National Beef Quality Audit–1995: Survey of Producer-Related Defects and Carcass Quality and Quantity Attributes[1]

S. L. Boleman*, S. J. Boleman*, W. W. Morgan*, D. S. Hale*, D. B. Griffin*, J. W. Savell*,[2], R. P. Ames†, M. T. Smith†, J. D. Tatum†, T. G. Field†, G. C. Smith†, B. A. Gardner‡, J. B. Morgan‡, S. L. Northcutt‡, H. G. Dolezal‡, D. R. Gill‡, and F. K. Ray‡

*Texas Agricultural Experiment Station, Department of Animal Science, Texas A&M University, College Station 77843-2471; †Department of Animal Sciences, Colorado State University, Fort Collins 80523; and ‡Department of Animal Science, Oklahoma State University, Stillwater 74078-0425

ABSTRACT: The National Beef Quality Audit–1995 was conducted to evaluate the progress of the beef industry since the time of the National Beef Quality Audit–1991 in improving quality and consistency of beef. Nine plants were assigned for auditing to Colorado State University, Oklahoma State University, and Texas A&M University. Personnel from each institution visited three of their nine plants twice, once in the spring/summer and once in the fall/winter. Data were collected on 50% of each lot on the slaughter floor and 10% in the cooler during a single day's production (one or two shifts, as appropriate). Of the cattle audited on the slaughter floor, 47.7% had no brands, 3.0% had a shoulder brand, 16.8% had a side brand, 38.7% had a butt brand, and 6.2% had brands in multiple locations. Data revealed that 51.6% of the carcasses had no bruises, 30.9% had one bruise, 12.8% had two bruises, 3.7% had three bruises, .9% had four bruises, and .1% had more than four bruises. In addition, 7.2% of the bruises evaluated were located on the round, 41.1% were on the loin, 20.8% on the rib, and 30.8% on the chuck. Livers, lungs, tripe, heads, tongues, and whole carcasses were condemned at rates of 22.2, 5.0, 11.0, .9, 3.8, and .1%, respectively. Mean USDA yield grade and quality grade traits were as follows: USDA yield grade, 2.8; carcass weight, 338.4 kg; adjusted fat thickness, 1.2 cm; longissimus muscle area, 81.9 cm^2; kidney, pelvic, and heart fat, 2.1%; USDA quality grade, High Select; overall maturity, A^{60}; and marbling score, Small-minus.

Key Words: Beef Quality, Meat Grades, Market Surveys

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Introduction

The USDA Market Consist Report (USDA, 1974) described cattle characteristics of that time; this information provided a benchmark for future studies of this kind. In the years following the USDA Market Consist Report, changes that influenced the beef industry included the influx of Continental European breeds of cattle and diet/health concerns of consumers. The National Beef Quality Audit–1991 (**NBQA–1991**; Smith et al., 1992; Lorenzen et al., 1993) was conducted to assess the impact of such changes and to establish production targets. Additionally, economic losses were quantified to illustrate the impact of producer practices on carcass value. Results of the NBQA–1991 were used to identify for producers steps to take to improve the quality and consistency of beef.

A recommendation was made in the NBQA–1991 (Smith et al., 1992) to conduct audits every 4 to 5 yr so producers could stay abreast of current changes in the beef industry. The National Beef Quality Audit–1995 (**NBQA–1995**) was conducted to monitor progress in the quality and if necessary to make midcourse corrections in advice offered to beef producers with regard to improving the quality, consistency, and competitiveness of beef.

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[2]To whom inquiries should be addressed (409-845-3935; Fax: 409-845-9454; E-mail: j-savell@tamu.edu).

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Materials and Methods

Nine federally inspected packing plants were assigned for auditing to Colorado State University, Oklahoma State University, and Texas A&M University (Table 1). Personnel from each institution visited three of their nine plants twice, once in the spring/summer and once in the fall/winter. Data were collected during a single day's production (one or two shifts, as appropriate) on the slaughter floor and in the cooler.

Slaughter Floor. On the slaughter floor, brands, bruises, viscera condemnations, and head/tongue condemnations were evaluated by observing 56,612, 42,156, 50,517, and 47,581 for these defects, respectively. Cattle in approximately 50% of each slaughter lot were evaluated for such defects. Incidence, location, and size of hot-iron brand scars within location were recorded. Hot-iron brand scars ("brands") on the round area were termed "butt" brands, those on the loin and(or) rib were termed "side" brands, and those on the shoulder were termed "shoulder" brands. Also, cattle were given a mud score (0 = no mud; 1 = mud on legs; 2 = mud on legs and belly; 3 = mud on legs, belly, and side) and were evaluated for presence or absence of horns (a horn is defined as any growth that required mechanical removal in the plant).

Carcasses were evaluated for the number and location of bruises, and each bruise was given a severity score (minor = .30 kg of trim to remove the bruise; major = .68 kg of trim to remove the bruise; critical = more than 1.45 kg of trim to remove the bruise). Also, at this site on the slaughter floor, carcasses were evaluated for incidence, and if present, severity of grubs, injection sites, and contamination. Incidence of condemnation was determined for livers, lungs, tripe, heads, tongues, and whole carcasses.

Cooler. A total of 11,799 carcasses representing approximately 10% of each slaughter lot was evaluated for USDA yield and quality grade factors (USDA, 1989) by trained personnel from the participating universities. All data obtained in the cooler were measured and reported in the same manner as that in Lorenzen et al. (1993). Carcasses were assigned to one of three breed types: native, dairy, or *Bos indicus*. Carcasses with dorsal thoracic humps (rhomboideus muscle and overlying muscles and s.c. fat) > 10.2 cm in height were classified as *Bos indicus* breed types. Dairy type cattle were identified as such when the conformation of the various parts of the carcass was averaged (USDA, 1965), and the overall muscling was generally thin in relation to their skeletal size. All other carcasses were classified as native breed types.

Statistical Analysis. Statistical analyses were performed to generate means and frequency distributions (SAS, 1986). Analysis of variance was conducted to determine the effects of yield grade, quality grade, hot carcass weight class, sex class, and breed on USDA quality and yield grade factors. Least squares means were generated for each trait to account for unequal cell sizes. When analyses of variance indicated statistical significance ($P < .05$), mean separation analyses were performed using the LSD procedure to account for unequal cell sizes. Data from the present study were compared to those from the NBQA–1991 using *t*-tests (Moore and McCabe, 1989).

To calculate monetary losses to the beef industry for quality defects, it was assumed that 28.4 million cattle were slaughtered annually.

Table 1. Location of plants audited

Beef America	Norfolk, NE
Excel, Inc.	Dodge City, KS
Excel, Inc.	Fort Morgan, CO
Excel, Inc.	Friona, TX
Excel, Inc.	Plainview, TX
Excel, Inc.	Schuyler, NE
Harris Ranch	Selma, CA
Hy-Plains	Dodge City, KS
IBP, Inc.	Amarillo, TX
IBP, Inc.	Boise, ID
IBP, Inc.	Dakota City, NE
IBP, Inc.	Emporia, KS
IBP, Inc.	Garden City, KS
IBP, Inc.	Genesseo, IL
IBP, Inc.	Pasco, WA
Sam Kane Beef Processors	Corpus Christi, TX
Monfort, Inc.	Cactus, TX
Monfort, Inc.	Des Moines, IA
Monfort, Inc.	Garden City, KS
Monfort, Inc.	Grand Island, NE
Monfort, Inc.	Greeley, CO
National	Liberal, KS
Packerland	Hosper, IA
Packerland	Green Bay, WI
Sunland	Tolleson, AZ
Taylor	Wyalusing, PA
Washington Beef	Sunnyside, WA

Results and Discussion

Slaughter Floor. Of the cattle audited, 47.7% had no brands, 38.7% were butt-branded, 16.8% were side-branded, and 3.0% were shoulder-branded (Table 2). Furthermore, 93.9% of the cattle had one brand or less, 5.7% had brands in two locations (butt, side, or shoulder), and .4% had brands in three locations (butt, side, and shoulder). Of the cattle that had brands, the mean size of the brand on the side was 645 cm^2, on the butt was 232 cm^2, and on the shoulder was 316 cm^2 (data not shown in tabular form). Lorenzen et al. (1993) indicated that 55.0% of the cattle in that audit had no brands, whereas 13.8% had side brands; compared with the present data, there was a higher percentage of cattle with no brands and a lower percentage with side brands in the Lorenzen et al. (1993) study. Field (1995) identified management opportunities that could affect value and stated that the industry needs to eliminate rib (side) brands and

Table 2. Characteristics of branded hides

	Brand size				
Brand site	% of Sample[a]	Mean, cm^2	SD	Minimum, cm^2	Maximum, cm^2
Shoulder	3.0	326.0	328.1	6.5	2,580.6
Side	16.8	728.1	883.2	6.5	10,322.6
Butt	38.7	259.4	256.7	6.5	8,387.1

[a]47.7% of the cattle had no brands, and 6.2% of the cattle had brands in multiple locations.

standardize brand laws to eliminate multiple branding. Furthermore, a major packing company indicated that butt-branded and side-branded hides received $4.50 and $8.00 discounts, respectively, compared to native hides (Scanga et al., 1995).

Of the cattle scored for mud, 61.6% had a score of 0, 18.8% had a score of 1, 14.5% had a score of 2, and 5.1% had a score of 3 (data not shown in tabular form). Horns were present on 67.8% of the cattle. The percentage of cattle with mud and the percentage of cattle with horns increased in the present study compared to data from the NBQA–1991 (Lorenzen et al., 1993). The presence of horns and(or) mud could be a detriment to the production and(or) processing of cattle. The majority of U.S. cattle are purchased on a dressing percentage basis; the more mud present on hides, the lower the dressing percentage. Furthermore, the presence of mud could influence the safety of beef. During slaughtering/dressing, especially as the hide is removed, mud and(or) feces can contaminate the carcass. The presence of horns could adversely affect the live-animal performance of other cattle in the same pen and could increase the presence and severity of bruising.

In data not reported here in tabular form, 51.6% of the carcasses had no bruises, 30.9% had one bruise, 12.8% had two bruises, 3.7% had three bruises, .9% had four bruises, and .1% had more than four bruises. Of the bruises evaluated, 41.1% were located on the loin, 30.8% on the chuck, 20.8% on the rib, and 7.2% on the round. When data were analyzed comparing severity scores within location, 11% or fewer of the bruises were classified as “critical” on the round, loin, or chuck (Figure 1). Also, 43% or more of the bruises located on the round, loin, or chuck were classified as “minor.” However, the rib had 15.4 and 45.7% of the bruises classified as “critical” and “major,” respectively. This percentage of “critical” bruises on the rib is alarming because the cuts that are derived from this primal are high in price. Gardner (1995)

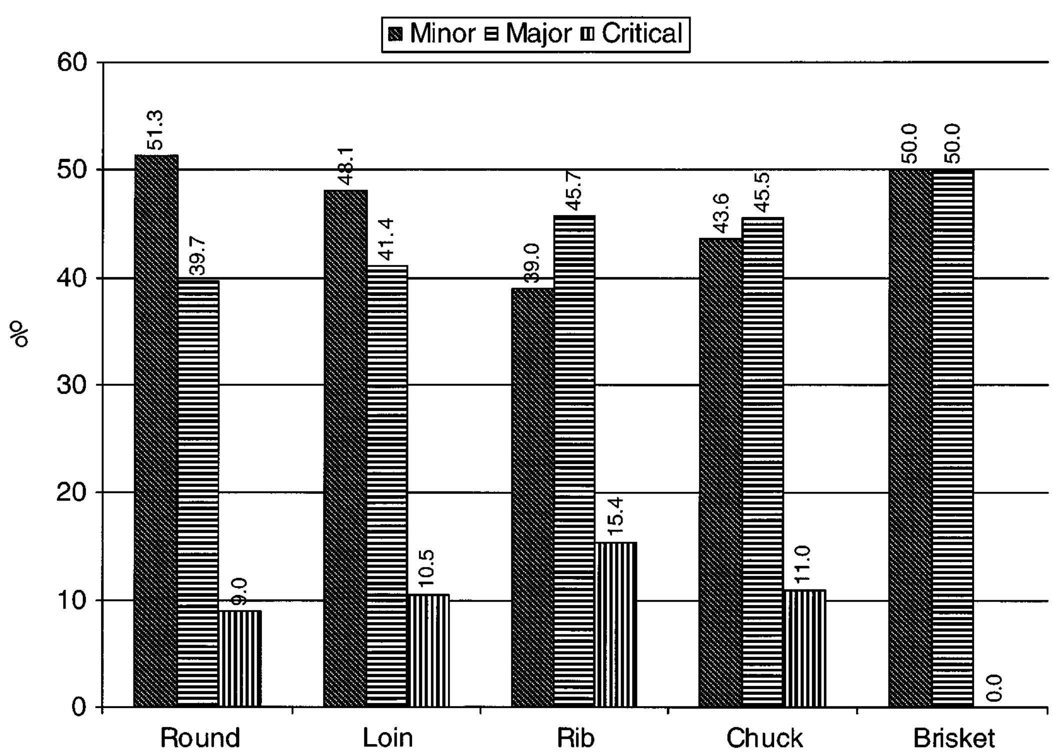

Figure 1. Frequency distribution of bruise severity within location.

Table 3. Means, standard deviations, and minimum and maximum values for USDA carcass grade traits

Trait	Mean	SD	Minimum	Maximum
USDA yield grade	2.8	.8	–.5	6.8
USDA quality grade[a]	679	56	307	883
Adjusted fat thickness, cm	1.2	.5	0	4.2
Carcass wt, kg	339.2	42.4	138.3	502.6
Longissimus muscle area, cm^2	82.6	10.3	38.7	128.4
Kidney, pelvic, and heart fat, %	2.1	.6	0	5.0
Marbling score[b]	406	90	150	950
Lean maturity[c]	154	19	100	330
Skeletal maturity[c]	163	31	100	490
Overall maturity[c]	160	23	100	400

[a]100 = $Canner^{00}$ and 800 = $Prime^{00}$.
[b]100 = Practically $devoid^{00}$ and 900 = $Abundant^{00}$.
[c]100 = A^{00} and 400 = D^{00}.

calculated the economic losses associated with carcass bruises, including the loss associated with trimming (and removal of weight) bruises from the carcass and the loss associated with the devaluation (creating a number-2 product) of the primals/subprimals. These data reveal that the beef industry is losing $4.03/animal for bruises and that bruising of cattle costs the beef industry $114,452,000 annually.

Grubs, injection sites, and contamination on the carcass occurred at a low rate (data not shown in tabular form). Of the carcasses surveyed, 99.7% had no grubs, 98.3% had no visible injection sites, and 97.4% of the carcasses had no visible contamination. Injection sites in beef cuts not only represent extensive monetary losses in terms of trim loss, but they also affect the tenderness attributes of affected cuts. George (1995) performed Warner-Bratzler shear force analyses on cooked steaks from rounds that had injection site lesions vs steaks from rounds that had no injection site lesions and found that lesion-afflicted steaks were significantly tougher even as far away as 7.62 cm from the lesion site. If injection-site lesions are present, the whole primal or subprimal could be devalued.

The incidence of condemnation for livers, lungs, tripe, heads, tongues, and whole carcasses was 22.2, 5.0, 11.0, .9, 3.8, and .1%, respectively. Of livers evaluated, 13.8% (62.2% of condemned livers) were condemned due to abscesses, 5.0% (22.5% of condemned livers) due to flukes, and 3.4% (15.3% of condemned livers) because of other reasons. Fetuses were present in 1.4% of the cattle audited. The incidence of condemnation was slightly higher for livers and tripe in the current audit than in those in the NBQA–1991 (Lorenzen et al., 1993). Gill and Smith (1995) estimated a $3.90/head loss due to condemnation losses; on a yearly basis, condemnation losses are estimated to be $110,760,000.

Cooler. Mean USDA yield grade and quality grade traits were as follows: USDA yield grade, 2.8; carcass weight, 339.2 kg; adjusted fat thickness, 1.2 cm; longissimus muscle area, 82.6 cm^2; kidney, pelvic, and heart fat, 2.1%; USDA quality grade, $Select^{79}$; overall maturity, A^{60}; and marbling score, $Small^{06}$ (Table 3).

Table 4. Occurrence[a] of marbling scores within USDA quality grades[b]

Marbling score	Overall[c]	Prime	Choice	Select	Standard
Abundant		1.4			
Moderately abundant	.3	15.0			
Slightly abundant	1.1	83.7	.1		
Moderate	3.3		6.6		
Modest	8.3		17.5		
Small	36.6		75.8	2.0	
$Slight^{+}$	15.4			32.3	1.3
$Slight^{\circ}$	13.4			28.1	3.7
$Slight^{-}$	17.7			37.6	13.4
Traces	3.7				79.7
Practically devoid	.1				1.9

[a]Rounding error prevents all categories from adding up to 100.0.
[b]USDA quality grade may have been affected by maturity and(or) dark cutting.
[c]Overall category represents USDA quality grades of Prime, Choice, Select, Standard, Commercial, Utility, and Cutter.

Table 5. Percentage distribution of carcasses stratified by USDA quality and yield grades[a]

Yield grade	Prime	Choice	Select	Standard	Commercial	Utility
1	.01	2.76	8.36	1.42	.04	.03
2	.33	19.49	23.63	1.49	.13	.17
3	.65	20.49	12.42	.39	.23	.09
4	.19	4.59	2.12	.06	.06	.04
5	.07	.49	.25	.01	.01	.00

[a]Carcasses with missing values for USDA quality or yield grades are not included.

Compared with data from the NBQA–1991 (Lorenzen et al., 1993), the carcasses in the current audit were lower ($P < .05$) in USDA yield grade (2.8 vs 3.2), adjusted fat thickness (1.2 vs 1.5 cm), carcass weight (339.2 vs 345.0 kg), kidney, pelvic, and heart fat (2.1 vs 2.2), marbling score (Small^{06} vs Small^{24}), and USDA quality grade (Select^{79} vs Select^{86}).

Data revealed that 1.6% of the carcasses had marbling scores that correspond to USDA Prime, 48.2% had marbling scores that correspond to USDA Choice, 46.5% had marbling scores that correspond to USDA Select, and 3.8% had marbling scores that correspond to USDA Standard (Table 4). Of the carcasses that graded USDA Choice, Select, or Standard, .1% of the USDA Choice, 2% of the USDA Select, and 18.4% of the USDA Standard had marbling scores that would have allowed them to grade USDA Prime, USDA Choice, or USDA Select, respectively (i.e., had enough marbling to have qualified for the next higher grade). These carcasses were penalized for being dark cutters and(or) for having a maturity score of “B.” Data revealed that 4.3% of the carcasses audited had a maturity score of “B,” and 2.7% were classified as dark cutters. Lorenzen et al. (1993) reported higher percentages of cattle that had marbling scores that corresponded to USDA Prime and Choice. Current data indicated that overall, marbling scores have decreased but there were fewer carcasses with marbling scores that corresponded to USDA Standard. The trend for the decrease in carcasses that had a marbling score of Traces or Practically Devoid is very encouraging, but the industry should be concerned with the decrease in the proportion of carcasses that have marbling scores that correspond to USDA Prime and Choice (Hale and Morgan, 1995). Morgan (1995) conducted an economic analysis associated with beef

Table 6. Least squares means of carcass traits (standard deviations) within quality grades

	USDA quality grade			
Trait	Prime	Choice	Select	Standard
USDA yield grade	3.4[d]	3.0[e]	2.6[f]	2.1[g]
	(.7)	(.7)	(.8)	(.8)
Adjusted fat thickness, cm	1.5[d]	1.3[e]	1.1[f]	.8[g]
	(.6)	(.5)	(.5)	(.4)
Carcass weight, kg	346.0[d]	343.1[d]	336.2[e]	330.0[f]
	(47.3)	(41.5)	(42.3)	(43.3)
Longissimus muscle area, cm^2	78.2[g]	81.4[f]	83.5[e]	86.4[d]
	(9.1)	(9.4)	(10.4)	(12.7)
Kidney, pelvic, and heart fat, %	2.3[d]	2.2[e]	2.0[f]	1.7[g]
	(.6)	(.6)	(.6)	(.6)
USDA quality grade[a]	818[d]	722[e]	646[f]	581[g]
	(15.4)	(21.4)	(27.1)	(16.0)
Marbling score[b]	755[d]	466[e]	348[f]	277[g]
	(46.6)	(64.8)	(29.1)	(34.3)
Lean maturity[c]	150[f]	151[f]	155[e]	164[d]
	(20.5)	(17.7)	(19.5)	(29.7)
Skeletal maturity[c]	168[d]	164[e]	160[f]	161[f]
	(32.1)	(26.0)	(24.6)	(29.3)
Overall maturity[c]	161[de]	159[e]	158[e]	163[d]
	(23.4)	(19.4)	(19.3)	(25.2)

[a]100 = Canner^{00} and 800 = Prime^{00}.
[b]100 = Practically devoid^{00} and 900 = Abundant^{00}.
[c]100 = A^{00} and 400 = D^{00}.
[d,e,f,g]Means within a row lacking a common superscript differ ($P < .05$).

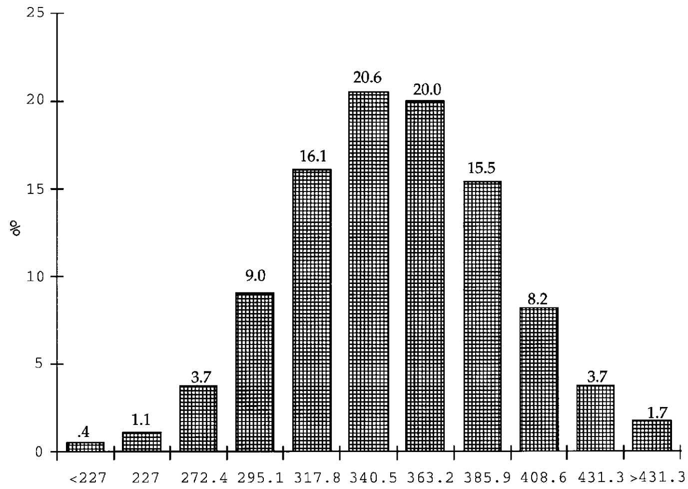

Figure 2. Frequency distribution across 11 carcass weight subclasses (partitioned in 22.7-kg increments).

toughness and reported that there are 1.7% consumer complaints, which corresponds to a loss of $7.64/ animal or, annually, to $216,976,000.

Carcasses were stratified across yield and quality grades, and the results are presented in Table 5. As expected, the majority of USDA Prime carcasses were of USDA yield grades 3 and 4, and the majority of the carcasses that graded USDA Choice or Select were of USDA yield grades 2 or 3. Approximately 75% of the carcasses evaluated were combinations of USDA Choice or Select and USDA yield grade 2 or 3.

Mean carcass traits within USDA quality grades are reported in Table 6. As USDA quality grade declined, USDA yield grade, adjusted fat thickness, and kidney, pelvic, and heart fat declined ($P < .05$). However, longissimus muscle area increased ($P < .05$) as USDA quality grade declined. As USDA yield grade increased in number (Table 7), adjusted fat thickness, carcass weight, kidney, pelvic, and heart fat, USDA quality grade, and marbling score generally increased. As numerical USDA yield grade decreased, longissimus muscle area increased ($P < .05$). The relationship of carcass weight to USDA quality and yield grade factors is illustrated in Table 8. The USDA yield grade, adjusted fat thickness, longissimus muscle area, skeletal maturity, and overall maturity increased ($P < .05$) with increased carcass weights. Some major packing plants are discounting carcasses outside the range of 272.2 to 385.6 kg. The current data show that 15.2% of the carcasses fell outside these established carcass weight boundaries (Figure 2).

Steer carcasses had less ($P < .05$) adjusted fat thickness and kidney, pelvic, and heart fat than heifer carcasses (Table 9). Even though the heifer carcasses were fatter, they had a more desirable ($P < .05$) mean USDA yield grade because the steer carcasses were 30 kg heavier than the heifer carcasses. Heifer carcasses had higher ($P < .05$) mean USDA quality grade and mean marbling score and lower ($P < .05$) mean scores

Table 7. Least squares means for carcass traits (standard deviations) within yield grades

	USDA yield grade				
Trait	1	2	3	4	5
USDA yield grade	1.6^{h}	2.5^{g}	3.4^{f}	4.3^{e}	5.4^{d}
	(.3)	(.3)	(.3)	(.3)	(.4)
Adjusted fat thickness, cm	$.7^{h}$	1.0^{g}	1.4^{f}	2.1^{e}	2.8^{d}
	(.2)	(.3)	(.3)	(.4)	(.4)
Carcass weight, kg	324.0^{h}	332.0^{g}	345.9^{f}	359.7^{e}	368.2^{de}
	(42.9)	(41.0)	(40.2)	(40.9)	(40.8)
Longissimus muscle area, cm^2	92.9^{d}	83.7^{e}	78.7^{f}	75.7^{g}	71.9^{h}
	(10.8)	(8.7)	(7.7)	(7.9)	(8.0)
Kidney, pelvic, and heart fat, %	1.7^{h}	2.0^{g}	2.2^{f}	2.4^{e}	2.6^{d}
	(.5)	(.6)	(.6)	(.6)	(.6)
USDA quality grade[a]	649^{h}	675^{g}	694^{f}	704^{e}	710^{de}
	(50)	(53)	(54)	(58)	(61.4)
Marbling score[b]	358^{h}	397^{g}	430^{f}	455^{e}	474^{de}
	(65)	(79)	(92)	(106)	(128)
Lean maturity[c]	155^{d}	153^{e}	151^{f}	151^{fg}	150^{efg}
	(22)	(19)	(18)	(20)	(19)
Skeletal maturity[c]	160^{h}	161^{gh}	164^{f}	169^{e}	171^{de}
	(30)	(29)	(31)	(36)	(33)
Overall maturity[c]	158^{e}	158^{e}	159^{e}	162^{d}	162^{de}
	(23)	(22)	(23)	(28)	(27)

[a]100 = Canner^{00} and 800 = Prime^{00}.
[b]100 = Practically devoid^{00} and 900 = Abundant^{00}.
[c]100 = A^{00} and 400 = D^{00}.
[d,e,f,g,h]Means within a row lacking a common superscript differ ($P < .05$).

Table 8. Least squares means carcass traits (standard deviations) within carcass weight classes

	Carcass weight class, kg						
Trait	< 227.0	227.0–272.3	272.4–317.7	317.8–363.1	363.2–408.5	408.6–453.9	> 454.0
USDA yield grade	2.1[j]	2.4[i]	2.6[h]	2.8[g]	3.0[f]	3.2[e]	3.6[d]
	(.7)	(.7)	(.7)	(.8)	(.8)	(.8)	(1.0)
Adjusted fat thickness, cm	.8[i]	1.0[h]	1.1[g]	1.2[f]	1.3[e]	1.3[e]	1.5[d]
	(.4)	(.4)	(.5)	(.5)	(.5)	(.5)	(.7)
Carcass weight, kg	208.0[j]	257.5[i]	298.7[h]	339.7[g]	380.6[f]	422.8[e]	467.3[d]
	(19.2)	(11.2)	(12.5)	(13.0)	(12.2)	(11.4)	(9.7)
Longissimus muscle area, cm^2	66.8[j]	72.7[i]	78.0[h]	82.7[g]	87.3[f]	91.7[e]	95.8[d]
	(9.3)	(7.7)	(8.2)	(9.2)	(9.4)	(10.8)	(11.6)
Kidney, pelvic, and heart fat, %	1.8[g]	2.0[f]	2.0[ef]	2.1[d]	2.1[d]	2.1[de]	2.1[de]
	(.7)	(.6)	(.6)	(.6)	(.6)	(.5)	(.6)
USDA quality grade[a]	659[g]	662[g]	675[f]	679[e]	683[d]	687[d]	692[de]
	(57)	(57)	(59)	(54)	(55)	(58)	(74)
Marbling score[b]	378[hi]	381[i]	401[h]	406[g]	412[f]	420[e]	453[d]
	(98)	(85)	(90)	(88)	(91)	(91)	(127)
Lean maturity[c]	150[fghi]	153[fghi]	153[h]	154[g]	155[f]	157[e]	162[d]
	(22)	(19)	(20)	(20)	(20)	(22)	(25)
Skeletal maturity[c]	145[j]	156[i]	161[h]	163[g]	166[f]	170[e]	189[d]
	(28)	(31)	(33)	(28)	(30)	(32)	(54)
Overall maturity[c]	146[j]	155[i]	158[h]	159[g]	162[f]	165[e]	179[d]
	(21)	(22)	(25)	(22)	(22)	(25)	(36)

[a]100 = Canner^{00} and 800 = Prime^{00}.
[b]100 = Practically devoid^{00} and 900 = Abundant^{00}.
[c]100 = A^{00} and 400 = D^{00}.
[d,e,f,g,h,i,j]Means within a row lacking a common superscript differ (P < .05).

Table 9. Least squares means for carcass traits (standard deviations) within sex class

Trait	Heifer	Steer
USDA yield grade	2.8[e]	2.9[d]
	(.8)	(.8)
Adjusted fat thickness, cm	1.3[d]	1.2[e]
	(.5)	(.5)
Carcass weight, kg	318.2[e]	348.8[d]
	(38.8)	(40.3)
Longissimus muscle area, cm^2	82.2	82.6
	(10.2)	(10.1)
Kidney, pelvic, and heart fat, %	2.2[d]	2.0[e]
	(.5)	(.6)
USDA quality grade[a]	681[d]	678[e]
	(58)	(55)
Marbling score[b]	412[d]	403[e]
	(92)	(88)
Lean maturity[c]	154	154
	(20)	(20)
Skeletal maturity[c]	168[d]	161[e]
	(34)	(28)
Overall maturity[c]	162[d]	158[e]
	(26)	(21)

[a]100 = Canner^{00} and 800 = Prime^{00}.
[b]100 = Practically devoid^{00}; 300 = Slight^{00}; 400 = Small^{00}; 900 = Abundant^{00}.
[c]100 = A^{00}; 200 = B^{00}; 300 = C^{00}; and 400 = D^{00}.
[d,e]Means within a row lacking a common superscript differ (P < .05).

for skeletal and overall maturity than did steer carcasses. Even though Lorenzen et al. (1993) showed no effect of gender on carcass traits in their study, the heifer carcasses tended to have a lower numerical USDA yield grade and tended to have a more desirable USDA quality grade, both of which support the findings of the present study.

The *Bos indicus* carcasses had the highest (P < .05) numerical USDA yield grade, skeletal, and overall maturity scores and the lowest (P < .05) USDA quality grade and marbling score compared to the native and dairy carcasses (Table 10). The native carcasses had the lightest (P < .05) carcass weights and the largest (P < .05) longissimus muscle areas, and the dairy carcasses had the highest (P < .05) USDA quality grades and marbling scores and had the least (P < .05) adjusted fat thickness compared to the other breed types. Lorenzen et al. (1993) reported that the dairy carcasses were the leanest and had the most desirable quality grades, and the native carcasses had the largest longissimus muscle areas, all of which is in agreement with the current data.

Implications

The NBQA–1991 and NBQA–1995 studies have provided the beef industry with benchmarks never before available. Genetic progress, especially in cattle, can be slow for growth and carcass variables. Management problems can be solved at a faster rate than can

Table 10. Least squares means for carcass traits (standard deviations) within breed type

Trait	Native	*Bos indicus*	Dairy
USDA yield grade	2.8[e]	3.0[d]	2.8[e]
	(.8)	(.9)	(.6)
Adjusted fat thickness, cm	1.2[e]	1.3[d]	.7[f]
	(.5)	(.6)	(.3)
Carcass weight, kg	338.9	340.6	342.4
	(42.0)	(45.4)	(43.2)
Longissimus muscle area, cm^2	83.2[d]	81.5[e]	71.9[f]
	(9.9)	(9.6)	(8.8)
Kidney, pelvic, and heart fat, %	2.1[d]	2.0[e]	2.1[de]
	(.6)	(.7)	(.6)
USDA quality grade[a]	679[e]	666[f]	691[d]
	(56)	(56)	(63)
Marbling score[b]	405[e]	386[f]	433[d]
	(89)	(76)	(113)
Lean maturity[c]	153[e]	160[d]	159[d]
	(20)	(19)	(21)
Skeletal maturity[c]	163[e]	170[d]	152[f]
	(30)	(34)	(25)
Overall maturity[c]	160[e]	166[d]	154[f]
	(23)	(25)	(19)

[a]100 = $Canner^{00}$ and 800 = $Prime^{00}$.
[b]100 = Practically $devoid^{00}$; 300 = $Slight^{00}$; 400 = $Small^{00}$; 900 = $Abundant^{00}$.
[c]100 = A^{00}; 200 = B^{00}; 300 = C^{00}; and 400 = D^{00}.
[d,e,f]Means within a row lacking a common superscript differ ($P < .05$).

genetic problems, but more cultural barriers exist for instituting different management practices. For example, it is difficult to persuade producers to change the locations and size of hot-iron brands. The beef industry has progressed in some areas (e.g., reduction of excess fat) but has failed in other areas (e.g., reduction in marbling and the increased incidence of brands and bruises) since the time of the NBQA–1991. The industry should strive to make progress in all areas of concern if product improvement and total cost reductions are to be achieved.

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