ASSESSING CARCASS QUALITY IN LAMBS BY USING 3D X-RAY MEASUREMENTS, A PILOT STUDY

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I. INTRODUCTION

Lamb carcasses in general have a large variation in conformation and fat content and thereby a wide individual variation in usefulness. Moreover, the classification is to a large extent based on subjective assessments. If it was possible to get an instant, accurate and non-destructive estimation of the distribution of muscle, fat, and bone in carcasses, the results could be used as a transparent unbiased quality assessment. Dual energy X-ray absorptiometry (DEXA) has been shown to predict the composition of lamb carcasses with a high precision while operating at the speed typically applied at commercial abattoirs [1]. However, X-ray computed tomography (CT) is still the most accurate technique when it comes to non-destructive carcass assessments [2].

II. MATERIALS AND METHODS

Ten ram lambs where slaughtered and their carcasses were evaluated (Table 1). The carcasses were scanned in a CT instrument of the Siemens Somatron type to produce 3D images with voxels with individual densities. The CT scanner had a tube current ranging from 24 to 360 mA and three fixed voltage values of 80, 110, or 130 kV. During the acquisition, the scanner rotated around the object, capturing a series of X-ray 3D images. The collected X-ray data was processed to generate cross-sectional images of the object. These images provided detailed information about the internal structures. The scanning resolution in the plane was 1 mm × 1 mm. The CT scanner was set to a tube current of 37 mA, a voltage of 110 kV, and an axial spacing of 5 mm. To identify specific regions in an object, a thresholding technique was used. In this study the density (kg/m^3) of the voxels were used for thresholding in-between the segments bone, muscle and fat. The threshold intervals for each segment are presented in Figure 1. Thickness of *Musculus longissimus dorsi* (LD) and subcutaneous fat were measured just after the last rib, using the CT images. Linear correlations in-between carcass parameters were evaluated by calculating the Pearson correlation coefficient (r).

III. RESULTS AND DISCUSSION

Live weight, age at slaughter and carcass characteristics of the lambs are presented in Table 1. Table 2 shows that there was a positive correlation between the thickness of LD estimated with the CT technique and the conformation score of the carcasses manually assessed at the abattoir. Further, the total volume of the muscle voxels in the carcasses was positively correlated to carcass weight as well as with the dressing percentage. The sum of the fat voxels in each carcass was positively correlated with the thickness of subcutaneous fat. In addition, the fat volume obtained from the CT scanning was positively correlated with the visually assessed fat score (Table 2). The results of this pilot study show that the CT technique is a powerful tool for non-destructive assessments of lamb carcasses and results are in line with earlier studies [3, 4].

Table 1. Live weight, age at slaughter of the lambs and their carcass characteristics (n=10)

	LW (kg)	Age (d)	CW (kg)	Dressing (%)	Conf.	Fatness	LD (mm)	SCF (mm)
Mean	54.9	195	22.7	41.4	8.60	7.00	32.2	3.84
StDev	0.66	18.5	8.86	1.44	1.26	0.66	2.48	1.06

LW=live weight; CW=carcass weight; conformation and fatness according to the EUROP-system ranging from 1 to 15; LD=thickness of *M. longissimus dorsi* and SCF=thickness of subcutaneous fat, both measured just behind the last rib.

Segment	Density (kg/m^3)	
	Min	Max
Fat	200	1019
Muscle	1020	1349
Bone	1350	3000

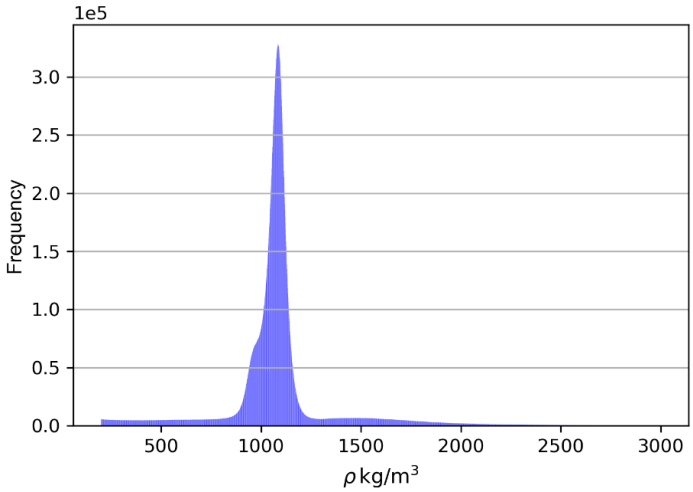

Figure 1. Density segmentations of bone, muscle and fat, and frequency distribution of the density as an average of 10 scanned carcasses.

Table 2. Pairwise Pearson correlations in-between physical carcass characteristics and data acquisitions from the 3D CT scanning

	Conf.	Fatness	CW	Dressing	Bone	Muscle	Fat	LD
Fatness	-0.13							
CW (kg)	0.41	0.19						
Dressing (%)	0.55	0.25	0.95					
Bone (vol)	0.09	-0.46	0.44	0.32				
Muscle (vol)	0.48	0.12	0.79	0.72	0.24			
Fat (Vol)	-0.11	0.32	0.26	0.33	-0.13	-0.32		
LD (mm)	0.65	0.30	0.38	0.49	-0.12	0.55	-0.13	
SCF (mm)	-0.08	0.33	0.02	0.07	-0.25	-0.44	0.81	-0.15

Conformation and fatness according to the EUROP-system ranging from 1 to 15; CW=carcass weight; LD=thickness of *M. longissimus dorsi* and SCF=thickness of subcutaneous fat, both measured just behind the last rib. Numbers with correlations above 0.55 are significantly correlated (P ≤ 0.05).

IV. CONCLUSION

We conclude that the data obtained using the CT scanning of the carcasses showed correlations with the physical characteristics of the manual assessments. Hence, this technique can be used as a tool to objectively assess carcass composition in a transparent unbiased way which is positive for both abattoirs, farmers and consumers.

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