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Influence of Body Condition Score on Live and Carcass Value of Cull Beef Cows¹

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ABSTRACT: Mature beef cows (n = 88) were slaughtered to determine the influence of body condition score (BCS) on carcass and live animal value. Cows were weighed and assigned a BCS (9-point scale), 24 h before slaughter. Hide and by-products weights were recorded during harvest. After a 48-h chill period, the right side of each carcass was fabricated into boneless subprimal cuts, minor cuts, lean trim, fat, and bone. Weights were recorded at all stages of fabrication. Carcass values (U.S.\$/100 kg of hot carcass weight) were calculated for U.S. Utility and U.S. Cutter grades, as well as for the Utility/Cutter mix for each BCS. Gross value included the carcass value and the value of the hide and by-products, whereas net value was calculated after harvest and fabrication costs and by-product value were considered. Live value (U.S.\$/100 kg of live weight) was computed by dividing the net value by the animal's live weight 24 h before harvest. The value of the hide and by-products for BCS-2 cows was greater ($P < .05$) than for cows assigned a BCS of 3 through 8. Even though U.S. Utility carcasses from BCS-8 cows produced the

least ($P < .05$) valuable subprimal cuts from the chuck, loin, and round, the gross and net values of BCS-8 cows were greater ($P < .05$) than those of BCS-3, 4, 5, and 6. Within the grade of U.S. Cutter, carcasses from BCS-6 cows had the highest ($P < .05$), and BCS-2 cows had the lowest ($P < .05$), gross and net values. Across the U.S. Utility/Cutter mix, cows designated with a BCS of 7 and 8 had greater ($P < .05$) gross and net values than cows assigned a BCS of 6, or lower. Live value increased linearly ($P = .0002$) from a low of \$76.10/100 kg for BCS-2 cows to a high of \$90.84/100 kg for BCS-7 cows. Carcasses from BCS-6 cows were relatively lean (8.4 mm of fat opposite of the longissimus muscle), and approximately 73% of the carcasses achieved a quality grade of U.S. Utility. Moreover, carcasses from BCS-6 cows had the highest total carcass values and live values comparable ($P > .05$) to BCS-7 cows. Information from this study can be used by the non-fed beef industry to establish a value-based marketing system. Data from this study would indicate that marketing cull beef cows at a BCS of 6 could optimize economic returns to both cow-calf producers and non-fed beef packers.

Key Words: Beef Cows, Conformation, Carcasses, Offal, Valuation

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Introduction

Cattle producers recognize the significance of external fatness, or body condition, on cowherd fertility, productivity, and profitability (Dziuk and Bellows, 1983; Richards et al., 1986). Yet, few producers realize that

the sale of cull beef cows accounts for 15 to 25% of the yearly gross revenues of cow-calf operations in the United States (Yager et al., 1980).

Smith et al. (1994) reported that producers lose approximately \$69.90 of potential revenues per non-fed animal slaughtered in the United States, but \$20.00 per animal could be recovered by feeding cull cows an energy-dense diet before slaughter. Feeding a high-energy diet to cull beef cows has been shown to increase carcass fat content (Faulkner et al., 1989; Cranwell et al., 1996b; Schnell et al., 1997), increase lean meat yields (Matulis et al., 1987; Cranwell et al., 1996b; Schnell et al., 1997), increase marbling in the longissimus muscle (Matulis et al., 1987; Faulkner et al., 1989; Cranwell et al., 1996a), produce a whiter external fat cover (Schnell et al., 1997), and improve cooked meat palatability (Cranwell et al., 1996a; Boleman et al., 1996). Schnell et al. (1997) indicated that improvements in the quality and consistency of beef products

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achieved through feeding a high concentrate diet could enhance the salvage value of cull beef cows.

Although body condition/external fatness plays an important role in the value of reproductively active cows, there is little information on the influence of body condition on the value of carcasses from cull beef cows. Therefore, the objective of this study was to determine the economic relationship between external fatness, as measured by body condition score, and carcass and live value of cull beef cows.

Materials and Methods

Animals. Mature ($n = 88$; 6 to 8 yr old) beef cows, representing British (straightbred or crosses, showing predominantly Angus, Hereford, or Red Poll breeding) phenotypes, were culled from the University of Arkansas Beef Research Unit at Fayetteville, AR, and the Southwest Research and Extension Center at Hope, AR. Cows arriving from the Southwest Research and Extension Center grazed native fescue pastures for 1-wk before processing. Cows from the University Beef Research Unit were processed shortly after arrival. Twenty-four hours before harvest, cows were weighed and assigned body condition scores (BCS), based on a 9-point scale (1 = extremely thin; 3 = thin; 5 = moderate condition; 7 = moderately fat; 9 = extremely fat; Richards et al., 1986), by 2 trained individuals.

Animal Harvest and Carcass Data Collection. Cows were harvested at the University of Arkansas Red Meat Abattoir according to humane, industry-accepted procedures. By-product weights were obtained during the slaughter process, and they included the hide, blood, feet (with hooves attached), oxlips, tongue, gullet, trachea, cheek meat, head meat, skull, tripe, honeycomb tripe, large intestines, spleen, mesenteric fat, weasand meat, kidneys, heart, lungs, and oxtail.

Blood was recovered during the exsanguination process by placing a large container under the animal for approximately 5 min. The forefeet were removed at the metacarpal bones, and the hindfeet were removed at the tarsal bone joint separating the metatarsal and the tibia. The hide was manually removed on a dehiding cradle. The head was removed between the axis and atlas. The tongue was removed from the head at the root, and the epiglottis (gullet) was also removed. The head was further separated by removing the masseter muscle (cheek meat) and oxlips, and the rest of the lean removed from the skull was designated as head meat.

The muscular tissue surrounding the esophagus (weasand meat) was removed, and the stomach was separated from the remainder of the viscera by cutting between the anterior end of the duodenum and the posterior end of the abomasum. The stomach compartments (rumen, reticulum, omasum, and abomasum) were split, and all stomach contents were removed. The reticulum (honeycomb tripe) was separated from the rumen at the rumenoreticular groove, and the remainder of the ruminal complex (tripe) was cleansed with

high-pressure hot (82°C) water. The small intestine (duodenum, ileum, and jejunum) was separated from the large intestine at the ileocecal valve, and the large intestine (consisting of the cecum, colon, and rectum) was removed at the posterior end of the rectum. The large intestines were hand-stripped of all excreta and cleansed with high-pressure hot (82°C) water. Mesenteric fat surrounding the digestive tract was removed, washed, and weighed. The liver was separated from the viscera by severing the posterior vena cava and hepatic veins at the base of the liver. The gall bladder was removed at the cystic duct connecting the gall bladder to the liver and discarded. Kidneys were removed by cutting the ureter and renal vein and artery at the base of the kidneys.

The heart was separated from the pluck by removing the pericardium surrounding the heart and then severing the superior vena cava, aorta, and pulmonary arteries at the base of the heart. The trachea was removed posterior to the epiglottis and separated from the lungs approximately 5 cm anterior to the main bronchi. Finally, the switch of the tail was removed near the 16th coccygeal vertebra, and the oxtail was removed from the carcass at the intervertebral disk between the 5th and 6th sacral vertebrae.

Carcasses were chilled (2°C) for 48 h. After chilling, carcasses were ribbed between the 12th and 13th ribs, and USDA quality and yield grade factors (skeletal maturity, lean maturity, marbling score, fat thickness, longissimus muscle area, and hot carcass weight) were collected by trained, experienced university personnel (USDA, 1989).

Carcass Fabrication. The right side of each carcass was processed into subprimal cuts, minor cuts, lean trim, fat, and bone following the fabrication procedures outlined by the National Association of Meat Purveyors (1992). Cuts and lean trimmings were trimmed to not exceed 6.4 mm of subcutaneous and visible intermuscular fat. The square-cut chuck (NAMP# 113) was fabricated into the shoulder clod, chuck roll, and chuck tender (NAMP# 114, 116A, and 116B, respectively). The ribeye roll (NAMP# 112A) was removed from the wholesale rib (NAMP# 103). The brisket (NAMP# 118), plate (NAMP# 121), and foreshank (NAMP# 117) were separated into lean trim, fat, and bone.

Heart fat from the forequarter (NAMP# 102) and kidney and pelvic fat from the hindquarter (NAMP# 155) were removed, weighed, and the actual percentage (hot carcass weight basis) of kidney, pelvic, and heart fat was used to calculate USDA yield grades. The hanging tender was removed from the hindquarter and included in the lean trim. The flank steak (NAMP# 193) was removed from the wholesale flank. The primal round (NAMP# 158) was fabricated into the knuckle, top (inside) round, bottom (outside) round, and eye of round (NAMP# 167, 168, 171B, and 171C, respectively). Loins (NAMP# 172) were fabricated into strip loins, top sirloin butts, bottom sirloin butts, and tenderloins (NAMP# 180, 184, 185, and 189, respectively).

Subprimal cuts, minor cuts, lean trim, fat, and bone weights were recorded during fabrication. Lean trimmings were not adjusted for fat content. Trimmed bruises were included in the fat trim weights, and bone weights included any heavy connective tissue removed during the fabrication process.

Value Calculations. Individual by-product values were computed by multiplying the weight of each by-product by the 1997 average price (USDA, 1997). The drop credit (U.S./100 kg) represents the total by-product value divided by the animal's live weight. Values of carcass components were calculated using average prices for 1997 obtained from the USDA, AMS National Carlot Meat Report (USDA, 1997). The hide and offal values for each cow were used to calculate the live value. The gross value included the carcass value and the value of the hide and by-products. Net value was calculated as the gross value minus a slaughter cost of \$28.00 per animal and a processing fee of \$17.05/100 kg hot carcass weight (USDA, 1997). Live value (U.S./100 kg of live weight) was calculated by dividing the net value by the animal's live weight taken 24 h before harvest. The National Carlot Meat Report (USDA, 1997) reports prices for both U.S. Utility- and U.S. Cutter-grade carcasses; therefore, carcass, gross, net, and live values were computed for carcasses according to the specific quality grade (Utility or Cutter) and across both quality grades (Utility/Cutter mix).

Statistical Analyses. No cows were designated with a BCS of 1 or 9; therefore, data were stratified across only seven BCS (2 through 8). Moreover, because of the uneven distribution of data across the seven BCS, data were analyzed with one-way analysis of variance using the GLM procedure of SAS (1990), with BCS as the main effect. Least squares means were computed for the main effect and separated statistically using the least significance difference procedure (SAS, 1990). The regression procedure of SAS (1990) was used to determine linear and quadratic effects of BCS on subprimal yields.

Results

Live and carcass characteristics are presented in Table 1. Live weight, hot carcass weight, dressing percentage, fat thickness, longissimus muscle area, and numerical yield grade increased ($P < .05$) as BCS increased from 2 to 8. Carcasses from BCS-2 cows received USDA quality grades of U. S. Cutter or lower, and carcasses from BCS-7 and BCS-8 cows received quality grades of U. S. Utility.

Hide and by-product values are presented in Table 2. Hides from BCS-2 cows were of greater ($P < .05$) value than hides from cows assigned a BCS of 3 or higher. The value of the tongue, tripe, and feet decreased linearly ($P < .0002$) as BCS increased from 2 to 8. Blood meal, liver, honeycomb-tripe, kidneys, heart, trachea, lungs, and bone meal from BCS-2 cows were more ($P < .05$) valuable than that of cows assigned a

Table 1. Least squares means (\pm SE) for live and carcass characteristics of cull beef cows differing in body condition scores

Item	Body condition score							
	2	3	4	5	6	7	8	
Number	6	6	11	32	15	12	6	
Live wt, kg	367.8 ^d \pm 20.9	466.7 ^e \pm 20.9	499.1 ^{ef} \pm 15.4	481.1 ^e \pm 9.0	531.8 ^f \pm 13.2	585.8 ^g \pm 14.7	637.9 ^h \pm 20.9	
Hot carcass wt, kg	176.6 ^d \pm 12.9	225.2 ^e \pm 12.9	244.4 ^e \pm 9.5	237.0 ^e \pm 5.6	272.2 ^f \pm 8.2	309.3 ^g \pm 9.1	350.6 ^h \pm 12.9	
Dressing percentage	48.3 ^d \pm 1.7	48.4 ^d \pm 1.7	48.8 ^d \pm 1.3	49.2 ^d \pm .7	51.3 ^{de} \pm 1.1	52.8 ^e \pm 1.2	55.1 ^e \pm 1.7	
Fat thickness, mm	.0 ^a \pm 1.5	1.2 ^{de} \pm 1.5	4.4 ^e \pm 1.1	4.0 ^e \pm .6	8.4 ^f \pm .9	14.8 ^g \pm 1.0	27.3 ^h \pm 1.5	
Longissimus muscle area, cm ²	38.9 ^d \pm 4.3	60.8 ^e \pm 4.3	62.8 ^e \pm 3.2	63.8 ^e \pm 1.9	69.9 ^{ef} \pm 2.7	74.2 ^f \pm 3.0	78.4 ^f \pm 4.3	
USDA yield grade ^a	2.1 ^{de} \pm .3	1.7 ^d \pm .3	2.2 ^{de} \pm .2	2.0 ^d \pm .1	2.6 ^e \pm .2	3.5 ^f \pm .2	4.9 ^g \pm .3	
U.S. Utility ^b , %	0	33.3	63.6	43.8	73.3	100.0	100	
U.S. Cutter ^c , %	100.0	66.7	36.4	56.2	26.7	0	0	

^aUSDA yield grade = $2.50 + (2.5 \times \text{adjusted fat thickness, in}) + (.2 \times \text{percentage of kidney, pelvic and heart fat, \%}) + (.0038 \times \text{hot carcass weight, lb}) - (.32 \times \text{longissimus muscle area, in}^2)$.

^bPercentage of carcasses with muscle quality characteristics indicative of U.S. Utility, or higher, and would be fabricated into boneless, subprimal cuts.

^cPercentage of carcasses with muscle quality characteristics indicative of U.S. Cutter, or lower, and would be destined for ground beef production.

^{d,e,f,g,h}Within a row, least squares means lacking a common superscript letter differ ($P < .05$).

Table 2. Least squares means (\pm SE) for hide and by-products value (U.S.\$/100 kg of live weight) from cull beef cows differing in body condition score

Item	Price ^a	Body condition score							L ^b	Q
		2	3	4	5	6	7	8		
Hide	157.30	11.81 ^g \pm .56	9.98 ^h \pm .51	10.13 ^h \pm .38	9.76 ^h \pm .22	9.64 ^h \pm .32	9.89 ^h \pm .36	9.59 ^h \pm .51	.0101	.1303
Head meat	118.80	.23 \pm .03	.23 \pm .03	.20 \pm .03	.24 \pm .02	.20 \pm .02	.19 \pm .03	.11 \pm .03	.0078	.1472
Cheek meat	151.80	.34 ^{gh} \pm .03	.36 ^g \pm .03	.28 ^{hi} \pm .02	.29 ^{hi} \pm .01	.28 ^{hi} \pm .02	.26 ⁱ \pm .02	.36 ^g \pm .03	.0045	.0070
Oxlips	149.60	.28 ^g \pm .03	.32 ^g \pm .03	.26 ^{gh} \pm .02	.27 ^g \pm .01	.25 ^{gh} \pm .02	.19 ⁱ \pm .02	.20 ^{hi} \pm .03	.0001	.3219
Tongue	334.40	.99 ^g \pm .05	.97 ^{gh} \pm .05	.87 ^{hi} \pm .03	.84 ⁱ \pm .02	.80 ^j \pm .03	.73 ^{jk} \pm .03	.69 ^k \pm .05	.0001	.5168
Gullet	13.20	.03 \pm .004	.04 \pm .004	.03 \pm .003	.03 \pm .002	.03 \pm .002	.03 \pm .003	.04 \pm .004	.7430	.5132
Weasand meat	154.00	.22 \pm .03	.19 \pm .03	.22 \pm .03	.21 \pm .01	.19 \pm .02	.21 \pm .02	.19 \pm .03	.6187	.7774
Tripe ^c	55.00	.67 ^g \pm .03	.58 ^h \pm .03	.55 ^h \pm .02	.55 ^h \pm .01	.49 ⁱ \pm .02	.50 ⁱ \pm .02	.49 ⁱ \pm .03	.0001	.0778
Honeycomb tripe ^c	112.20	.27 ^g \pm .02	.27 ^g \pm .02	.22 ^h \pm .01	.22 ^h \pm .01	.22 ^h \pm .01	.19 ^h \pm .01	.22 ^h \pm .02	.0021	.1169
Liver	81.40	1.01 ^g \pm .05	.89 ^{gh} \pm .05	.85 ^h \pm .04	.84 ^h \pm .02	.85 ^h \pm .03	.82 ^h \pm .03	.86 ^h \pm .05	.0099	.0297
Kidneys	34.10	.10 ^g \pm .006	.08 ^h \pm .006	.08 ^h \pm .004	.08 ^h \pm .002	.08 ^h \pm .004	.08 ^h \pm .004	.07 ^h \pm .006	.0052	.0263
Heart	59.40	.27 ^g \pm .01	.23 ^h \pm .01	.20 ^{hij} \pm .01	.21 ^{hi} \pm .01	.21 ^{hi} \pm .01	.18 ^j \pm .01	.19 ^{ij} \pm .01	.0001	.2906
Oxtail	323.40	.80 \pm .06	.68 \pm .07	.61 \pm .05	.70 \pm .03	.71 \pm .04	.81 \pm .05	.81 \pm .07	.0446	.0201
Blood meal ^d	61.60	.43 ^g \pm .03	.38 ^{gh} \pm .03	.34 ^h \pm .02	.36 ^h \pm .01	.36 ^h \pm .02	.32 ^h \pm .02	.30 ^h \pm .03	.0051	.9170
Feet	81.40	1.99 ^g \pm .06	1.56 ^h \pm .06	1.50 ^{hi} \pm .05	1.45 ^{hi} \pm .03	1.39 ⁱ \pm .04	1.27 ^j \pm .05	1.18 ^j \pm .06	.0002	.0337
Trachea	13.20	.04 ^g \pm .004	.02 ^h \pm .004	.02 ^h \pm .003	.02 ^h \pm .002	.02 ^h \pm .002	.02 ^h \pm .003	.02 ^h \pm .004	.0076	.0218
Lungs	7.15	.11 ^g \pm .006	.10 ^g \pm .006	.07 ^{hi} \pm .005	.08 ^h \pm .003	.07 ^{hi} \pm .004	.06 ⁱ \pm .005	.06 ⁱ \pm .006	.0687	.0862
Large intestines	77.00	1.04 ^{gh} \pm .08	1.02 ^{gh} \pm .08	.91 ^h \pm .06	.92 ^h \pm .03	.94 ^h \pm .05	1.11 ^g \pm .05	1.15 ^g \pm .08	.0034	.0008
Spleen	11.00	.02 \pm .002	.02 \pm .002	.01 \pm .001	.01 \pm .001	.01 \pm .001	.01 \pm .002	.01 \pm .002	.1991	.4784
Mesenteric fat	30.80	.17 ^g \pm .05	.35 ^{hi} \pm .06	.31 ^h \pm .04	.37 ^{hi} \pm .02	.46 ⁱ \pm .03	.60 ^j \pm .04	.66 ^j \pm .05	.0001	.1095
Bone meal ^e	28.60	.74 ^g \pm .03	.59 ^h \pm .03	.53 ^{hi} \pm .02	.56 ^h \pm .01	.51 ⁱ \pm .02	.45 ^j \pm .02	.44 ^j \pm .03	.0001	.1746
Drop credit ^f		21.79 ^g \pm .67	18.75 ^h \pm .61	18.16 ^h \pm .45	17.98 ^h \pm .26	17.70 ^h \pm .38	17.89 ^h \pm .43	17.62 ^h \pm .61	.0001	.0012

^a1997 average price (U.S.\$/100 kg).

^bSignificance of linear (L) and quadratic (Q) effects of body condition scores.

^cValue of tripe and honeycomb tripe are based on estimated 60% yield after the scalding process (Terry et al., 1990).

^dValue of blood meal is based on an estimated 20% yield after processing fluid blood (Christensen, 1986).

^eValue of bone meal is based on an estimated 80% yield after processing the skull (Bengtsson and Homqvist, 1984).

^fTotal value of hide and by-products (U.S.\$/100 kg of live weight).

^{g,h,i,j,k}Within a row, least squares means lacking a common superscript letter differ ($P < .05$).

BCS of 4 or higher. Body condition scores had no effect ($P > .05$) on values of the head meat, gullet, weasand meat, oxtail, or spleen. Cows with BCS-7 and 8 had higher ($P < .05$) mesenteric fat values than cows designated with a BCS of 2 through 6 and higher ($P < .05$) large intestines value than cows in moderate condition (BCS of 4, 5, and 6). On the other hand, value of the oxlips was lower ($P < .05$) for BCS-7 and 8 cows than cows designated with a BCS of 2, 3, 4, or 5. Cows assigned a BCS of 3 and 8 had higher ($P < .05$) cheek meat values than BCS-4, 5, 6, and 7 cows. The total value of the hide and by-products (referred to as drop credit) for the thinnest-conditioned (BCS-2) cows was greater ($P < .05$) than for cows assigned a BCS of 3 through 8, and drop credit tended to decrease linearly ($P = .0001$) with increases in the external fatness/body condition of these beef cows.

The value of subprimal cuts, minor cuts, lean trimmings, fat, and bone from U.S. Utility carcasses is reported in Table 3. Within the Utility grade, BCS had no ($P > .05$) effect on the value of the chuck roll, ribeye roll, strip loin, bottom sirloin butt, flank steak, or lean trimmings. The shoulder clod from carcasses of BCS-3 and 5 cows had more ($P < .05$) value than the shoulder clod from carcasses of BCS-7 or 8 cows. Moreover, carcasses from BCS-5 cows had more valuable ($P < .05$) chuck tenders than carcasses of BCS-6, 7, and 8 cows. Top sirloin butts from carcasses of BCS-3 and 5 cows and tenderloins from carcasses of BCS-3 cows had greater ($P < .05$) value than those from carcasses of cows assigned a BCS of 6, 7, or 8. Value of the knuckle was higher ($P < .05$) for carcasses from BCS-4 cows than carcasses of cows assigned a BCS of 7 or 8. Inside rounds from BCS-7 and 8 cows were of less ($P < .05$) value than inside rounds from BCS-3 and 5 cows. Carcasses of BCS-8 cows had less ($P < .05$) valuable outside rounds than carcasses of cows assigned a BCS of 3, 5, 6, and 7, and less ($P < .05$) valuable eye of rounds than carcasses of cows assigned a BCS of 3, 4, 5, and 6.

Fat value increased linearly ($P = .0262$) and bone value decreased linearly ($P = .0001$) as BCS increased from 3 to 8 (Table 3). Carcasses from BCS-8 cows had the least ($P < .05$) valuable subprimal cuts from the chuck, loin, and round; therefore, within the Utility grade, carcasses from the fattest group (BCS of 8) of cows had less ($P < .05$) total value than all other groups of cows.

The value of U.S. Cutter carcasses and their components is reported in Table 4. The shoulder clod from BCS-4, 5, and 6 cows had more ($P < .05$) value than that from BCS-2 and 3 cows. Value of the chuck roll was similar ($P > .05$) across BCS; however, chuck tenders from carcasses of BCS-2 cows were more ($P < .05$) valuable than chuck tenders from carcasses of BCS-5 and 6 cows. Even though carcasses from BCS-6 cows had higher ($P < .05$) strip loin values than carcasses from BCS-2 and 4 cows, BCS had no ($P > .05$) effect on the value of the ribeye roll, top sirloin butt, bottom sirloin butt, or tenderloin. Knuckles from carcasses of

BCS-5 cows were less ($P < .05$) valuable than knuckles from carcasses of BCS-2, 4, and 6 cows. Carcasses from cows assigned a BCS of 6 produced more valuable ($P < .05$) inside rounds than carcasses of BCS-2 and 5 cows. Moreover, outside round values from BCS-5 and 6 cows were greater ($P < .05$) than outside rounds from carcasses of cows assigned a BCS of 2 or 3. Carcasses from BCS-2 cows had less ($P < .05$) valuable eye of rounds than carcasses from BCS-3, 5, and 6 cows, whereas carcasses from BCS-2 and 4 cows had more ($P < .05$) valuable flank steaks than carcasses from BCS-5 and 6 cows.

Within the U.S. Cutter grade, carcasses from cows assigned a BCS of 2 had less ($P < .05$) valuable lean trimmings and greater ($P < .05$) bone values than carcasses of BCS-3, 5, and 6 cows (Table 4). Value of fat removed during fabrication was not ($P > .05$) affected by BCS. The total value of Cutter grade carcasses from BCS-6 cows was greater ($P < .05$) than carcasses from BCS-2, 4, and 5 cows, because BCS-6 cows produced carcasses with the most valuable strip loins, subprimal cuts from the round, and lean trimmings.

When comparing across quality grades within a BCS, U.S. Utility carcasses had higher total values per 100 kg. Subprimal cuts from the chuck, rib, and loin of Utility carcasses received higher prices than those from Cutter carcasses. The price extensions for the chuck tender, ribeye roll, tenderloin, knuckle, and flank steak were much higher for Utility carcasses than for Cutter carcasses. The inside round, outside round, and eye of round from Cutter carcasses, however, had higher price differentials than these round cuts from Utility carcasses. Some subprimal cuts from U.S. Cutter carcasses are not marketed like those from U.S. Utility carcasses. The shoulder clod, chuck roll, strip loin, top sirloin butt, and bottom sirloin butt from U.S. Cutter carcasses are marketed by the nonfed beef industry as lean trim instead of closely trimmed subprimal cuts.

Component values of all carcasses, across both quality grades (Utility/Cutter mix), are presented in Table 5. Although the values of the shoulder clod and top sirloin butt were similar ($P > .05$) across BCS groups, the chuck roll and strip loin from carcasses of cows assigned a BCS of 7 and 8 had values that were higher ($P < .05$) than those from cows receiving a BCS ≤ 5 . Carcasses from BCS-2 cows had more valuable ($P < .05$) chuck tenders and flank steaks than carcasses from carcasses assigned a BCS of 3 or higher. The value of the ribeye roll from carcasses of BCS-6, 7, and 8 cows was greater ($P < .05$) than from carcasses of cows designated with a BCS of 2, 3, and 5. Moreover, carcasses of BCS-7 cows produced more ($P < .05$) valuable bottom sirloin butts than carcasses from BCS-2 and BCS-4 cows. Tenderloin value decreased linearly ($P = .0003$) as BCS increased from 3 to 8, with carcasses from BCS-3 cows having higher ($P < .05$) tenderloin values than carcasses from BCS-4, 6, 7, and 8 cows. Knuckle from carcasses of BCS-2 and 4 cows were more ($P < .05$) valuable than knuckle from carcasses of BCS-5, 7, and

Table 3. Least squares means (\pm SE) for component values (U.S./100 kg hot carcass weight) of U.S. Utility carcasses from cull beef cows differing in body condition score

Item	Price ^a	Body condition score						L ^b	Q
		3	4	5	6	7	8		
Shoulder clod	221.10	13.06 ^c \pm 1.40	10.79 ^{cd} \pm .75	12.70 ^c \pm .53	11.46 ^{cd} \pm .60	10.61 ^d \pm .57	9.60 ^d \pm .81	.0133	.1474
Chuck roll	221.10	12.21 \pm 1.40	13.99 \pm .75	13.53 \pm .53	14.13 \pm .60	13.73 \pm .57	13.77 \pm .81	.6405	.4971
Chuck tender	248.60	2.12 ^{cd} \pm .13	2.05 ^{cd} \pm .07	2.15 ^c \pm .05	1.94 ^{de} \pm .05	1.83 ^e \pm .05	1.51 ^f \pm .07	.0186	.0018
Ribeye roll	378.40	9.88 \pm 1.60	11.19 \pm .85	10.41 \pm .60	11.19 \pm .68	10.97 \pm .65	10.75 \pm .92	.7372	.7617
Strip loin	334.40	9.45 \pm .95	8.97 \pm .51	9.08 \pm .36	9.99 \pm .41	9.19 \pm .39	9.48 \pm .55	.5348	.7214
Top sirloin butt	248.60	9.65 ^c \pm .76	8.25 ^{cd} \pm .40	8.70 ^c \pm .29	7.60 ^{de} \pm .32	7.67 ^{de} \pm .31	6.96 ^e \pm .44	.0004	.8982
Bottom sirloin butt	235.40	7.05 \pm .86	5.89 \pm .46	6.99 \pm .33	6.21 \pm .37	6.51 \pm .35	5.57 \pm .50	.2713	.2623
Tenderloin	739.20	16.51 ^c \pm 1.25	13.02 ^{de} \pm .67	14.42 ^{cd} \pm .47	12.36 ^e \pm .53	12.91 ^e \pm .51	10.61 ^f \pm .72	.0004	.5233
Knuckle	259.60	6.18 ^{cd} \pm .76	6.37 ^c \pm .41	6.09 ^{cd} \pm .29	6.06 ^{cd} \pm .33	5.35 ^{de} \pm .31	4.79 ^e \pm .44	.0032	.2105
Inside round	290.40	18.63 ^c \pm 1.12	16.74 ^{cd} \pm .60	17.16 ^c \pm .42	16.27 ^{cd} \pm .48	15.39 ^{de} \pm .46	13.93 ^e \pm .65	.0001	.2397
Outside round	275.00	12.80 ^c \pm 1.00	11.22 ^{cd} \pm .54	12.19 ^c \pm .38	11.90 ^c \pm .43	11.66 ^c \pm .41	9.75 ^d \pm .58	.0902	.0486
Eye of round	301.40	5.74 ^c \pm .44	4.67 ^d \pm .23	4.93 ^{cd} \pm .17	4.74 ^d \pm .19	4.57 ^{de} \pm .18	3.96 ^e \pm .25	.0026	.4501
Flank steak	356.40	1.98 \pm .31	1.95 \pm .17	1.93 \pm .12	1.79 \pm .13	1.71 \pm .13	1.63 \pm .18	.0608	.7664
Lean trimmings, 70:30	156.20	39.92 \pm 2.19	42.48 \pm 1.17	42.83 \pm .83	43.02 \pm .93	42.20 \pm .89	41.62 \pm 1.26	.9009	.1501
Fat	50.60	1.40 ^c \pm .89	2.68 ^{cd} \pm .48	2.02 ^c \pm .34	3.60 ^{de} \pm .38	4.59 ^e \pm .37	7.25 ^f \pm .52	.0262	.0016
Bone	28.60	6.77 ^c \pm .42	6.10 ^{cd} \pm .23	6.13 ^c \pm .16	5.58 ^{de} \pm .18	5.36 ^e \pm .17	4.65 ^f \pm .24	.0001	.3303
Total		173.32 ^c \pm 4.48	166.37 ^c \pm 2.39	171.25 ^c \pm 1.69	167.83 ^c \pm 1.91	164.22 ^c \pm 1.83	155.84 ^d \pm 2.59	.0524	.0148

^a1997 average prices (U.S./100 kg hot carcass weight).

^bSignificance of linear (L) and quadratic (Q) effects of body condition scores.

^{c,d,e,f}Within a row, least squares means lacking a common superscript letter differ ($P < .05$).

Table 4. Least squares means (\pm SE) for component values (U.S.\$/100 kg hot carcass weight) of U.S. Cutter carcasses from cull beef cows differing in body condition scores

Item	Price ^a	Body condition score					L ^b	Q
		2	3	4	5	6		
Shoulder clod	156.20	7.85 ^c \pm .39	7.53 ^c \pm .48	9.13 ^d \pm .48	9.08 ^d \pm .23	9.53 ^d \pm .48	.0006	.9676
Chuck roll	156.20	8.76 \pm .48	10.33 \pm .59	8.80 \pm .59	9.04 \pm .28	10.10 \pm .59	.6219	.6185
Chuck tender	244.20	2.40 ^c \pm .09	2.15 ^{cd} \pm .12	2.26 ^{cd} \pm .12	2.04 ^d \pm .05	2.07 ^d \pm .12	.0038	.3882
Ribeye roll	260.15	6.58 \pm .37	7.04 \pm .45	6.28 \pm .45	7.35 \pm .21	7.48 \pm .45	.0473	.6433
Strip loin	156.20	3.04 ^c \pm .34	4.04 ^{de} \pm .28	3.42 ^{cd} \pm .28	4.01 ^{de} \pm .13	4.37 ^e \pm .28	.0008	.8774
Top sirloin butt	156.20	5.20 \pm .21	5.46 \pm .25	5.14 \pm .25	5.35 \pm .12	5.34 \pm .25	.6839	.9029
Bottom sirloin butt	156.20	3.66 \pm .27	4.48 \pm .34	3.79 \pm .34	4.52 \pm .16	4.26 \pm .34	.0475	.3599
Tenderloin	660.00	14.21 \pm .62	14.19 \pm .76	12.99 \pm .76	12.80 \pm .36	13.82 \pm .76	.1047	.1839
Knuckle	253.00	7.13 ^c \pm .50	6.03 ^{cd} \pm .62	7.61 ^c \pm .62	5.60 ^d \pm .29	7.04 ^c \pm .62	.1557	.2296
Inside round	345.40	20.09 ^c \pm .52	20.96 ^{cd} \pm .63	21.44 ^{cd} \pm .63	20.44 ^c \pm .30	22.64 ^d \pm .63	.1396	.3043
Outside round	332.20	13.04 ^c \pm .43	12.96 ^c \pm .53	13.84 ^{cd} \pm .53	14.19 ^d \pm .25	15.41 ^e \pm .53	.0005	.1942
Eye of round	332.20	4.35 ^c \pm .21	5.39 ^d \pm .26	4.79 ^{cd} \pm .26	5.26 ^d \pm .12	5.45 ^d \pm .26	.0026	.4578
Flank steak	347.60	2.98 ^c \pm .23	2.33 ^{cd} \pm .28	2.56 ^c \pm .28	1.93 ^d \pm .13	1.83 ^d \pm .28	.0002	.6262
Lean trimmings, 70:30	156.20	36.41 ^c \pm 1.29	40.98 ^d \pm 1.58	36.75 ^c \pm 1.58	40.86 ^d \pm .75	42.83 ^d \pm 1.58	.0043	.7086
Fat	50.60	.90 \pm .27	.92 \pm .33	.42 \pm .33	1.29 \pm .16	1.18 \pm .33	.1616	.5827
Bone	28.50	8.57 ^c \pm .26	7.50 ^d \pm .31	7.77 ^{cd} \pm .31	6.54 ^e \pm .15	6.38 ^e \pm .31	.0001	.5128
Total		145.17 ^c \pm 2.29	152.28 ^{cd} \pm 2.81	146.97 ^c \pm 2.81	150.30 ^c \pm 1.32	159.71 ^d \pm 2.81	.0094	.1758

^a1997 average prices (U.S.\$/100 kg hot carcass weight).

^bSignificance of linear (L) and quadratic (Q) effects of body condition scores.

^{c,d,e}Within a row, least squares means lacking a common superscript letter differ ($P < .05$).

Table 5. Least squares means (\pm SE) for component values (U.S.\$/100 kg hot carcass weight) of carcasses (U.S. Utility/Cutter mix) from cull beef cows differing in body condition scores

Item	Body condition score							L ^a	Q
	2	3	4	5	6	7	8		
Shoulder clod	7.85 \pm .87	9.38 \pm .87	10.19 \pm .65	10.66 \pm .38	10.94 \pm .55	10.61 \pm .62	9.60 \pm .87	.0017	.0047
Chuck roll	8.76 ^b \pm 1.02	10.95 ^{bc} \pm 1.02	12.11 ^{cd} \pm .75	11.00 ^c \pm .44	13.05 ^{cd} \pm .64	13.73 ^d \pm .72	13.77 ^d \pm 1.02	.0001	.9396
Chuck tender	2.40 ^b \pm .08	2.14 ^c \pm .08	2.12 ^c \pm .06	2.09 ^c \pm .04	1.97 ^{cd} \pm .05	1.83 ^d \pm .06	1.51 ^e \pm .08	.0001	.0580
Ribeye roll	6.58 ^b \pm .96	7.98 ^b \pm .96	9.41 ^{cd} \pm .71	8.69 ^c \pm .41	10.20 ^d \pm .61	10.97 ^d \pm .68	10.75 ^d \pm .96	.0001	.8233
Strip loin	3.04 ^b \pm 1.02	5.84 ^{bc} \pm 1.02	6.95 ^{cd} \pm .75	6.23 ^c \pm .44	8.49 ^{de} \pm .64	9.19 ^e \pm .72	9.48 ^e \pm 1.02	.0001	.8539
Top sirloin butt	5.20 \pm .66	6.86 \pm .66	7.12 \pm .49	6.81 \pm .29	6.99 \pm .42	7.67 \pm .47	6.96 \pm .66	.0344	.2521
Bottom sirloin butt	3.66 ^b \pm .58	5.33 ^{cd} \pm .58	5.13 ^c \pm .43	5.60 ^{cd} \pm .25	5.69 ^{cd} \pm .36	6.51 ^d \pm .41	5.57 ^{cd} \pm .58	.0014	.1204
Tenderloin	14.21 ^{bc} \pm .72	14.96 ^b \pm .72	13.01 ^c \pm .53	13.51 ^{bc} \pm .31	12.75 ^c \pm .45	12.91 ^c \pm .51	10.61 ^d \pm .72	.0003	.2737
Knuckle	7.13 ^b \pm .47	6.08 ^{bcd} \pm .47	6.82 ^b \pm .35	5.82 ^{cd} \pm .21	6.32 ^{bc} \pm .30	5.35 ^{de} \pm .34	4.79 ^e \pm .47	.0004	.6455
Inside round	20.09 ^{bc} \pm .94	20.18 ^b \pm .94	18.45 ^{bc} \pm .70	19.01 ^{bc} \pm .41	17.97 ^c \pm .60	15.39 ^d \pm .67	13.93 ^d \pm .94	.0001	.0086
Outside round	13.04 ^{bc} \pm .66	12.90 ^{bc} \pm .66	12.17 ^c \pm .49	13.31 ^b \pm .29	12.83 ^{bc} \pm .42	11.66 ^c \pm .47	9.75 ^d \pm .66	.0028	.0011
Eye of round	4.35 ^{ef} \pm .24	5.51 ^b \pm .24	4.71 ^{cde} \pm .18	5.12 ^{bc} \pm .10	4.93 ^{cd} \pm .15	4.57 ^{de} \pm .17	3.96 ^f \pm .24	.0005	.0001
Flank steak	2.98 ^b \pm .20	2.21 ^c \pm .20	2.17 ^c \pm .15	1.93 ^{cd} \pm .09	1.80 ^{cd} \pm .13	1.71 ^d \pm .14	1.63 ^d \pm .20	.0019	.0316
Lean trimmings	36.41 ^b \pm 1.34	40.63 ^c \pm 1.34	40.40 ^c \pm .99	41.72 ^c \pm .58	42.97 ^c \pm .84	42.20 ^c \pm .94	41.62 ^c \pm 1.34	.0021	.0124
Fat	.90 ^b \pm .50	1.08 ^b \pm .50	1.85 ^b \pm .37	1.61 ^b \pm .22	2.95 ^c \pm .32	4.59 ^d \pm .35	7.25 ^e \pm .50	.0005	.0001
Bone	8.57 ^b \pm .29	7.26 ^c \pm .29	6.70 ^{cd} \pm .21	6.36 ^d \pm .12	5.79 ^e \pm .18	5.36 ^e \pm .20	4.65 ^f \pm .29	.0001	.2384
Total	145.17 ^b \pm 4.06	159.29 ^{cd} \pm 4.06	159.32 ^{cd} \pm 3.00	159.46 ^{cd} \pm 1.76	165.66 ^d \pm 2.57	164.22 ^{cd} \pm 2.87	155.84 ^{bc} \pm 4.06	.0027	.0095

^aSignificance of linear (L) and quadratic (Q) effects of body condition scores.

^{b,c,d,e,f}Within a row, least squares means lacking a common superscript letter differ ($P < .05$).

8 cows. Carcasses from BCS-3 cows had greater ($P < .05$) inside round values than carcasses from BCS-6, 7, and 8 cows, whereas carcasses from BCS-5 cows had higher ($P < .05$) outside round values than cows assigned a BCS of either 4 or 7 and 8. The value of the eye of round from BCS-3 cows was higher ($P < .05$) than the thinnest (BCS-2) and fatter (BCS-6, 7, and 8) cows.

Lean trimmings from BCS-2 cows were of less ($P < .05$) value than all other BCS groups (Table 5). Value of fat removed during carcass fabrication was highest ($P < .05$) for BCS-8 cows, and carcasses from BCS-7 carcasses had greater ($P < .05$) fat values than carcasses from BCS ≤ 6 cows. Bone value decreased linearly ($P = .0001$) as BCS increased from 2 to 8. Total carcass value increased ($P < .05$) from \$145.17/100 kg at a BCS of 2 to \$165.66/100 kg at a BCS of 6 and then tailed off to \$155.84/100 kg at a BCS of 8. The rise in value from BCS 2 to 6 is indicative of the observed change in the percentage of cows grading U.S. Utility. The price differential between Utility and Cutter carcasses greatly influences the value of carcasses from BCS 2 through 6 cows. Although 100% of the carcasses from BCS-7 and BCS-8 cows graded U.S. Utility or higher, the downward turn in carcass value may be explained by increased fabrication costs and higher trim losses.

Absolute gross and net values, as well as live value, of cull beef cows can be found in Table 6. Within the grade of U.S. Cutter, carcasses from BCS-2 cows had the lowest ($P < .05$) and carcasses from BCS-6 cows had the highest ($P < .05$) gross and net values. By contrast, BCS had no ($P > .05$) effect on the live value of cows, when their carcasses received a quality grade of U.S. Cutter or lower. Among U.S. Utility carcasses, the gross and net values of BCS-8 cows were greater ($P < .05$) than the gross values of BCS-3, 4, 5, and 6; however, the live value of cows producing Utility carcasses was unaffected ($P > .05$) by BCS.

Across both quality grades (Mix), gross and net value increased linearly ($P = .0001$) as BCS increased from 2 to 8 (Table 6). Cows designated with a BCS of 7 and 8 had greater ($P < .05$) gross and net values than cows assigned a BCS of 6 or lower. Moreover, BCS-6 cows had higher ($P < .05$) gross and net values than BCS-2, 3, 4, and 5 cows; BCS-2 cows had the lowest ($P < .05$) gross and net values. Live value also increased linearly ($P = .0002$) from a low of \$76.10/100 kg for BCS-2 cows to a high of \$90.84/100 kg for BCS-7 cows.

Discussion

Quality grades are designed to segregate carcasses into predictable palatability groups, and the quality grades presently applicable to carcasses of mature cows are U.S. Commercial, Utility, Cutter, and Canner (USDA, 1989). Moreover, quality grades have some bearing on what type of products can be fabricated from carcasses of mature cows. Because many cull beef cows are typically marketed in poor condition immediately after being culled from the breeding herd, their car-

casces have the inferior lean-quality characteristics indicative of the lowest two quality grades (U.S. Cutter and Canner). These low-quality carcasses are destined for the production of "manufacturing beef," used in ground beef and sausage production (Hilton et al., 1996). On the other hand, fatter carcasses with desirable lean-quality characteristics equivalent to U.S. Commercial and/or Utility are typically fabricated into several boneless subprimal cuts from the rib, loin, and round that can be marketed to the food-service trade (Hodgson et al., 1992). For this reason, the National Non-Fed Quality Audit concluded that cattle producers could recover approximately \$14.60 per animal by simply improving cattle management practices to minimize quality deficiencies (Smith et al., 1994).

Smith et al. (1994) also indicated that cattle producers could recoup \$27.65 per non-fed animal by monitoring body condition, and an additional \$27.65 by marketing cows in a timely manner. In many regions of the United States, beef cows are bred to calve in the spring. As a result, cows are culled at weaning in late autumn, resulting in significant seasonal variations in live slaughter cow prices (Yager et al., 1980).

The most obvious alternative is to feed cull cows a high-energy diet to improve external fatness/body condition and carcass quality characteristics, thereby delaying the sale of these cows to the spring when seasonal prices are the highest. In one of the first cow-feeding experiments, Wooten et al. (1979) reported that fat thickness, marbling, and boneless carcass weight increased by feeding a high-concentrate diet to cull cows. Subsequent research has shown that feeding a high-energy diet to cull beef cows can increase carcass fat content (Faulkner et al., 1989; Cranwell et al., 1996b; Schnell et al., 1997), increase lean meat yields (Matulis et al., 1987; Cranwell et al., 1996b; Schnell et al., 1997), increase marbling in the longissimus muscle (Matulis et al., 1987; Faulkner et al., 1989; Cranwell et al., 1996a), produce a whiter external fat cover (Schnell et al., 1997), and improve cooked meat palatability (Cranwell et al., 1996a; Boleman et al., 1996; Schnell et al., 1997).

Information from this study shows that BCS can be useful to both cow-calf producers and slaughter-cow processors in making market decisions. Although BCS-7 and BCS-8 cows produced carcasses grading U.S. Utility or higher and had the highest gross and net values, carcasses from these two scores had the lowest yields of trimmed or denuded subprimal cuts from the chuck and round (Apple et al., 1999). Additionally, carcasses from BCS-7 and 8 cows would incur the greatest labor costs associated with trimming subprimal cuts. Cows assigned a BCS of 2 had the greatest by-product values, but these values may be somewhat inflated because very few by-products from these cows were condemned during the slaughter process. Moreover, BCS-2 cows produced the least valuable carcasses and also had the lowest gross, net, and live values among all BCS. Beef cows designated with a BCS of 2 would require additional feed inputs to improve carcass quality traits, car-

Table 6. Least squares means (\pm SE) for gross, net, and live values of cull beef cows differing in body condition score

Item	Body condition score							L ^a	Q
	2	3	4	5	6	7	8		
	Gross value, U.S.\$ ^e								
Cutter ^b	323.55 ^h \pm 17.84	403.37 ⁱ \pm 19.95	408.73 ⁱ \pm 19.95	434.76 ⁱ \pm 9.40	496.32 ^j \pm 19.95			.0001	.9467
Utility ^c		536.76 ^{hi} \pm 50.51	523.95 ^{hi} \pm 27.00	504.68 ^h \pm 19.09	563.19 ^{ij} \pm 21.54	611.94 ^{jk} \pm 20.62	659.12 ^k \pm 29.16	.1507	.0437
Mix ^d	323.55 ^h \pm 31.29	447.83 ⁱ \pm 28.56	482.05 ⁱ \pm 21.10	465.35 ⁱ \pm 12.37	545.36 ^j \pm 18.07	611.94 ^k \pm 20.20	659.12 ^k \pm 28.56	.0001	.2385
	Net value, U.S.\$ ^f								
Cutter ^b	266.42 ^h \pm 16.40	339.70 ⁱ \pm 18.33	343.58 ⁱ \pm 18.33	367.24 ⁱ \pm 8.64	425.58 ^j \pm 18.33			.0001	.8850
Utility ^c		464.93 ^{hi} \pm 46.45	451.71 ^h \pm 24.83	435.14 ^h \pm 17.56	487.46 ^{hi} \pm 19.80	531.21 ^{ij} \pm 18.96	571.34 ^j \pm 26.82	.0001	.0532
Mix ^d	266.42 ^h \pm 29.03	381.44 ⁱ \pm 26.50	412.39 ⁱ \pm 19.57	396.95 ⁱ \pm 11.47	470.96 ^j \pm 16.76	531.21 ^k \pm 18.74	571.34 ^k \pm 26.50	.0001	.2776
	Live value, U.S.\$/100 kg ^g								
Cutter ^b	76.10 \pm 3.26	76.61 \pm 3.65	69.05 \pm 3.65	76.73 \pm 1.72	80.56 \pm 3.65			.4302	.1372
Utility ^c		91.84 \pm 4.76	90.13 \pm 2.54	89.37 \pm 1.80	91.51 \pm 2.03	90.84 \pm 1.94	89.58 \pm 2.75	.9400	.9432
Mix ^d	76.10 ^h \pm 4.10	81.69 ^{hi} \pm 3.75	82.46 ^{hi} \pm 2.77	82.26 ^{hi} \pm 1.62	88.59 ^{ij} \pm 2.37	90.84 ^j \pm 2.65	89.58 ^{ij} \pm 3.75	.0002	.8483

^aSignificance of linear (L) and quadratic (Q) effects of body condition scores.

^bCarcasses with quality characteristics indicative of the U.S. Cutter quality grade.

^cCarcasses with quality characteristics indicative of the U.S. Utility quality grade.

^dRepresents all carcasses across the mix of U.S. Utility and Cutter quality grades.

^eGross value is the sum of the carcass value and the offal value.

^fNet value is the gross value minus a slaughter fee (\$28.00/animal) and a fabrication fee (\$17.05/100 kg hot carcass weight).

^gLive value is the net value divided by the live weight of the animal.

^{h,i,j,k}Within a row, least squares means lacking a common superscript letter differ ($P < .05$).

cass value, and, ultimately, live value; however, feeding cull beef cows can introduce a substantial amount of risk due to increased feed costs (Yager and Greer, 1977). Data from this study indicate that marketing cows at a BCS of 6 could optimize economic returns to both cow-calf producers and non-fed beef packers. Feeding to, or marketing at, a BCS of 6 would result in a high percentage (73.3%) of carcasses grading U.S. Utility and maximize total lean product yields (Apple et al., 1999). Carcasses from BCS-6 cows were lean ($8.4 \pm .9$ mm fat thickness) and would produce subprimal cuts requiring minimal trimming to achieve a marketable fat-trim level of 6.4 mm.

Implications

Body condition at harvest affects product, carcass, and live values. Fatter cows, with a body condition score (BCS) of 7 or 8, should have the greatest gross and net values because their carcasses should grade U.S. Utility or higher. Subprimal cuts from these carcasses would incur the greatest labor costs associated with trimming to a marketable fat-trim level. Thin-conditioned (BCS-2 and 3) cows will have less value and may require additional feed to improve their value. The non-fed beef industry could optimize returns to producers and processors by marketing cull beef cows with a BCS of 6. Carcasses from BCS-6 cows should be the most valuable, and the live value should be similar to BCS-7 and 8 cows. Information about carcasses from cull cows is necessary as the non-fed beef industry moves closer to a value-based marketing system.

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