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The effect of creep feeding on genetic evaluation of Berkshire pig; Possibility of earlier and simpler evaluation with favorable correlated response

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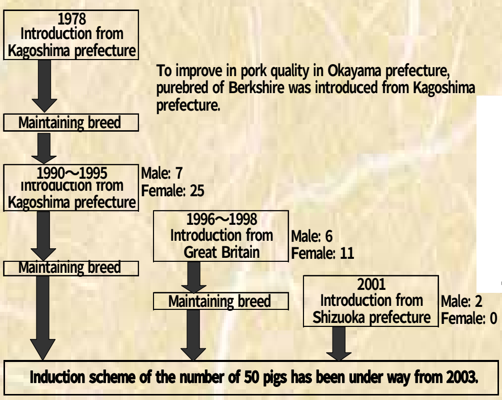
【Introduction】

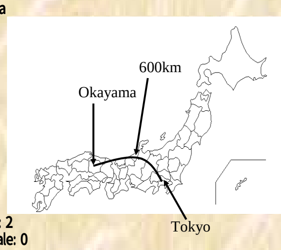
Heavy body weight at birth is important not only for survival, but also for lifetime performance. The importance of lifetime performance has also been described: low body weight at birth has a negative influence on postnatal growth.

The biased estimates of direct additive genetic variance are estimated when the maternal genetic and the common environmental effect are excluded from the analytical model. Whereas the inclusion of a great number of effects in the model may also cause biased estimates. Thus use of appropriate model is important for small dataset.

Moreover, we have reporteded the effectiveness of index selection for multi-traits including traits at 60 d of age (Tomiyama et al. 2009). The genetic relationships of the traits at 60 d of age with traits before 60 d of age have, however, not been studied in the Berkshire population.

The objective of this study was to find optimal traits for inclusion in selection criteria by estimating genetic parameters for growth traits before 60 d of age under an open breeding population, and to evaluate genetic relationships for traits at 60 d of age.





【Materials and Methods】

Statistical analysis

Berkshire pigs in Okayama were founded on base population introduced from Kagoshima prefecture in 1978. Outline of the introduction is shown above figure.

Estimation for genetic parameters was performed using VCE-5.

$$y_i = Xb_i + Za_i + Wm_i + Sc_i + e_i$$

where $\boldsymbol{y}_i$ is a vector of observations for the *i*th trait, $\boldsymbol{b}_i$ is a vector of fixed effects including a contemporary group, sex effect (except in WW) and parity effect, and covariate including weaning age for only WW for the *i*th trait. For the *i*th trait, $\boldsymbol{a}_i$ is a vector of random animal effects, $\boldsymbol{m}_i$ is a vector of random maternal genetic effects, $\boldsymbol{c}_i$ is a vector of random common environmental effects and $\boldsymbol{e}_i$ is a vector of random errors; **X**, **Z**, **W** and **S** are incidence matrices relating records of the trait A management group was defined as a contemporary group according to year and season of birth (spring: March to May; summer: June to August; autumn: September to November; and winter: December to February).

Animal s and Management

Records of 4,548 purebred Berkshire (2,344 males and 2,204 females) pigs produced from 36 sires mated with 114 dams between 1994 and 2005 were used in this study.

Animals from the same litter were reared together in the same pen from birth to 60 d of age. All the pigs were provided with restricted feeding and allowed free access to water. The feeding regime was determined by the age of the piglets that were weaned on the nearest Thursday after reaching 25 days of age. Three different diets were fed for piglets according to their age; creep diet (from 0 d to 29 d), post-weaning diet (25 d to 39 d) and growing diet (40 d to 60 d). The age of the pigs at weaning was 28.6 ±2.5 d.

【Results and discussion】

Table 1. Estimate of direct (h_d^2±SE) and maternal genetic effects (h_m^2±SE), genetic correlation (r_{dm}±SE) between direct and maternal genetic effects, common environmental effect (c^2±SE) and phenotypic variance (σ_p^2)

Traits[1]	N	Means	S.D.	C.V.	h_d^2	h_m^2	r_{dm}	c^2	σ_p^2
IBW	4543	1.39	0.27	0.19	0.07±0.02	0.19±0.03	-0.21±0.15	0.03±0.01	0.07
W14	4056	4.00	0.95	0.24	0.19±0.03	0.07±0.03	0.52±0.21	0.07±0.02	0.92
WW	4051	6.58	1.64	0.25	0.14±0.03	0.06±0.02	0.27±0.22	0.12±0.02	2.16
W60	3779	20.1	3.80	0.19	0.18±0.03	0.03±0.02	0.25±0.35	0.12±0.02	13.03
DGW60	3775	0.39	0.09	0.23	0.19±0.04	0.01±0.02	-0.04±0.52	0.15±0.02	0.01

[1]IBW: birth weight, W14: body weight at 14 days of age, WW: weaning weight, W60: body weight at 60 days of age, DGW60: daily gain from weaning to 60 days of age.

Our result is contrary to previous results showing a gradual decrease of the maternal genetic effect and an increase of the direct genetic effect up to the age of weaning and, consequently, the maternal genetic effect is almost equivalent to the direct genetic effect.

This phenomenon seems to have been caused by artifact of the population (e.g. selection effect) or influence of the creep feeding. We are speculating that the actual suckling of the piglets ended earlier than at weaning age because the feeding started just after the birth of the piglets and continued throughout the pre-weaning period.

The genetic evaluation of piglets can be conducted at an earlier age than when a standard feeding program is instituted. It is suggested that the direct genetic effect on the piglets can be evaluated at an earlier age, and the analytical model for W14 and WW can be simpler by including only direct genetic effect as a random effect.

Table 2. Estimates of genetic correlations (±SE) between traits.

Traits[1]	W14-d	WW-d	W60-d	DGW60-d
IBW-m	0.12±0.12	-0.16±0.19	-0.12±0.21	-0.12±0.17
W14-d		0.67±0.07	0.31±0.11	0.02±0.13
WW-d			0.67±0.07	0.34±0.13
W60-d				0.87±0.03

[1]IBW: birth weight, W14: body weight at 14 days of age, WW: weaning weight, W60: body weight at 60 days of age, DGW60: daily gain from weaning to 60 days of age, -d: direct genetic effect, -m: maternal genetic effect.

- In this study, a large maternal genetic effect was estimated only for IBW. The genetic correlation of direct genetic effect for W60 with maternal genetic effect for IBW was low. Therefore, IBW can be regarded as being of little value as a selection trait for the genetic improvement of W60.
- The direct genetic relationship of WW with W60 was relatively high. Therefore WW can be included in selection criteria for genetic improvement of W60. Because IBW and W14 have positive direct genetic correlations with W60, these records can be also included in selection criteria. In this context, WW was found to be the most informative trait among the traits of the pre-weaning period.

【Conclusion】

- It is suggested that the analytical model for W14 and WW can be simpler by including only direct genetic effect as a random effect with utilization of creep feeding.
- WW was found to be an informative trait among the traits of body weight at the pre-weaning period.