THE CONSEQUENCES OF LEAN MEAT YIELD SELECTION AND THE RN GENE

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There is a relatively new field in science known as Darwinian medicine. It describes how some diseases develop as *a trade-off* to maximize the evolutionary goal of the complete animal, usually reproduction. Some well known examples are improved resistance to malaria from Sickle cell anemia, promiscuous behavior during the pre-clinical onset of Huntington's cholera, or increased resistance to tuberculosis with susceptibility to gastric ulcers (Nesse and Williams, 1998). It's a fascinating field but what does it have to do with meat science?

As a research scientist with Agriculture and Agri-Food Canada in Lacombe, Alberta my current work involves the identification of genetic markers important to the livestock industry. I have started to realize (as have many others) that many of the current selection and merit scoring systems in the livestock industry have led to a *trade-off* in a number of genetic disorders which can be quite detrimental to the animal or product. This is a very common, re-occurring problem in the meat industry. Some examples are the double muscling myostatin (GDF8) gene in cattle causing birthing problems (dystocia) (Kambadur et al., 1997) or the muscle hypertrophy callipyge gene in sheep causing extremely tough mutton (Koohmaraie et al., 1995). My last project was on the porcine RN gene which increases muscle glycogen >2-3 times. The RN gene also increases loin eye depth (Enfalt et al., 1997) and since most processing plants grade pig carcasses using fat and muscle depth probes like the Destron or Hennessy probes, this gene has become prevalent in the commercial swine industry. But now, the pork industry wants carriers of the RN allele removed because the meat from animals that carried this gene may become acidic and watery. Although, not as bad as the RYR1 (Halothane) mutation which caused pig deaths and extremely watery pork (Murray and Johnson, 1998), the two are related because they arose in the commercial pig population merited exclusively on lean meat yield.

Recently we performed a series of tests on randomly selected pork chops from retail displays at local grocery stores. Pork chops were evaluated on their Glycolytic Potential (GP), Modified Napole Yield, pH, color, and genotype. GP is the estimated sum of glycogen, the intermediate metabolites of glycogen breakdown, and the end product, lactate. Excessively high GP was found in 25% of the samples. High GP correlated with a significant (P>0.05) drop in pH (5.8 to 5.7), a paler (L^* value; 54.1 to 57.5) more yellowish (b^* value; 9.6 to 11.6) color, and an increased cooking loss (9% to 18%), typical of the RN^- phenotype. Blood and pork chop samples were also DNA tested for the genetic markers linked to the RN gene and a newly developed DNA test for coat color. DNA markers *Sw120* and *Sw936,* which are linked near to the RN gene on porcine chromosome 15, did not significantly correlate with the published European data for predicting high glycogen content in this study. Therefore, removal of the RN allele will require pedigree analysis of the breeding herd and biochemical testing for GP. The genetic test for skin color was made because the RN allele is also known as the Hampshire gene (Sayer et al., 1963; Monin and Sellier, 1985) and as a result, commercial pig producers are dropping the Hampshire pig from their breeding lines. Hampshire pigs are recognized by their black and white coat color. However, if crossed with a pig homozygous for the dominant white alleles of the Kit gene, coat color would be blocked in all offspring (Moller et al., 1996).

If Hampshire pigs carrying the RN gene were introduced into breeding stock being selected for superior carcass grades and homozygous for the dominant white gene, the RN gene would be amplified in the population of phenotypically white pigs. Our data indicated that 79% of the high GP pork was from phenotypically white pigs.

It appears that the RN allele will remain in the commercial pig population for a while, until a blood marker like the HAL-1843™ DNA test for the Halothane gene (Fujii et al., 1991) is discovered. Fortunately, the RN gene is dominant to the normal glycogen genes. This should make it easier to identify in carriers. We have also found that pork from RN animals had almost 5 times more glucose post mortem than normal (Meadus and MacInnnis, 1999) and are now trying to develop non-invasive test based on this difference.

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