ESTIMATING CARCASE WEIGHT IN LIVE CATTLE

B.L. McINTYRE* and W.J. RYAN*

SUMMARY

Data from 252 steers either grazed on pasture or fed an *ad libitum 80* per cent grain diet were analysed by regression techniques to develop equations for the prediction of hot carcase weight. Variables examined were full or empty live weight, type of diet, fat thickness and type of diet x live weight. Type of diet had the most important influence on the prediction of hot carcase weight apart from live weight. Fat thickness and type of diet x live weight made small though significant (P <.05) improvements in the accuracy of the prediction. Provided type of diet was included in the regression equation hot carcase weight was predicted as accurately from full live weight as from empty live weight.

INTRODUCTION

Currently in Australia there is a number of different methods of 'selling available to beef producers. Prices can be based on either $/head or ¢/kg carcase weight. To compare these different quotes it is necessary to have an accurate estimate of the carcase weight of the animal.

Despite the commercial importance of estimating carcase weight, very few studies have been conducted on the relationship between carcase weight and live weight. However, some studies have been reported in which carcase weight has been used to predict body weight (free from any gut contents) (Lofgreen *et al.* 1962, Holzer and Levy 1969, Fox *et al.* 1976). These have generally shown a close correlation between carcase weight and live weight.

Because changes in gut fill result in changes in live weight any prediction of carcase weight based on live weight must account for gut fill. The variation in gut fill between individual animals is thought to be greater in those weighed straight off feed (full weight) than those fasted for a given period (empty weight) and it is generally accepted that the prediction of carcase weight from empty live weight (ELW) is more accurate than the prediction based on full live weight (FLW).

The aims of this investigation were firstly, to test the effects of type of diet (TD) and fat thickness (FT), in addition to live weight on the accuracy of prediction of hot carcase weight (HCW). Secondly to compare the accuracy of predicting HCW based on either FLW or ELW after accounting for the effects of TD and FT.

MATERIALS AND METHODS

A total of 252 animals from a wide range of breed types was involved in this investigation. They consisted of 79 Hereford, 6 Angus, 23 Shorthorn, 57 Friesian x Angus, 26 Friesian x Shorthorn, 28 Three-way Cross (1/2 British Breed x 1/4 Dairy Breed x 1/4 Brahman), 30 Wokalup Multibreed (l/4 Hereford or Angus x 1/4 Friesian x 1/4 Brahman x 1/4 Charolais) and 3 Friesian. All were steers between 10 to 20 months of age at slaughter.

---

* Beef Branch, W.A. Department of Agriculture, South Perth, W.A. 6151.

For at least one month before slaughter, 79 steers were fed *ad libitum* either in individual pens or in small groups, a diet of 80 per cent grain and 20 per cent roughage. Mineral and vitamin supplements were added to the ration which was adjusted to the equivalent of 14 per cent crude protein by the addition of urea. The remaining 173 steers were grazed on annual grass and clover pasture in the South West of Western Australia at a stocking rate of 0.8 to 1.0 head/ha.

The animals were slaughtered in a number of groups between 1975 and 1979 using the following procedure:

On day 1 the animals were yarded at approximately 1600 hours and FLW recorded. They remained in the yards without access to feed or water and were weighed empty at approximately 0800 hours on day 2. The animals were then transported to the abattoir and slaughtered on day 3. HCW was measured with kidneys, kidney and channel fats and cod fat "in" and tail "off". FT was measured in mm after quartering between the 10th and 11th ribs on both sides of the carcase at the X and Y positions as described by Yeates (1952). The mean of the four FT measurements was used in the subsequent analysis.

The data were analysed using multiple linear regression techniques with HCW as the dependent variable. The independent variables ELW (or FLW), FT, TD and the interaction ELW x TD (or FLW x TD) were entered in a stepwise manner. Variables were included in the equations used to predict HCW only when they caused a significant ($P < .05$) reduction in the residual sum of squares. Variables TD and ELW (or FLW) were always included in equations if ELW x TD (or FLW x TD) was present.

RESULTS

Table 1 summarises the live animal and carcase data for the grain and pasture fed animals used in this investigation. Grain fed steers lost on average 4.5 per cent of their FLW during the fasting period compared with 7.9 per cent for the pasture fed steers. Average dressing percentages for grain and pasture fed steers were 59.7 and 56.5 respectively on an ELW basis and 57.0 and 52.0 on a FLW basis.

TABLE 1 Mean, standard deviation (SD) and range of live and carcase measurements of grain and pasture fed animals

	Grain fed (n=79)			Pasture fed (n=173)		
Measurement	Mean	SD	Range	Mean	SD	Range
Full live weight (kg)	400	59	226-605	444	59	180-595
Empty live weight (kg)	382	56	205-570	409	56	170-555
Loss during fasting (%)	4.5	2.0	1.2-10.8	7.9	1.5	4.2-11.8
Hot carcase weight (kg)	228	40	112-363	231	36	77-308
Full dressing percentage	57.0	2.9	47.1-61.3	52.0	2.4	42.8-56.9
Empty dressing percentage	59.7	2.8	49.5-65.1	56.5	2.6	45.3-61.8
Fat thickness (mm)	10.2	4.9	1.8-22.3	8.3	3.3	0.0-15.0

Table 2 shows the regression equations derived for the prediction of HCW together with their per cent of variance accounted for (R^2) and their residual standard deviation.

TABLE 2 Regression equations for the prediction of hot carcase weight (HCW) with the stepwise inclusion of empty live weight (ELW) or full live weight (FLW), type of diet (TD), fat thickness (FT) and ELW x TD or FLW x TD

Equation	R^2	RSD[a]	Diet	Variables included[b]
(1) HCW = -19.53 + 0.623 (ELW)	.908	11.3	Both	ELW
(2) HCW = -19.86 + 0.648 (ELW)	.936	9.4	Grain	ELW+TD
(3) HCW = -33.71 + 0.648 (ELW)			Pasture	
(4) HCW = -13.64 + 0.603 (ELW) + 1.064 (FT)	.944	8.9	Grain	ELW+TD+FT
(5) HCW = -24.36 + 0.603 (ELW) + 1.064 (FT)			Pasture	
(6) HCW = -28.64 + 0.643 (ELW) + 1.028 (FT)	.946	8.8	Grain	ELW+TD+FT+
(7) HCW = -17.38 + 0.587 (ELW) + 1.028 (FT)			Pasture	ELWxTD
(8) HCW = -9.17 + 0.556 (FLW)	.861	13.9	Both	FLW
(9) HCW = -17.38 + 0.612 (FLW)	.936	9.5	Grain	FLW+TD
(10) HCW = -40.50 + 0.612 (FLW)			Pasture	
(11) HCW = -11.32 + 0.570 (FLW) + 1.066 (FT)	.944	8.9	Grain	FLW+TD+FT
(12) HCW = -30.66 + 0.570 (FLW) + 1.066 (FT)			Pasture	
(13) HCW = -24.56 + 0.604 (FLW) + 1.024 (FT)	.945	8.8	Grain	FLW+TD+FT+
(14) HCW = -24.42 + 0.557 (FLW) + 1.024 (FT)			Pasture	FLWxTD

[a] RSD = Residual Standard Deviation
[b] All variables included significant at $P < .05$

One notable feature of the results was the superiority of ELW alone (equation 1) over FLW alone (equation 8) as a predictor of HCW. However, when TD was included with either ELW (equations 2 and 3) or FLW (equations 9 and 10) the per cent variance accounted for was identical.

Further improvements in the accuracy of prediction were achieved by the inclusion of firstly FT (equations 4, 5, 11 and 12) and secondly the ELW or FLW x TD interaction term (equations 6, 7, 13 and 14).

DISCUSSION

The simplest method of predicting carcase weight from live weight is to use a fixed dressing percentage. In our analyses dressing percentages calculated from the equations increased with increases in live weight. This indicates that the practice of predicting carcase weight from an "average' dressing percentage would result in overestimates of carcase weight at lower live weights and underestimates at higher live weights.

In research, animals are commonly fasted before weighing as this is considered to reduce the variation in gut fill. Our results supported this view when the data for both diets were analysed together (equations 1 and 8). However, after accounting for diet the accuracy of the prediction based on FLW was the same as that based on ELW (equations 2 and 3 vs 9 and 10). Therefore we suggest that variation in gut fill among animals on the same diet was not reduced by fasting. This is contrary to results of Koch *et al.* (1958) who attributed a decrease in the variation in live weight after a 12 hour fast to decreased variation in gut fill. They concluded that fasted weight was a more accurate indicator of weight and gain. However, because their animals were not slaughtered their conclusion can not be applied to the prediction of carcase weight. We attribute the superiority of ELW over FLW (equation 1 vs 8) to a reduction in the difference in gut fill between pasture fed and grain fed animals. As shown in Table 1 full dressing percentages indicate that pasture fed animals had greater gut fill than grain fed animals and they also lost more during the fasting period.

The slight improvement in accuracy of the prediction of HCW by the addition of FT confirms the findings of Holzer and Levy (1969). The positive sign of the regression coefficient of the FT term however, agrees with the common observation that fatter animals have higher dressing percentages. Fatness was positively correlated with live weight and increasing live weight was associated with increasing dressing percentage in all equations.

Although carcase FT was used in the generation of these prediction equations their application would require the assessment of fatness in the live animal. In research this can be done with a fairly high degree of confidence using ultrasonic methods. In the on-farm situation fatness can be estimated using the Livestock Market Reporting Service's fat scoring system.

While the fatness and liveweight x diet terms were statistically significant ($P < .05$) they are of little practical significance since their inclusion has almost no effect on the predicted HCW.

The conclusions of our investigation are:

(1) When estimating hot carcase weight from liveweight separate prediction equations should be used for each type of diet. This is due to the apparent effect of type of diet on gut fill in both fasted and unfasted animals. Where separate equations are used the common practice of fasting animals before weighing may not be necessary.

(2) If hot carcase weight is predicted using these equations rather than a fixed dressing percentage the inclusion of fatness contributes little to the accuracy of prediction.

REFERENCES

FOX, D.G., DOCKERTY, T.R., JOHNSON, R.R. and PRESTON, R.L. (1976). J. Anim. Sci. 43:566.

HOLZER, Z. and LEVY, D. (1969). Israel J. Agric. Res. 19:195.

KOCH, R.M., SCHLEICHER, E.W. and ARTHAUD, V.H. (1958). J. Anim. Sci. 17:604.

LOFGREEN, G.P., HULL, J.L. and OTAGAKI, K.K. (1962). J. Anim. Sci. 21:20.

YEATES, N.T.M. (1952). Aust. J. Agric. Res. 3:68.