

# Beef carcass composition assessed by X-ray Computed Tomography scanning of primal joints

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- Carcass quality is related to its composition
- Dissection is the reference method for assessing composition
  - costly and time consuming
- X-ray computed tomography (CT) provides very accurate predictions of carcass composition from measurements of live sheep
- Scanning of beef cattle is restricted by size of the scanner gantry. However, beef primal cuts are small enough to be scanned

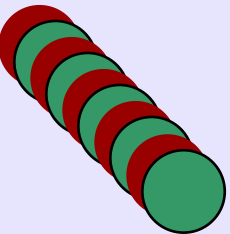


# Spiral CT scanning

- Spiral CT scanning (SCTS)
  - Captures entire anatomic regions as a continuous volume of contiguous slices (vs one slice at a time)
  - Very accurate measurement of muscle weights in live sheep ( $R^2 \sim 0.97$ )



- Calculation of tissue weights by



– VOLUME:  $\Sigma$  Tissue area x Thickness of the slices

– WEIGHT: Volume x Tissue Density

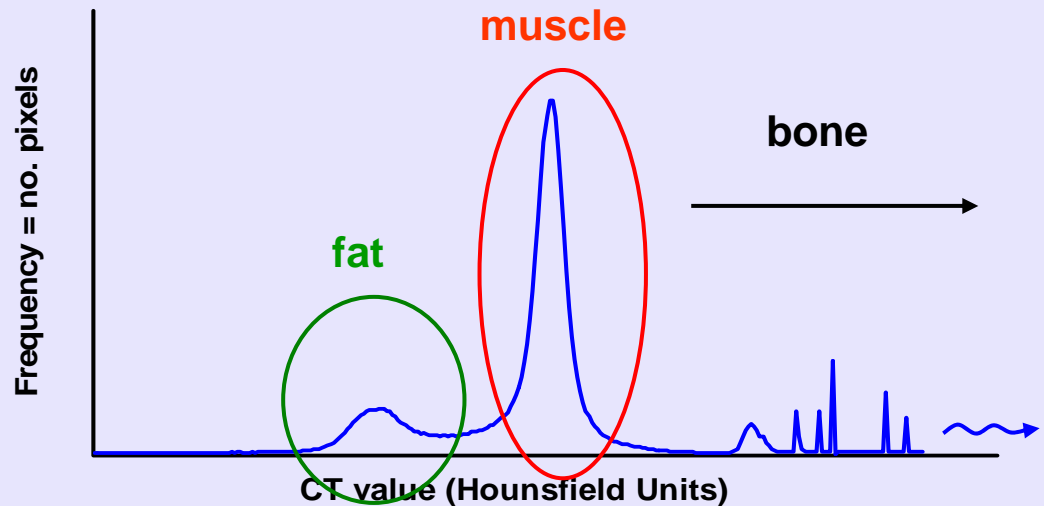
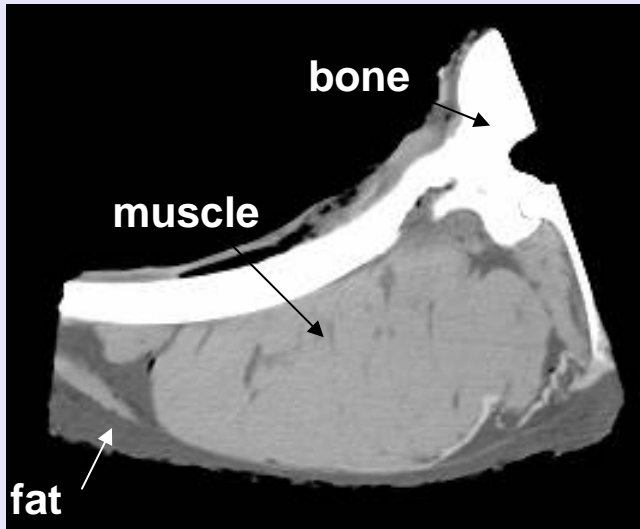
» Tissue density ( $\text{g/cm}^3$ ) = (Density in HU x 0.00106) + 1.00062

HU= Hounsfield Units

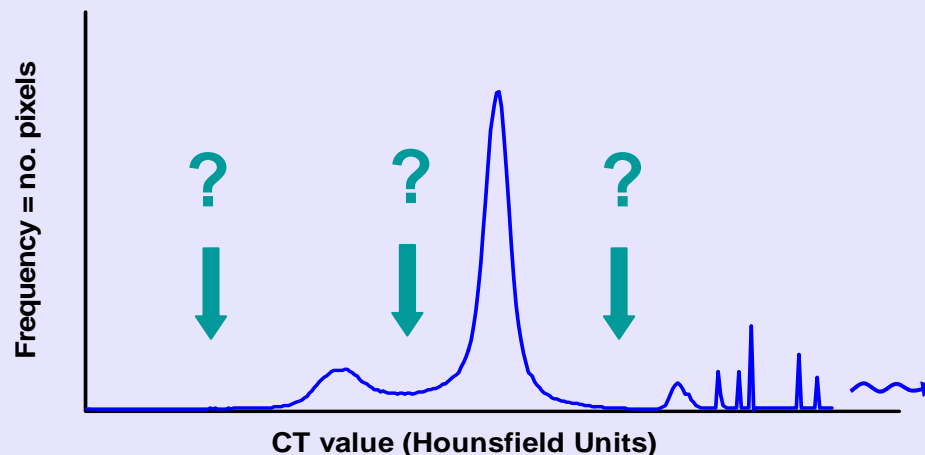
Fullerton (1980)

# CT image analysis

- CT is based on differences in attenuation of X-rays of tissues and objects due to differences on their real densities
  - Attenuations values → CT values
- Tissues appear in the CT images with different grey shades



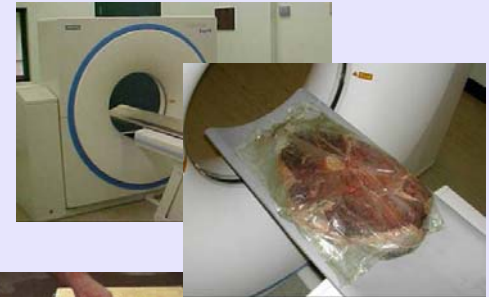
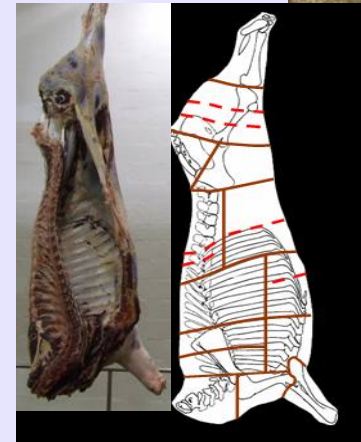
- CT is based on differences in attenuation of X-rays of tissues and objects due to differences on their real densities
  - Attenuations values → CT values
- Tissues appear in the CT images with different grey shades
- To measure the areas required to assess weights
  - Information to discriminate each pixel into fat, muscle or bone
  - Range of CT values for each tissue (CT tissue thresholds)



- To develop a CT image analysis procedure to measure fat, muscle and bone weights of beef carcasses from SCTS of beef primals
  - Estimation of CT tissue thresholds
- To evaluate its accuracy

# Materials and Methods

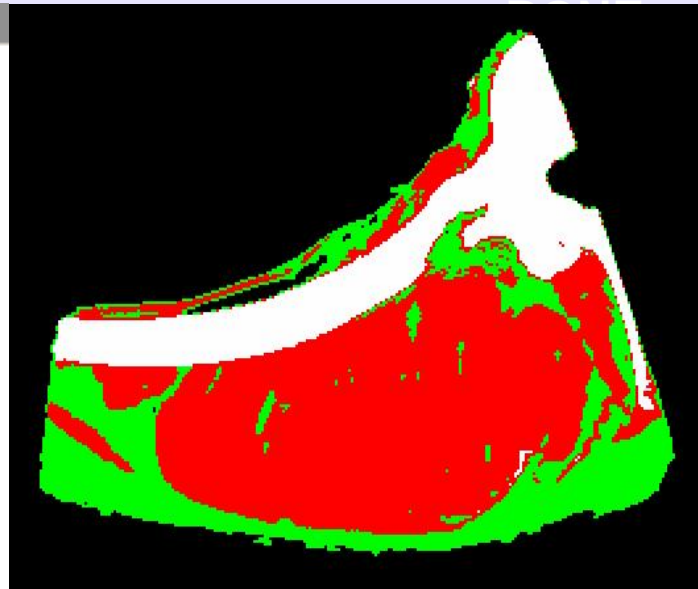
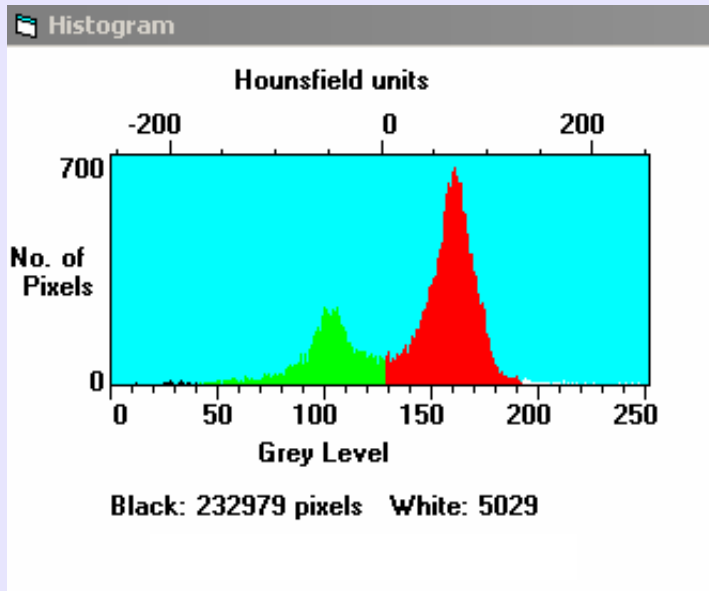
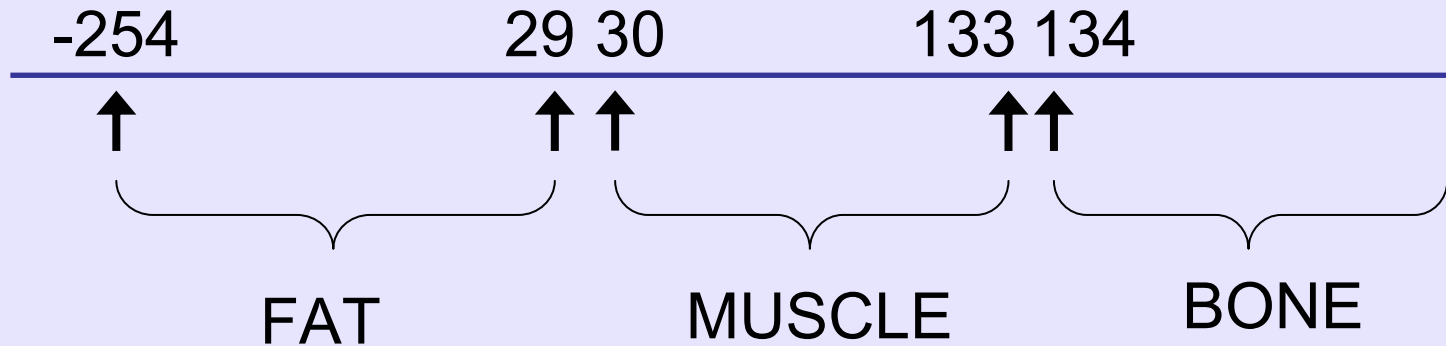
- 44 crossbred Angus and Limousin steers slaughtered in 3 batches in Oct-Nov 2006
- 48 hours after slaughter left carcass sides were split into 20 primal cuts, which were vacuum packed
- Primal cuts were transported to CT Unit and CT scanned
- SCTS were collected for each cut (slices 8 mm thick)
- Primal cuts were dissected into lean, fat and bone, and weighed



- Data split into 2 sets: estimation and validation
  - 22 animals balanced by breed and batch
  - 240 primal cuts
- Estimation of thresholds
  - Histograms of pixel values (>-256 HU) vs. dissection data
  - The thresholds were those that minimised the prediction errors in the three tissues
- Image analysis using STAR (developed by BioSS-SAC)
- Accuracy by linear regression analysis:  $y = \beta x$ 
  - Intercept zero
  - $y$ = dissection weight;  $x$ = CT weight

# Results – Tissue Thresholds

- Tissue thresholds (HU):



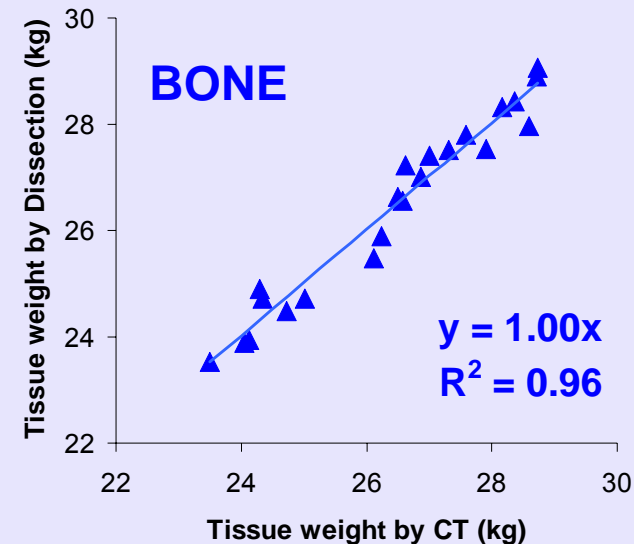
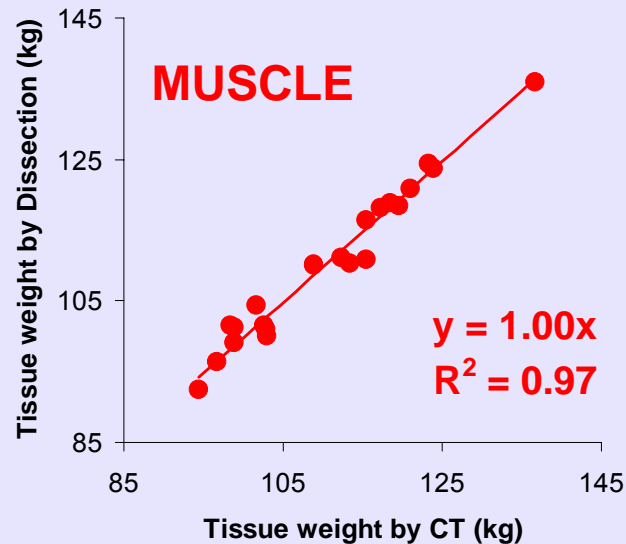
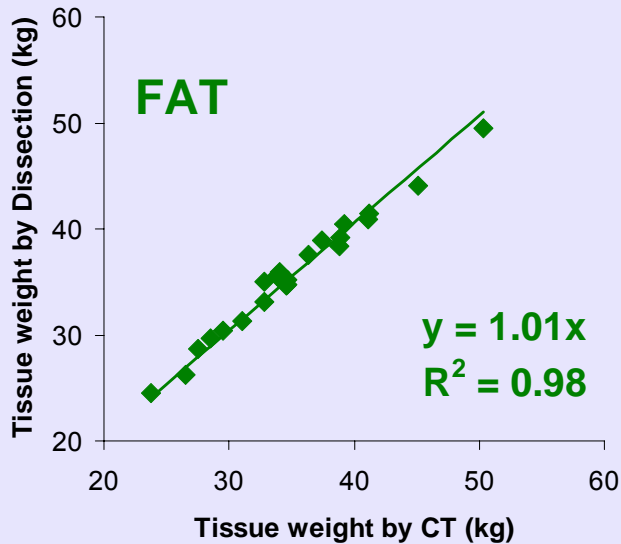
# Results – Tissue weights of primal cuts

- Regression analysis
  - »  $y$  = tissue weights of primal cuts by dissection
  - »  $x$  = tissue weights of primal cuts by CT

<b>Tissue</b>	<b>Estimated slope (<math>\pm</math> s.e.)</b>	<b>R<sup>2</sup></b>
<b>Fat</b>	<b>0.987 <math>\pm</math> 0.006</b>	<b>0.90</b>
<b>Muscle</b>	<b>0.990 <math>\pm</math> 0.003</b>	<b>0.99</b>
<b>Bone</b>	<b>0.996 <math>\pm</math> 0.005</b>	<b>0.95</b>

- High R<sup>2</sup> values
- Regression slope close to 1

# Results - Beef carcass composition

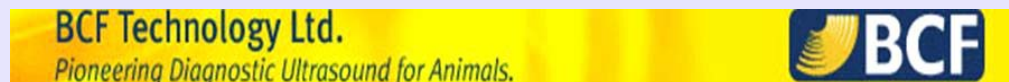


- High  $R^2$  values
- Regression slope of 1 (or close)

- Very accurate measurements of weights of fat, muscle and bone of beef primal cuts and of carcasses
- Validation results are consistent with those already presented.  $R^2$  values were only slightly lower
- Image analysis and data management allow fast processing of a significant number of carcasses
- This technique may reduce costs and time of assessing carcass composition:
  - estimation of genetic parameters
  - breeding programmes (progeny tests for carcass quality)
  - validation/calibration of other techniques to assess carcass quality

# Acknowledgements

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**THANK YOU**