Use Of MRI To Assess Carcass And Primal Cut Composition In Different Pig Breeds

U. Baulain[*], M. Friedrichs[†], R. Höreth[‡], M. Henning[*] and E. Tholen[§]

Introduction

Accurate prediction of carcass composition is a basic requirement in pig breeding programs. In Germany, lean meat content of stationary tested pigs is currently estimated by separate regression equations for sire and dam lines which comprise linear carcass measurements ("Bonn formula", newly developed by Tholen *et al.* (2004)). During the last 15 years the precision of on-line carcass grading systems as AutoFOM has been improved significantly. Along with the lean meat content of the carcass, these systems are able to determine tissue composition of primals automatically with high precision. To evaluate and establish new grading techniques also for use in performance testing a reference method is needed. Magnetic Resonance Imaging (MRI) is a non invasive technique known as very accurate to estimate body composition in pig, sheep and poultry in vivo (Baulain 1997; Mitchell *et al.* 2001) as well as post mortem (Collewet *et al.* 2005; Monziols *et al.* 2006).

Material and methods

Experimental design. A total of 202 pigs originating from stationary sibling and progeny performance testing were taken to evaluate the suitability of MRI for determination of carcass composition. Along with two commercial crossbred lines (Pi×Westhybrid) and db.65×db.classic), the study comprised purebreds of the sire line Piétrain (Pi) and of two dam lines, German Yorkshire (LW) and German Landrace (LR). The fattening period started at 35 kg and ended between 75 and 115 kg. Carcasses were stratified in four different weight classes. Table 1 shows the distribution of pigs in weight classes and sex. All pigs were slaughtered at a commercial abattoir of the Westfleisch-Company in Hamm-Uentrop. Performance testing was conducted according to the rules of stationary tests in Germany. 24 hours after on-line grading, linear fat measurements were taken. Lean content of the entire carcass was estimated by the "Bonn formula" as mentioned above. After transportation to the Institute of Farm Animal Genetics in Mariensee, the left carcass sides were scanned by Magnetic Resonance Imaging (MRI). On basis of the MR images muscle and fat volumes of the whole carcass and of virtual cuts (T1-T5) as presented in figure 1 were determined. The cross sectional images were allocated to the five specified cuts during image analysis, which was performed by means of the Analyze 4.0 visualization software. A full dissection of the left carcass side according to the EU-method (Scheper and Scholz 1985; Walstra and Merkus

[*]Institute of Farm Animal Genetics (FLI), Höltystraße 10, 31535 Neustadt/Mariensee, Germany
†Genossenschaft zur Förderung der Schweinehaltung eG (GFS), Zum Pöpping 29, 59387 Ascheberg, Germany
‡Department of Safety and Quality of Meat (MRI), E.-C.-Baumann-Straße 20, 95326 Kulmbach, Germany
[§]Institute of Animal Science, University of Bonn, Endenicher Allee 15, 53115 Bonn, Germany

1995) served as reference.

Statistical analysis. Muscle weights of carcass sides and primal cuts were estimated by regression equations within breeds using muscle and fat volumes measured by means of MRI as regressors. Coefficient of determination (R^2), root mean square error (RMSE) and the relative estimation error (coefficient of variation; CV = RMSE/mean) were used to evaluate the different regression models. Modelling was accomplished by a stepwise regression procedure of the SAS 9.1 statistical analysis software.

Table 1: Distribution of slaughtered pigs in breed, sex and weight groups

Weight group	Piétrain		LW/LR		Pi×Westhybrid		db.65×db.classic	
	barrows	gilts	barrows	gilts	barrows	gilts	barrows	gilts
75-85 kg	-	10	-	-	10	10	9	9
85-95 kg	-	9	20	-	9	9	10	9
95-105 kg	-	-	16	-	9	9	9	9
105-115 kg	-	-	-	-	9	9	9	9
Total	-	19	36	-	37	37	37	36

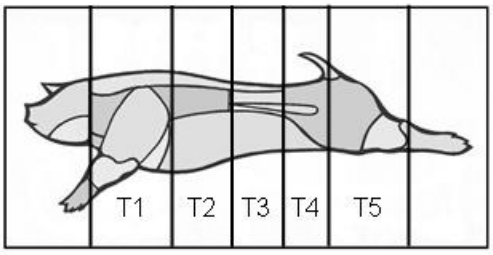

Figure 1: Virtual cuts T1 - T5 defined from cross sectional MR images

Results and discussion

Accuracies of the different regression equations are shown in figure 2. It is obvious that the best estimation is possible by a combination of all virtual cuts (T1-T5). This fit, using muscle and fat volumes from the different body regions, is superior to a fit based on the total tissue volumes only (Total). The virtual cut T5, representing the ham, shows the highest estimation errors in all breeds. For the extremly lean sire line Piétrain one exclusive scan of region T1 (shoulder) would be sufficient to estimate the muscle content of the entire carcass. Parameters of accuracy of the best fitting models are summarized in table 2. For all breeds R^2 is greater than 0.95. The coefficients of variation range from 1.6 to 2.3 %.

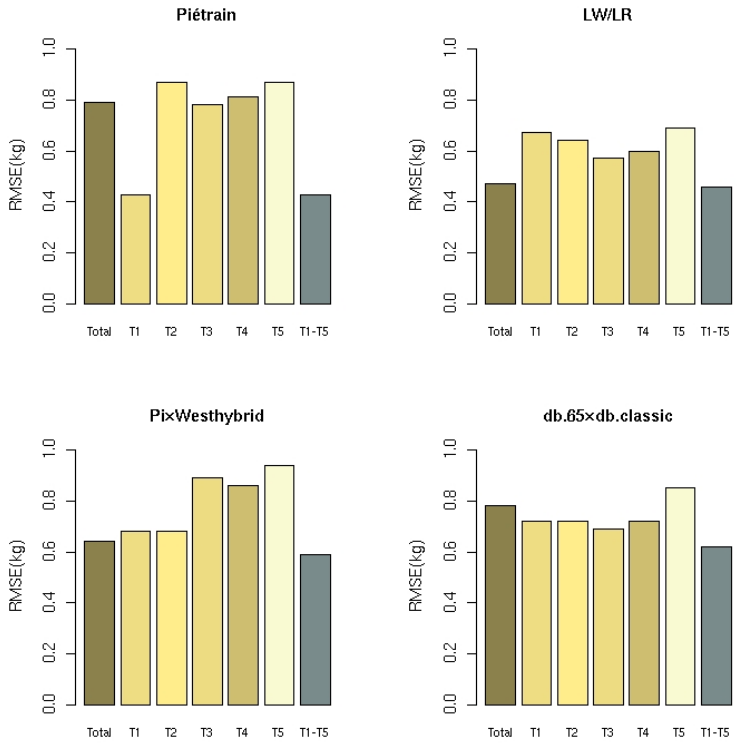

Figure 2: Accuracy of muscle weight estimation (CV) by breed and virtual cut (T1-T5)

Table 2: Accuracy of muscle weight estimation by breed (best fit)

	Piétrain	LW/LR	Pi*Westhybrid	db.65*db.classic
R^2	0.97	0.96	0.97	0.97
RMSE (kg)	0.43	0.46	0.59	0.62
CV (%)	1.63	1.97	2.22	2.33

Muscle weights of the primals shoulder, loin, belly and ham were estimated with a lower precision compared to the entire carcass, although all available MRI information (T1-T5) was used in the stepwise regression analysis. Figure 3 shows a comparison of the cuts based on the coefficient of variation. A reliable estimation was possible for the ham only (CV < 2.5%). In particular, the assessment of belly muscle content was not sufficient. In a previous study it was shown that muscle content of bellies scanned separately could be estimated with a higher precision (Baulain *et al.* 1998).

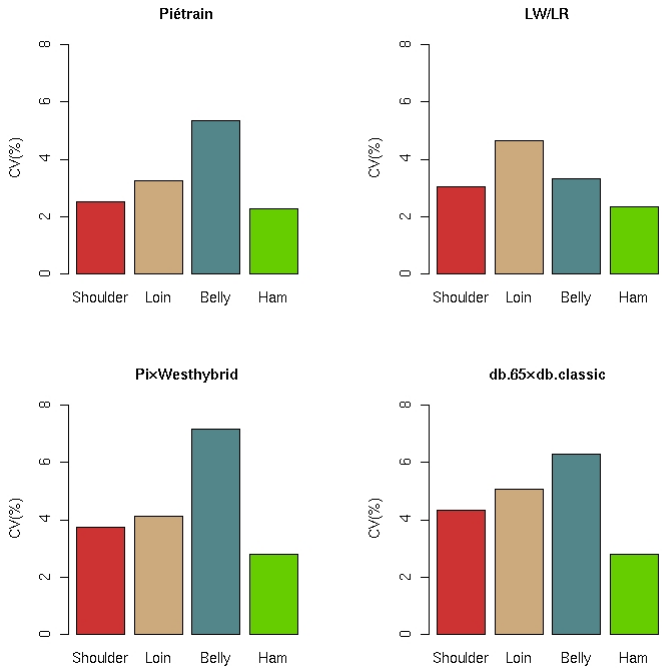

Figure 3: Accuracy of muscle weight estimation (CV) in primal cuts by breed

Conclusion

MRI is suitable as a reference technique to estimate carcass composition of pig breeds with a different lean content. It can be applied instead of full dissection, when i. e. new measuring techniques or measuring sites have to be evaluated for their benefit in performance testing. To assess tissue composition of primal cuts with higher (sufficient) accuracy, a better adjustment of the MRI virtual cuts to the EU reference dissection scheme is needed.

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