

Changes in, and relationships among, lamb growth and carcass traits measured by CT

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Abstract

Male and female Texel (Tex, n=130) and Scottish Blackface (SBF, n=103) lambs were CT scanned four times between 8 weeks of age and slaughter (live-weights ~13-47kg). CT traits studied included: total weights and proportions of fat, muscle and bone (predicted from CT reference scans in the leg, loin and chest); tissue distribution (areas of fat and muscle in each reference scan as a proportion of total area in the three scans); muscle shape in the hind-leg and loin (depth:width ratio); eye muscle area; tissue densities. After adjusting traits for fixed effects and sire (random), relationships among CT traits and between CT traits and live-weight were investigated within breed, to assess changes with growth. Increased live-weight (per 10kg when numbers given) was associated with (i) increases in: total fat proportion (Tex=28%, SBF=25%), fat:muscle ratio, muscle:bone ratio, proportion of fat in the chest region (Tex=4%, SBF=9%) and bone density (Tex =5%, SBF=7%), in both breeds, as well as proportion of muscle in the loin (3%), and leg-muscle shape (5%) in Tex lambs; (ii) decreases in: proportion of fat in the leg in both breeds (Tex=-2%, SBF=-9%), and leg-muscle shape (-6%) and fat density (-3%) in SBF lambs. Similar trends between CT traits and total fat proportion suggest that associations hold for increasing maturity, as well as size.

Introduction

- Value of lamb depends on amount and distribution of fat, muscle and bone in the carcass
- Carcass composition / conformation during growth mainly studied in terminal sire breeds in the past
- Different breeds likely to differ in growth and carcass characteristics
- New possibilities for studying changes during growth using Computer tomography (CT) scanning

Aims

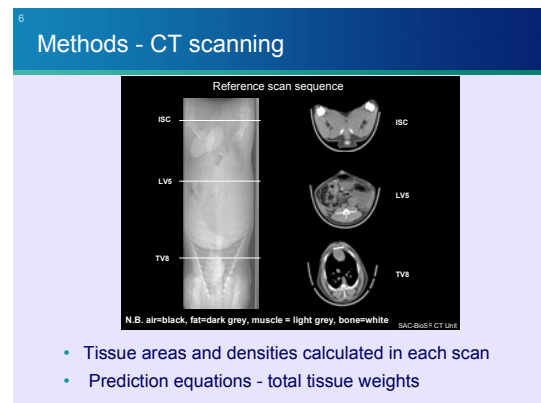
The aims of this study were to investigate:

- changes in lamb carcass traits, measured using *in vivo* CT scanning, over growth period
- relationships among carcass traits in two contrasting breeds (terminal sire vs. hill breed)

Methods

Animals

- Scottish Blackface (n=103) and Texel (n=130) lambs
- female and entire male
- grazed on lowland paddocks in mixed-breed groups from birth to slaughter
- Finished for slaughter in 5 batches over 12 weeks (mixed breed and sex)
- First slaughter batch after weaning



- Lambs CT scanned four times during growth:
 - 8 weeks old
 - 11 weeks old
 - 16 weeks old (weaning)
 - pre-slaughter
- Live weight range across scanning events:
 - Scottish Blackface (SBF) 13-44kg
 - Texel (Tex) 13-47kg

Traits measured:

Carcass composition

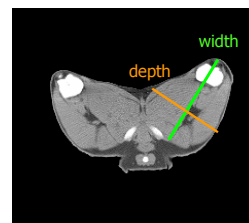
- predicted fat weight (F_{WT}) and proportion (F_P)
- predicted muscle weight (M_{WT}) and proportion (M_P)
- predicted bone weight (B_{WT}) and proportion (B_P)

Tissue distribution

- proportion of fat in each reference scan* (F_{PISC} , F_{PLV5} , F_{PTV8})
 - proportion of muscle in each ref. Scan* (M_{PISC} , M_{PLV5} , M_{PTV8})
 - proportion of bone in each ref. Scan* (B_{PISC} , B_{PLV5} , B_{PTV8})
- (*area in scan as proportion of total area in 3 scans)

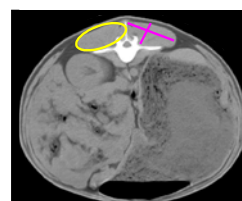
Muscle shape (2-dimensional)

- hind-leg shape (HLS)
(leg muscle depth:width)
- loin muscle shape (LMS)
(eye muscle depth:width)
- loin muscle area (LMA)



Tissue densities

- average fat density (F_D)
- average muscle density (M_D)
- average bone density (B_D)



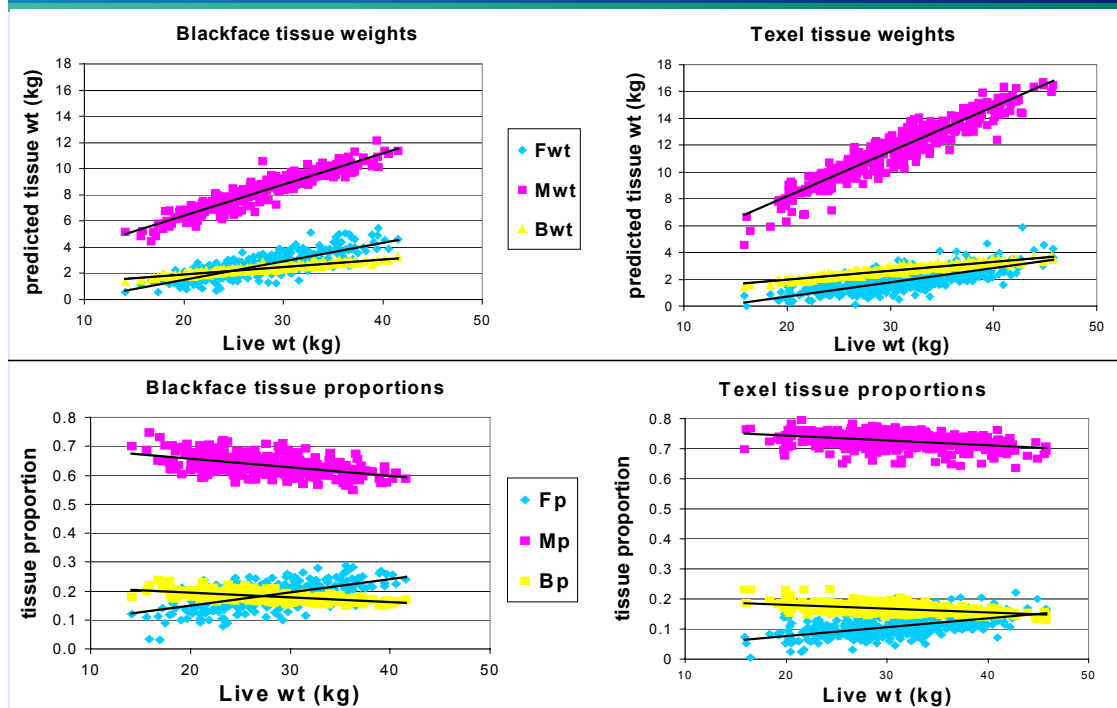
Statistical analysis:

- REML analyses (Genstat) performed within breed
- Model fitted for each trait:
 - sex, rearing rank, sex.rearing rank, dam age (fixed)
 - sire (random)
- Live weight adjusted for same factors (SBF: reduced model of sex + rearing rank)
- CT trait residuals regressed on live weight residuals
- Correlations estimated between all residuals

Results

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Results - carcass composition

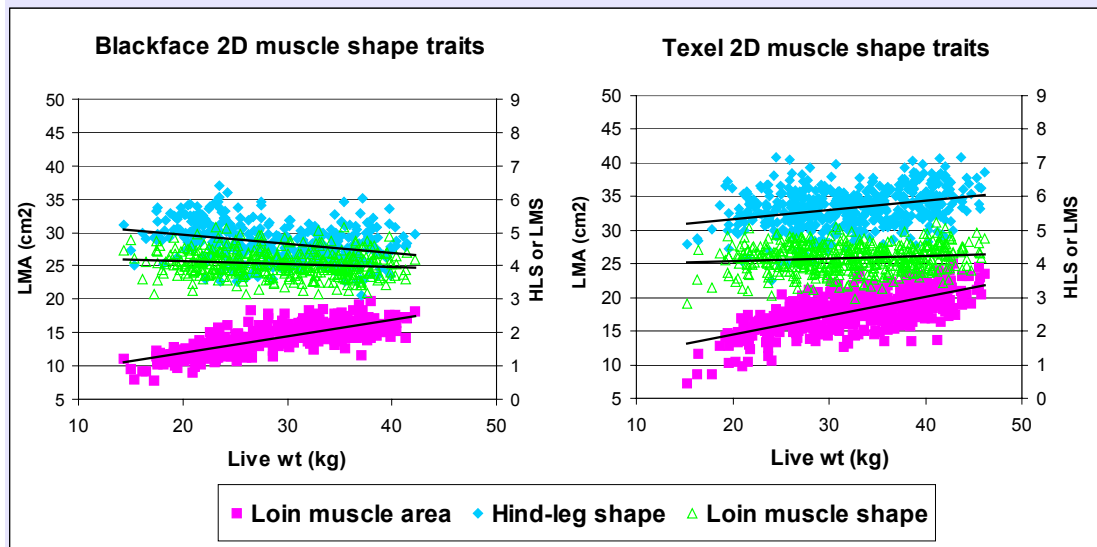


Average percentage changes in CT traits expected following a 10kg increase in live weight

Trait	Tex	SBF	Trait	Tex	SBF	Trait	Tex	SBF
F _{WT}	+58	+54	F _P ISC	-2	-9	HLS	+5	-6
M _{WT}	+28	+29	F _P LV5	-3	ns	LMS	+2	-2
B _{WT}	+25	+25	F _P TV8	+4	+9	LMA	+16	+18
F _P	+28	+25	M _P ISC	-1	-0.7	F _D	-1	-3
M _P	-2	-5	M _P LV5	+3	ns	M _D	ns	-0.7
B _P	-7	-9	M _P TV8	ns	+1	B _D	+5	+7

ns = not significantly different from zero ($P > 0.05$)

Results - 2D muscle shape



N.B. Higher values for hind-leg shape and loin muscle shape denote 'rounder' muscles

Findings

- Similar relationships between CT traits and fat proportion (degree of maturity) as live weight (size)
- Carcass composition changed at different rates in each breed (not explained fully by mature size)
- Little difference in fat and muscle distribution with growth (stronger relationships with fat %: $F_{PISC} \downarrow$; $M_{PLV5} \uparrow$ Tex / $\downarrow$ SBF)
- 'Roundness' of leg and loin muscles with growth: increased in Texels; decreased in Blackface lambs
- Increase in bone density, decrease in fat and muscle densities (stronger relationships with fat %) with growth
- Implications for target slaughter weights
 - slaughter SBF lighter: not over-fat, higher M_P , rounder muscles
 - slaughter Tex heavier: less likely to become over-fat, more muscle in loin region, rounder muscle cross-sections

Future research

- Use 3D spiral CT scanning to investigate tissue distribution in more detail
- Investigate genetic relationships between growth and carcass traits in different breeds
- Investigate relationships between growth RATE and carcass traits in different breeds