



Video Image Analysis (VIA) for sheep carcasses.

**A summary report on an evaluation of the
use of video image analysis to predict the
classification and meat yield of sheep
carcasses**

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Introduction

Sheep classification is not a legal requirement in the EU, however in the UK, when classified, sheep carcasses are assessed visually for fat and conformation according to the EUROP grid. This then forms the basis of payment from processor to producer.

Video image analysis (VIA) machines can provide a rapid, automatic and objective way of classifying a carcass and thereby help foster greater trust and transparency in the relationship between producer and processor. VIA machines can also be used to predict saleable meat yield from individual carcasses, although the challenge here is predicting the splits between the high value cuts and the lower value cuts rather than just total yield.

VIA technology is already used by the meat industries in a number of countries largely for classification of beef but also for classification of lamb. It is not currently in commercial use in the UK, although some abattoirs have been evaluating the technology for beef.

A study to evaluate the use of VIA to predict classification and meat yield has been jointly funded by the English Beef and Lamb Executive (EBLEX), Hybu Cig Cymru/Meat Promotion Wales (HCC), Quality Meat Scotland (QMS) and the Livestock and Meat Commission of Northern Ireland (LMCNI). The study, managed by the Meat and Livestock Commission (MLC), took place at the Welsh Country Foods plant on Anglesey and used the VSS 2000 video image analysis equipment from E+V Technology GmbH.

This report provides a brief summary of the evaluation project, the results and the conclusions reached.

The full technical report, titled '*An evaluation of the use of video image analysis to predict the classification and meat yield of sheep carcasses*', was published in May 2007 and copies are available online via the websites of EBLEX, HCC, QMS, and LMCNI.

Objectives for the evaluation

1. To ensure compatibility between the current subjective classification system and VIA.
2. To ensure that operational procedures e.g. suspension method, which may impact on industry uptake of VIA technology, are taken into consideration.
3. To develop an accurate generic prediction equation for conformation and fat class.
4. To demonstrate, based on a specific butchery method, the ability of VIA technology to predict meat yield.

How the evaluation was done

The way VIA works, in normal practice, is that the system is integrated into the slaughter line, usually near to the scale area. Suspended carcasses are illuminated and digital video images of each carcass are captured and processed using specialised software to extract data relating to the carcass shape or conformation. The fat level is determined via interpretation of the colour or grey level across the carcass. The image information can also be used to make predictions on carcass yield.

For the evaluation study at the Welsh Country Foods plant, the VIA system was not integrated into the line but was set up on a by pass section of the slaughter line operating at the normal line speed.

Classification

Following the initial installation and setting up of the equipment in the plant, 500 carcasses were classified and imaged to allow the development of the classification prediction equations. Then a further group of 800 carcasses were classified and imaged – data from 200 of these carcasses was used to fine tune the classification prediction equations and the other 600 carcasses were used to validate the classification prediction equations.

A range of standard industry carcass suspension methods giving different leg and shoulder presentations were assessed and carcasses spread right across the EUROP classification grid were evaluated.

A panel of three UK expert classifiers from the Meat and Livestock Commission, Rural Payments Agency and Scottish Executive in addition to the MLC in-plant classifier were used to classify the carcasses.

In order to assess the accuracy of VIA in predicting conformation and fat class, a set of three criteria were used

1. Professional judgement of acceptable accuracy between expert classifiers and VIA using the current 5/7 point scale levels as follows:

Conformation:	80% total agreement of classification awarded
	99% agreement within one class difference
	100% agreement within two classes difference
Fatness:	70% total agreement of classification awarded
	90% agreement within one class difference
	99% agreement within two classes difference
2. VIA to achieve same level of agreement with the expert classifiers as the classifiers achieve with each other.
3. The level of agreement of VIA with the expert classifiers to match the level of agreement between the MLC in-plant classifiers and the expert classifiers.

Evaluations were also considered on a 15-point scale, where each of the main classes has been further divided into three sub-classes.

Meat Yield

To evaluate the ability of VIA to predict meat yield a separate set of 500 carcasses were used. These were selected as evenly as possible across the classification grid and butchered by a team of four butchers according to a standard butchery protocol. Prior to jointing, the accurate cold carcass weight of each carcass was recorded together with all primal (chump, leg, loin, shoulder, and breast) and subsequent butchery weights (trimmed primal cuts, lean trim, fat and bone trim and waste).

Data from 300 of the carcasses were used to develop the prediction equations. Data from the remaining 200 carcasses were retained and used by an independent statistician to validate accuracy.

In addition to the main objectives of the trial, a further piece of analysis was undertaken as part of a PhD project to investigate the potential of VIA technology to predict meat yield in terms of saleable meat yield (SMY), saleable primal meat yield (SPMY) and the carcass components - leg, chump and loin - as compared with MLC scoring. Total SPMY was expressed as the sum of weights of all sub-primal cuts as a proportion of cold carcass weight and SMY was the sum of weights of all sub-primal cuts plus the residual lean tissue of the trimming process as a proportion of cold carcass weight.

Overview of Results

The study delivered on its four objectives:

- The study took account of different operational procedures e.g. suspension methods and dressing specifications, which may impact on industry uptake of VIA technology.
- The study was successful in developing prediction equations for conformation and fat class. In addition to developing an equation for the most common configuration of carcass presentation, the E+V team successfully developed prediction equations for five other carcass configurations to meet the specific requirements of industry.

Agreement between VIA classification and the median classification from the expert classifiers using the current 5/7 point scales for conformation and fatness

Shoulders	Legs	Conformation			Fatness		
		% agreements within class			% agreements within class		
		0	1	2	0	1	2
Banded	Gambrelled	72	100	100	50	93	98
Banded	Crossed	72	100	100	49	93	99
Banded	Together	68	99	100	48	94	99
Unbanded	Gambrelled	72	99	100	55	95	99
Unbanded	Crossed	74	99	100	51	95	99
Unbanded	Together	74	99	100	53	95	99
Target Accuracy		80	99	100	70	90	99

- VIA achieved the percentage targets for accuracy within 1 or 2 class(es) difference for conformation and fatness, but generally it did not meet the accuracy target for total agreement with the expert classifiers. However these accuracy targets were not achieved with respect to total agreement between the expert classifiers nor for total agreement between the MLC in-plant classifiers and the expert classifiers.
- For conformation, VIA did not achieve the same levels of total agreement with the expert classifiers as the classifiers achieved with each other, but VIA met or exceeded the targets for within 1 or 2 class(es) difference. For fatness VIA did not match the levels of agreement between the experts themselves at any of the target levels.
- VIA performed as well as the MLC in-plant classifiers for conformation, but less well with respect to fatness.
- The study demonstrated, based on a specific butchery method, the ability of VIA technology to predict meat yield and the weight of primal cuts. The results showed the importance of several parameters (e.g. carcass weight and gender) but that overall VIA has a better predictive precision of saleable meat yield than current EUROP class/sub class based systems.

The prediction of primal cut weight was more stable than the prediction of primal cut proportion. The adjustment for gender and slaughter date improved both methods of prediction.

The prediction of trimmed primal weights (grams) by VIA

Primal Cut	Mean	SD	RMSE
Leg	4456	810	168
Chump	749	172	53
Loin	2895	608	218
Breast	1517	420	169
Shoulder	5135	1061	260

(SD – a measure of variation)

RMSE – a perfect score of 0.0 would mean there was no error in the prediction.

An RMSE smaller than the SD indicates that there is a good prediction)

The prediction of Saleable Meat Yield (SMY), Saleable Primal Meat Yield (SPMY) and carcass components and its precision using VIA traits or MLC standard classification

Predicted Variables (%)	VIA		MLC classification	
	R ²	Root mean square error RMSE	R ²	Root mean square error RMSE
SMY	0.66	0.013	0.55	0.015
SPMY	0.66	0.012	0.54	0.014
Leg	0.81	0.008	0.62	0.011
Chump	0.59	0.002	0.48	0.002
Loin	0.31	0.008	0.30	0.010

(R² - a perfect score of 1.0 would mean that all the variations in that particular parameter could be explained by the prediction method used.

RMSE – a perfect score of 0.0 would mean there was no error in the prediction).

Conclusions

1. Video image analysis can provide a repeatable, automated objective assessment of sheep carcass conformation and fatness. The evaluation demonstrated that video image analysis was as accurate and more consistent than the expert classifiers at predicting conformation, however it was less accurate and less consistent than the expert classifiers at predicting fatness.
2. Video image analysis offers sheep abattoirs a means of predicting both meat yield and primal weights. The evaluation demonstrated that video image analysis had greater precision in predicting meat yield than current EUROP class/sub class based systems.
3. This trial enables the industry to assess the potential that the equipment offers in these areas of operation.

Further Information

Copies of the full technical report are available at www.eblex.org.uk, www.hccmpw.org.uk, www.qmscotland.co.uk, or www.lmcni.com

Technical and background information on the VSS 2000 video image analysis equipment from E+V Technology GmbH is available from:

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