E-mail:
dns17423@cc.okayama-u.ac.jp

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Estimates of genetic parameters for reproduction and production traits of purebred Berkshire in Japan.

Masamitsu Tomiyama[*1], Takuro Oikawa[1], Toru Sano[2], Tomohiro Arakane[2] and Hisashi Mori[2],*
[1]Faculty of Agriculture, Okayama University, Okayama, Japan. [2]Okayama Prefectural Center for Animal Husbandry and Research, Okayama, Japan.

【Introduction】

Pigs produced from three-way cross are common for daily meat market in Japan. Whereas, annual production of purebred Berkshire is about 180,000 (2.2% of total population) for premium pork market in Japan. Berkshire breed is produced few in most countries because it is smaller body size and slower growth than modern pig breeds. Japanese consumers require high-quality pork that do not have artificial additives.

Berkshire pigs in Okayama, founded on base population introduced from Kagoshima prefecture in 1978. Afterward, through several introductions, the research institute maintains 35 Berkshire. Outline for introduction is shown in Fig. 1.

Untill now, Berkshire breed in Okayama hasn't been through organized selection program. Thus, the population seems to have possibility for genetic improvement of overall performance.

The aim of this study is to initiate genetic improvement of Berkshire population by estimating genetic parameters.

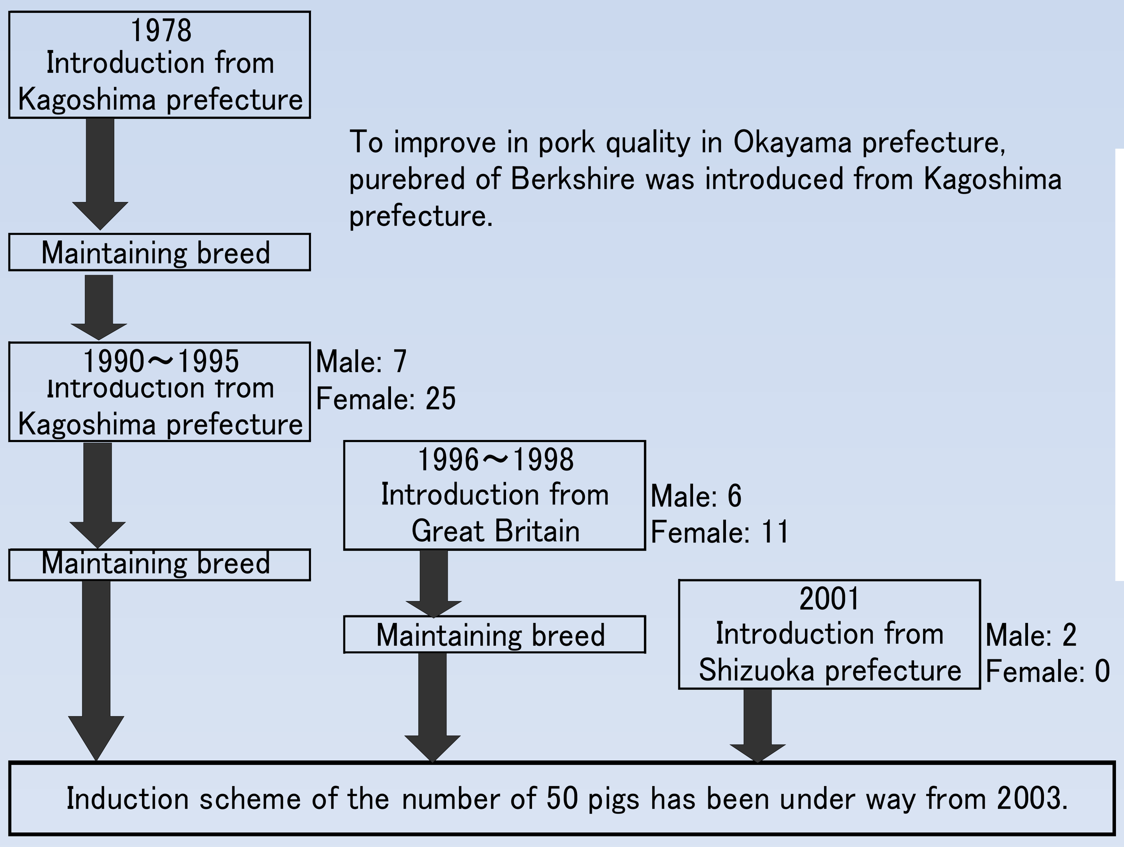

Fig. 1 History for introduction of purebred Berkshire in Okayama prefecture.

【Materials and Methods】

Records on 2956 (1,537 males, 1,419 females) pigs from Okayama Prefectural Center For Animal Husbandry & Research were used. The structure for records is shown in Table 1. Traits analyzed shown in Fig. 2.

Table 1. Data structure of Berkshire breeding population in Okayama.

	Class	Number of records[1]
Sire		24
Dam		70
Sex	Male	1538
	Female	1425
Birth year	1994	310(174)
	1995	332(174)
	1996	340(164)
	1997	291(150)
	1998	271(129)
	1999	310(163)
	2000	291(139)
	2001	417(226)
	2002	401(218)
Total records		2963

[1]The number within parentheses is the number of male animals.

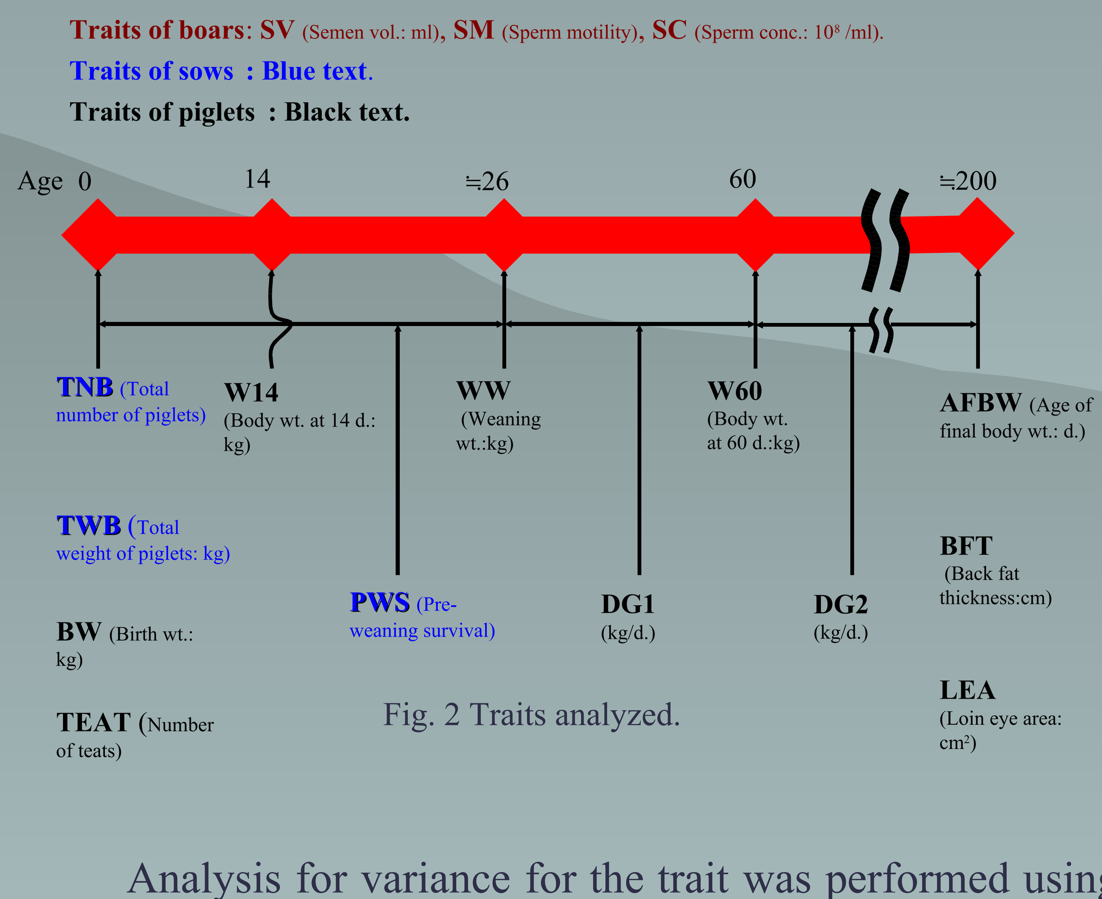

Fig. 2 Traits analyzed.

$$y = Xf + Za + Wm + Spe + e$$

$$\mathrm{var}\begin{bmatrix} a \\ m \\ pe \\ e \end{bmatrix} = \begin{bmatrix} g_{11}A & g_{12}A & 0 & 0 \\ g_{21}A & g_{22}A & 0 & 0 \\ 0 & 0 & I\sigma^2_{pe} & 0 \\ 0 & 0 & 0 & I\sigma^2_{e} \end{bmatrix}$$

Analysis for variance for the trait was performed using mixed procedure of SAS. Estimation for genetic parameters was performed using VCE-5. One example of statistical models for estimation of genetic parameters is shown above (piglets). The statistical model is used for estimation of genetic parameters in piglet. Fixed effect in the model was determined by analysis of SAS. In the above model, ***y*** is observations, ***f*** is fixed effects, ***a*** is additive genetic effects, ***pe*** is permanent environmental effects, ***e*** is vector of random residual effects. ***X*** and ***Z*** are incidence matrices relating to records to fixed and additive genetic effect, respectively.

【Results and discussion】

Table 2. Heritabilities(on diagonal), r_g(above diagonal) and r_p(below diagonal) in boars

Traits	SV	SM	SC
SV	**0.32±0.04**	**-0.37±0.15**	**-0.52±0.14**
SM	**-0.12**	**0.15±0.05**	**0.44±0.18**
SC	**0.27**	**0.28**	**0.35±0.06**

SV: Semen volume, SM: Sperm motility, SC: Sperm concentration..

Estimation for genetic parameters in boar using three-traits model is shown in Table 2. Heritabilities for SV and SC were 032 and 0.35, respectively. Therefore, these traits are considered to be candidate traits for selection program although genetic correlation between the traits was negative (-0.52).

Table 3. Heritabilities(on diagonal), r_g(above diagonal) and r_p(below diagonal) in sows

Traits	TNB	PWS	TWB
TNB	**0.20±0.04**	**-0.07±0.25**	**0.58±0.09**
PWS	**-0.16**	**0.21±0.05**	**0.20±0.18**
TWB	**0.65**	**0.17**	**0.13±0.03**

TNB: Total number of piglets, PWS: Pre-weaning survival, TWB: Total weight of piglets.

Estimation for genetic parameters in sow using three-traits model is shown in Table 3. Heritabilities were slightly low. Since the traits are economic important, further study seems to be needed. Reported literature indicating that birth weight and survival rate decrease when litter size increases and the number of mortality increase when birth weight decrease. Thus, we need the r_g into account to construct selection program.

Table 4. Heritability in direct and maternal genetic effect, and r_g in piglets

	BW	W14	WW	W60	AFBW	DG1	DG2	BFT	LEA	TEAT
h^2_{a+m}	0.45	0.34	0.32	0.42	0.65	0.52	0.22	0.43	0.70	0.55
SE	±0.03	±0.03	±0.04	±0.04	±0.08	±0.02	±0.05	±0.08	±0.10	±0.04
h^2_a	0.07	0.02	0.07	0.23	-	0.38	-	-	-	0.48
SE	±0.03	±0.02	±0.03	±0.03	-	±0.05	-	-	-	±0.06
h^2_m	0.22	0.19	0.11	0.06	-	0.03	-	-	-	0.03
SE	±0.04	±0.03	±0.03	±0.03	-	±0.02	-	-	-	±0.01
r_{am}	-0.25	0.08	0.59	0.07	-	0.36	-	-	-	0.31
SE	±0.40	±0.46	±0.28	±0.03	-	±0.38	-	-	-	±0.26

BW: Birth weight, W14: Body weight at 14 days, WW: Weaning weight, W60: Body weight at 60 days, AFBW: age of final body weight.. h^2_{a+m} is direct and maternal genetic effect, h^2_a is direct genetic effect, h^2_m is maternal genetic effect and r_{am} is correlation between direct and maternal effect are shown.

Estimated heritabilities in piglets using two-traits model is shown in Table 4. Since estimated maternal genetic effects in BW, W14 and WW were 0.22, 0.19 and 0.11 respectively, the traits could be improved by using maternal genetic effect. Heritability for BFT was within the estimates of reported literatures and no difference among breeds was not found. Heritability for LEA was higher than reported estimates.

Table 5. Genetic (above diagonal) and phenotypic correlations (below diagonal) in piglets

Traits	BW	W60	AFBW	BFT	LEA	TEAT
BW		0.50±0.07	-0.28±0.13	-0.24±0.13	0. 26±0.14	0. 07±0.07
W60	0.38		-0.36±0.10	-0.29±0.17	0.12±0.16	0.14±0.08
AFBW	-0.27	0.24		0.72±0.14	-0.48±0.19	-0.45±0.18
BFT	-0.11	-0.01	0.02		-0.93±0.16	-0.18±0.16
LEA	0.15	0.10	-0.03	-0.31		0.43±0.17
TEAT	0.12	0.11	-0.04	-0.01	0.00	

BW: Birth weight., W60: Body weight at 60 days, AFBW: Age of final body weight, BFT: Back fat thickness, LEA: Loin eye area.

Estimation for genetic correlations in piglets using two-traits model is shown in Table 5. Genetic correlation between BFT and LEA was more highly negative than other reports. This negative correlation is favorable as LEA is increased by decreasing BFT. Variances of permanent environmental effect were all small (not in the table).

【Conclusion】

- BW, W14, WW can be used to improve maternal effect.
- High heritabilities of W60, AFBW, BFT and LEA suggest that they be a candidate traits for improvement.