IMPACT OF SIRE LINE AND SEX ON FAT FIRMNESS

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I. INTRODUCTION

Fat quality has gained increasing importance as a factor in pork quality over the past 10-15 years. Particularly in the North American markets where fat firmness for bellies used in bacon production is of great importance. Currently the benchmark standard for assessing fat firmness is iodine value (IV). The purpose of this research was to determine the degree that genetics (sire line - SL) and sex influence IV under commercial conditions.

II. MATERIALS AND METHODS

Pigs (n=2001) from 3 commercial farms were harvested in a commercial slaughter facility. Four unique genetic-background commercial SL were used [Duroc (n=344) Hampshire (n=324), Pietrain (n=427) and Synthetic (n=906)] with a sex distribution of 1018 barrows and 983 gilts. All pigs were ear tagged at birth allowing identification of SL, gender, and age. All SL and sexes were represented on each farm. Hot carcass weight (HCW; head-off) and grading probe (Fat-o-Meat'er; Carometec, Peosta, IA, USA) data were collected. At 24 h post mortem, belly fat samples were collected on the midline of the belly at the first teat. Samples were frozen until analysis, thawed, and then the skin was removed and the sample was analyzed on the outer fat layer using a Bruker MPA Multi-Purpose FT-NIR Analyzer (Billerica, MA, USA). The PROC RSQUARE procedure of SAS was used to determine potential covariates (COV). Data were then analyzed using the PROC GLM procedure of SAS. All models included the fixed effects of farm, SL, sex, and SL x sex. Sequential models were developed using single or multiple COV to develop models with a better fit. The COV included in the models included HCW along with the linear (BFL) and quadratic (BFQ) effects of backfat.

III. RESULTS AND DISCUSSION

Initial data analysis consisted of determining R^2 of the traits measured with IV to determine the best candidates for COV analysis when determining SL and sex effects on IV (Table 1). All traits ranked in the same order regardless of using the mixed sex, barrow, or gilt only data. BF had the highest R^2 value followed by lean percentage, HCW, age, daily carcass gain, and loin depth. Thus, it was determined that backfat and HCW would be the best candidates for COV analysis. Although lean percentage had a high R^2, this was likely due to its direct relationship with BF. Furthermore, age and daily carcass gain were excluded as they both had lower R^2 values than HCW and all three are very interrelated.

Table 1 R-square of selected traits with belly fat iodine value

Trait	Mixed Sex	Barrows	Gilts
Backfat	0.39	0.33	0.28
Lean percentage	0.35	0.29	0.24
Hot carcass weight	0.17	0.16	0.14
Age	0.11	0.11	0.07
Daily carcass gain	0.07	0.08	0.07
Loin depth	0.01	0.01	0.00

Differences between SL and sex existed, however the magnitude of the difference depended greatly on which COV was used (Table 2). Differences in fat composition reflective of fat firmness due to genetics and sex have been previously reported (1,2). The Duroc and Pietrain SL had the lowest and highest IV levels respectively ($P < 0.05$). The magnitude of difference was 1.64 IV units without a COV and this was reduced to 0.98 IV units when BFL, BFQ, and HCW were included as COV. When no COV was used, all SL were different from one another ($P < 0.05$), but when BFL, BFQ, and HCW were included as COV no differences were observed between the Duroc and Synthetic SL. Similarly, the magnitude of difference between sexes was reduced when COV were added with 3.17 IV units (no COV) vs. 1.95 IV units difference (with BFL, BFQ, and HCW as COV). Clearly, BF and HCW have an effect on IV (Figure 1) with the effect of BF (HCW constant) being more pronounced than that of HCW (BF constant). However, BF and HCW are not independent of one another and based on these data a 4.3 kg increase in HCW will result in a 1 mm increase in BF: [BF = -3.72427 + (0.23266 x HCW); R^2=0.28]. Furthermore, these data indicate that after BF reaches 16 mm the rate of decrease in IV is slowed as BF is further increased.

Table 2 Effect of sire line or gender on belly fat iodine value using different covariate variables

Item	No covariate	HCW	BFL	BFL-HCW	BFL-BFQ-HCW
R-square	0.3586	0.3939	0.4870	0.4886	0.4940
Residual MSE	2.645	2.572	2.367	2.363	2.351
Sire line					
Duroc	74.97 ± 0.14 [a]	75.04 ± 0.14 [a]	75.13 ± 0.13 [a]	75.13 ± 0.13 [a]	75.16 ± 0.13 [a]
Synthetic	75.60 ± 0.10 [b]	75.59 ± 0.10 [b]	75.39 ± 0.09 [a]	75.40 ± 0.09 [ab]	75.37 ± 0.09 [a]
Hampshire	76.08 ± 0.15 [c]	75.91 ± 0.14 [bc]	75.71 ± 0.13 [b]	75.68 ± 0.13 [b]	75.70 ± 0.13 [b]
Pietrain	76.61 ± 0.13 [d]	76.25 ± 0.13 [c]	76.21 ± 0.12 [c]	76.14 ± 0.12 [c]	76.14 ± 0.12 [c]
Duroc vs. Pietrain difference	1.64	1.21	1.08	1.01	0.98
Sex					
Barrow	74.23 ± 0.09 [e]	74.25 ± 0.09 [e]	74.61 ± 0.08 [e]	74.60 ± 0.08 [e]	74.62 ± 0.08 [e]
Gilt	77.40 ± 0.09 [f]	77.14 ± 0.09 [f]	76.61 ± 0.09 [f]	76.58 ± 0.09 [f]	76.57 ± 0.09 [f]
Gender difference	3.17	2.89	2.00	1.98	1.95

[abcd] Means within a column with different superscripts were significantly different from one another ($P < 0.05$).
[ef] Means within a column with different superscripts were significantly different from one another ($P < 0.0001$).

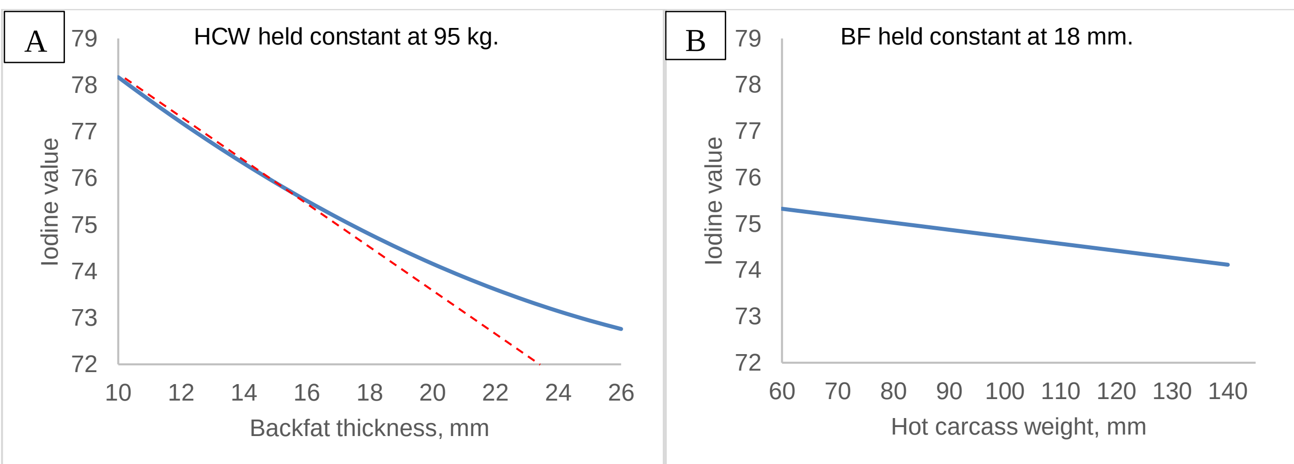

Figure 1. Effect of BF (A) or HCW (B) on belly fat IV. Determined using the equation: IV = [85.698 + (BF-Linear x -0.7140) + (BF – Quadratic x 0.0104) + (HCW x -0.0150966)].

IV. CONCLUSION

Differences in IV between SL and sex exist, but practical importance is minimized when corrected for BF and/or HCW considering the difference between the Duroc vs. Pietrain-based SL (2 modern breed extremes) is less than 1 IV point when the standard deviation of IV was 3.3 IV units in these data. This suggests that most modern breeds should have very minor differences in IV if fed similar diets.

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