Assessing Strategies to Reduce Variation in Quality Across Ontario Farms

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A three year study has been started in 2005, initially funded by Ontario Pork and latterly with additional contributions from the National Science and Engineering Research Council. The aims of the project are:

1. Identify the scale of variability in pork meat quality produced in Ontario.
2. Systematically evaluate behavioural, nutritional and genetic interactions contributing to this variability.
3. Investigate basic mechanisms whereby these factors impact on quality through proteomics, genomics and the biochemical conversion of muscle to meat.
4. Identify management strategies to improve the quality of pork produced in Ontario.

Twenty-two commercial farms have been identified and contacted with the cooperation of a packing plant, and to date, data have been collected from approximately 50% of these and from two groups produced at a University of Guelph facility.

For each farm, genetic, management, nutrition and behaviour information were collected, and 24 pigs were identified and individually marked for tracking from farm through processing. At the plant, video records were used to quantify behaviour during handling, and blood samples were collected for analyses of stress parameters. Temperature and pH were recorded over the first 48 hours in the ham and loin, and tissue samples were collected at 1.5 hours postmortem and stored at – 70 ^{o}C for analyses of gene expression and biochemistry. Loin and ham samples were also sent to the University of Guelph Meats Lab for subjective evaluation of meat quality (colour, marbling, firmness, wetness) and objective determination of colour (L* a* b* scale), pH, drip loss and Warner-Bratzler shear force (an instrumental measure of tenderness). Shear force measurements were conducted on cooked longissimus chops and smoked ham. From the first set of 312 samples statistical analyses, were conducted to identify outliers based on drip loss and colour of the loins. Individual farm/day effects were accounted for in the model. Samples from the extremes have been extracted for microarray analysis to determine patterns of gene expression peri-mortem in pigs with differing meat quality parameters. These gene expression measurements and biochemical measures of a key enzymic pathway involved in both drip formation and tenderness development are currently underway.

The minimum – maximum range of values from measurements analysed to date are as follows:

	Measurements on Loin (Longissimus muscle)		**Measurements on Ham (Semimembranosus muscle)**	
Parameter	**Minimum**	**Maximum**	**Minimum**	**Maximum**
pH (initial)	5.45	6.60	5.47	6.65
pH (final)	5.29	6.27	5.47	6.58
Colour (L*)	35.47	54.35	40.56	61.58
Drip loss %	2.69	12.54	3.12	12.27
Shear force	2.08	7.66	1.67	5.43

A detailed report on stress response and animal behaviour as related to these variations in meat quality is given by Dr Widowski elsewhere in this 2006 CSRU.

The min-max ranges tabulated above clearly show an extensive range of values. Figure 1 shows the range in two measures often associated with meat quality concerns; Colour L* Value and Drip Loss (%), both measured on the loin eye muscle. The L* value from the Minolta colour meter is a standard measure of the brightness of the meat. Higher L* values are associated with pale pink pork chops. The percentage of drip loss is a direct indicator of the water holding capacity of the post-rigor muscle tissue which has a large impact on the further processing potential as well as the consumer acceptability of the product. Plotting these two components of quality reveals the range of quality in the pigs seen in the sample of pigs we tested. (A drip loss value of 2.5% is the goal established by the US National Pork Board. Similarly, an L* value of less than 50 is desirable, and anything greater than that is considered pale.)

There is extensive variation in the values shown in Fig.1; as with other parameters, the variation between pigs from the same farm is on the same order of magnitude as great as the variation between farms. This indicates that physiological effects in individual animals and their interactions with handling and nutrition may well have a large influence on end product quality. The next step in the project is to interpret gene expression and biochemical analyses of selected samples to explain how these differences come about at the level of individual genes, proteins and enzymes in the meat. The strategic aim of the project as a whole is to suggest nutritional strategies and handling strategies that improve meat quality parameters overall, but also to look at ways to reduce the real outliers.

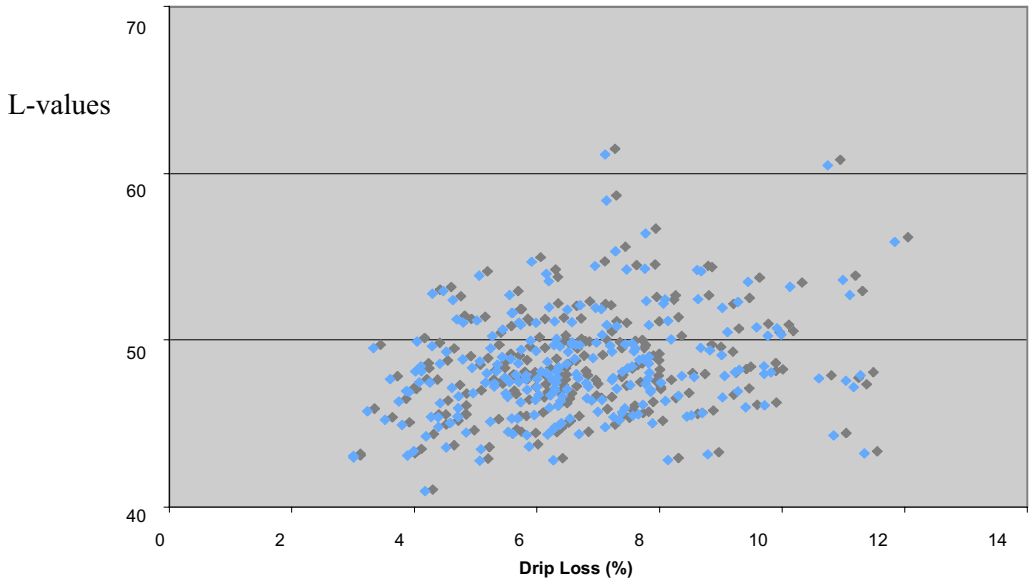

Figure 1. L* values (lightness) versus drip loss (%) values from loin samples only.