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# Usefulness of live animal measurement of meat productivities for genetic improvement of carcass traits in Berkshire pig

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## 【Introduction】

In a review, phenotypic relationship between back fat thickness in live and that in slaughtered animals is reported strongly positive, and that the phenotypic relationship between loin eye area in live animals and that in slaughtered animals is moderate to strongly positive.

The accuracy of measurements on live animals is crucial because it influences selection efficiency because of an increase in error components. In the present study**,** back fat thickness and loin eye area were measured by ultrasound scanning equipment (US) in a Berkshire population to evaluate meat productivity of the live animals.

The objective of this study was to estimate genetic parameters of meat productivity traits in live and slaughtered animals in a population of Berkshire and to evaluate the accuracy of measurements by US.

## 【Materials and Methods】

Estimation for genetic parameters was performed using VCE-5.

$$y_i = Xb_i + Za_i + e_i$$

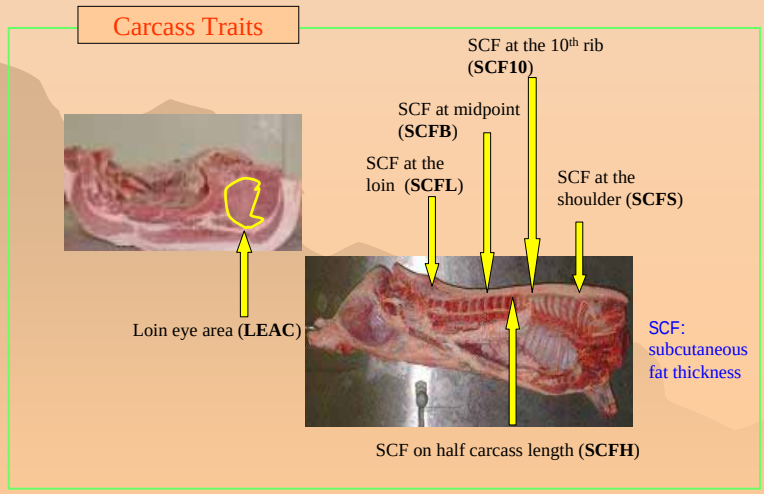
where $\boldsymbol{y}_i$ is a vector of observations for the *i*th trait, $\boldsymbol{b}_i$ is a vector of fixed effects including contemporary groups, sex effect and covariates including age at finish, body weight at finish or slaughter age for the *i*th trait; $\boldsymbol{a}_i$ is a vector of random additive genetic effect for the *i*th trait, $\boldsymbol{e}_i$ is a vector of random error for the *i*th trait; **X** and **Z** are incidence matrices relating records. 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).

Records of 959 purebred Berkshire (380 males and 579 females) pigs produced from 38 sires mated with 121 dams between 1994 and 2007 were used in this study. A pedigree record is constructed for a total of 4,931 animals.

Animals from the same litter were reared together in the same pen from birth to 60 d of age. The animals were reared under the restricted feeding. Breeding animals were then selected (around 20%) based on their body weight at 60 d of age because of limited breeding capacity and the management system. Traits at finish (when body weight reached 105kg) were measured in only selected animals; unselected pigs were reared separately for fattening.

### *Traits Analyzed*

Traits studied in live animals were age at finish (**AGF**, d), daily gain from birth to finish (**DG**, kg/d), back fat thickness at finish (**BFTF**, cm), and loin eye area at finish (**LEAF**, cm$^2$).




## 【Results and discussion】

Table 1. Number of records (n), Minima of records (Min), Maxima of records (Max), means, standard deviations (SD), coefficient of variation (CV) and heritabilities ($h^2$)

| Traits[1] | | n | Min | Max | Means | SD | CV | $h^2 \pm$ SE |
|---|---|---|---|---|---|---|---|---|
| Live animal | AGF | 959 | 153 | 319.0 | 209.5 | 20.9 | 0.10 | 0.46±0.05 |
| | DG | 888 | 0.37 | 0.8 | 0.50 | 0.1 | 0.20 | 0.11±0.04 |
| | BFTF | 948 | 0.86 | 2.83 | 1.88 | 0.50 | 0.27 | 0.52±0.07 |
| | LEAF | 928 | 14.78 | 44.7 | 25.5 | 4.7 | 0.18 | 0.37±0.06 |
| Carcass | SCFB | 297 | 1.30 | 5.4 | 2.30 | 0.50 | 0.22 | 0.31±0.09 |
| | SCFS | 297 | 2.40 | 6.4 | 4.27 | 0.63 | 0.15 | 0.22±0.07 |
| | SCFL | 297 | 0.10 | 5.7 | 3.60 | 0.66 | 0.18 | 0.41±0.11 |
| | SCFH | 297 | 1.00 | 4.5 | 2.60 | 0.53 | 0.20 | 0.27±0.09 |
| | SCF10 | 297 | 1.60 | 4.8 | 3.00 | 0.52 | 0.17 | 0.44±0.10 |
| | LEAC | 249 | 15.30 | 37.6 | 22.2 | 2.9 | 0.13 | 0.44±0.15 |

[1]AGF =age at finish; DG = daily gain from birth to finish; BFTF = back fat thickness at finish; LEAF = loin eye area at finish; SCFB = subcutaneous fat thickness on back; SCFS = subcutaneous fat thickness on shoulder; SCFL = subcutaneous fat thickness on loin; SCFH = subcutaneous fat thickness at 1/2 on carcass length; SCF10 = subcutaneous fat thickness between 10th and 11th rib, LEAC = loin eye area on carcass.

➢The heritabilities for SCFB, SCFS, SCFL, SCFH, and SCF10 in Berkshire pigs under a restricted feeding regimen ranged between 0.22 and 0.44 and were consistent with the average estimate in the other reports. Thus, it is suggested that the heritabilities for subcutaneous fat thickness do not depend upon the difference of breeds or breeding populations.

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

| Traits[1] | | SCFB | SCFS | SCFL | SCFH | SCF10 | LEAC |
|---|---|---|---|---|---|---|---|
| AGF | $r_g$ | 0.38±0.20 | 1.00±0.03 | -0.24±0.23 | 0.16[2] | 0.24±0.19 | -0.48±0.22 |
| | $r_p$ | 0.06 | 0.20 | -0.28 | 0.11 | 0.05 | -0.07 |
| DG | $r_g$ | 0.22±0.30 | -0.55±0.33 | -0.14±0.31 | -0.40±0.36 | -0.36±0.30 | 0.97±0.24 |
| | $r_p$ | 0.00 | -0.11 | -0.04 | 0.01 | 0.00 | 0.12 |
| BFTF | $r_g$ | 0.91±0.14 | 0.87[2] | 0.51[2] | 0.97±0.08 | 0.75±0.12 | -0.22±0.22 |
| | $r_p$ | 0.47 | 0.35 | 0.29 | 0.43 | 0.48 | 0.01 |
| LEAF | $r_g$ | -0.36±0.20 | -0.29±0.23 | 0.03±0.20 | -0.52±0.21 | -0.17±0.20 | 0.37±0.18 |
| | $r_p$ | 0.03 | 0.10 | 0.19 | 0.05 | 0.13 | 0.18 |

[1]AGF =age at finish; DG = daily gain from birth to finish; BFTF = back fat thickness at finish; LEAF = loin eye area at finish; SCFB = subcutaneous fat thickness on back; SCFS = subcutaneous fat thickness on shoulder; SCFL = subcutaneous fat thickness on loin; SCFH = subcutaneous fat thickness at 1/2 on carcass length; SCF10 = subcutaneous fat thickness between 10th and 11th rib, LEAC = loin eye area on carcass.
[2]SE was not estimated.

➢The strong genetic correlations of BFTF with SCFB, SCFS, SCFH, and SCF10 were considerably favorable for genetic improvement of carcass traits and consistent with other reports. Taken together, these data suggest that back fat measured by US is a prospective trait in selection criteria for the improvement of back fat thickness of carcasses, although in our study, loin eye area in live animals measured by US was not effective in improving loin eye area in carcasses because the estimated genetic correlation between LEAF and LEAC was low.

➢The negative genetic correlations of DG with SCF were estimated stronger than those of other reports. This result seems to be caused restricted feeding.

## 【Conclusion】

➢ Because the weak correlation in the present study could have been caused by operator effect, as suggested by Szabo et al., (1999), technical training standards need to be established for operating ultrasound equipment.

➢ Our study suggests that measurements of fat thickness (but not of loin eye area) in live pigs by US is effective in improving the carcass counterpart.