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PREDICTION OF BEEF CARCASS YIELD USING WHOLE CARCASS VIASCAN®

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VIASCAN® is the registered trade name of the Video Image Analysis systems developed by the Meat Research Corporation, Australia.

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Background

It is generally accepted that an accurate description of beef carcass yield is pivotal in the development of a value-based marketing system. To that end, Video Image Analysis (VIA) offers more promise than other technologies both in terms of accuracy and practicability. In Australia, three VIASCAN® systems have been developed by Systems Intellect for the Meat Research Corporation (MRC) of Australia. The Whole carcass VIASCAN® system (WCVIA) was developed for use on the slaughter-floor. This system, captures and processes digital images of the lateral view of carcass sides to automatically predict saleable carcass yield. The Chiller Assessment and Retail Cuts VIASCAN® systems utilise the same principal to measure quality attributes such as marbling, meat and fat colour and tissue or cut dimensions on chilled quartered sides and sliced retail cuts, respectively. Trials to date (I. Thompson, *unpublished data*) indicate that accurate predictions of saleable carcass yield are achieved using WCVIA. However, further improvements in accuracy have been observed when the measurement data from the Whole Carcass and Chiller Assessment VIASCAN® systems are combined.

The work reported here represents one of a series of validation studies initiated by the MRC. This particular study was undertaken in collaboration with an Australian meat processor (AMH, Limited) to investigate the potential of WCVIA as the central platform for carcass description on the slaughter-floor in their abattoirs. The objective of this study was to quantify the accuracy of WCVIA to predict saleable beef yield across a wide range of carcass types. In addition, the accuracy of WCVIA was compared against the standard carcass measurement combination of side weight and P8 fat depth. This baseline measurement combination are currently used to describe and value carcasses in Australia.

Methods

Groups of carcasses representing four quality market categories were sampled from the daily slaughter in an export abattoir. The categories were grassfed Japanese export, grassfed Korean export, 150-day grainfed Japanese export and 70-day grainfed domestic. WCVIA images of the lateral views of the left and right sides, in addition to the standard slaughter-floor measurements of hot standard side weight (HSSW) and P8 fat depth (P8FD), were collected on approximately 60-80 carcasses specific to each category. Within each category, a sub-sample of approximately 30 carcasses were then selected for saleable yield determinations. These carcasses were selected on the basis of P8FD to cover an evenly distributed range in fatness, and by inference, saleable beef yield (SBY%). SBY% was then determined on one side using an AMH boning team. Cutting lines and trimming procedures were in accordance with commercial specifications where each boneless primal cut was trimmed to a maximum fat coverage of approximately 10 - 12mm. SBY% was defined as the weight of the boneless, trimmed primal cuts, plus manufacturing meat trim and was expressed as a percentage of cold side weight.

Customised software was used to extract WCVIA parameters from the images. These data comprised linear carcass dimensions and descriptions of colour within specific regions over the lateral view of the carcass. The data posed two main problems; firstly there was a large amount of data which necessitated some form of data summarisation and, secondly, many of the dimension and colour parameters were highly correlated and so their use in a regression model would result in multicollinearity. Principal components analysis was used to overcome both these problems, where the carcass dimension and colour data were analysed separately. The first two principal component vectors were selected as predictors in an all possible sub-sets regression analysis. The cumulative variance of the first two vectors for both carcass dimensions and carcass colour at the different regional sites accounted for 0.76 to 0.93 of the total variance associated with the parameters.

For the prediction of SBY%, the best predictive WCVIA principal component models were screened. A second analysis was performed with HSSW and P8FD included as independent variables. These models were then compared with the accuracy provided by the baseline combination of HSSW and P8FD. Accuracy was compared using the adjusted coefficient of determination (Adj. R^2) and standard errors of the estimates (SEE). All models were determined for each market category and over the entire data set (n=129).

Results and Discussion

The within category descriptive statistics for HSSW, P8FD and SBY% are shown in Table 1. Within market category, side weight and P8FD ranged approximately 50 kg and 20 mm, respectively. Although for the heavier Japanese grainfed category, the range was higher, particularly for P8FD (34 mm). The categories listed across Table 1 are shown in increasing order of magnitude with respect to P8FD and to a lessor degree, hot side weight.

Table 1: Within category means, standard deviations and ranges for side weight, P8 fat depth and percent saleable beef yield

Carcass Trait	Grassfed Kor. Export (n=30)	Grainfed Domestic (n=30)	Grassfed Jap. Export (n=30)	Grainfed Jap. Export (n=39)
Side weight (kg) (HSSW)	140.7 ± 10.2 (115.0 -154.5)	122.1 ± 11.8 (100.0 - 141.5)	164.1 ± 11.2 (85.5 - 137.0)	185.8 ± 24.2 (147.5 - 210.0)
P8 fat depth (mm) (P8FD)	12.4 ± 5.0 (3.0 - 22.0)	12.6 ± 4.0 (4.0 - 21.0)	17.7 ± 5.8 (8.0 - 29.0)	24.2 ± 7.7 (6.0 - 40.0)
Saleable Beef Yield % (SBY%)	71.9 ± 1.2 (69.6 - 73.9)	71.5 ± 1.7 (67.7 - 75.1)	71.7 ± 1.9 (67.5 - 74.5)	70.9 ± 1.8 (67.2 - 74.7)

Table 2: Adj. R^2s and SEEs for the prediction of SBY% using combinations of standard carcass measurements and WCVIA dimension and colour principal components

Model	Grassfed Kor. Export		Grainfed Domestic		Grassfed Jap. Export		Grainfed Jap. Export		Overall (n=129)	
	Adj. R^2	*SEE*	*Adj.* R^2	*SEE*	*Adj.* R^2	*SEE*	*Adj.* R^2	*SEE*	*Adj.* R^2	*SEE*
HSSW + P8FD	-0.04	1.20	0.01	1.72	0.16	1.70	0.42	1.38	0.21	1.51
Best 5 parameter WCVIA model	0.31	0.98	0.44	1.29	0.62	1.14	0.30	1.52	0.20	1.53
HSSW + P8FD + (best 5 parameter WCVIA model)	0.25	1.02	0.50	1.22	0.62	1.14	0.50	1.29	0.29	1.44

Table 2 shows the accuracy of using HSSW and P8FD to predict percentage saleable meat yield. In this study, the accuracy of this measurement combination to predict SBY% varied enormously between categories, with the highest accuracy being observed for the very fat grainfed Japanese export carcasses, and the poorest in the leaner grassfed Korean export and domestic grainfed carcasses. The fat depth range and also the inherent difficulties associated with predicting a variable endpoint such as SBY% are possible reasons for the failure of these standard measurement combination. What has also been observed in the past when using commercial boning room teams is that the fat trimmers are less diligent than say a laboratory boning team. With the leaner Korean and domestic categories (4 - 20 mm P8FD) where the specified fat trim was 10-12 mm subcutaneous coverage, it is possible that a large proportion of the sample received little or no fat trim, resulting in a non-linear relationship between fat depth and SBY%. In addition Johnson et al (1991) have shown that despite the efforts of trimmers to standardise the fat trim, the fat content within trimmed primals still ranged between 11 - 24%, with a trend for higher fat content as carcass fatness increased. Another factor implicated in their result was the differences between breeds in fat partitioning between the subcutaneous and intermuscular depots (Kempster et al 1976, Thompson and Barlow 1981). It is virtually impossible to standardise the levels of intermuscular fat without destroying the integrity of the cut. Certainly there was a trend in our results for the accuracy of the HSSW and P8 combination to improve as fatness of the category increased.

In our study, WCVIA accounted for an additional 35 - 46% of the variation in SBY% compared with the standard combination of HSSW and P8FD for both the grassfed export and domestic grainfed categories. An exception to this trend was observed for the 150-day grainfed export carcasses where the combination of HSSW and P8FD accounted for more variance (12% on an adjusted R^2 basis) in SBY% than the best WCVIA model. By virtue of their long finishing period on a grain ration, these cattle were heavy and excessively fat compared to carcasses in the other categories (see Table 1). It is possible that since the WCVIA system uses colour to quantify subcutaneous fat coverage, the relationship between WCVIA colour and fat coverage was less useful in overfat carcasses. This might be overcome by the addition of measurement data, in particular fat coverage over the ribeye, from the Chiller Assessment VIASCAN unit. This approach of combining the measurements from the two VIASCAN systems in order to maximise predictive accuracy is currently recommended by the MRC.

The inclusion of HSSW and P8FD within the best WCVIA models produced equivocal results in terms of improving accuracy. For the two grass finished categories, no improvement was observed, in fact the inclusion of HSSW and P8FD resulted in a decrease in the adjusted R^2. However in both the grainfed categories, there was a substantial improvement in the predictive accuracy by the inclusion of both standard carcass measurements within the best WCVIA models. It is difficult to speculate why this occurred as there was a large range in fat thickness within both the grain- and grass-finished categories. A major difference between these groups was fat colour, where grain finished carcasses were typified by a whiter fat. It is likely that this may have been influential on the relationship between colour and fat coverage.

There was virtually no difference in predictive accuracy between WCVIA and the standard carcass measurement combination when the four categorised were combined. More importantly, there was a substantial reduction in predictive accuracy relative to the results on a within category basis. This strongly suggests that in terms of maximising the potential of WCVIA, category specific prediction equations are highly desirable. This concept is not new, even with respect to the application of prediction equations based on standard carcass measures such as HSSW, P8FD and eye muscle area (Johnson and Priyanto 1994). Given that Australia caters for a wide variety of domestic and export markets, each with differing specifications in terms of carcass weight and fatness, the benefits of category specific equations warrants further investigation.

Conclusions

WCVIA offers new opportunities for the prediction of SBY% on the slaughter-floor. When fatness is not excessive, WCVIA is more accurate than the standard combination of HSSW and P8FD. Moreover, this advantage is maximised when analysed on a within market category basis. In the context of a national beef carcass description system, more effort will be placed on defining category descriptors and limits. The failure of HSSW and P8FD in the leaner categories was attributed to the lack of adherence to the trim specification. However, if so, it begs the question, why wasn't there a similar effect on the WCVIA predictions. This is now the subject of new investigations.

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