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Using X-ray Computed Tomography to predict intramuscular fat content in terminal sire sheep

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Abstract

Intramuscular fat content is an important factor in producing tender, juicy meat. Sheep breeding programmes are using increasingly accurate tools such as X-ray computed tomography (CT) to select for carcass lean and fat contents in the live animal. Such tools may also be useful to predict other carcass attributes such as intramuscular fat content. Terminal sire lambs of three breeds (Suffolk n=100, Texel n=40, Charollais n=20) were CT scanned, one fifth at each of 14, 18 and 22 weeks and two fifths at 26 weeks of age. CT scanning produced cross-sectional scans at 7 anatomical landmarks [ischium, femur, hip, 5th and 2nd lumbar vertebrae (LV), 6th and 8th thoracic vertebrae (TV)] from which fat, lean and bone areas and densities were determined. After CT scanning, lambs were slaughtered and the *M. longissimus dorsi* dissected out and chemically analysed for fat %. All-subsets regression of intramuscular fat % on CT tissue areas and densities and pre-scan live weight showed that intramuscular fat % can be predicted with moderate accuracy by only two variables from a single anatomical position, 2nd LV fat area and 2nd LV muscle density (R^2=0.566). Including more predictors or a breed effect did not improve prediction accuracy.

Background

- decline in lamb consumption over recent decades

- partly due consumer preference for a leaner meat

- many breeding programmes select against fatness

- intramuscular fat content of meat important (Wood, 1990)
  - tenderness
  - juiciness

- high, positive correlation between total carcass fat and intramuscular fat so may be a need for caution when selecting strongly against fat

Background

- tools in use for predicting other carcass attributes may also be useful to predict intramuscular fat content (e.g. X-ray Computed Tomography (CT) scanning)

- lean tissue density may be a useful predictor of intramuscular fat content

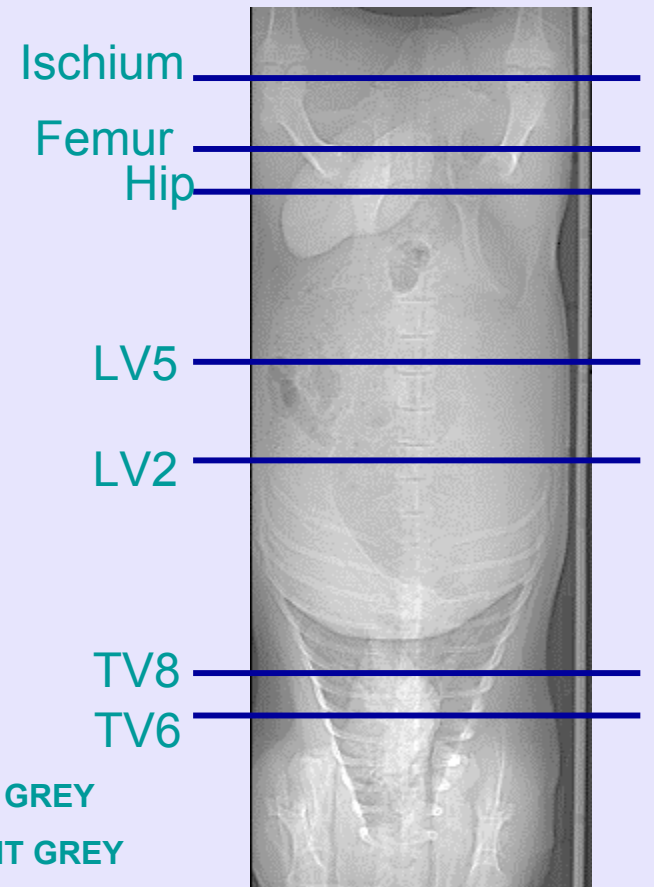- can measure density of tissues using CT scanner

What is CT scanning?
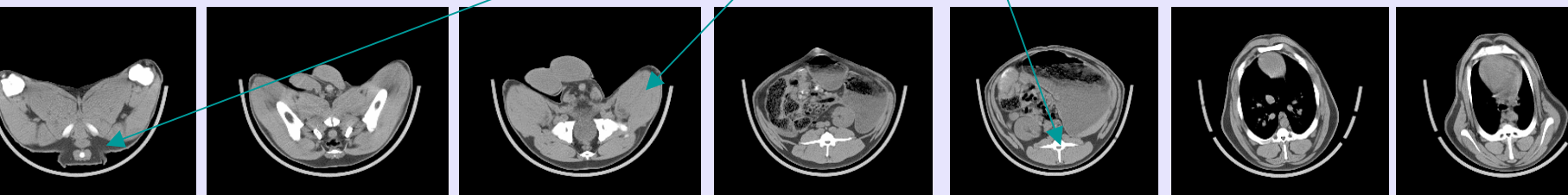
whole body scanning using X-rays

longitudinal topogram taken

grey-scale cross-sectional scans produced

tissue areas and densities measured from scans

Ischium

Femur

Hip

LV5

LV2

TV8

TV6

FAT - DARK GREY

LEAN - LIGHT GREY

BONE - WHITE

Aims

- develop equations for predicting intramuscular fat content from CT scanning information

- assess accuracy of prediction of intramuscular fat content from CT scanning information

- determine whether breed-sex-selection line specific prediction equations are required

Data

- **160 lambs:** 50 Suffolk males, 50 Suffolk females, 40 Texel males, 20 Charollais males

- CT scanned and then slaughtered at either 14, 18, 22 or 26 weeks of age

			Age at slaughter				
Breed	Sex	Line	14	18	22	26	n
Suffolk	F	LTG	5	5	5	10	*25*
Suffolk	F	C	5	5	5	10	*25*
Suffolk	M	LTG	5	5	5	10	*25*
Suffolk	M	C	5	5	5	10	*25*
Texel	M	LTG	4	4	4	8	*20*
Texel	M	HC	4	4	4	8	*20*
Charollais	M	LTG	4	4	4	8	*20*

Suffolk

Texel

Charollais

Data

Each lamb was:

- CT scanned at 7 anatomical landmarks (ischium, 5th & 2nd lumbar vertebrae (LV), 8th & 6th thoracic vertebrae (TV))

- slaughtered and *m. longissimus dorsi* dissected out of left carcass side

- fat content of *m. longissimus dorsi* determined chemically

Methods

- Measurements

  - live weight and lean and fat tissue areas and densities from CT scans at 7 anatomical landmarks

  - chemically determined intramuscular fat content of *m. longissimus dorsi*

- Analysis

  - best sub-sets regression procedures to determine best set of predictors

  - regression to identify whether breed-sex-selection line effects were important and develop prediction equations

- only two variables needed, both from single scan site

    – fat area at 2nd lumbar vertebra in mm^2(LV2FA)

    – lean tissue density at 2nd lumbar vertebra in Hu (LV2LD)

- moderately accurate prediction of intramuscular fat % ($R^2 = 0.566$; r.s.d. = 0.608)

- inclusion of group effects, live weight or other predictors did not improve prediction accuracy

intramus. fat % = a + b LV2FA - c LV2LD

a = 13.60 (s.e. 5.52)

b = 0.000173 (s.e. 0.0000168)

c = 0.0757 (s.e. 0.0366)

Conclusions

- possible to predict intramuscular fat content with moderate accuracy using CT scanning

- require information from only 1 CT scan

- effects of breed, sex and genetic selection line not important in prediction so equation could be used generally across terminal sire sheep

- maybe possible to include measurement in selection programmes in future

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