VISION METHOD TESTED TO PREDICT THE LEAN MEAT PERCENTAGE OF A PIG CARCASS IN RELATION TO THE REFERENCE DISSECTION METHOD.

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Background

The calibration and monitoring of pig carcass grading instruments involves the dissection of at least 120 half carcasses. This is costly and time consuming and requires highly skilled labour to achieve consistent results. The purpose of the Workpackage 3 of the European Eupigclass project was to test indirect methods of measuring the lean meat percentage of a carcass that, compared to dissection, will be less costly, at least as accurate and more consistent. The vision method was one of three indirect methods tested and the X-Ray CT and NMRI techniques are the other methods.

Objectives

The vision technology has be examined in this project in order to make firm conclusions about its accuracy relative to the dissection method. *Cemagref* partner has developed a vision system that can estimate the lean meat percentage of carcass from images of cut faces. The approach was to adapt this using vision technology method to take images of a larger number of cut faces in order to find a combination of images that can accurately predict the lean meat percentage in the whole carcass.

Methods

Carcass Sampling

A total of 120 half carcasses was assessed in two equal batches. All the carcasses were sourced in Hungary from two pure lines (Pietrain and Large White) and two hybrid lines (Seghers and Dalland), according to the plan shown in the table 1. Overall, there were equal numbers of gilts and castrates. Within each group the carcasses were selected in three fat groups, thick, medium and thin fat depth, in the proportion 40%: 20%: 40%. The thin and thick fat groups were defined within each group (breed type) in relation to their backfat depth measured on the live animal by ultrasound.

The pigs were slaughtered at the pilot-scale abattoir at the University of Kaposvar. Carcasses were graded with the normal grading equipment and chilled overnight before imaging or dissection. The left half of each carcass was fully dissected (excluding head and feet) according to the EU method by the team of butchers and the right side was assessed by the indirect methods.

Definition of cuts

After primary cut of three main joints of the right half carcass according to EU reference method (Walstra 1996), 10 cuts were performed in three joints of 120 half carcasses and were studied by a vision system (figure 1):

- 2 cuts in leg : between leg and hind shank and at 5cm from the top of thighbone
- 1 cut between loin and belly,
- 4 cuts in loin : between the first and the second last lumbar vertebra
  between the third and the fourth lumbar vertebra
  between the twelfth and thirteenth first rib
  between the fourth and fifth rib
- 3 cuts in belly : at 4 cm from the last rib
  between the 10th and eleventh first rib
  between the fourth and fifth rib.

Image acquisition system

A color vision system devised in France by the Cemagref was installed and adjusted in the Diagnostic institute of Kaposvar University in Hungary.

This system have got two 3CCD color cameras, a frame grabber in a PC to obtain RGB (Red, Green, Blue) images on 3*8 bits, a uniform and indirect lighting system to avoid specular reflection on meat, a post to hang the half carcass, an inclinable and removable table for the joints, a set of patches and a grey uniform background for color calibration of image. Twelve RGB images of the cuts are grabbed with this system (figure 1). The images were transform in L*a*b* images by a color image calibration.

Image processing

After acquisition and calibration, the images were treated by segmentation methods to distinguish fat, muscle, bone and rind regions. For each color image of cut, a fat region and a muscle region were obtained and their areas were named *Fatn* and *Musclen* where *n (n= 4 to 15)* was the name of the image.

Statistic treatments

Statistic treatments were performed on *Fatn* and *Musclen* features in relation to dissection data to predict lean meat content. Linear regression methods were applied on *Fatn* and *Musclen* variables to predict lean meat percentage of full dissection and European reference dissection . For each model $R^2_{adjusted}$ and the residual standard deviation were calculated.

Results and discussion

On the graph of the figure 2 the residual standard deviation appeared in relation of number of variables of the regression model for the full dissection. When the number of variables increase upper 5 variables the residual standard deviation of the predicted lean meat % decrease under 1.5 to reach 1.3. If the weight of the carcass was introduced in the model the residual standard deviation decrease under 1.3. Differences were found between sex and breed kinds of animals.

By an other way, the lean meat % was measured on the left half carcass by dissection and there are important differences between butchers, particularly in the cutting lines for the various joints in the dissection. This lead to systematic errors in determining the lean meat percentage by the reference method. So vision features gave a good prediction of the lean meat % with regard to the dissection. The results of the vision method were very close to the X-Ray CT and NMRI methods results.

Conclusions

The vision technology was tested as an indirect method of measuring the lean meat percentage of a carcass, compared to dissection. The accuray of this methods are very close by X-Ray CT and NMRI methods accuracy. This method provide good accuracy result and will be less costly than dissection. This method could be improved by a better choice of cuts after a study of most predictive cuts by NMRI or X-Ray CT methods. This technology has the potential to be applied with a good accuracy in regards to dissection and is cheaper and faster than dissection.

Acknowledgement

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References

WALSTRA P., MERKUS G.S.M. 1996. Procedure for assessment of the lean meat percentage as a consequence of the new EU reference dissection method in pig carcass classification. Report ID-DLO 96 014. DLO- Institute for Animal Science and Health éd. Lelystad. The Netherlands. 22 p.

Table 1 Sampling plan for the trial

Fat class	Sex	Seghers	Dalland	Pietrain	Large White	Total
Thick	Gilts	4	4	12	4	24
	Castrates	8	8		8	24
	Total	12	12	12	12	48
Medium	Gilts	2	2	6	2	12
	Castrates	4	4		4	12
	Total	6	6	6	6	24
Thin	Gilts	4	4	12	4	24
	Castrates	8	8		8	24
	Total	12	12	12	12	48
Total	Gilts	10	10	30	10	60
	Castrates	20	20	0	20	60
	Total	30	30	30	30	120

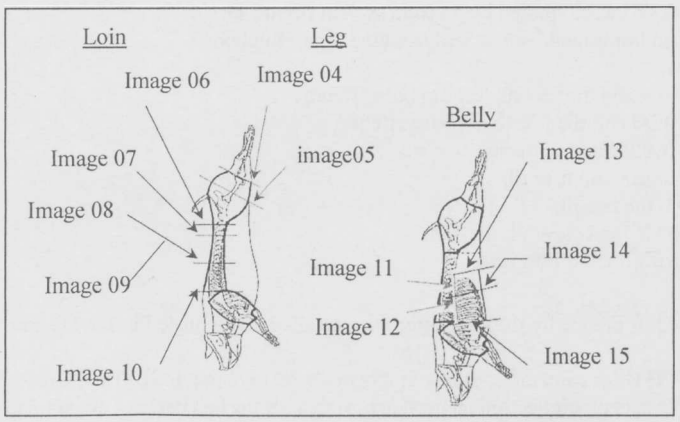

Figure 1 12 RGB images of cuts of half carcass

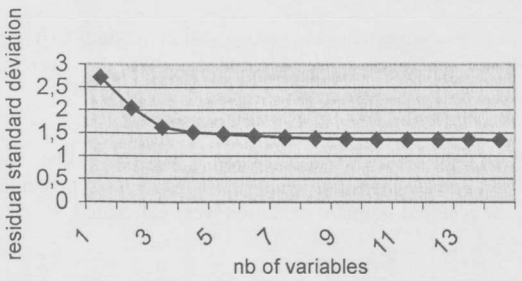

Figure 2 Graph of the residual standard deviation of predicted lean meat % in relation of the number of variables of the regression models for the full dissection