WHAT KIND OF PREDICTORS FOR CALIBRATING THE PIG CLASSIFICATION METHODS

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Background

Pig classification is regulated in the European Union by a common scheme. This scheme for grading by using objective measurements to estimate lean proportion was introduced in 1984 (EC Regulation N°3220/84). A new definition of the lean meat proportion, based on the dissection of the 4 main joints, was adopted in 1994 (EC Regulation N°3127/94). As a consequence all Member States would realize a new dissection trial and assess new grading methods.

As dissection trials are expensive the countries have looked for means to reduce costs. Two Member States, France and Germany, are using the most efficient way, consisting in a calibration procedure introducing an intermediate national reference method. The german reference has failed in particular because of lack of accuracy when testing new technology like Autofom (Branscheid et al., 1997). The french reference method (Daumas and Dhorne, 1997) is more accurate (RMSE = 1.67) than the german one and than all the classification devices used today in the slaughterhouses in the world. Furthermore, the french reference method is also more sophisticated allowing specific predictors for each classification method (Causeur and Dhorne, 2000). But it is expected in the future a slight improvement in the accuracy of the classification methods and principally a change in the nature of the measurements.

This make necessary an improvement of the accuracy of the french reference method and an enlargement of the nature of the variables participating to this reference. To estimate this accuracy dissection is needed. The last french dissection trial contained interesting data to investigate the accuracy of various predictors.

Objectives

The general aim is to build a new reference method, more accurate than the present one but not too costly, for calibrating the pig classification methods in France. The specific aim of this contribution is to study the gain in accuracy for predicting the lean meat proportion when including linear measurements, joints weights and tissue weights.

Methods

A very large dissection trial was performed in France in 1996. A sample of 582 carcasses was selected in 5 slaughterhouses according the regional production. Sex (females and castrated males) and genotype (4 groups) were crossed in a 2 dimensional factorial plan, respecting the proportions as in the population.

On both warm carcasses and cold carcasses (after chilling overnight) the following depths were measured :

- at the splitline : the minimal fat depth over the muscle gluteus medius (Fsplit) and the minimal muscle depth between gluteus medius and spinal canal (Msplit) ;
- at 8 cm off the midline, between 3rd/4th last lumbar vertebra, the fat depth (F34LV) ;
- at 6 cm off the midline, between 2nd/3rd last ribs, the fat depth (F23LR) and the muscle depth (M23LR) ;
- at 6 cm off the midline, between 3rd/4th last ribs, the fat depth (F34LR) and the muscle depth (M34LR).

The measurements at the splitline and the cold measurements were taken with a caliper, the last ones after transversal cross-sections of the loin. The warm lateral depths were measured with an experimental invasive probe, equipped with the same needle as the commercial device CGM.

After chilling overnight and measurements on cold carcasses, the left sides were cutted according the 1995 normalized european cutting and the 4 main joints (ham, loin, shoulder and belly) were fully dissected into muscles (including fascia and tendons), subcutaneous fat (including rind), intermuscular fat and bones (Walstra and Merkus, 1996). All the joints and the tissues of each dissected joint were weighted. The lean meat proportion was calculated according EC Regulation n° 3127/94.

The right sides from a subsample were cutted according a national normalized procedure, called DHN (Métayer and Daumas, 1998). This subsample of 320 carcasses was also representative of the french pig population for both sex and genotype. This cutting was normalized from the most current industrial primal cutting. Anatomically it corresponds to a partial dissection, because of the removing of the backfat from the loin. The other joints are ham, shoulder, belly, feet and head. All the joints were weighted.

In order to compare the accuracy of all the potential predictors for predicting the lean meat proportion, regressions were performed on the subsample which was the largest common sample. After removing missing data the final subsample size was of 272 carcasses.

Results and discussion :

On the full sample the average dissected lean meat proportion was 59.5. The proportions of tissues weights in the 4 main joints are reported in table 1. The proportion of muscles was 72.8 % in the ham, 67.7 % in the shoulder, 61.8 % in the belly and 59.9 % in the loin (with backfat).

The accuracy of lean meat proportion (RSD and adjusted R^2) is reported in table 2 for warm and cold measurements. Accuracy is always better for cold measurements, reducing the RSD of 0.3 with 1 predictor and with 0.2 for 7 predictors. In both cases, the best predictor was fat depth at the ¾ last ribs (F34LR). Then muscle depth at the ¾ last ribs (M34LR) is introduced followed by fat depth at the splitline (Fsplit). The 4th predictor was the muscle depth at the 2/3 last ribs (M23LR) on cold carcasses while it was the fat depth at the ¾ lumbar vertebrae (F34LV) on warm carcasses. Adding one or two predictors only decreased slighty the RSD. The model with 7 predictors, including 4 fat depths and 3 muscle depths, explained 73% of the variance and had a RSD of 1.79. Realizing a good compromise between accuracy, cost and feasability, this model has been chosen in France as national reference method for the calibration of its classification methods (Daumas et al., 1998).

The accuracy of lean meat proportion (RSD and adjusted R^2) is presented in table 3 for joints weights from the national cutting (DHN). The 1st predictor was backfat, which explained 62% of the variance and achieved a RSD of 2.14. Following predictors were respectively ham, loin, shoulder and belly. These 5 joints explained 80% of the variance and achieved a RSD of 1.56. Compared with the model with 7 cold linear measurements the RSD was decreased by 0.23 points.
The accuracy of lean meat proportion (RSD and adjusted R^2) is presented in table 4 for tissues proportions. The 1st predictor was subcutaneous fat, which explained 82% of the variance and had a RSD of 1.46 ; it means 0.1 point RSD less than this of the model with the 5 joints weights. The 2nd predictor was the weight of the 4 main joints, which decreased the RSD to 0.90. Finally the weight of intermuscular fat or bones explained 96% of the variance for a RSD respectively of 0.68 and 0.66.

Conclusions :

Achieving a RSD less than 1 when predicting the lean meat proportion of pig carcasses has needed to cut the carcasses into joints, to weight them and to remove the subcutaneous fat from the 4 main joints. Removing the intramuscular fat or deboning is too long and too costly compared with the poor benefit in accuracy.
Removing only the subcutaneous fat from the loin has resulted in a noticeable loss of accuracy (increased RSD to 1.56). Using only the weight of the backfat increased the RSD to 2.14, value close to those (2.28) obtained by the cold fat depth at the ¾ last ribs. It cab be therefore concluded that measuring several fat depths on the back would be insufficient to achieve an accurate prediction of lean meat proportion. Adding muscle depths should be also insufficient.
Informations about subcutaneous fat of the 4 main joints (loin, ham, shoulder and belly) are essential for hoping a RSD close to 1. Additional informations about the internal layers of the belly should lead to a high accuracy. Further investigations are needed to elaborate a more accurate reference method for the calibration of the classification methods. The Magnetic Resonance Imaging (MRI) could be a powerful technique for this kind of investigations. The dissection trials including MRI, planned in the european project EUPIGCLASS (www.eupigclass.org) about standardisation of the pig classification methods, would deliver some useful answers.

Pertinent literature :

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Table 1 : Proportions of tissues weights in the 4 main joints (european cutting)

in %	Muscles (including fascia and tendons)	Subcutaneous fat with rind	Intermuscular fat	Bones
Ham	72.8	16.6	2.9	7.7
Loin	59.9	25.6	4.0	10.5
Shoulder	67.7	16.4	7.1	8.9
Belly	61.8	19.1	12.5	6.6

Table 2 : Accuracy of prediction of lean meat proportion from warm and cold linear measurements

Predictors (warm predictor)	RSD		Adjusted R^2	
	Warm	Cold	Warm	Cold
F34LR	2.59	2.28	0.44	0.57
F34LR + M34LR	2.28	1.93	0.56	0.69
F34LR + M34LR + Fsplit	2.13	1.84	0.62	0.72
F34LR + M34LR + Fsplit + M23LR (or F34LV)	2.08	1.81	0.64	0.73
F34LR + M34LR + Fsplit + M23LR (or F34LV)+ Msplit	2.02	1.80	0.66	0.73
F34LR + M34LR + Fsplit + M23LR + Msplit + F34LV	1.97	1.79	0.67	0.73
F34LR + M34LR + Fsplit + M23LR + Msplit + F34LV + F23LR	1.97	1.79	0.67	0.73

Table 3 : Accuracy of prediction of lean meat proportion from joints weights (DHN)

Predictors	RSD	Adj. R^2
Backfat	2.14	0.62
Backfat + Ham	1.86	0.71
Backfat + Ham + Loin	1.71	0.75
Backfat + Ham + Loin + Shoulder	1.62	0.78
Backfat + Ham + Loin + Shoulder + Belly	1.56	0.80

Table 4 : Accuracy of prediction of lean meat proportion from tissues proportions

Predictors	RSD	Adj. R^2
Subcutaneous fat	1.46	0.82
Subcutaneous fat + Joints	0.90	0.93
Subcutaneous fat + Joints + Intermuscular fat	0.68	0.96
Subcutaneous fat + Joints + Bones	0.66	0.96