PREDICTING LEAN MEAT YIELD OF AUSTRALIAN PIG CARCASSES

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Background

Consumers are demanding lean, consistently high quality pork products. The Australian pork industry has made significant progress toward producing a leaner carcass to meet consumer requirements for lean pork. This has largely been achieved by selecting against fatness at the P2 site (defined as fat depth at the last rib, 65 mm from the carcass midline) at a given liveweight. The majority of Australian pigs are traded on the basis of price per kilogram hot carcass weight (HCW) using a grid pricing system with fat depth at the P2 site and HCW measured on the slaughter floor. However, these price grids do not adequately reflect the actual commercial differences in value that exist between pork carcasses with regard to yield and quality attributes. Anecdotal evidence suggests that, over recent years, the selection of pigs for leanness at the P2 site by producers to better meet grid pricing specifications has resulted in a repartitioning of carcass fat away from the P2 site to other areas of the carcass. Grid pricing does not capture the full extent of the yield variation between pigs as it places the population into relatively large discrete groups, limiting its ability to predict actual market value of any carcass. Lean meat percentage is used in many countries as the basis for quality grading, prediction of actual meat value and payment for pig carcasses. Value based marketing provides the mechanism for clear communication of price signals between consumers and producers to ensure that industry profitability is maximised by supplying pork reflecting preferred consumer specifications.

Objective

This project was designed to provide the Australian pig industry with current yield information to facilitate the implementation of value based trading systems for pig carcasses. The objective of this project was to determine whether lean meat yield of Australian pig carcasses could be accurately predicted by regression analysis using the Hennessy Grading Probe 4 to measure fat thickness and muscle depth at a number of sites along the backbone.

Methods

A total of 165 pigs (88 entire male and 79 female) from a total of 24 different vendors were selected on the slaughter floor of two commercial pig abattoirs in Victoria. Carcasses were selected on the basis of sex (entire male or female) across a carcass weight range of 55.1 to 110 kg and P2 fat depth of 6 to > 22 mm. Weights of heads, fore-trotters, kidneys and flair fat from each carcass was recorded. Fat and muscle (Mus) thickness (mm) was measured in duplicate on the slaughter floor using a Hennessy Grading Probe 4 at four different sites: between the fourth and fifth hindmost thoracic vertebrae, 3cm from the carcass midline (LR45); between the third and fourth hindmost thoracic vertebrae, 6cm from the carcass midline (LR34); between the second and third hindmost thoracic vertebrae, 7cm from the carcass midline (LR23) and at the P2 site, 6.5cm from the carcass midline. All carcasses were conventionally chilled and boned the following day. In the boning room, the right side of each carcass was split into three major primals - shoulder, middle and leg and cold carcass weight (CCW) determined. Each primal was then fully dissected into bone, rind, subcutaneous fat, intermuscular fat and lean tissue. Fat content of lean trim was determined (Atkinson et al. 1972) and adjusted to 100CL and added to the lean tissue weight. The weights of the non-dissected jowl and tenderloin were also recorded. Lean meat yield was determined as the weight of lean tissue expressed as a percentage of CCW.

Data was analysed using General Linear Regression models by Genstat 5.4 (Payne *et al.* 1987).

Results and Discussion

Models were developed to predict lean meat yield of pig carcasses selected in this study (Table 1). Using general linear regression, fat depth at the P2 site (P2 fat) was found to be an inaccurate predictor of lean meat yield percentage, accounting for only 38% of the variation in lean meat yield with a residual standard deviation (r.s.d.) of 3.01. In contrast, fat depth at the LR45 site accounted for 47.6% of the variation in lean meat yield of pigs. The inclusion of muscle depth at the LR23 (LR23Mus) as a second variable in the multiple regression analysis accounted for more variation in lean meat yield compared to inclusion of muscle depth at the LR45 (LRMus45). The accuracy of predicting lean meat yield was significantly improved by measurement of fat and muscle depths on the slaughter floor at multiple sites.

To improve the predictive accuracy of the algorithm, sex and P2 fat depth were then added to the regression equation. When added singularly, the percentage variance accounted for by the two models was equal (R^2 57.1, r.s.d. 2.63). P2 fat depth was removed from the final equation as it did not account for a large amount of variation in predicted lean meat yield nor was the r.s.d. improved appreciably once LR45Fat and LR23Mus depths were included. The inclusion of vendor into the algorithm improved both the R^2 and the r.s.d. (R^2 63.2, r.s.d. 2.44). It was recognised by Ferguson (1989) that it is important that the accuracy of prediction equations is not biased by genotype or sex effects. In this study, this assumption was not justified. Differences in lean meat yield due to vendor did not appear to be related to the specifications of carcasses selected within each vendor consignment, but may reflect genetic variability and/or management differences between different vendors. In this study, hot carcass weight was not found to be a significant term in the prediction model.

In comparison to the EU who have stipulated that grading probes for classification of pig carcasses can only be used if the r.s.d. is lower than 2.5 % and R^2 is greater than 0.64, regression equations developed for the prediction of lean meat yield in this study did not achieve this requirement. This may reflect a much greater variability in lean meat yield in Australian pigs due to genetic and management differences.

Table 1: Models developed to predict lean meat yield percentage

Predictors	R^2	r.s.d.
Lean meat yield (%) =		
P2	37.7	3.17
LR45Fat	47.6	2.91
LR45Fat + LR45Mus	50.6	2.82
LR45Fat + LR23Mus	55.2	2.69
LR45Fat + LR23Mus + Sex	57.1	2.63
LR45Fat + LR23Mus + P2 fat	57.1	2.63
LR45Fat + LR23Mus + LR45Mus + P2 fat	58.4	2.59
LR45Fat + LR23Mus + Sex + P2	59.1	2.57
LR45Fat + LR23Mus + Sex + Vendor	**63.2**	**2.44**

The regression equation for prediction of lean meat yield percentage determined from the model (s.e. in parenthesis) was:

Lean meat yield (%) = 55.62 – 0.7045 (0.0571)*LR45Fat + 0.1401 (0.0357) * LR23Mus + 1.353 (0.464) * Male (Sex) –Vendor

$R^2 = 0.632$ r.s.d. 2.44

The average lean meat yield of all pigs in this study was 51.9%, which is significantly lower than lean meat percentage figures published for all countries within the EU (Daumas and Dhorne 1998), Canada (Sather *et al.* 1996) and previously in Australia by Ferguson (1989). This suggests that, on average, Australian pigs may not be comparable in terms of lean meat yield compared with our overseas competitors or may have resulted from differences in carcass dissection methodologies and calculation of lean meat yield.

The lean meat yield of pig carcasses sampled in this study was also extremely variable. For example, the average lean meat yield of pig carcasses of 65-90 kg HCW and 6-13 mm at the P2 site was 53.5 ± 3.85%, ranging from 45.0 to 65.6 %. This indicates that the current method of payment for pig carcasses does not accurately reflect true carcass worth in terms of carcass lean meat yield. Therefore, the use of a single P2 measurement as an indicator of carcass lean meat yield provides neither producers nor processors with clear market value of the carcass.

Conclusions

In this study, the accuracy of the prediction of lean meat yield was significantly improved by the inclusion of fat depth between the fourth and fifth last thoracic vertebrae, 3 cm from the midline of the carcass and muscle depth between the second and third last thoracic vertebrae, 6 cm from the midline of the carcass as well as sex and vendor. However, it was found that the accuracy of lean meat yield prediction did not attain standards set by the EU without the inclusion of vendor in the equation. This suggests that procedures used for slaughter pig selection, genetic variability and/or differences in production management practices in south east Australia contributed to the significant differences in lean meat yield across different vendors observed in this study.

Although the inclusion of multiple sites improved the accuracy of the regression equation in this study, the commercial implementation of such a system in Australia using a manual probe appears impractical due to processing speed and the need for additional labour to measure multiple sites. The continued development of fully automated systems for measurement of fat and muscle depth at multiple sites of the carcass may offer the Australian industry an opportunity to implement value based marketing systems. However, since some major Australian processing plants operate as contract slaughter plants, the installation of costly automatic systems will remain difficult to justify by abattoir management due to the benefit of grading carcasses on the basis of lean meat yield accruing to the producer and purchaser of the carcass.

References

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