Relationship Between Backfat Depth and its Individual Layers and Intramuscular Fat Percentage in Swine

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Summary and Implications

Results show the correlations between IMF and different measures of total fat thickness are of similar magnitude, regardless of the measure being a single measure of total subcutaneous fat or a sum of the individual layers. Results also show that the correlation between the inner and outer backfat layers is less than the correlation between the middle layer and the inner and outer layers.

Introduction

Intramuscular fat percentage and total subcutaneous backfat depth are moderately correlated (Sellier, 1998). Recent investigation into the three individual subcutaneous backfat layers has led to some speculation that the innermost layer develops last, around the same time as intramuscular fat, and this relationship could be higher than the relationship with total fat depth (Eggert, et al., 1998). All pigs have three distinct layers of subcutaneous backfat, and extremely lean pigs only the outer and middle layers are distinguishable.

Backfat and lean percentage are moderate to highly correlated (Sellier, 1998). To improve lean percentage, producers have selected for decreased backfat as a way to improve the trait indirectly. Accurate measures of backfat are therefore needed to make genetic improvement. By dissecting the genetic control of backfat into the three distinct layers, more improvement may be made in lean percentage without sacrificing intramuscular fat percentage.

Materials and Methods

Data from 330 purebred Duroc barrows (n=284) and gilts (n=46) from the Bilsland Memorial Swine Breeding Farm at Iowa State University were used to determine the relationship between 10th rib backfat depth and its three individual layers and intramuscular fat percentage of the longissimus muscle. Cross-sectional ultrasound images were collected at the 10th rib 5 d prior to harvest by a National Swine Improvement Federation certified ultrasound technician using an Aloka 500 SSD ultrasound machine fitted with a 12-cm linear array transducer (Corometrics Medical Systems, Inc., Wallingford, CT). Off-midline backfat (SBF) and loin muscle area (SLMA) were measured. Individual subcutaneous backfat layers were measured in the same location as backfat: outer (O), middle (M), and inner (I). Off-midline backfat (CBF) and loin muscle area (SLMA) were measured on the carcass 24 h post-mortem. A slice from the 10th rib of the loin muscle was obtained for intramuscular fat percentage determination (IMF) by chloroform-methanol extraction (Bligh and Dyer, 1959). Descriptive statistics are shown in Table 1.

A mixed linear model with fixed effects of sex and contemporary group, off-test weight as a covariate, and a random sire effect was used to estimate heritability from the sire variance component. A multiple-trait fixed linear model with fixed effects of sex and contemporary group was used to estimate residual correlations.

Results and Discussion

Heritability estimates and residual correlations are shown in Table 2. Heritability estimates for the outer, middle, and inner backfat layers were 0.30, 0.40, and 0.70, respectively. Heritability estimates for SBF, CBF, SLMA, and CLMA were 0.42, 0.54, 0.19, and 0.36, respectively. Heritability for IMF was estimated as 0.65. Residual correlations between IMF and CBF, SBF, O, M, and I were 0.29, 0.27, 0.23, 0.21, and 0.27, respectively. Residual correlations between O and M, O and I, and M and I were 0.61, 0.38, and 0.62, respectively.

Table 1. Descriptive statistics for carcass composition and meat quality traits

Trait[a]	Mean	Std Dev	Min	Max
Off-test weight, lb	252.8	17.5	214.0	312.0
SBF, in	0.82	0.18	0.40	1.38
SLMA, in^2	6.28	0.72	4.35	8.65
CBF, in	0.81	0.20	0.40	1.40
CLMA, in^2	6.44	0.69	4.75	8.45
OUT, in	0.41	0.06	0.27	0.61
MID, in	0.24	0.09	0.04	0.52
INN, in	0.16	0.06	0.03	0.42
IMF, %	3.77	1.21	1.39	9.05

[a] SBF= 10th rib off-midline backfat measured with ultrasound; SLMA= 10th rib loin muscle area measured with ultrasound; CBF= 10th rib off-midline backfat measured on the carcass with a ruler; SLMA= 10th rib loin muscle area measured on the carcass with a plastic grid; OUT= outermost backfat layer measured with ultrasound; MID= middle backfat layer measured with ultrasound; INN= innermost backfat layer measured with ultrasound; IMF= intramuscular fat percentage determined using chloroform-methanol extraction

References

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Table 2. Heritability estimates (on diagonal) and residual correlations among carcass composition and meat quality traits[a]

	IMF	SBF	SLMA	CBF	CLMA	OUT	MID	INN
IMF	0.65	0.27	-0.10	0.29	-0.24	0.23	0.21	0.27
SBF		0.42	-0.16	0.83	-0.34	0.74	0.91	0.79
SLMA			0.19	-0.17	0.68	-0.15	-0.14	-0.09
CBF				0.54	-0.34	0.63	0.77	0.65
CLMA					0.36	-0.30	-0.30	-0.24
OUT						0.30	0.61	0.38
MID							0.40	0.62
INN								0.70

[a] SBF= 10th rib off-midline backfat measured with ultrasound; SLMA= 10th rib loin muscle area measured with ultrasound; CBF= 10th rib off-midline backfat measured on the carcass with a ruler; SLMA= 10th rib loin muscle area measured on the carcass with a plastic grid; OUT= outermost backfat layer measured with ultrasound; MID= middle backfat layer measured with ultrasound; INN= innermost backfat layer measured with ultrasound; IMF= intramuscular fat percentage determined using chloroform-methanol extraction