

EVALUATION OF THE COMPUTER VISION SYSTEM (CVS) TO PREDICT PRIMAL COMPOSITION OF MATURE COWS

J. Segura¹, J. L. Aalhus¹, I. L. Larsen¹, N. Prieto¹, M. Juarez¹, and O. Lopez-Campos^{1*},

¹Lacombe Research and Development Centre, Agriculture and Agri-Food Canada, Lacombe, Canada,

*oscar.lopezcampos@canada.ca

I. OBJECTIVES

Yield prediction using ribeye or cold carcass cameras (CCC) is not achievable on mature animals. This study was undertaken to determine the potential of the Computer Vision Systems (CVS) for the whole-side or hot carcass camera (HCC) to predict primal composition (fat, lean, and bone) of mature cows.

II. MATERIALS AND METHODS

A total of 111 mature cows were slaughtered at the Applied Aerodynamics and Flow Control Lacombe Research and Development Centre federally inspected abattoir. Immediately after slaughter, pictures of each carcass side were taken using an HCC (VBS 2000, e+v[®] Technology GmbH, Germany). Following 72 h of chilling at 2°C, carcass sides were weighed and knife-ribbed between 12th and 13th ribs. After 20 min of atmospheric exposure, CCC (VGB 2000 e+v[®] Technology GmbH, Germany) pictures at the grade site from left and right ribeyes were taken. All images were analyzed using camera software to yield 166 and 99 variables from the HCC and CCC, respectively. Left carcass sides were fabricated into primal cuts, with carcass breakpoints identified following the Institutional Meat Purchase Specifications for Fresh Beef Products: Chuck (#113), rib (#103), loin (#172A), and round (#158A). Then, all primals were fully dissected into fat, lean, and bone and weighed by qualified personnel. Partial least squares regression procedure was used to predict primal composition using the CVS data as independent variables. The accuracies were assessed by the coefficient of determination (R^2) and root mean square error of cross-validation.

III. RESULTS

Overall, proportion of variation in primal composition accounted for by HCC prediction equations was very high across the primal cuts studied (Table 1); most of the lean and fat predictions for the primal cuts showed high coefficients of determination, being R^2 values for fat ($R^2 \sim 0.85$ on average) slightly higher than those for lean ($R^2 \sim 0.75$ on average). Specifically, HCC predictions showed higher R^2 values for the fat composition of rib (0.87) and round (0.85) than those observed for CCC with limited improvement by using data from both grading cameras (HCC + CCC). In the case of lean, HCC improved the R^2 values for chuck ($R^2 = 0.85$), loin ($R^2 = 0.82$), and round ($R^2 = 0.90$) compared to the CCC, but superior prediction was obtained for the rib using the CCC ($R^2 = 0.69$) and the combined CCC + HCC ($R^2 = 0.79$). Overall, observed R^2 values for predicting bone in the primals were lower ($R^2 = 0.36$ – 0.79) using the HCC than those for lean and fat. CCC alone had limited ability to predict bone ($R^2 = 0.09$ – 0.38), but when combined with the HCC, predictions for bone in the chuck and the loin were slightly improved ($R^2 = 0.71$ and 0.76 , respectively). On average, the explained variability with HCC was 3.32%, 24.4%, or 61.8% higher than that observed with CCC for fat, lean, or bone, respectively.

Table 1.

Relationship (R^2)^a and root mean square error of cross-validation between CVS^b values and the primal composition for lean, fat, and bone of mature cow carcasses.

Tissue	Primal	HCC ^c		CCC ^d		HCC + CCC	
		R ²	RMSE	R ²	RMSE	R ²	RMSE
Fat	Chuck	0.88	2.3678	0.91	2.1435	0.87	2.8515
	Rib	0.87	1.1126	0.78	2.0276	0.86	1.3099
	Loin	0.81	2,5542	0.91	1.3322	0.85	2.1950
	Round	0.85	0.6854	0.72	1.3811	0.88	0.6259
	Overall	0.92	29.407	0.93	30.104	0.91	35.532
Lean	Chuck	0.85	4.6386	0.52	14.710	0.88	3.9094
	Rib	0.66	1.2365	0.69	1.1224	0.79	0.7751
	Loin	0.82	1.5263	0.58	3.5920	0.82	1.5196
	Round	0.90	2.0669	0.65	7.2982	0.86	2.9706
	Overall	0.89	36.092	0.67	104.53	0.93	23.044
Bone	Chuck	0.68	0.4167	0.38	0.8187	0.71	0.3886
	Rib	0.36	0.1358	0.11	0.1896	0.36	0.1369
	Loin	0.64	0.1272	0,09	0,3185	0.76	0.0848
	Round	0.79	0.2256	0.36	0.6723	0.75	0.2622
	Overall	0.82	2.4731	0.31	9.2266	0.84	2.1539

- ^aR²: Coefficient of determination. ^bCVS: Camera Vision System
- ^cHCC: Hot/whole-side carcass camera. ^dCCC: Cold/rib-eye carcass camera.

IV. CONCLUSION

Early literature has reported the suitability of CCC to predict total lean or saleable carcass yields. However, the current preliminary results suggest that individual primal cut composition of mature cows can be accurately predicted by CVS using the HCC alone. This is an important finding for slaughter systems, such as those used for mature cattle in Canada, that do not routinely knife rib carcasses which negates the use of CCC.

Keywords: beef primals, cold carcass camera, cull cows, ribeye camera, whole-side camera