Improving beef eating quality

R. Roehe, E. Navajas, D. Ross, J. H. Hyslop,
K. McLean, L. Bünger, G. Simm

Sustainable Livestock Systems Group
Scottish Agricultural College, Edinburgh, UK

SEERAD Work Package 2.5

Livestock Genetics and Management for Product Quality and Sustainability

Strand 1
Improving product quality

Sub-strand 1.1
Improved measurement techniques for carcass and meat eating quality in beef and lamb

Sub-strand 1.2
Designing and testing breeding programmes to improve carcass and meat eating quality

Improving product quality

Investigate improved measurement techniques for carcass and meat quality in beef

and

their optimal use in breeding programmes

in order to

substantially improve the efficiency of Scotland's livestock farmers in an increasingly competitive food chain.

Aims/Objectives - Improving beef quality

- Investigate techniques for prediction beef carcass and meat eating quality from

    - live animal measurements

    - carcass measurements

- Investigate the influence of marker genotypes on predicted and direct measures of meat eating quality.

Aims/Objectives - Improving beef quality

- Identify the most cost-effective breeding programme designs to achieve genetic improvement of carcass and meat eating quality in beef

- Investigate the use of canalised selection to reduce variability in meat eating quality

- Test the use of novel selection criteria to improve meat eating quality in the target livestock species

Beef meat quality experimental research

Jul 2006	• **Pilot trial of 44 beef cattle**
	    – SAC experimental farm Easter Howgate
	    – Limousin sired crossbred animals
	    – Aberdeen Angus sired crossbred animals

Oct 2006 Nov 2006	• **Three slaughter batches at Scotbeef**
Jul 2007	• **Main trial of 150 beef cattle (Easter Howgate)**
Sep 2007 Oct 2007 Nov 2007	• **Five slaughter batches at Scotbeef**
Jan 2008 Feb 2008	• **Three slaughter batches at Scotbeef**

Pilot trial to establish the improved measurement techniques

- Use of numerous measurement techniques
  - Live animals
  - Carcass cuts

- Sensory (taste) panel

- Analytical determination of fatty acid

- DNA samples for molecular analysis

- Ultrasonic measurements
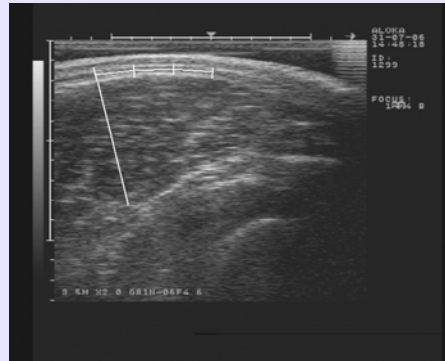
- Video Image Analysis (VIA)
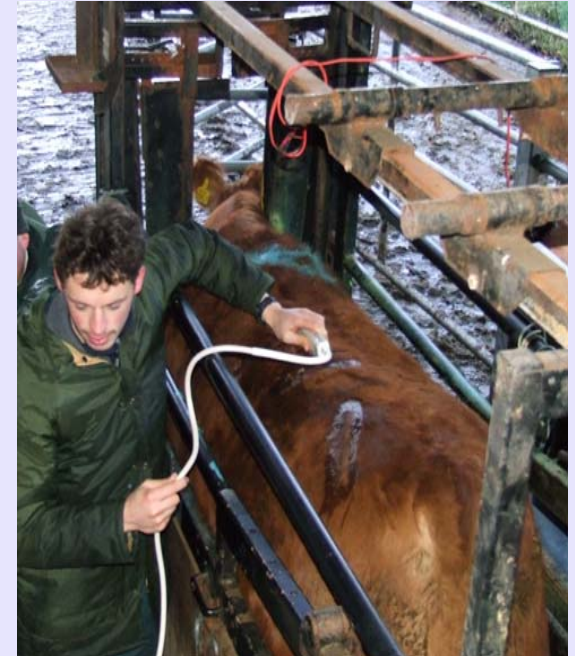
SAC experimental farm Easter Howgate

Sire breed differences in ultrasonic measurements at slaughter day (Signet)
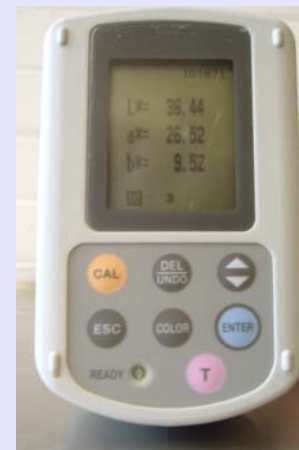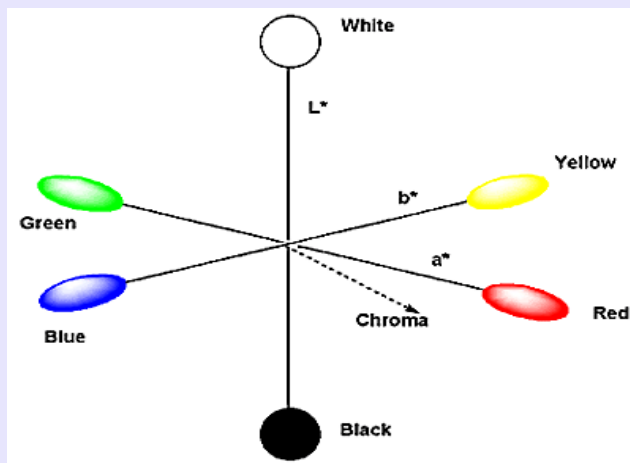
	Aberdeen Angus	Limousin	Significance
Live weight (kg)	632	611	**
Carcass weight (kg)	347	352	
Muscle depth (mm)	66.7	72.7	***
Fat depth (mm)	9.3	6.1	***

Prediction of meat quality on the carcass at Scotbeef

- ## Measurements of pH and temperature profiles

Changes in pH after slaughter

1 hr

5 hr

48 hr
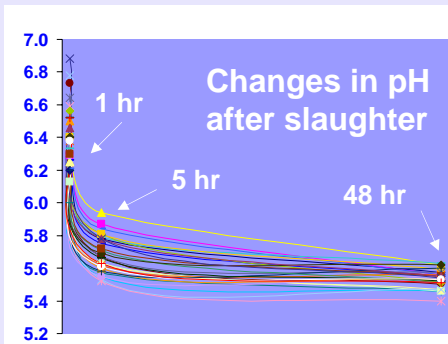
- ## Meat colour measurements

White

L*

Yellow

b*

Green

a*

Chroma

Red

Blue

Black

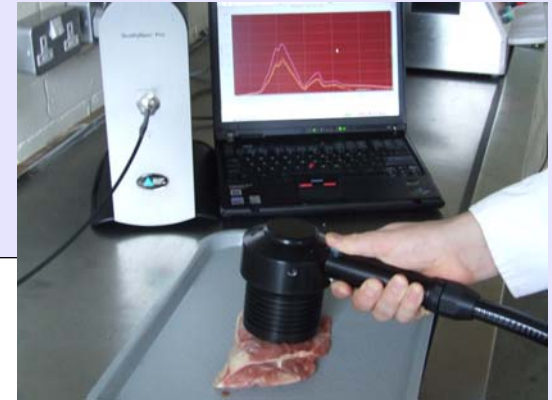- ## Slice shear force

Shear slice force

- ## MIRINZ tenderometer

MIRINZ tenderometer

Prediction of meat quality on a steak

- ## Near-Infra-Red (NIR) scanning for meat quality prediction

Slice shear force (SSF) and NIR scanning

- Minimum SSF
- "Average" SSF
- Maximum SSF

Prediction of meat quality by Computer tomography

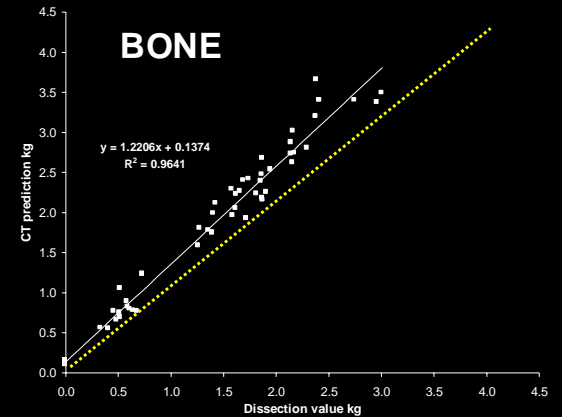S A C
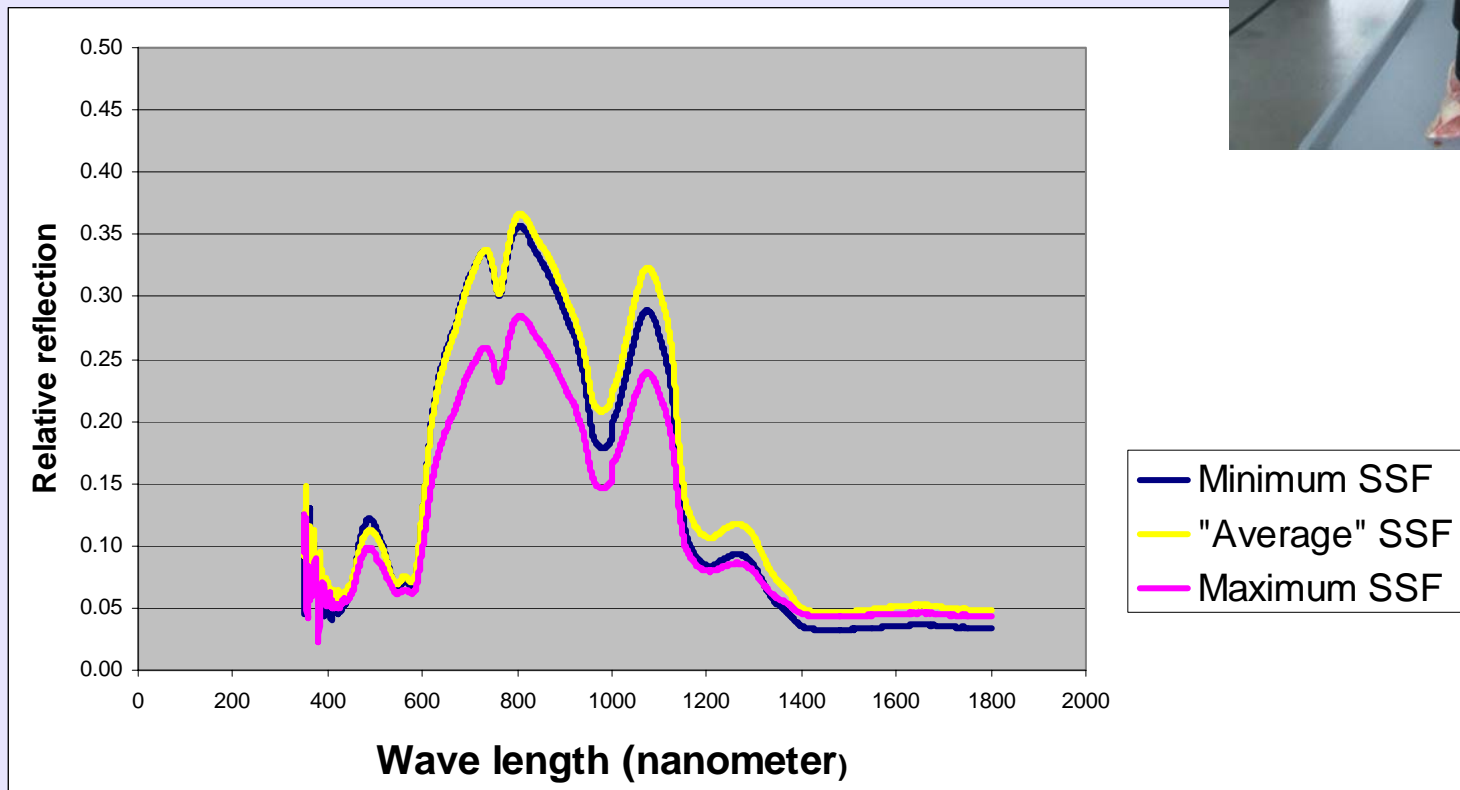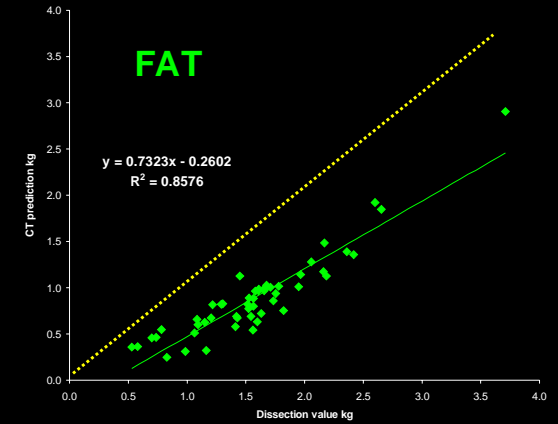
- Scanning of primals using X-ray Computer tomography (CT) at SAC

CT cross-sectional image

bone

fat
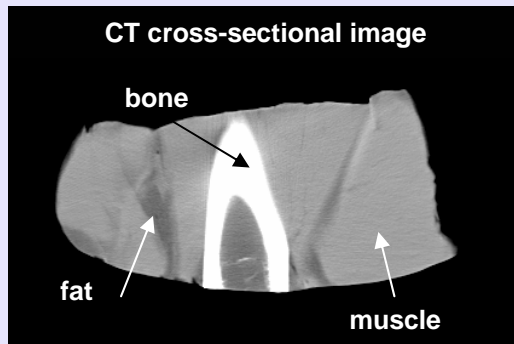
muscle

Muscle density measured by CT: Good predictor for main components of meat quality in sheep (beef?)

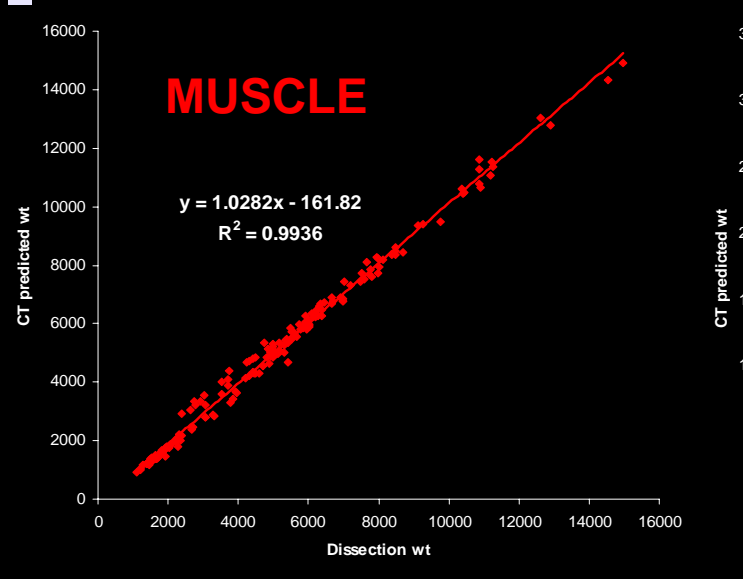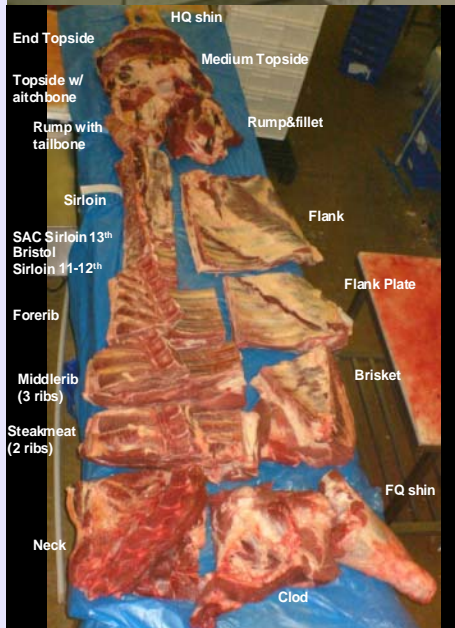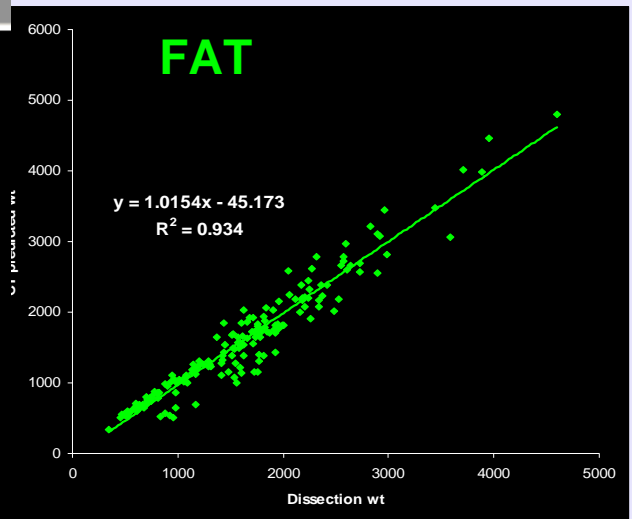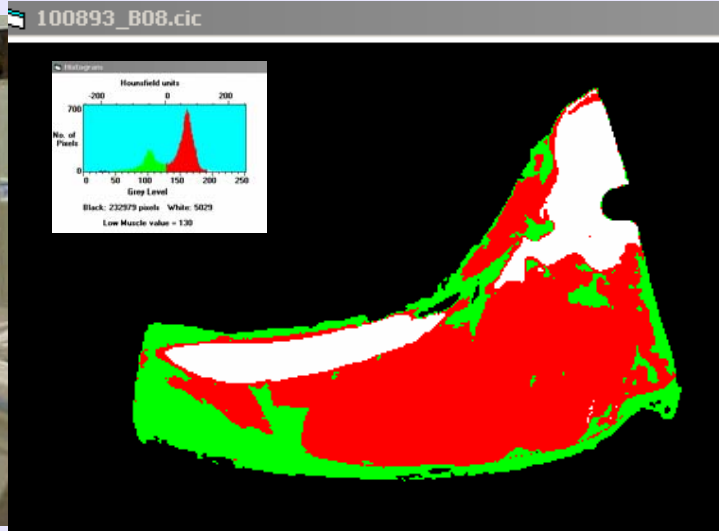# Prediction of beef carcass composition by CT using tissue thresholds used for sheep

E. Navajas & K. McLean

BioSS and SAC
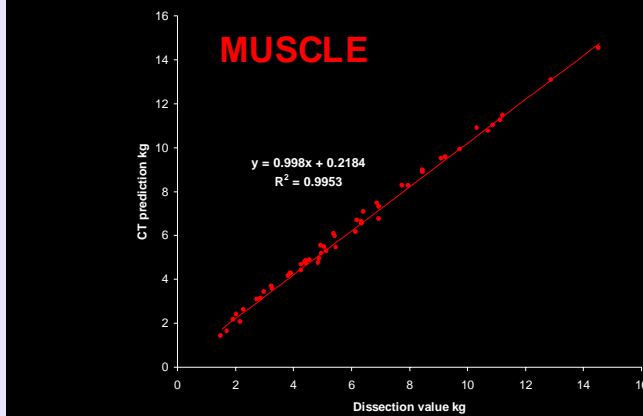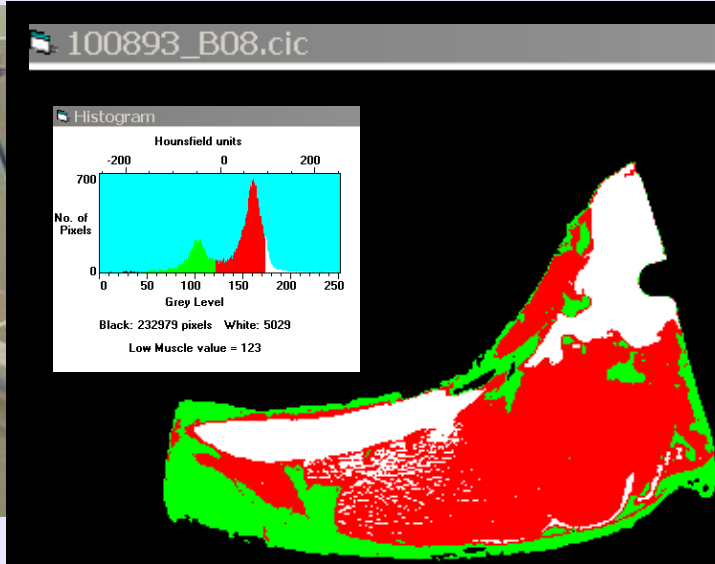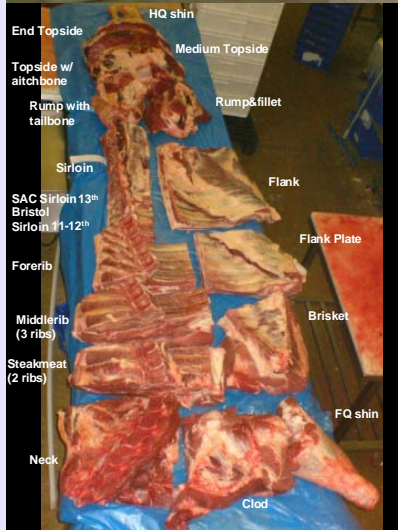
Development of tissue thresholds to predict beef carcass composition by CT using new beef data

BioSS and SAC
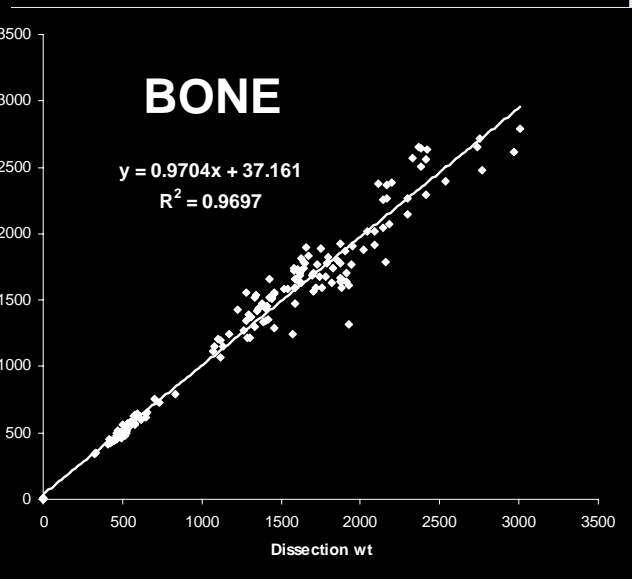
- Dissection of all primals in lean, fat and bone tissue at the University of Bristol

- Development of prediction equations to determine entire carcass composition from dissection of the loin

- Development of prediction equations to determine entire carcass composition by using computer tomography
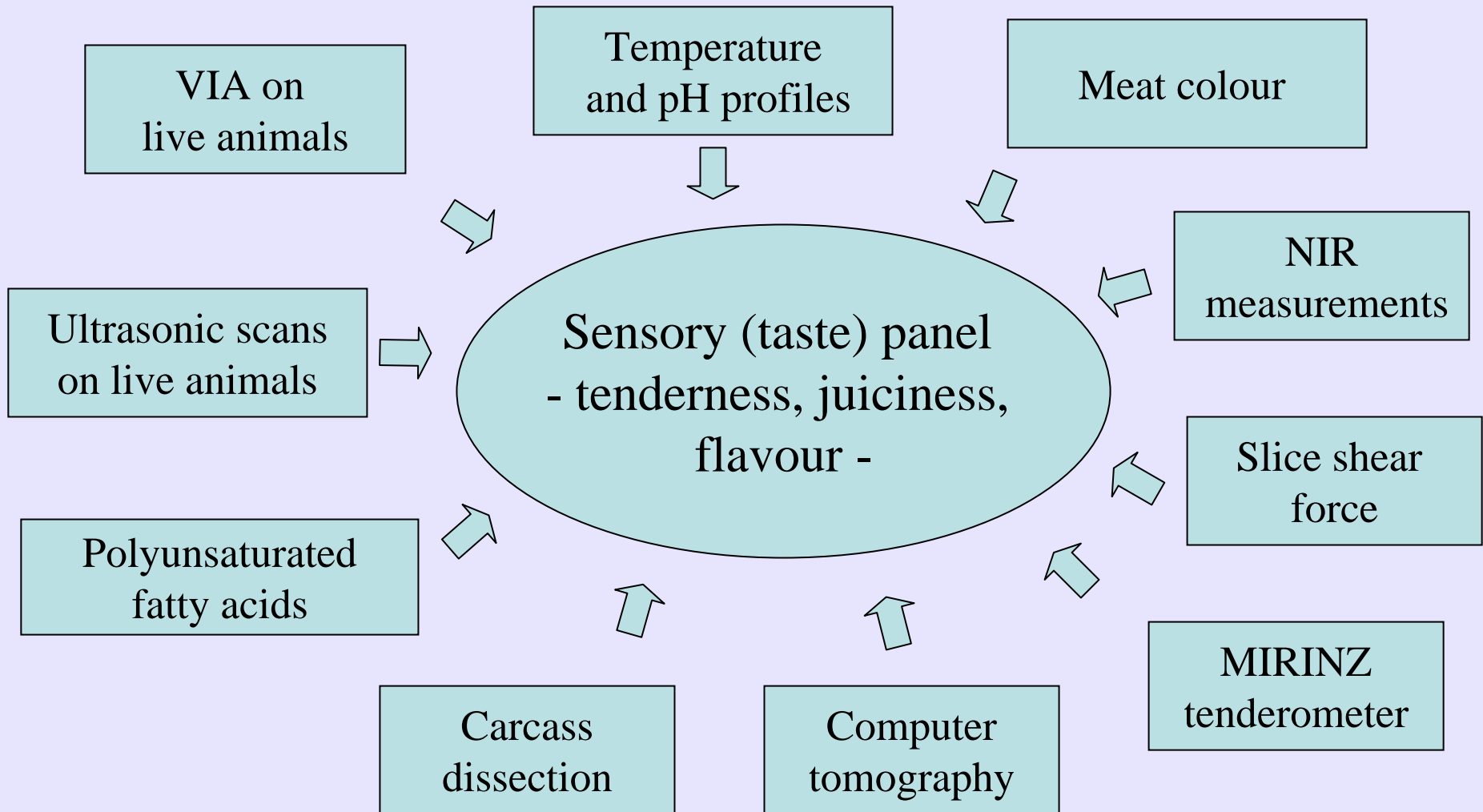
- Trained assessors evaluate beef eating quality at the University of Bristol

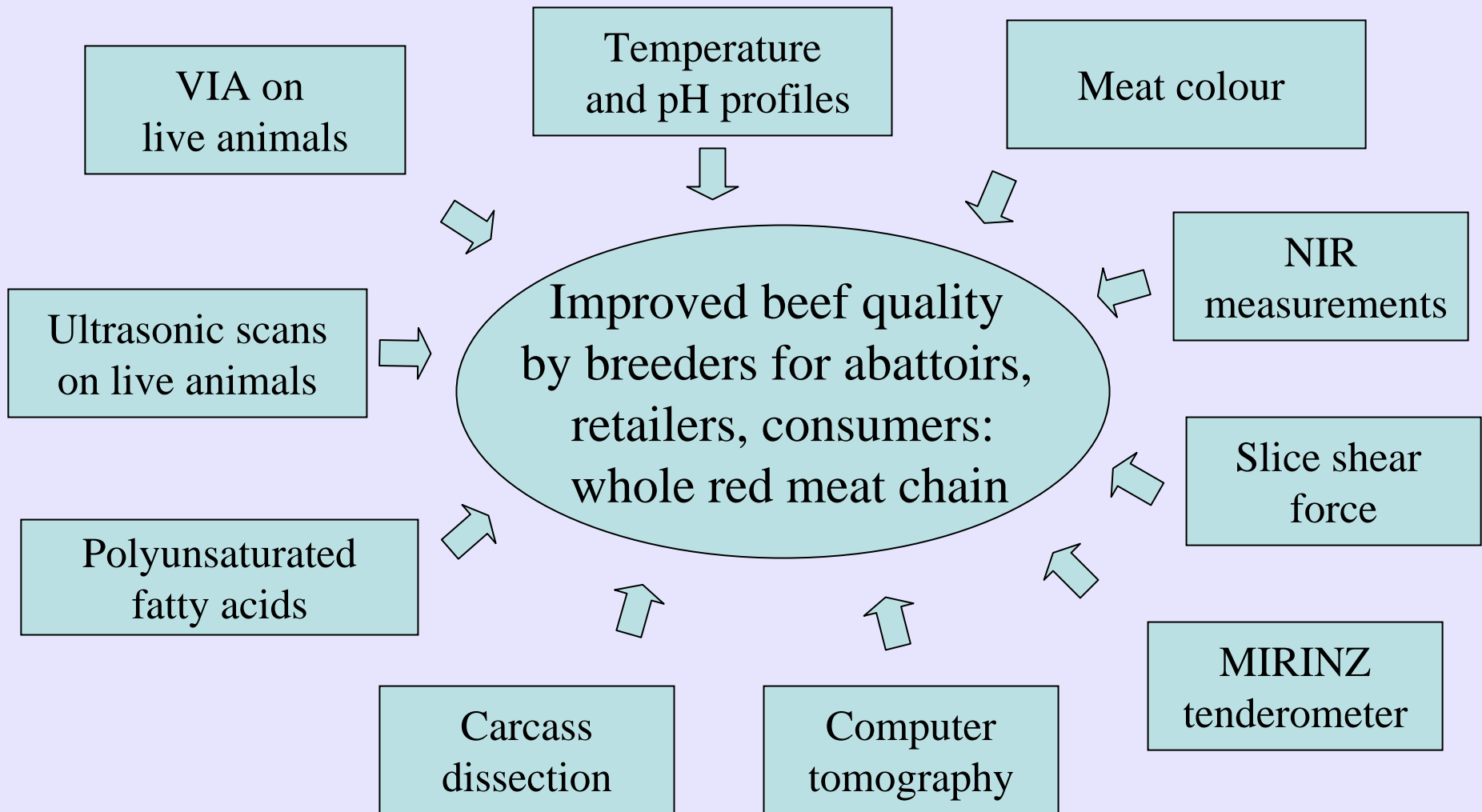# Determination of fatty acids and intramuscular fat

- Analytical methods to determine polyunsaturated fatty acid (PUFA) and saturated fatty acid (SFA)

  - Fatty acid composition is a major factor in the nutritional value of meat

  - Ratio of PUFA to SFA of 0.4 or above advised for human nutrition

- Analysis of phenotypic associations between fatty acid composition of beef and its eating quality (sensory panel and or laboratory techniques)

- Association of total intramuscular fat and meat eating quality

Associations of improved measured techniques to meat eating quality

VIA on live animals

Temperature and pH profiles

Meat colour

Ultrasonic scans on live animals

Sensory (taste) panel - tenderness, juiciness, flavour -

NIR measurements

Slice shear force

Polyunsaturated fatty acids

MIRINZ tenderometer

Carcass dissection
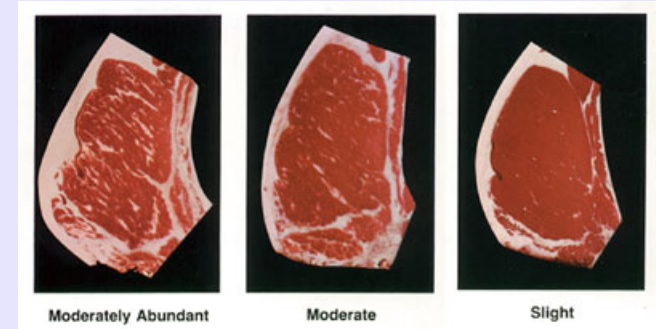
Computer tomography

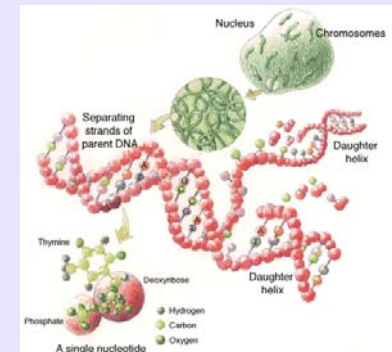Associations of improved measured techniques to meat eating quality

Commercial markers of beef meat quality
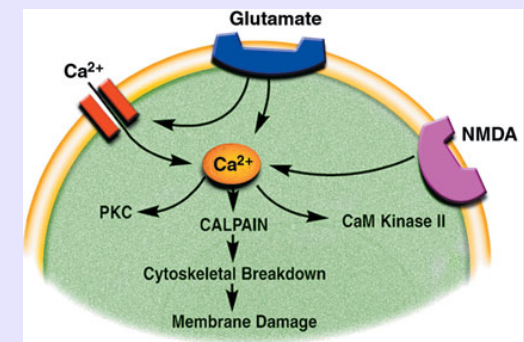
- **Genetic solution**
  - Genstar tenderness: 4 markers
  - Genstar marbling: 4 markers

- **Merial**
  - Igenity L: Leptin
  - Igenity Tender Gene: Calpain (two mutation)
    Calpastatin (one mutation)
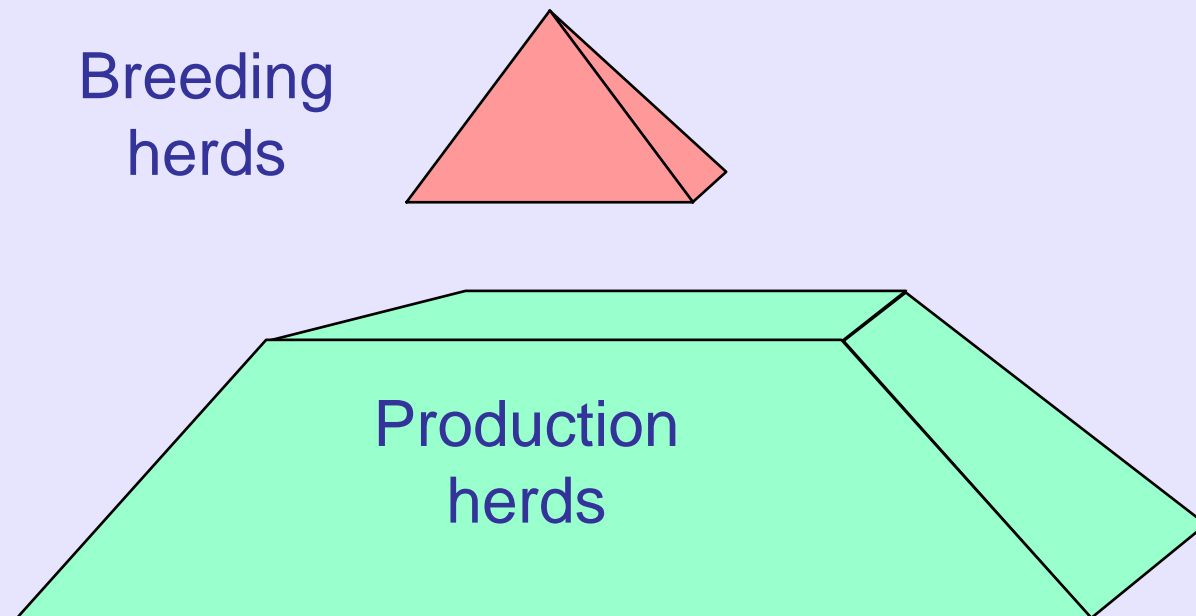 - OptiGrid: multiple marker genes

- **Prescribe Genomics Co.**
  - GH1: Marbling
  - SCD: Fatty acid ratio

Moderately Abundant   Moderate   Slight

Optimal use of improved measurements in breeding programmes

- Investigation of the optimal integration of improved measurement techniques into breeding programmes

- Genetic improvement is permanent, cumulative and ideally disseminated over the entire population and therefore highly cost-effective

Breeding herds

Production herds

- Genetic improvement of the uniformity of carcass and meat eating quality using canalised selection
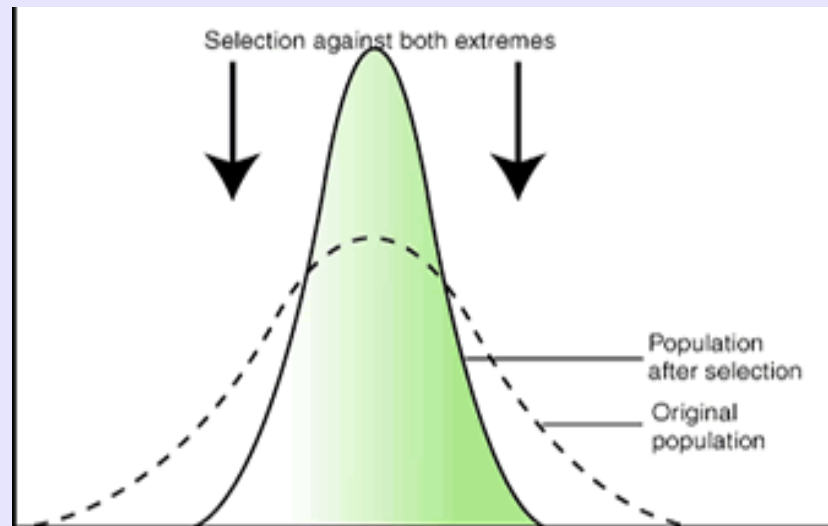
- Optimal integration of molecular and conventional quantitative genetic information into breeding programmes

  - genomic markers have been shown to be of particular interest for genetic improvement of meat quality traits

'For the future, livestock farmers will need to adopt **practices and technologies** that enables them to **operate effectively** as the first link in an **increasingly competitive food chain**, contributing to the **production of safe, high quality food** at the **right price** and adapting to changing market signals'

Strategic Research for SEERAD, Environment, Biology and Agriculture 2005-2010.

Policy Relevance (Illustrative Outputs)

- Technical advice on appropriate and optimal use of animal breeds

- New technology and decision support tools to enable production of consistent and high quality livestock

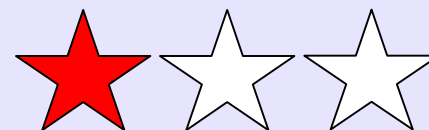- Knowledge leading to advice on genetics on product quality attributes.

  Strategic Research for SEERAD, Environment, Biology and Agriculture 2005-2010.

Cross-Cutting Themes (CCT)	
CCT 1: Responding to Climate Change	★☆☆
CCT 2: Protecting Biodiversity and Genetic Diversity	★☆☆
CCT 3: Environmental, Social and Economic Sustainability of Rural Scotland	★★★

Key KT activity to date

- Animal Welfare Open Day - June 2006
- SAC KT week workshop - Sept 2006
- SAC Beef Open Day - Oct 2006
- SAC Sheep Open Day - Oct 2006
- SSPCA Staff conference - Oct 2006
- Scottish Animal Health & Welfare Conference - Nov 2006
- Sheep and Beef News article - Feb 2007
- Advice to SAC consultants, breed societies and individual farmers
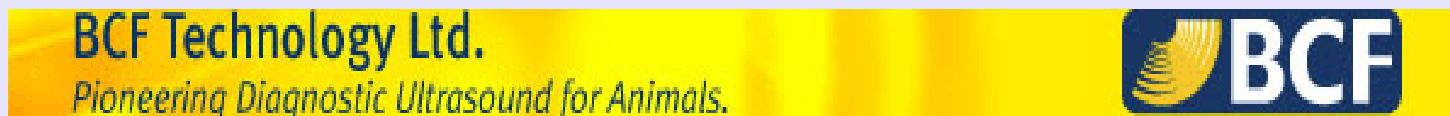- Visits from Deputy Agriculture Minister, SSPCA

Acknowledgement

The research on beef meat quality is funded by the

Further acknowledgements

Thank you very much!