

Incorporating meat quality into commercial sheep breeding programmes

Background

Domestic consumption of lamb (Wales and UK) has been falling over the last two decades and lamb has a significantly lower frequency of consumption than other sources of protein in the UK. For the majority of consumers, lamb is an occasional meat of choice consumed less than once a month and the majority of Welsh lamb is consumed outside of Wales. This is partly a reflection of the retail price to the consumer and the perceived limited versatility of lamb as a dish. Public health campaigns have also made the consumer increasingly aware of the nutritional quality of their food and red meat in particular.

Many factors influence meat quality and eating quality - from the birth of the lamb to its processing, packaging and cooking. It has been shown that a substantial proportion of the differences in texture, juiciness and flavour are attributable to variation between individual animals that is probably genetic in origin. Previous studies have also shown that there is genetic variation between individuals in the fatty acid composition of meat and the concentration of the essential nutrients, zinc and iron. However, the ability to genetically improve the quality of sheep meat has been difficult in the absence of clear *in vivo* measures and the high cost of genetic and meat eating quality assessments. Muscle density (as determined by CT scanning) is one quantitative measure that has been associated with meat eating quality in terms of juiciness, flavour, and liking of sheep meat and also with the fatty acid composition of the meat in terms of the levels of saturated, monounsaturated and polyunsaturated fatty acids. These factors were used in the assessment of the impact of new QTLs on the eating quality of lamb as part of the recently completed TM-QTL project. These studies indicate that substantial genetic progress is likely to be possible for a number of selection criteria related to meat quality but confirmation in independent populations of commercial sheep has not yet been undertaken.

Genetic improvement could therefore provide a cost effective and permanent means of improving the eating quality of lamb as well as meeting the carcass requirements of the processors and retailers (in terms of weight, size and fat composition of the most valuable cuts). It also offers the potential for increasing the consumption of lamb by improving its nutritional quality, in terms of fatty acid profile and the provision of essential nutrients such as zinc and iron and so this is worthy of further investigation.

This project therefore aims to take forward the original research findings that were originally undertaken in Scottish Blackface sheep by providing an industry scale trial which will establish a number of the essential elements required to incorporate meat eating quality and nutritional value into commercial sheep breeding objectives. CT scanning is currently used as a tool to aid selection to improve carcass composition. Improvements in the genetic background of terminal sire lines has the capability to deliver the widest industry impact and so this project will use the Innovis terminal sire line as a commercial model.

Scope and aims of the project

Previous studies have indicated that muscle density measured by computerised tomography (CT) in live lamb is both highly heritable and has a strong negative correlation with eating quality. Muscle density measurements have a strong negative correlation with intramuscular fat levels and it is well established that favourable eating quality is associated with increased levels of intramuscular fat. Whereas increasing intramuscular fat to improve eating quality may be desirable, this would be expected to lead to an increase in overall carcass fatness, which would be undesirable. This project will therefore investigate this relationship using Innovis terminal sire lines with the aim of developing selection protocols for inclusion of muscle density measurements in the breeding programme. These protocols should then be transferable to the wider industry.

Innovis has developed a novel, technology-based, commercial breeding programme which provides breeding stock to breeders throughout Wales. To date more than 5000 Innovis crossbred breeding females are being used on commercial farms in the UK and around 180 terminal sires were supplied in 2010. Slaughter lambs from a considerable number of these flocks are processed by Dalehead Foods through the Waitrose supply chain. With more than 1400 ewes, the Innovis nucleus flock probably represents the largest recorded sheep flock in the UK. This flock therefore offers a unique resource from which a rich data set can be used to enable the relationship between CT muscle density measurements and eating quality to be established. Muscle density measurements, obtained through CT scanning of a very limited number of animals each year, have been included within the Innovis selection criteria thus far.

This project therefore entails an industry scale “high / low” trial to establish the range of muscle density values across a population and to identify lambs which have very high and conversely very low muscle density values for further investigation. These lambs would be used to sire progeny within a single commercial lowland flock and the progeny tested for their meat quality attributes and subjected to a trained taste panel and meat quality assessments. *In vivo* methods of measuring fatty acid composition and levels of zinc and iron will be undertaken by Aberystwyth University (IBERS). Increasing carcass fatness in total increases trimming and disposal costs for the processor and thus reduces the value of the lamb carcass. Therefore one aim of the project will be to establish methods to increase or modify intramuscular fat while decreasing the weight of fat in other depots, thus retaining carcass value.

Work programme

Aim: To develop the knowledge base and protocols required in order to incorporate lamb eating and nutritional quality into the commercial breeding programme

Primary Objectives:

- To identify the extent of genetic variation in eating quality and nutritional quality in a terminal sire line using the Innovis Charollais x Texel as a model
- To evaluate the genetic and phenotypic relationship between CT muscle density measurements and eating quality in this terminal sire line
- To evaluate the genetic and phenotypic relationship between nutritional quality of meat and eating quality.
- To evaluate the genetic relationship of CT traits and eating quality with other traits included in the Innovis terminal sire line selection objectives (.e.g growth and lambing ease).
- To provide guidance on the incorporation of eating quality into the selection objective

In October 2010, 200 Texel ewes were mated using AI to 5 Charollais sires who all rate highly on the breed's Lean Index as part of the Innovis Terminal Sire breeding programme. Approximately 150 male and 150 female progeny were born in March 2011. These lambs will form the pool from which this trial will be conducted. During 2011 all the lambs were weighed at birth and again at eight weeks of age and twenty weeks of age.

July – Sept 2011

For this trial to proceed, all lambs will have subcutaneous fat and muscle depth of the longissimus dorsi measured at 20 weeks of age by ultrasonic scanning. 150 ram lambs will be CT scanned at between 20 to 24 weeks of age. These lambs will be pre-selected on structural soundness but not on ultrasonic muscle or fat depth.

From these, 7 ram lambs with a low muscle density and 7 with a high muscle density will be selected with the aim of collecting semen from 5 within each group to use in a progeny test. Each ram lamb selected should have muscle density values above (or below) the value represented by 1.5 standard deviations above (or below) the mean of the entire group. Ideally all ram lambs selected will have a predicted fat proportion within one standard deviation of the mean for the whole group.

October 2011 – February 2012

Semen will then be collected from the selected ram lambs and used to inseminate 200 commercial (Aberdale) ewes in Autumn 2011. The lambs of these ewes will be born and reared in commercial conditions but with basic recording of parentage, birth weight, type (single/twin etc), sex and date of birth.

April – September 2012

Progeny from the high / low rams will be selected for slaughter at a target weight and fat cover, and weighed and ultrasonically scanned prior to slaughter (within 48 hours). Following slaughter and

conventional carcass dressing and conditioning, meat quality measurements would be made on 200 lambs. These measurements would include ultimate pH, colour, tenderness (shear force), succulence, flavour and eating quality as assessed by a trained taste panel as well as determining the fatty acid composition of the meat in relation to the various traits. (Zinc and iron levels etc)

October – December 2012

Data will be analysed to quantify:

1. The difference in meat quality between progeny of high and low muscle density sires
2. The variation in eating quality traits expressed in 'commercial' lambs
3. The phenotypic and genetic correlations of performance traits recorded on farm (live weights and ultrasonic scanning) and eating quality traits

January – February 2013

Project reporting and dissemination of results to industry

Project partners

The project partners for this project would be Innovis, Dalehead Foods, and IBERS. Innovis will take responsibility for the management of the project, coordination and reporting.