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Evaluation of ultrasound scanning to predict carcass composition of Austrian meat sheep

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ABSTRACT

Aims of the study were to evaluate the routine ultrasound scanning plus subjective muscle scoring system for meat sheep in Austria in terms of (1) their ability to predict carcass quality and composition, (2) the repeatability of ultrasound scanning and (3) a comparison of three anatomical scanning sites. Lambs of six breeds ($n = 189$; mean bodyweight 39 kg) were scored for the muscling of their shoulder, back and hindquarter and were scanned with an ultrasound device for back fat and *longissimus dorsi* muscle depth lateral of the spine at 10th/11th (US1) and 13th (US2) thoracic vertebrae as well as at 3rd/4th (US3) lumbar vertebrae. Each ultrasound picture was taken twice within a few minutes to check on within operator repeatability. After slaughter the carcasses were classified according to the EUROP system and back fat and muscle depth were measured on a carcass cross section, and 36 carcasses were dissected to lean meat, fat and bone to evaluate carcass composition. Relationships between carcass and dissection traits and routine performance testing traits (live weight, fat and muscle depth at US3) were evaluated based on partial regression coefficients additionally considering breed, sex (carcass traits only) and birth type as fixed effects. Further, fat and muscle depth at scan sites US1 and US2 were fitted alternatively and Pearson's correlation coefficients were calculated. Correlations between ultrasonic and carcass measures ranged from $r = 0.60$ (muscle depth at US1 and EUROP conformation class) to $r = 0.84$ (muscle depth at US1 and muscle depth at carcass). Repeatabilities for muscle and backfat thickness ranged from 0.90 to 0.95. The results support the usefulness of the currently routine ultrasound scans as relatively easy method to predict carcass composition in live lambs of different breeds. Muscle scans are valuable to estimate amount of carcass lean and EUROP conformation class, but fat scans have greater power to predict the fattiness of the carcass as well as lean percentage. Subjective muscle scoring of live animals seems to be mainly influenced by the fattiness of the animal. The comparison of three anatomical scanning sites did not give definite results. US1 seems to be favourable for estimating muscle depth, for the prediction of lean and in terms of repeatability whereas US2 and US3 had small advantages in scanning fat depth and in the prediction of EUROP classification and carcass fat.

1. Introduction

Producing lamb meat is the main economic activity in Austrian sheep farming. Consumer demand for lean meat has made selection for leaner animals necessary. Since the

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Table 1
Number of animals per breed and sex.

Breed	Male	Female	Total
Merinoland	20	20	40
Bergschaf	20	20	40
Suffolk	13	19	32
Jura	16	15	31
Texel	15	15	30
Schwarzköpfiges Fleischschaf	15	1	16
Total	99	90	189

year 2000, ultrasound scanning has been routinely used for performance testing of sheep of meat focused breeds in Austria. Herd book animals both male and female are obligatorily scanned for back fat and *longissiumus dorsi* depth and additionally get subjective scores for the muscularity of their shoulder, back and hindquarter. Even though methods to predict carcass quality of lambs were already examined (Delfa et al., 1995, 1996; Hopkins et al., 2008; Leeds et al., 2008; Stanford et al., 1998, 2001), most other studies analysed quite homogeneous animal groups, of the same breed and from the same feeding background, often of similar age and weight. Aim of the present study was to analyse the particular situation of routine performance testing of meat sheep in Austria, where quite heterogeneous animals of different breeds from different farms are examined with the same methods. The study is not intended to compare different breeds or animals, but rather to evaluate the methods under routine conditions. Additionally, the literature is not concordant about the optimal anatomical position for scanning lambs (Ripoll et al., 2009; Theriault et al., 2009). In detail, the aims of this study were to evaluate

(1) how accurate the current ultrasound scanning and scoring systems predict the carcass composition of lambs taking further effects like breed and sex into account,
(2) the repeatability of ultrasound scanning as test-retest reliability and
(3) if three different scan sites vary in prediction of carcass composition and or repeatability.

2. Materials and methods

2.1. Animals

In total 189 slaughter lambs were bought from 34 different Austrian farms and transported to the Agricultural Research and Education Centre Raumberg-Gumpenstein in Styria, Austria. They were pure bred animals of the six main breeds for lamb production in Austria: Merinoland, Tiroler Bergschaf (Tyrolean Mountain Sheep), Suffolk, Jura, Texel and Schwarzköpfiges Fleischschaf (Blackheaded Meatsheep). Sexes were almost equally distributed, except for Schwarzköpfiges Fleischschaf, where 15 males, but only one suitable female lamb was available for the trial. Table 1 shows the number of animals per breed and sex.

The lambs were on average 4 months old (min 81 days, max 263 days) and represented the normal slaughter weight in Austria of about 39 kg (Table 2).

2.2. Measures on live animals including ultrasound

The live animals were weighed (without prior restriction of feed and water) and given subjective scores (1 = worst to 9 = best) for muscling of shoulder, back and hindquarter. Subsequently back fat and *longissimus dorsi* muscle thickness were scanned with an ultrasound device (Mindray DP-6900 Vet, 5 mHz). Ultrasound pictures were taken laterally of the spine (right side) on three different anatomical sites: (1) in the area of 10th/11th thoracic vertebrae (= US1); (2) around 13th thoracic vertebrae (last rib) (= US2); and (3) at 3rd/4th lumbar vertebrae (= US3). US3 is the site used routinely for performance testing for meat sheep in Austria. Fig. 1 is an example of an ultrasound picture at site 2.

Table 2
Descriptive statistics (mean, standard deviations, minimum and maximum values).

	Mean	SD	Min	Max
Measurements on live animals (*n* = 189)				
Live weight (kg)	38.8	4.7	29.4	51.6
Average daily gain (g/d)	317	76	161	536
Muscling scores (1–9; 9 = best)				
Shoulder	6.2	0.8	5	8
Back	6.3	0.8	5	8
Hindquarter	6.2	0.8	4	9
Ultrasound scanning at three anatomical sites[a] (n = 189)				
MusUS1 (mm)	20.5	3.2	12.8	28.4
MusUS2 (mm)	20.4	3.1	12.5	28.7
MusUS3 (mm)	19.5	3.3	12.1	26.0
FatUS1(mm)	5.5	1.0	3.4	10.1
FatUS2 (mm)	6.0	1.2	3.8	10.2
FatUS3 (mm)	6.9	1.7	3.4	12.6
Carcass traits (*n* = 189)				
Cold carcass weight (kg)	18.4	2.6	12.6	26.2
Dressing percent	48.4	0.3	39.5	56.5
EUROP conformation class[b]	3.0	0.8	1	5
EUROP fat class[c]	2.3	0.8	1	4
MusC (mm)	29.2	4.6	18.0	42.3
FatC (mm)	2.9	1.6	0.3	8.5
Dissection of right carcass halves (*n* = 36)				
Lean meat (kg)	5.1	0.8	3.8	6.5
Lean meat %	57.7	4.9	49.3	68.6
Fat (kg)	1.8	0.6	0.8	3.6
Fat %	19.4	4.9	10.8	30.8
Bone (kg)	2.0	0.3	1.5	2.8
Bone %	22.6	2.7	17.8	28.5

[a] US1 measured in the area of 10th/11th thoracic vertebrae; US2 measured around 13th thoracic vertebrae (last rib); US3 measured at 3rd/4th lumbar vertebrae
[b] 5 = E (most muscular), 4 = *U*, 3 = *R*, 2 = O, 1 = *P* (poorly muscled)
[c] 1 = leanest, 5 = fattest

Fig. 1. Ultrasound picture at 13th thoracic vertebra (US2), same animal pictured as in Fig. 2.