Growth of Spanish, Boer×Angora and Boer×Spanish goat kids fed milk replacer

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Abstract

Seventy-seven male kids were used to compare growth performance of Spanish (S, n=26), Boer×Angora (BA, n=21) and Boer×Spanish (BS, n=30) kids during the preweaning period. All kids were removed from does 3 days postpartum, moved indoors and randomly allocated to individual cages. Kids received goat milk fortified with milk replacer for approximately 1 week followed by 600 ml of milk replacer (23% CP, 30% crude fat) twice daily until weaning at 8 week. At 3 week of age, all kids had ad libitum access to a commercial goat starter diet (20% CP). Feed intake was measured daily and BW gain at 2-week intervals. There were interactions (P<0.05) between breed and time or 2-week period in BW, BW gain and feed efficiency. Boer crosses (i.e., BA and BS) were heavier than S kids at 2, 6 and 8 weeks of age (P<0.05), but there were no BW differences between Boer crosses (P>0.10). From Week 3–8, Boer crosses gained BW more rapidly (P=0.001) than did S kids (60, 71 and 77 g/day for S, BA and BS, respectively), although BW gain of S in Week 3–4 was greater (P<0.05) than that of Boer crosses (60, 50 and 54 g/day for S, BA and BS, respectively). Starter diet DM intake in Week 3–8 was greatest for BS (S versus BA and BS, P=0.05; BA versus BS, P<0.01) (23, 24 and 37 g/day for S, BA and BS, respectively). The ratio of BW gain to total DM intake in Week 3–8 was greater (P<0.03) for BA and BS than for S (0.52, 0.59 and 0.58 for S, BA and BS, respectively). The incidence of scours was 17, 21 and 31% for S, BA and BS kids, respectively (P>0.10). These results reflect that crossbreeding with Boer goats can improve growth of young kids and, thus, potentially increase economic returns for goat producers. © 2000 Elsevier Science B.V. All rights reserved.

Keywords: Growth; Boer crossbred; Spanish goat

1. Introduction

Contributions of heterosis for economically important traits have been well documented in other species (DeRouen et al., 1992). The Boer goat has long been recognized for its superior meat producing ability and is widely used to improve growth and carcass traits of local breeds through crossbreeding (Newman and Paterson, 1997). Garza and Garza (1997) noted that Boer crossbred kids were 15–20% heavier at weaning than pure-bred kids of the dam breed. Lewis et al. (1997) reported greater BW and BW gain for Boer crosses than for Spanish goats, although feed efficiency was similar. Under an extensive management system, Boer crosses (Alpine, Spanish and Tennessee stiff-legged goats used as maternal breeds) were heavier at 4, 8 and 12 weeks of age compared with pure-bred Boer goats, although the advantage diminished postweaning with advancing age (Gebrelul and Iheanacho, 1997). However, a computer simu-
lation (Blackburn, 1995) suggested that Boer goats may not excel in growth and reproduction under extensive management conditions, implying genotype × environment interactions. Though performance of Boer goats under extensive management systems has not yet been well characterized, benefits in offspring performance with Boer use as a terminal sire breed under intensive management conditions are generally accepted.

Acidified milk replacer has been widely used in rearing young calves and kids, with advantages of reducing milk feeding and labor costs and simplifying management (Sahlu et al., 1992; Galina et al., 1996). Kids fed cow milk replacer can grow as rapidly as kids given goat or cow milk (Galina et al., 1995). Milking ability of the dam can greatly influence the opportunity of kids to express growth potential; therefore, hand-rearing eliminates such maternal effects. However, information is lacking on how performance of Boer crosses compares with Spanish goat kid performance during the preweaning period under identical feeding and management conditions, such as with feeding of milk replacer. Therefore, the objective of this study was to compare preweaning performance of two Boer crossbreds and Spanish goats under standardized nutritional conditions—feeding acidified milk replacer in an intensive management system.

2. Materials and methods

Forty-five Spanish and 67 Angora does were randomly mated to four Boer bucks, and 88 Spanish does were randomly mated to four Spanish bucks to produce Boer × Angora (BA), Boer × Spanish (BS) and pure-bred Spanish (S) kids. All does grazed grass-based pasture. One month before kidding, does were dewormed, injected with 200,000 IU vitamin A, 20,000 IU Vitamin D3 and 600 IU Vitamin E and vaccinated (Clostridium perfringens Types C and D plus Corynebacterium, pseudotuberculosis and tetanus toxoid). Kids were ear-tagged within a few hours after birth and separated from does 2 or 3 days postpartum. Ninety-eight male kids (25 BA, 38 BS and 35 S) were moved to a barn and randomly allocated to individual cages (91 cm × 91 cm × 76 cm). Data from 21 kids were excluded from the statistical analysis. A small number died and the majority were removed early in the experiment because of low or no consumption of the starter diet. Kids were given a vitamin injection (50,000, 5000 and 150 IU Vitamins A, D3 and E, respectively) and dehorned (hot iron) at 10 days of age. At 4 week of age, kids were vaccinated for Clostridium organisms, with a booster given 3 week later. Kids were given ad libitum access to goat milk fortified with milk replacer (48 g of milk replacer/l of goat milk) by bottle-feeding, after being trained to suckle from an artificial nipple. A kid consuming in excess of 600 ml of milk in one feeding was considered fully trained and was then abruptly switched to feeding of 100% milk replacer. A commercial acidified goat milk replacer (Lamnurs®, Evergreen Mills Inc., Ada, OK) was used, having a guaranteed analysis of not less than 23% CP and 30% fat, and containing dried whey and whey protein concentrate as CP sources and vegetable and animal fats. Liquid milk replacer was prepared fresh daily according to manufacturer’s specifications (90 g/l of warm water); later analysis indicated that the milk replacer mixture contained 87.1 g DM/l. A restricted amount of liquid milk replacer (600 ml per feeding) was offered to kids twice daily in bottles at 08:30 and 15:00 hours, with consumption recorded, until weaning at 8 week of age. Milk bottles were washed with soapy bleach water and then rinsed; fecal trays were cleaned each morning; and floors were spray-washed and then flushed with bleach water as a disinfectant.

After 3 week of age, kids were offered ad libitum access to a goat starter pelleted diet (20% CP, 2.5% fat, 12% crude fiber and 30 mg/kg of decoquinate as a coccidiostat) consisting primarily of soybean meal, oats and corn. Initially, a small amount of milk replacer was sprinkled on pellets to stimulate consumption. Feed intake was recorded daily and body weight (BW) every 2 week throughout the experiment. Feed DM content was analyzed weekly. It was observed that once a kid began consuming approximately 30 g/day of starter diet, daily intake increased steadily thereafter; hence, the first day of starter diet consumption was determined as the first day that consumption exceeded 30 g. Feces were observed daily, and the incidence of scours in the first 5 week was recorded to monitor health conditions.

Experimental data were analyzed using GLM procedures of SAS (1990). Milk replacer intake and feed
conversion ratio in Week 3–4, 5–6 and 7–8, starter diet intake in Week 5–6 and 7–8, BW after 2, 4, 6 and 8 week and BW gain in Week 3–4, 5–6 and 7–8 were analyzed as a split-plot design, with breed as the main plot and time or 2-week period as the subplot. Interactions between breed and time or 2-week period were significant \( (P<0.05) \); thus, analyses were conducted by time or 2-week period. In addition, intake of milk replacer or milk replacer plus goat milk in the training period was analyzed as a split-plot in time, with a subplot of week. However, because of a problem in initial data recording, the number of observations for milk replacer intake in Week 1 was 13, 13 and 15 for S, BA and BS, respectively. Orthogonal contrasts were employed to test effects of crossbreeding (i.e., S versus the mean of BA and BS) and crossbred type (i.e., BA versus BS); significance was determined at \( P<0.10 \). Regression analysis was performed to test the linear and quadratic effects of time or 2 week interval on BW and BW gain for each breed. A \( \chi^2 \)-test of independance was conducted to evaluate differences in the incidence of scours.

3. Results and discussion

In the first week following birth, BA kids had higher milk replacer intake than S and BS kids (S versus BA and BS and BA versus BS; \( P<0.05 \)) (Fig. 1). In the first 2 week after birth, BA kids were trained to consume milk replacer more easily than S or BS kids. Milk replacer intake increased rapidly until 3 week of age, after which it remained stable until weaning.

The first day of starter diet consumption was greater \( (P=0.02) \) for BA versus BS kids (Table 1). For all breeds, intake of starter diet increased gradually from Week 5 to 8. Starter diet DM intake in Week 5–6, 7–8 and 3–8 by BS kids was much higher than by BA and S kids (3–8 week: crossbreeding, \( P=0.05 \); crossbred type, \( P<0.01 \)). Starter diet DM intake in Week 5–6 was not affected by crossbreeding \( (P>0.10) \), but was less \( (P=0.10) \) for S versus BA and BS in Week 7–8. Total DM intake by BS kids in Week 3–8 was greater \( (P=0.01) \) than that of BA kids (132 versus 119 and 119 g/day). BA kids did not consume significant amounts (\(<16\) g/day) of a starter diet in the first 6 week of life.

Initial BW of Boer crosses was greater than for S kids \( (P<0.05; \text{Fig. 2}) \). BW of all three breeds increased linearly \( (P<0.01) \) as the trial progressed. BW gain of S kids did not vary markedly among 2-week period as the trial progressed, whereas Boer crosses grew more

Fig. 1. Milk replacer DM intake for Spanish, Boer×Angora and Boer×Spanish kids.
rapidly after 4 week than before, particularly after 6
week (Table 1). In Week 3–4, S kids grew faster than
did Boer crosses ($P$ $\leq$ 0.03). After Week 4, BW gain of
S kids remained constant, whereas BW gain of Boer
crosses increased dramatically, surpassing BW gain of
S kids in Week 5–6 ($P$ > 0.10) and 7–8 ($P$ = 0.001).
Linear and quadratic effects of 2-week period on BW
gain were not significant ($P$ > 0.10).

Table 1
Performance data of Spanish (S), Boer×Angora (BS) and Boer×Spanish (BS) goat kids

<table>
<thead>
<tr>
<th>Item</th>
<th>Week</th>
<th>Breed</th>
<th>SE</th>
<th>Contrast P value</th>
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<tbody>
<tr>
<td></td>
<td></td>
<td>S</td>
<td>BS</td>
<td></td>
</tr>
<tr>
<td>n</td>
<td>26</td>
<td>21</td>
<td>30</td>
<td></td>
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<tr>
<td>Starter diet DM intake (g/day)$^a$</td>
<td>5–6</td>
<td>21.7</td>
<td>16.8</td>
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<td></td>
<td>7–8</td>
<td>47.0</td>
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<td>71.9</td>
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<td></td>
<td>3–8</td>
<td>22.9</td>
<td>23.7</td>
<td>37.2</td>
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<td>Total DM intake (g/day)</td>
<td>3–8</td>
<td>120</td>
<td>119</td>
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<td>First day of consumption (day)</td>
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<td>15.7</td>
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<td>BW gain (g/day)</td>
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<td>59.8</td>
<td>50.2</td>
<td>54.4</td>
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<td>60.3</td>
<td>71.3</td>
<td>76.8</td>
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<tr>
<td>Feed conversion ratio (g BW gain: kg DM intake)</td>
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<td>548</td>
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<td>5–6</td>
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<td></td>
<td>3–8</td>
<td>517</td>
<td>590</td>
<td>577</td>
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<tr>
<td>Incidence of scours (%)</td>
<td>17</td>
<td>21</td>
<td>31</td>
<td></td>
</tr>
</tbody>
</table>

$^a$ Starter diet was first offered in Week 4, during which time consumption was negligible. Starter diet intake was recorded when exceeding
30 g/day. Values for Week 5–6 are on a 14-day basis, although the first day of starter diet intake greater than 30 g/day was during Week 5 for
most kids.

Fig. 2. Preweaning BW for Spanish, Boer×Angora and Boer×Spanish kids. SE=0.150.
BW gain for S and Boer crosses in the preweaning period was lower than observed by Machen et al. (1996) under extensive production conditions. It is unclear whether the feeding of milk replacer was responsible for this difference. Galina et al. (1996) discussed several experiments comparing artificial feeding of goat kids with goat milk, cow milk replacer and goat milk replacer in which BW gain was similar regardless of feeding method. Sahlu et al. (1992) found that kid growth was not significantly impaired by the feeding of milk replacer.

Differences among breeds in feed conversion ratio in the 2-week periods were generally similar to those noted for BW gain; feed conversion ratio for Boer crosses in Week 7–8 and 3–8 was significantly greater ($P \leq 0.03$) than for S kids (Table 1). Although, S kids demonstrated more efficient BW gain than did Boer crosses in Week 3–4 ($P = 0.07$). There were no differences in feed conversion ratio between BA and BS kids ($P > 0.10$).

There were no differences in the incidence of scours among the three breeds ($P > 0.10$), although BS and BA kids tended to have a higher incidence than did S kids (31, 21 and 17%, respectively; Table 1). Reasons for this trend are unclear. The incidence of scours in this study was higher compared with that noted by Sahlu et al. (1992), who reported no scours in Angora kids during a 10-week milk replacer feeding period. Most scours occurred in the first 4 week of the present experiment. Similarly, Nocek and Braund (1986) reported the highest incidence of scours in calves consuming milk replacer twice daily in the first 25 days. In the first 4 week of the present experiment, milk replacer constituted a greater proportion of DM intake than later. The relatively high incidence of scours early in the experiment may thus be caused by digestive disorders attributable to milk replacer, although there are many causes of scours in young animals, such as disturbances due to bacteria, protozoa or viruses.

Milk replacer consumption was limited in most of the experiment. However, restricted feeding in the first 4 week may affect kid growth and prevent full expression of growth potential. Nocek and Braund (1986) showed that calves consuming acidified milk replacer ad libitum ingested more DM and gained BW more rapidly up to 35 days of age compared calves restricted in milk replacer intake. This suggests that high milk replacer intake for kids of all genotypes in the first 4 week following birth, and early offering of solid feed no later than at 3 week of age, offer greatest opportunities for genotypes to express differences in growth potential.

4. Conclusions

Boer × Angora kids consumed more milk replacer from birth to 3 week of age than did BS and S kids, although intake was similar among genotypes in Week 3–8. Starter diet intake was greatest among genotypes for BS, and the feed conversion ratio was 13% greater for Boer cross kids than for S kids. This study reflects that Boer crosses exhibit superior growth and feed efficiency during the preweaning period compared with Spanish kids under intensive management conditions.

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