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Predicting Carcass Dressing Percentage in Feedlot Bulls and Heifers

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Abstract: The objective of this study was to evaluate commercial feedlot growth performance factors that contribute to the variation in DP of bulls and heifers. Feedlot growth-performance data involving 878 pens of bulls and 784 pens of heifers were used to develop models for predicting Dressing Percentage (DP, 100* hot carcass weight/ final slaughter weight). Dressing percentage was similar for bulls and heifers, averaging 61.7±0.9%. Final Slaughter Weight (FSW, kg) explained 92% of the variation in Empty Body Weight (EBW, kg=15.941+0.877FSW; r^2=0.921) and 89% of the variation in hot carcass weight (HCW, kg=27.827+0.554FSW; r^2 = 0.893). However, FSW, alone, explained much less (r^2 = 0.10) of the variation in DP. Digestive tract fill averaged 11.4% with a range of 7.8 to 15.6%. Dressing percentage of bulls and heifers was inversely associated with DMI (DP = 68.061 -.874 DMI, kg; r^2 = 0.32). Initial weight of cattle when entering the feedlot (IW, kg) was a better single predictor of DP than DMI, explaining 46% of the variation. However, IW was also a good predictor of DMI (r^2 = 0.66): DMI = 4.6346 +.01422 IW. Based on stepwise regression analysis, factors that best described variation in DP were IW, FSW and DMI: DP =62.277-0.0131 IW+ 0.00920 FSW-0.212 DMI (r^2 = 0.49). However, because of the close association between IW and DMI (lack of independence), the contribution of DMI to the prediction was small. Removing DMI from the equation, the model becomes: DP = 61.857-0.148 IW + 0.00759 FSW (r^2 = 0.48). We conclude that the effect of gender on DP is small and nonappreciable. Initial weight and FSW are useful linear predictors of DP, explaining 48% of the variation. Dressing percentage decreases with increasing IW. For a given IW, DP increases with increasing FSW.

Key words: Dressing percentage, beef carcass, live weight

INTRODUCTION

Dressing Percentage (DP, hot carcass weight as a proportion of final slaughter weight) is the carcass measurement of greatest apparent economic importance in merchandizing livestock on a live-weight basis. However, very little quatitative information has been published regarding factors that influence DP. Williams *et al.*[1] observed that although Final Slaughter Weight (FSW) and carcass weight were closely associated, FSW explained less than 2% of the variation in DP. Dressing percentage has been associated with fat and protein deposition[2]. The proportion of fat and protein in gain is directly related to rate of gain, live weight and mature FSW[3,4].

MATERIALS AND METHODS

Feedlot growth-performance data involving 878 pens of bulls and 784 pens of heifers were used to develop an equation for predicting dressing percentage. The trial was conducted at a commercial feedlot, located in Culiacan, Sinaloa, Mexico. Data collection began in March, 2001 and ended in February, 2003. Pen means (representing 70±34 bulls or heifers) were used as experimental units. Cattle were predominantly Zebu crosses, originating from the states of Sinaloa, Nayarit, Chiapas, Jalisco and Veracruz, Mexico. Upon arrival into the feedlot, animals were processed (hot-iron branding, vaccinated, treated for parasites and injected with Vitamin A). Cattle were allowed ad libitum access to feed and water. Fresh was provided twice daily, 40% of daily allocation in the morning feeding and 60% in the afternoon feeding. Cattle were transitioned onto a finishing diet consisting of 62.5% steam-flaked corn, 13% corn stubble, 8.5 % protein supplement, 3.7% tallow, 9.3 % cane molasses and 3% mineral supplement. The NEm and NEg values (DM basis) of the finishing diet were 2.21 and 1.52 Mcal kg^{-1}, respectively. The finishing diet was fed during the final 83±18d before commercial slaughter. Zilpaterol clorhidrate (Zilmax®; Intervet, Boxmeer, The Netherlands) was added (6 mg kg^{-1}) to the diet 33 d., before slaughter. Zilpaterol was withdrawn from the diet 3 d before slaughter. Bulls weighing less than 250 kg upon arrival

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into the feedlot were implanted with Ralgro® (72 mg of zeranol; Schering-Plough Animal Health, Kenilworth, N.J.). Otherwise, bulls were implanted on arrival with Implemax® (140 mg of TBA and 28 mg of estradiol; Intervet, Boxmeer, The Netherlands). Bulls that were on feed greater than 120 d were reimplanted with Implemax sixty to ninety days before slaughter. Heifers weighing less than 255 kg upon arrival into the feedlot were implanted with Revalor G® (40 mg of TBA and 8 mg of estradiol; Intervet, Boxmeer, The Netherlands). Otherwise, heifers were implanted on arrival with Revalor-H® (200 mg of TBA and 20 mg of estradiol; Intervet, Boxmeer, The Netherlands). Heifers that were on feed greater than 120 days were reimplanted with Revalor-H sixty to ninety days before slaughter. On a per-head basis, cattle were provided with 10.1 ± 1.6 m2 pen space, 29±6 cm linear feed bunk space and 1.9±0.3 m2 overhead shade space. Cattle were shipped for slaughter when they had achieved an expected final empty body fat of 23 to 24%. The slaughter plant is located immediately adjacent to the feedlot. Final slaughter weights were obtained at the slaughter plant immediately following stunning (captive bolt) and thus represent a "full" weight (cattle were not fasted prior to obtaining final weight). Dressing percentage was calculated as 100*HCW/FSW, where HCW is hot carcass weight. Growth performance and carcass data were analyzed using GLM proceedures for regression analysis (Statistix®, Analytical Software, Tallahassee, FL).

RESULTS AND DISCUSSION

Growth performance, HCW and dressing percentage of feedlot bulls and heifers is summarized in Table 1. Dressing percentage was similar for bulls and heifers, averaging 61.7 ± 0.9%. As evidenced by the small standard deviation (0.9), dressing percentages for 95% of the pen close-outs fell within the comparatively narrow range of 59.9 to 63.5%. Final slaughter weight explained 92% of the variation in Empty Body Weight (EBW, kg = 15.941+ 0.877FSW; $r^2 = 0.921$) and 89% of the variation in HCW (HCW, kg = 27.827 + 0.554FSW; $r^2 = 0.893$). However, FSW, alone, explained much less

Table 1: Average values of performance of bulls and heifers

Item	Bulls 878 pens	SD	Heifers 784 pens	SD
Live weight(kg)				
Initial (purchase)	238.2	49.38	224.8	42.9
Final (slaughter)	420.0	19.5	419.0	16.9
Days on feed	150.0	36.0	168.0	37.0
Gain, kg d^{-1}	1.23	.10	1.17	.11
DMI, kg d^{-1}	7.28	.56	7.14	.60
DMI/gain	5.70	.44	6.10	.56
Hot carcass weight(kg)	270.4	11.8	270.5	10.6
Dressing percentage[a]	61.7	.90	61.8	.90

[a]Hot carcass weight/final full weight x 100

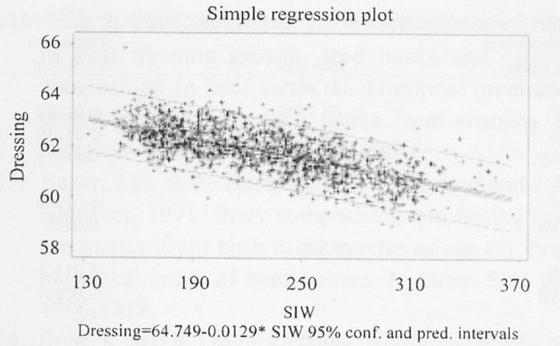

Fig. 1: Relationship between shrunk initial weight and dressing percentage for bulls and heifers

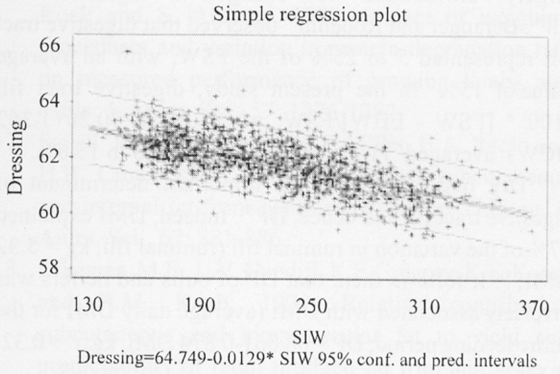

Fig. 2: Relationship between shrunk initial weight and dry matter intake for bulls and heifers

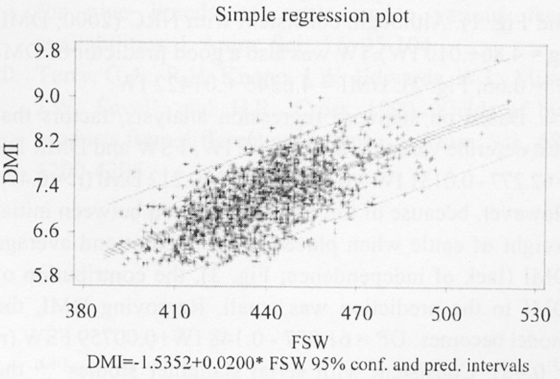

Fig. 3: Relationship between final slaughtered weight and dry matter intake

($r^2 = 0.10$) of the variation in DP. Likewise, Williams *et al.*[1] observed that although FSW and EBW were closely associated ($r^2 = 0.97$), FSW explained less than 2% of the variation in DP.

Due to the close association between HCW and EBW (EBW,kg = 30.26 + 1.362 HCW; $r^2 = 0.99$;[3,5]

Table 2: Regression models of dressing percentage to bulls (n= 878) and heifers (n=784)

Independent variables	Intercept	Regression coefficient	SE	P=value	R^2
HCW	61.668	.0003	0.89	0.86	0.00
IW	64.7508	-0.01292	0.66	0.00	0.46
FW	68.2984	-0.01559	0.85	0.00	0.10
DMI	68.0615	-0.87472	0.74	0.00	0.32
	65.1623			0.00	
IW		-0.01206	0.66	0.07	0.46
DMI		-0.0846			
IW	62.59		0.409	0.0	0.48
FW		-0.013	0.000575	0.0	
DMI		0.00861	0.00114	0.0	
		-0.2	0.048	0.0	
IW	62.35		0.4	0.0	0.47
FW		-0.015	0.004	0.0	
		0.007	0.001	0.0	

it is generally considered that variation in DP is largely attributable to changes in digestive tract fill[6]. Beranger and Robellin[7] observed that digestive tract fill represented 5 to 25% of the FSW, with an average value of 15%. In the present study, digestive tract fill (100 * [FSW - EBW]/FSW; where EBW=30.26+1.362 HCW) averaged 11.4% with a range of 7.8 to 15.6%.

Dry mater intake is an important determinant of digestive tract fill and hence, DP[8]. Indeed, DMI explained 97% of the variation in ruminal fill (ruminal fill, kg = 5.32 DMI;[9]. It follows then, that DP of bulls and heifers was inversely associated with DMI (average daily DMI for the entire feeding period; DP = 68.061-0.874 DMI, kg; r^2 = 0.32; Table 2).

Initial weight of cattle when entering the feedlot (IW; full purchase weight) was a better single predictor of DP than DMI, explaining 46% of the variation (Table 2 and Fig. 1). Although, consistent with NRC (2000; DMI, kg = 4.86+.010 IW), IW was also a good predictor of DMI (r^2 = 0.66; Fig. 2): DMI = 4.6346 +.01422 IW.

Based on stepwise regression analysis, factors that best describe variation in DP were IW, FSW and DMI: DP = 62.277 - 0.0131 IW + 0.00920 FSW - 0.212 DMI (r^2 = 0.49). However, because of the close association between initial weight of cattle when placed in the feedlot and average DMI (lack of independence; Fig. 3), the contribution of DMI to the prediction was small. Removing DMI, the model becomes: DP = 61.857 - 0.148 IW+0.00759 FSW (r^2 = 0.48). Consistent with serial slaughter studies[10,2] the model predicts that for a given initial weight, DP increases with increasing final weight. This effect may be partially explained by a pattern of decreasing DMI as a proportion of live weight over the course of the finishing phase. Dry matter intake of feedlot cattle increased rapidly during the initial receiving period. However, during the finishing phase increases in DMI are small (4 g DMI kg^{-1} increase in live weight[11]). Indeed, during the late finishing phase, when empty body fat exceeds 23%, daily DMI tends to decline[12].

The decline in DP with increasing IW may be due to slower relative growth of the alimentary tract[11,13,14]. Thus, adjusting for IW, DP increases with increasing FSW. However, when taken independently of the IW when cattle are placed in the feedlot, the relationships between digestive tract fill and slaughter weight is nonappreciable[1].

Other factors that have influenced DP include season[8], interaction of the time of weighing before slaughter and patterns in water and feed consumption[8,15] diet composition[1], age[10], handling conditions at weighing[16], postmortem trimming of subcutaneous fat and muscle tissues[17,18] and hide weight. Hide weight represents 5.6 to 9.2 % to of live weight. Thus, variation in DP do to hide weight can be appreciable[19]. Terry *et al.*[20] observed that hide weight was the non-carcass byproduct most affected by cattle breed and type. Variation in DP due to presence of horns is apparently small (head weight ranges between 2.1 to 2.6% of live weight among breeds[20].

Implications: Initial weight when cattle enter the feedlot and final slaughter weight are useful predictors of DP, explaining 48% of the variation. Estimates of dressing percentage are not affected by gender (bulls versus heifers). Dressing percentage decreases with increasing IW. For a given IW, DP increases with increasing FSW.

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