Ultrasound feedlot sorting

Evaluation of feedlot sorting system using ultrasound and computer technology

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ABSTRACT: The objective of this study was to determine the profitability of sorting feedlot cattle at re-implant time using ultrasound and computer technology to group cattle into uniform market groups. The Designer Genes (**DG**) sorting system combines initial body weight, estimated backfat thickness (**BF**), *longissimus dorsi* muscle area (**LMA**), and percentage intramuscular fat (**IMF**), as well as average daily gain (**ADG**) and ribeye shape to predict days on feed needed to reach optimum carcass composition. The DG sorting system was applied to 311 steers at re-implant time. Steers were scanned and alternately assigned to one of four system-assigned test groups or the control group. An implant regime was also recommended on individual basis for the test group steers. Implant protocol and harvest date were determined by feedyard management for the control steers. Initial value was assigned to all steers based on live weight at scanning. Each of the four test groups were marketed as a single group based on the projected days on feed from the DG sorting system. Profit was defined as carcass value, less the cost of feed, implant, and ultrasounding and the initial value of the steer. Data were analyzed using the General Linear Model Procedure of SAS (SAS Inst. Inc., Cary, NC). There was not a significant reduction in variability due to sorting. Initial weight and value, ADG, BF, LMA, and profitability did not differ between sorted and non-sorted steers. Sorted steers were fed 11.1 days longer ($P = 0.001$). Sorted steers had 11.3 kg heavier ($P = 0.022$) hot carcass weights, 0.2

higher (P = 0.005) yield grades, 0.1 higher (P = 0.039) quality grades, and 14.1% more sorted steers graded USDA Choice (P = 0.017). Total costs were $24.45 per head higher ($P$ = 0.001) for sorted steers. Although, there was a difference in hot carcass weight, there was no significant difference in weight discount or yield grade premium based on the pricing model. Quality premium approached significance at $0.02 per kg carcass weight higher (P = 0.052) for sorted steers, and carcass value was $47.75 higher ($P$ = 0.001) per head for sorted steers. Sorting resulted in a better distribution of carcass quality grades; however, additional days on feed and increased feed costs limited the profitability of the sorted steers. Key Words: beef cattle, carcass, ultrasound

INTRODUCTION

The application of ultrasound for detecting density changes of biological tissues was first reported over fifty years ago (Wild, 1950). Although seedstock producers have already begun to embrace this technology, the feedlot sector has been somewhat slower to capitalize on the possibilities. Since the introduction of ultrasound, several studies have tested its use on beef cattle shortly before harvest to accurately predict retail product by estimating ribeye area and backfat thickness (Smith et al., 1992; Greiner et al., 2003), as well as estimating marbling scores (Brethour, 1990).

Recent studies suggest ultrasound data taken at extended periods prior to slaughter could be useful for predicting carcass composition (Houghton, 1988; Brethour, 2000; Crews et al., 2002; Wall et al., 2004), and consequently, this data could be utilized to sort cattle into uniform groups based on body composition. Studies have also evaluated the effectiveness of utilizing ultrasound to sort feeder cattle into uniform groups, thereby increasing carcass value (Sainz and Oltjen, 1994, Basarab et al, 1999, Trenkle, 2001).

Feedlot managers often market entire pens as mixed groups, potentially resulting in lower quality, over-finished, or heavyweight carcasses. As the cattle industry has moved towards value-based marketing systems, finding a cost-effective tool that can predict future carcass merit and sort cattle into outcome groups that will produce a more uniform product at harvest is of interest to feedyard managers. The objective of this paper was to determine the profitability of sorting feedlot cattle at re-implant time using ultrasound and computer technology in an attempt to group cattle into uniform market groups.

MATERIAL AND METHODS

The study was conducted in cooperation with Champion Feeders, Hereford, Texas, using 311 crossbred feedlot steers owned by Broseco Ranches, Inc. Animals moved to a separate pen for treatment or animals that died were removed from the dataset. Steers with missing carcass or ultrasound data were also deleted from the dataset. Live weight of the steers at scanning ranged from 356.4 to 578.9 kg. All steers were at re-implant time in the feeding period.

Steers were scanned by personnel of Designer Genes Technologies, Inc. (**DG**), Harrison, Arkansas, in 2004. Images were collected using an Aloka 500V real-time ultrasound machine (Corometrics Medical Systems, Wallingford, CT) equipped with a 17-cm, 3.5 MHz linear array transducer. Live animal measurements recorded during the scanning session were: 1) live weight; 2) a cross-sectional image taken between the 12^{th} and 13^{th} ribs to obtain subcutaneous fat thickness measured at three-fourths the distance from the medial end of the *longissimus dorsi* muscle (**LM**); 3) LMA; and 4) four independent images collected laterally across the 12^{th} and 13^{th} ribs and averaged to estimate the percentage of intramuscular fat (**IMF**) within the LM. Images were interpreted chute-side and used to sort the steers into one of four projected outcome groups, and to determine an implant protocol. The sorting models are proprietary, but included live weight, backfat estimation, LMA estimation, an estimation of percent IMF, as well as average daily gain (**ADG**) and ribeye shape. As cattle were scanned, every other animal recommended for each outcome group was placed into either that test group or into the control group, ensuring the control group had a similar proportion of each outcome group as the sorted cattle.

Implant protocol for the test groups was determined individually by the DG system for each test animal. Implant regime was determined primarily by percent IMF. Test group steers were assigned to one of three levels of the implant regime – none, moderate, and aggressive. Animals assigned to the moderate level received Revalor IS (Intervet Inc., Millsboro, DE). Steers assigned to the aggressive level received Component TE-S (Ivy Laboratories, Inc., Overland Park, KS). All control animals received Component TE-S according to the feedyard's implant protocol.

The four test groups were harvested based on projected marketing times generated from the DG sorting system. Group 1 (n = 23) was harvested 83 days post-scan. Group 2 (n = 36) was harvested 97 days post-scan. Group 3 (n = 29) was harvested 113 days post-scan. Group 4 (n = 49) was harvested 125 days after the scanning date. The control group (n = 146) was harvested in a single group on a date selected by feedyard management 97 days after the scanning date.

Carcass data collected by the slaughter facility with the aid of the Computer Vision System (Research Management Systems, USA Inc., Fort Collins, CO) were: 1) hot carcass weight (**HCW**); 2) actual backfat thickness (**BF**); 3) actual LMA; and 4) yield grade (**YG**). In addition, official USDA quality grades were recorded for each carcass. A corresponding quality grade number was assigned to each quality grade: USDA Choice = 5, USDA Select = 4, No Roll

= 3. No Roll carcasses did not meet USDA minimum marbling requirements for USDA Select or possessed defects, such as blood splash or dark cutting, which prevented them from qualifying for an official USDA grade upon initial examination.

Initial value was assigned to the steers at re-implant, based on their weight at that time. Calf value per kg was estimated using the USDA market reports for the week the cattle were sorted, extrapolated from the 386 kg feeder steer price at Oklahoma City (USDA, 2004b) and the Panhandle direct slaughter price that week (USDA, 2004c). Cost of gain was calculated from total cost of feed and total gain per pen. Base carcass price was set at $2.96 per kg, the five-state-area, weighted average, dressed price for steers 35 to 65% Choice for the harvest week of the control group (USDA, 2004a). Premiums of $0.0441, 0.0331, and 0.1874 per kg carcass weight were given to YG1, YG2, and Choice carcasses, respectively. Discounts of $0.2205, 0.4410, 0.2426, and 0.6615 per kg carcass weight were given to YG4, YG5, no roll, and heavy weight carcasses (>453.5 kg), respectively. Premiums and discounts were based on the pricing model for Ranchers Renaissance, Englewood, Colorado. Profit was based solely on time between sorting and harvest. Profit was defined as carcass value, less the cost of feed, implant, and ultrasounding and the initial value of the steer at the time of scanning.

Data were analyzed using the General Linear Model Procedure of SAS (SAS Inst. Inc., Cary, NC). Initial, performance, and carcass traits were subjected to an analysis of variance. Performance traits were evaluated only between sorting and harvest. All data were subjected to an analysis of variance which included sorting type (sorted or non-sorted) as the only source of variation. Carcass traits, carcass value, and profit were subjected to Brown and Forsythe's test for homogeneity of variance to determine if sorting improved variability. Effects of breed type were not included in these analyses to allow for inference over a wide variety of cattle types.

RESULTS AND DISCUSSION

There was not a significant reduction in variability due to sorting for HCW, BF, LMA, YG, quality grade (Table 1), carcass value, or profitability (Table 2).

At scanning, body weight did not differ (*P* = 0.099) between sorted and non-sorted steers (Table 1). The sorted steers were fed 11.1 more days than the control steers (*P* = 0.001). All control steers were marketed 97 days after scanning, determined by feedyard management. However, sorted steers were marketed in four groups based on the DG sorting system recommendations. ADG did not differ (*P* = 0.151) between sorted and non-sorted steers. Sainz and Oltjen (1994) did not find differences in ADG when comparing unsorted steers to steers sorted by weight or steers sorted by estimated days on feed. However, Basarab et al. (1999) saw improved ADG for steers sorted with the Kansas State University sorting system, which is designed to improve ADG and feed efficiency.

There were significant differences between sorted and unsorted steers for HCW, YG, quality grade, and percent grading USDA Choice (Table 1). LMA did not differ (*P* = 0.321) between sorted and control steers, nor did BF (*P* = 0.207). Hot carcass weight for sorted steers was 11.3 kg heavier (*P* = 0.002) than the control steers, likely due to additional days on feed. Due to heavier carcass weights, YG for sorted steers was 0.2 higher (*P* = 0.018) than non-sorted steers. Quality grade was 0.1 higher (*P* = 0.039) for sorted steers, and 14.1% more sorted steers graded USDA Choice (*P* = 0.017). Sainz and Oltjen (1994) did not find differences in HCW, BF, LMA, or marbling score between groups. Likewise, Basarab et al. (1999) reported similar HCW, BF, LMA, marbling score, and lean meat yield between sorting systems.

Initial value did not differ (*P* = 0.100) between sorted and non-sorted animals (Table 2). This should be expected because initial value was based on live weight at scanning, and there was no significant difference in body weight at scanning. Total costs were \$24.45 higher (*P* = 0.001) per head for sorted cattle. Most of this difference can be attributed to feed costs, which were \$19.02 higher (*P* = 0.001) per head for sorted steers. Implant cost was \$0.57 lower (*P* = 0.001) per head for sorted animals. All control animals received the same implant according to feedyard management recommendations, but animals in test groups were assigned to an individual implant regime based on the DG sorting system. Although all animals were scanned to evenly distribute steers between the control and test groups, ultrasound costs were not included in the total cost for control animals.

Carcass value was \$47.75 higher (*P* = 0.001) per head for sorted steers (Table 2). Yield grade premium was not significantly different (*P* = 0.391) between sorted and control steers, nor was weight discount (*P* = 0.092). Quality grade premium approached significance at \$0.02 higher (*P* = 0.052) per kg carcass weight for sorted steers. Sorting resulted in a higher percent grading USDA Choice; however, additional days on feed and increased feed costs limited the profitability of the sorted steers. Profitability did not differ (*P* = 0.182) between sorted and non-sorted steers. Basarab et al. (1999) attributed increased profitability of the Kansas State University sorting system steers to improved ADG, as well as a better distribution of carcass yield and quality grades.

IMPLICATIONS

The use of ultrasound feedlot sorting systems has the potential to increase profitability. Currently, ultrasound and computer technology is capable of grouping cattle to increase carcass value, primarily through quality premiums. However, extra feed costs from additional days on feed are limiting the implementation of ultrasound technology as a cost-effective tool to sort feedlot cattle. Further evaluation is needed before ultrasound sorting systems can replace visual appraisal and feedlot protocol as the common method for determining feeder cattle marketing points.

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Table 1. Descriptive statistics for initial, performance, and carcass characteristics of control and sorted steers

Trait	Control Mean	Control SD	Sorted Mean	Sorted SD	p-value[1]
N	146		137		
Initial Traits					
Scan Weight, kg	448.7[†]	36.03	456.1[†]	38.21	
Performance Traits[2]					
Days on Feed	97.0***	0.0	108.1***	15.72	
Average Daily Gain, kg/d	1.60	0.30	1.54	0.35	
Carcass Traits					
Hot Carcass Weight, kg	377.6**	30.43	388.9**	31.04	0.923
Backfat thickness, mm	11.6	5.14	12.4	5.08	0.989
L. dorsi area, cm^2	96.7	10.61	95.5	9.93	0.412
Yield grade	2.5*	0.90	2.7*	0.84	0.821
Quality grade[3]	4.36*	0.52	4.49*	0.56	0.069
Percent Choice, %	37.7*	48.6	51.8*	50.2	

[1] *P* < 0.05 indicates unequal variances

[2] Performance traits were evaluated only between scanning and harvest

[3] 5 = USDA Choice, 4 = USDA Select, 3 = No Roll

Within row, [†] designates *P* < 0.10; * designates *P* < 0.05; ** designates *P* < 0.01;

*** designates *P* < 0.001

Table 2. Descriptive statistics for economic performance of control and sorted steers

Trait	Control		Sorted		p-value[1]
	Mean	SD	Mean	SD	
Cost, $/hd					
Feed	160.25***	29.85	179.27***	42.36	
Implant	2.85***	0.00	2.28***	0.94	
Ultrasound	0.00***	0.00	6.00***	0.00	
Discounts and premiums, $/kg					
Yield premium	0.010	0.081	0.003	0.071	
Quality premium	0.066†	0.101	0.090†	0.109	
Weight discount	-0.014†	0.094	0.000†	0.000	
Carcass value	1138.36***	91.10	1186.11***	102.46	0.497
Initial value[2]	933.92	65.19	947.07	68.86	
Costs	163.10***	29.85	187.55***	42.58	
Profit[3]	41.34	69.37	51.49	56.84	0.622

[1] $P < 0.05$ indicates unequal variances

[2] Initial live value was determined at scanning based on live weight.

[3] Profit based solely on period between scanning and harvest.

Within row, † designates $P < 0.10$; * designates $P < 0.05$; ** designates $P < 0.01$;

*** designates $P < 0.001$