Milk Yield and Quality in Cows Sired by Different Beef Breeds 1,2

M. A. Brown,*3 PAS, and D. L. Lalman,† PAS
*USDA-ARS, Grazinglands Research Laboratory, El Reno, OK 73036; and †Department of Animal Science, Oklahoma State University, Stillwater 74078

ABSTRACT

Breed differences in milk production and milk quality are related to differences in calf preweaning growth, differences in cow maintenance requirements, and differences in efficiency of production. Cows from Brangus dams and sired by 12 Bonsmara, 12 Brangus, 15 Charolais, 18 Gelbvieh, 13 Hereford, and 13 Romosinuano sires were sampled in 2005 (n = 45), 2006 (n = 50), 2007 (n = 53), and 2008 (n = 50) to evaluate sire breed differences in milk yield and quality. There was little evidence of daily milk yield differences among cows sired by Bonsmara, Brangus, Charolais, Gelbvieh, or Hereford sires, but Romosinuano-sired cows produced less milk (P < 0.05) than the other breed groups. Gelbvieh-sired cows had less milk fat than Brangus-, Charolais-, and Hereford-sired cows (P < 0.05). Percentage of milk fat was greater in Romosinuano-sired cows than in Brangus-, Charolais-, Gelbvieh-, and Hereford-sired cows (P < 0.05), whereas percentage of milk protein was greater in Bonsmara-sired cows than in Charolais- and Gelbvieh-sired cows (P < 0.05). Percentage of milk lactose was similar for Bonsmara- and Romosinuano-sired cows, which both had greater percentages of milk lactose than Hereford-sired cows (P < 0.05). Somatic cell counts for Romosinuano-sired cows were less than those of Bonsmara-, Charolais-, Gelbvieh-, and Hereford-sired cows (P < 0.05) but not Brangus-sired cows. Percentage of milk protein was greater in Romosinuano-sired cows than in Brangus-, Charolais-, Gelbvieh-, and Hereford-sired cows (P < 0.05), whereas percentage of milk protein was greater in Bonsmara-sired cows than in Charolais- and Gelbvieh-sired cows (P < 0.05). Percentage of milk lactose was similar for Bonsmara- and Romosinuano-sired cows, which both had greater percentages of milk lactose than Hereford-sired cows (P < 0.05). Somatic cell counts for Romosinuano-sired cows were less than those of Bonsmara-, Charolais-, Gelbvieh-, and Hereford-sired cows (P < 0.05) but not Brangus-sired cows. Percentage of milk lactose was similar for Bonsmara- and Romosinuano-sired cows, which both had greater percentages of milk lactose than Hereford-sired cows (P < 0.05). Somatic cell counts for Romosinuano-sired cows were less than those of Bonsmara-, Charolais-, Gelbvieh-, and Hereford-sired cows (P < 0.05) but not Brangus-sired cows. The lack of differences in milk yield among the sire breeds, with the exception of Romosinuano, suggests possible nutritional limitations on native rangeland that prevent expression of the full genetic potential for milk yield. The lower milk yields and SCC in the Romosinuano suggest possible advantages for this breed in efficiency of production and mastitis resistance.

Key words: beef cattle, Bonsmara, Brangus, milk yield, Romosinuano, tropically adapted

INTRODUCTION

Milk production in beef cows has an important influence on the weaning weight of calves (Brown and Brown, 2002), cow production and maintenance requirements (Minick et al., 2001; Jenkins and Ferrell, 2004), and the efficiency and profitability of cow-calf enterprises (Brown and Dinkel, 1982; Miller et al., 1999). Cow-calf production in the southeastern United States has been largely based on utilization of Bos indicus germplasm, which has been shown to be adapted to subtropical production environments. Bos indicus cattle are better adapted to hotter climates, are more resistant to ectoparasites, and are more efficient in utilizing poor-quality forages than Bos taurus cattle (Frisch and Vercoe, 1978; Turner, 1980). At the same time, Bos indicus cattle have less reproductive efficiency, have more perinatal calf losses, are later in sexual maturity, and have a longer gestation period and calving interval than Bos taurus cattle (Turner, 1980). More important to the stocker industry is the finding that carcasses of calves with 50% or greater Bos indicus breeding have lower marbling scores than their Bos taurus counterparts (Carpenter et al., 1961; Peacock et al., 1979). There have also been reports of less tenderness in meat from Bos indicus cattle (Carpenter et al., 1961; Crouse et al., 1989; Johnson et al., 1990). More recently, elevated calpastatin activity has been implicated as the major cause of tenderness problems (Wheeler et al., 1990;
Whipple et al., 1990; Shackelford et al., 1991). Additionally, there is some evidence that feedlot BW gains of calves with 50% Bos indicus breeding are less than the BW gains of calves with less Bos indicus breeding (Brown et al., 1999). Bos indicus cattle are well adapted for cow-calf production in the southern United States, but their relative performance in the feedlot is questionable. Efforts are underway to find new beef cattle germplasm to retain needed tropical adaptation while improving the utility of tropically adapted calves as stockers and finished cattle (Hammond et al., 1996; Elzo et al., 1998; Chase et al., 2000; Thrift et al., 2000; Phillips et al., 2006; Brown and Lalman, 2008) with breeds such as Bonsmara and Romosinuano. Little work has been done in the evaluation of the maternal ability of these newer breeds, and there is a need for evaluation of milk yield and milk quality from cows sired by non-Zebu tropically adapted breeds in comparison with more conventional sire breeds such as Charolais, Gelbvieh, Hereford, and Brangus. Consequently, the objectives of this research were to evaluate milk yield and milk quality from cows sired by Bonsmara, Brangus, Charolais, Gelbvieh, Hereford, and Romosinuano sires.

MATERIALS AND METHODS

All experimental procedures were reviewed and accepted by the ARS Animal Care and Use Committee and were in accordance with the Federation of Animal Science Societies’s Guide to the Care and Use of Agricultural Animals in Agricultural Research and Teaching.

Registered Brangus females (n = 246) representing a wide sampling of the breed were acquired between 1998 and 2000 and bred by AI and natural service to Bonsmara, Brangus, Charolais, Gelbvieh, Hereford, and Romosinuano sires to produce the cows used in this study. Sires used for AI were randomly selected from commercial AI studs, and cleanup sires were purchased locally based on soundness and general conformation.

Cows used in the study were born from 2001 to 2005 and were managed on native rangeland and supplemented in the winter with hay (prairie hay, bermudagrass, old world bluestem) and protein cubes (40% CP, 76% TDN) consistent with forage DM availability and quality. Long-term averages for forage CP for native rangeland pastures at the location averaged approximately 9% for late April and early May and decreased to approximately 5% for late September. Forage IVDMD for the same pastures averaged approximately 59% for late April and early May and decreased to approximately 48% by late September.

Cows representing 12 Bonsmara, 12 Brangus, 15 Charolais, 18 Gelbvieh, 13 Hereford, and 13 Romosinuano sires were sampled in 2005 (n = 45), 2006 (n = 50), 2007 (n = 53), and 2008 (n = 50) for estimates of milk yield and quality. The number of daughters per sire averaged 2.45 and ranged from 1 to 11. Distribution of ages of cows in the study included 78 cows 2 yr of age, 48 cows 3 yr of age, 41 cows 4 yr of age, and 31 mature cows (5+ yr of age). Generally, different cows were used each year and repetition of cows across years was minimal. Milk yield was measured each year using a single-cow portable machine beginning at an average of 40 d postpartum. Measurement of milk yield began in late April and ended in late September.

Cows and calves were separated at approximately 1900 h in the evening before milking and were held for approximately 14 h overnight with water provided. There was no milk-out before separation. Ten minutes before milking, cows were given 1.5 mL of acepromazine maleate (10 mg/mL, i.m.); in addition, 1.0 mL of oxytocin (20 USP units/mL) was given immediately before milking to facilitate milk letdown. After a cow was milked out, milk was weighed on a digital platform scale. Milk yield was adjusted to a 24-h basis (24-h milk yield) as [(milk weight/14) × 24] (Brown et al., 1996). Milk quality was analyzed by a commercial dairy laboratory and included estimates of milk fat, milk protein, milk urea nitrogen, SCC, milk lactose, and milk solids-not-fat (SNF).

Repeated measures analyses for milk yield and quality were done using least squares mixed models procedures. The initial linear models included the fixed effects of year, age of cow, breed of sire of cow (Brangus, Hereford, Charolais, Gelbvieh, Romosinuano, Bonsmara), month of lactation (repeated measure), estimable 2- and 3-factor interactions among the main effects, days postcalving (linear), days postcalving (quadratic), and random effects of sire of cow in breed, sire × age of dam in breed, and a random residual. Models were reduced to exclude unimportant (P > 0.25) fixed interactions. Tests of sire breed effects were performed using t-tests if sire breed main effects were significant (P < 0.10) in the ANOVA.

RESULTS AND DISCUSSION

24-h Milk Yield

Initial repeated measures analyses for 24-h milk yield indicated little evidence of sire breed of cow × month of lactation. Least squares means and SE of 24-h milk yield are given in Table 1, averaged over the month of lactation. Milk yields were similar among Bonsmara-, Brangus-, Charolais-, Gelbvieh-, and Hereford-sired cows, whereas milk yield of Romosinuano-sired cows was less than all of the other breed groups (P < 0.05). In a study by Melton et al. (1967), Charolais cows had greater milk yield than Angus or Hereford cows, but in a study by Marshall et al. (1976), milk yield of Charolais cows was less than those of Angus and reciprocal cross cows. Reynolds et al. (1978) reported greater total milk yields in Brangus cows than in Angus or Afrikaner-Angus cows. Daley et al. (1987) reported that Angus × Charolais cows ranked highest in milk yield, followed by Angus × Hereford, Brahman × Angus, and Brahman
Milk yield and quality in beef cows

Gregory et al. (1992) reported that breed group means for milk yield for Gelbvieh were greater than those for Charolais, which were greater than those for Angus, which were greater than those for Hereford. Jenkins and Ferrell (1992) reported that milk yields of Gelbvieh were greater than those for Charolais and Hereford. In a dialled study with Angus and Brahman, Brown et al. (2001) reported greater milk yields in the Brahman × Angus reciprocal crosses than in either Angus or Brahman. Jenkins and Ferrell (2004) reported that the total milk yield of Angus- and Hereford-sired cows exceeded that of Tull-sired cows.

Given that a larger sample size in this study would have been beneficial in detecting breed differences, differences among the breed groups that were not statistically significant were also of little practical significance. The lack of practically significant differences among 5 of the 6 sire breeds of cows in this study suggests the possibility of nutritional limitations from grazing native rangelands that prevented the expression of full genetic potential for milk yield and which tended to standardize production. Brown et al. (2005) suggested that expression of genetic potential for milk production, as indicated by expected progeny differences for milk, was suppressed by nutritional limitations in grazing native tallgrass rangeland. Efficiency of production to weaning or slaughter is less favorable in cattle with a high potential for milk yield (Montaño-Bermedez and Nielsen, 1990). Consequently, if potential is limited by nutrition, it is possible that the efficiency of cattle with a high potential for milk yield on native range may be further impeded and breeds with lower milk potential, such as the Romosinuano, may have an advantage in efficiency.

**Milk Fat**

There was little evidence that cow sire breed differences in milk fat as a percentage of milk weight or total daily kilograms of milk fat produced varied across sample dates. Least squares means for percentage of milk fat and total daily milk fat are given in Tables 1 and 2, respectively. Gelbvieh-sired cows had less milk fat than Bonsmara, Charolais, Hereford, and Romosinuano-sired cows ($P < 0.05$) but not Brangus-sired cows. Percentage of milk fat in Brahman × Hereford cows was greater than those in Angus × Hereford, Angus × Charolais, and Brahman × Angus cows in a study in Nevada (Daley et al., 1987). Brown et al. (2001) reported that percentage of milk fat was intermediate in Brahman × Angus reciprocal crosses to Angus and Brahman cows. Bonsmara-sired cows in this study had greater daily milk fat production (kilograms/d) than Gelbvieh- and Romosinuano-sired cows ($P < 0.05$) but not Brangus-, Charolais-, or Hereford-sired cows, whereas Brangus- and Charolais-sired cows had greater daily milk fat production than Romosinuano-sired cows ($P < 0.05$). Consequently, in spite of a greater percentage of milk fat in Romosinuano-sired cows, total daily production of milk fat was less than those in Bonsmara-, Brangus-, and Charolais-sired cows ($P < 0.05$) and was numerically less than those in Gelbvieh- and Hereford-sired cows. Daley et al. (1987) reported greater daily milk fat yields in Angus × Charolais than in Angus × Hereford, Brahman × Hereford, and Brahman × Angus.

**Milk Protein**

There was little evidence that sire breed of cow differences in milk protein as a percentage of milk weight or total daily kilograms of milk protein produced varied across sample dates. Least squares means for percentage of milk protein and total daily milk production than Romosinuano-sired cows ($P < 0.05$) and was numerically less than those in Gelbvieh- and Hereford-sired cows. Daley et al. (1987) reported greater daily milk fat yields in Angus × Charolais than in Angus × Hereford, Brahman × Hereford, and Brahman × Angus.

### Table 1. Least squares means and SE for milk yield and milk quality from cows sired by different sire breeds

<table>
<thead>
<tr>
<th>Sire breed</th>
<th>Milk yield, kg/d</th>
<th>Milk fat, %</th>
<th>SCC, In count</th>
<th>Milk protein, %</th>
<th>SNF, %</th>
<th>Milk urea N, mg/dL</th>
<th>Lactose, %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bonsmara</td>
<td>7.60 ± 0.33a</td>
<td>3.92 ± 0.11a</td>
<td>3.25 ± 0.22a</td>
<td>3.32 ± 0.05b</td>
<td>9.22a</td>
<td>15.90 ± 0.37a</td>
<td>4.90 ± 0.04a</td>
</tr>
<tr>
<td>Brangus</td>
<td>7.47 ± 0.33a</td>
<td>3.74 ± 0.11a</td>
<td>3.12 ± 0.20a</td>
<td>3.22 ± 0.05b</td>
<td>8.90a</td>
<td>16.87 ± 0.37a</td>
<td>4.80 ± 0.04a</td>
</tr>
<tr>
<td>Charolais</td>
<td>7.44 ± 0.32b</td>
<td>3.81 ± 0.11a</td>
<td>3.36 ± 0.21a</td>
<td>3.15 ± 0.05c</td>
<td>9.56a</td>
<td>17.54 ± 0.35a</td>
<td>4.88 ± 0.04a</td>
</tr>
<tr>
<td>Gelbvieh</td>
<td>7.28 ± 0.28a</td>
<td>3.52 ± 0.09</td>
<td>3.34 ± 0.18a</td>
<td>3.13 ± 0.05d</td>
<td>9.45a</td>
<td>15.87 ± 0.31a</td>
<td>4.88 ± 0.04a</td>
</tr>
<tr>
<td>Hereford</td>
<td>6.98 ± 0.31c</td>
<td>3.95 ± 0.10a</td>
<td>3.65 ± 0.19a</td>
<td>3.21 ± 0.05e</td>
<td>8.91a</td>
<td>16.43 ± 0.35a</td>
<td>4.78 ± 0.04a</td>
</tr>
<tr>
<td>Romosinuano</td>
<td>5.85 ± 0.30a</td>
<td>4.01 ± 0.10a</td>
<td>2.63 ± 0.19a</td>
<td>3.46 ± 0.05a</td>
<td>8.94a</td>
<td>16.38 ± 0.34a</td>
<td>4.91 ± 0.04a</td>
</tr>
</tbody>
</table>

a,cMeans in the same column with differing superscripts differ ($P < 0.05$).
b,dMeans in the same column with differing superscripts differ ($P < 0.10$).

SNF = solids-not-fat.
greater percentage of milk protein in Romosinuano-sired cows did not compensate for the lower milk yield, so total daily production of milk protein was less than those in Bonsmara-, Brangus-, and Charolais-sired cows (P < 0.05) and was numerically less than those in Gelbvieh- and Hereford-sired cows. Percentage of protein was greatest in Angus x Charolais cows, whereas daily kilograms of protein was greatest in Angus x Charolais. Brown et al. (2001) reported that percentage of milk protein was greater in Angus x Charolais cows than in Angus x Hereford, Angus x Charolais, and Brahman x Angus cows, whereas daily kilograms of protein was greatest in Angus x Charolais. Sire breed differences for percentage of milk protein were similar among Angus, Brahman, and reciprocal cross cows.

**Milk Lactose**

Cow sire breed differences for percentage of milk lactose and total daily kilograms of milk lactose were similar across sample dates. Least squares means for percentage of milk lactose and total daily milk lactose are given in Tables 1 and 2, respectively. Percentage of milk lactose was similar for Bonsmara- and Romosinuano-sired cows, which were both greater than that for Hereford-sired cows (P < 0.05). Total daily kilograms milk lactose was less in Romosinuano-sired cows than in Bonsmara, Brangus-, Charolais-, and Gelbvieh-sired cows (P < 0.05) but not Hereford-sired cows. Therefore, the greater percentage of lactose in the Romosinuano-sired cows compared with Hereford-sired cows did not compensate for the lesser milk yields in the Romosinuano-sired cows, so they were similar to total daily kilograms of lactose in Hereford-sired cows. Daley et al. (1987) reported that percentage of lactose was greatest in Brahman x Hereford cows compared with Angus x Hereford, Angus x Charolais, and Brahman x Angus cows, whereas daily kilograms of lactose was greatest in Angus x Charolais cows.

**Solids-Not-Fat**

There was little indication of a sire breed of cow x sample date interaction for percentage of SNF or total daily kilograms of SNF. Least squares means and SE for percentage of SNF and total daily kilograms of SNF are given in Tables 1 and 2, averaged over sample date. Bonsmara- and Romosinuano-sired cows were similar in percentage of SNF and were greater than Brangus-, Charolais-, Gelbvieh-, and Hereford-sired cows (P < 0.05). Romosinuano-sired cows had fewer total daily kilograms of SNF than Bonsmara-, Brangus-, Charolais-, and Gelbvieh-sired cows (P < 0.05), reflecting the lesser daily milk yield in the Romosinuano-sired cows. In a study by Daley et al. (1987), percentage of SNF was greater in Brahman x Hereford cows than in Angus x Hereford, Angus x Charolais, and Brahman x Angus cows, whereas daily kilograms of SNF was greatest in Angus x Charolais cows.

**Milk Urea Nitrogen**

Sire breed of cow differences were consistent across sample dates, and least squares means and SE for milk urea nitrogen for each sire breed of cow are given in Table 1. Milk urea nitrogen in Brangus-sired cows was greater than those of Charolais- and Gelbvieh-sired cows (P < 0.05) but was similar to those of Bonsmara-, Hereford-, and Romosinuano-sired cows.

**Somatic Cell Count**

Least squares means and SE for log<sub>10</sub> of SCC for each sire breed of cow are given in Table 1. Somatic cell counts for Romosinuano-sired cows were lesser than those of Bonsmara-, Charolais-, Gelbvieh-, and Hereford-sired cows (P < 0.05) but not Brangus cows. This suggests the potential for greater disease resistance in Romosinuano-influenced cattle compared with the other sire breed of cow groups in this study. In a diallel study with Brahman and Angus, Brown et al. (2001) reported favorable heterosis for SCC and hypothesized that crossbred cows might have more disease resistance than purebred cows.

**IMPLICATIONS**

Greater genetic potential for milk yield is positively related to calf weaning weights but is unfavorably related to cow efficiency. Research at the USDA-ARS Grazinglands Research

---

**Table 2. Least squares means and SE for milk component daily yields**

<table>
<thead>
<tr>
<th>Sire breed</th>
<th>Milk fat, kg/d</th>
<th>Milk protein, kg/d</th>
<th>SNF, kg/d</th>
<th>Lactose, kg/d</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bonsmara</td>
<td>0.30 ± 0.02&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.25 ± 0.01&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>0.70 ± 0.03&lt;sup&gt;uv&lt;/sup&gt;</td>
<td>0.37 ± 0.02&lt;sup&gt;uv&lt;/sup&gt;</td>
</tr>
<tr>
<td>Brangus</td>
<td>0.28 ± 0.02&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>0.24 ± 0.01&lt;sup&gt;u&lt;/sup&gt;</td>
<td>0.68 ± 0.03&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.37 ± 0.02&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Charolais</td>
<td>0.28 ± 0.02&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>0.24 ± 0.01&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>0.67 ± 0.03&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.36 ± 0.02&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Gelbvieh</td>
<td>0.26 ± 0.01&lt;sup&gt;b&lt;/sup&gt;</td>
<td>0.23 ± 0.01&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>0.66 ± 0.03&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.36 ± 0.01&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Hereford</td>
<td>0.27 ± 0.02&lt;sup&gt;abc&lt;/sup&gt;</td>
<td>0.22 ± 0.01&lt;sup&gt;abc&lt;/sup&gt;</td>
<td>0.61 ± 0.03&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>0.33 ± 0.02&lt;sup&gt;abc&lt;/sup&gt;</td>
</tr>
<tr>
<td>Romosinuano</td>
<td>0.24 ± 0.02&lt;sup&gt;abc&lt;/sup&gt;</td>
<td>0.20 ± 0.01&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>0.55 ± 0.03&lt;sup&gt;b&lt;/sup&gt;</td>
<td>0.29 ± 0.02&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

<sup>a</sup>Means in the same column with differing superscripts differ (P < 0.05).

<sup>b</sup>Means in the same column with differing superscripts differ (P < 0.10).

<sup>1</sup>SNF = Solids-not-fat.
Laboratory evaluated milk yield and milk quality from cows sired by Bonsmara, Brangus, Charolais, Gelbvieh, Hereford, and Romosinuano breeds. The only differences in milk yields noted were in Romosinuano-sired cows, which had smaller milk yields than the other breed groups. The lack of differences among the Bonsmara-, Brangus-, Charolais-, Hereford-, and Gelbvieh-sired cows may be attributable to nutritional limitations on grazing native tallgrass prairie that impeded the expression of genetic potential for milk yield. If greater potential for milk yield is unfavorably associated with efficiency of production, efficiencies may be further impeded through failure of these breed groups to be allowed full expression of calf growth during the preweaning period through the nutrition limitations.

**LITERATURE CITED**


