritability of meat traits differed largely. The 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).

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 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♂xEL♀	682	0.12	0.27
Pi♂xH♀	26	NE	NE
Average	10 411	0.08	0.14

NE – not estimated

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] 0.11[2]	0.01 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.

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***	

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.

To select pigs for breeding, more attention should be given 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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