Fitness of meat goat does sired by Kiko, Myotonic, Savanna, and Spanish bucks in the southeastern United States

R. Browning, Jr.*, M. L. Leite-Browning†, and E. G. Hayes*

*Tennessee State University, Department of Agricultural Sciences, 3500 John A. Merritt Blvd., Nashville, TN 37209-1561 USA
†Alabama A&M University, Cooperative Extension Service, P.O. Box 967, Normal, AL 35762 USA

Summary

Fitness traits were assessed in meat goat does sired by Kiko (K), Myotonic (M), Savanna (V) and Spanish (S) bucks. Daughters included crossbred and purebred progeny for each of the sire breeds. Does (n = 216) were semi-intensively managed on humid, subtropical pasture. Measurements (1197 doe-year-time records) were taken on does at breeding, kidding, and weaning. Traits measured included internal parasite burden indicators, litter size profiles, doe survivability, and various whole-herd reproductive values. Sire breed affected ($p < 0.05$) nearly all traits recorded. Values for M-sired does were consistently more favorable than V-sired does across the fitness traits studied. The K- and S-sired does were moderate in performance. Does sired by K tended to separate from the V-sired does more so than S-sired does. The K- and S-sired does did not separate from M-sired does for any whole herd reproductive trait or survival. More work is needed to better understand the relative values of Savanna and the other breeds as sires for producing meat goat herd replacement does.

Keywords: meat goats, sire breed, crossbreeding, fitness
Introduction

Goat production in the US is a non-traditional, alternative animal industry that continues to fall short of meeting domestic demand for goat meat. Various breeds have been considered for use in commercial meat goat production in the US, primarily Boer (Casey & Van Niekerk, 1988), Kiko (Batten, 1987), and Spanish (Shelton, 1978). Evaluation of these breeds, along with the Myotonic, have revealed significant breed differences for fitness traits with Boer females exhibiting consistently lower fitness (Browning et al., 2011; Pellerin & Browning, 2012; Wang et al., 2017). Fitness-related traits (i.e., health and reproduction) are important in the economic success of a meat animal enterprise. Internal parasitism in goats is a major barrier to good animal health and productivity along with enterprise sustainability, especially in warm, wet climates. Improved breed selection may be used as an effective approach to mitigating internal parasitism in meat goats (Baker & Gray, 2004). New breeds are usually introduced as sires to improve the growth rate or carcass merit of offspring. However, crossbred females from new sire breeds are often kept as doe herd replacements. The latest ‘new’ meat goat breed to gain popularity in the US is the Savanna. Savanna goats are from South Africa like the Boer (Campbell, 2003; Visser et al., 2004; Pieters et al., 2009). Also like the Boers when they first gained popularity in the 1990s, there are currently no reports available in the scientific literature regarding the relative performance merits of Savanna goats. The objective of this study is to assess the comparative fitness of does when sired by Savanna bucks and three other sire breeds.
Materials and methods

Herd management

Across four production years, daughters of 12 Kiko (K, n = 55 does, 104 doe-yr entries), 4 Myotonic (M, n = 31 does, 71 doe-yr entries), 11 Savanna (V, n = 73 does, 119 doe-yr entries), and 10 Spanish (S, n = 57 does, 105 doe-yr entries) sires were evaluated. The dams of the study does included Boer-crossbred does and straightbred does of the four sire breeds. Most K-, M-, and S-sires does were produced by purebred or backcross matings. Most daughters of V sires were F1 crosses from K and S does or three-breed crosses that included Boer germplasm. Does were 2 to 5 years of age balanced across sire breeds. The herd was managed at the Tennessee State University research station in Nashville, Tennessee, USA (36.176°N, 86.828°W). Nashville is in the humid, subtropical southeastern US. Over the six years that included the birth and production years of the study does, mean annual precipitation was 1267 mm and mean annual temperature was 16.2°C. Both values were higher than the 30-yr averages for this location.

The study does were semi-intensively managed on cool-season tall fescue (Festuca arundinacea) and warm-season bermudagrass (Cynodon dactylon) pastures. Numerous other browse species were available in the pastures for consumption at various times of the year. During the winter, does received orchardgrass hay (Dactylis glomerata) for ad libitum consumption and 454 g/d of whole cottonseed. The herd was maintained at approximately 10 does per hectare. Does were bred to produce spring kids. March-born and May-born kids were weaned at approximately 90 d of age. Service sires included the same sire breeds in planned purebred or backcross matings. Does were vaccinated for clostridial diseases and pneumonia during late gestation and dewormed once annually at kidding. Doe weights, blood hematocrit values (PCV) and fecal parasite egg counts (FEC) were determined for each doe at fall breeding. The same three measurements were recorded at kidding and weaning on does with kids at the respective time points.

Statistical analysis

Statistical models included the fixed effects sire breed, sampling time (breeding, kidding, or weaning) and doe age. There were a total of 1197 doe records analysed. Sampling time was only included in models for repeated measures (doe weight, FEC, PCV). The breed*time interaction term was included in the FEC and PCV models. Year was included in all models as a random effect. Sire breed was tested against sire(sire breed) as the nested random error term. Mixed model analysis of variance was used for doe weight, FEC (log10 +1), and PCV. Generalized linear mixed model was used for kidding and weaning rates (does producing kids per doe buck exposed), annual doe survival rate and kid crop born and weaned (kids produced per does in herd at breeding) and litter size. Probability levels less than 0.05 for the F-statistic indicated a significant effect. The Tukey-Kramer procedure was used to compare least squares means (α = 0.05).

Results and discussion

The breed*time interaction was important (p < 0.05) for PCV. Sire breed as a main effect
affected ($P \leq 0.05$) all traits measured except for PCV ($p = 0.18$) and litter size at weaning ($p = 0.15$). Does of K sires were heavier than S-sired does (Table 1). These breed rankings were the same as reported in straightbred does (Browning et al., 2011; Wang et al., 2017). The intermediate weight of M-sired does differ from the low weight ranking for M does in Wang et al. (2017), probably because the current study include M crossbred does. Savanna sires did not increase doe weights (Table 1). Savanna-sired does had higher FEC than K- and M-sired does with M-sired does also having lower FEC than S (Table 1). The breed rankings were identical to how the four sire breeds ranked for replacement doeling FEC (Goolsby et al., 2017). In straightbred does, M also had the lowest FEC (Wang et al., 2017). Higher FEC for the V-sired does matched the generally higher values reported for straightbred Boer does (Browning et al., 2011; Wang et al., 2017). Elevated FEC indicates higher internal parasite burden. The PCV means were lower ($p < 0.05$) at weaning (18.5 ± 1%) that at breeding (23.4 ± 1%) and kidding (24 ± 1%). Within the breed*time interaction for PCV, the sire breed differences were most notable at weaning as M-sired does had higher ($p < 0.05$) PCV values (20.8 ± 1.3%) than does with V- (16.1 ± 1.3%) and S-sires (17.2 ± 1.2%). Lower PCV at weaning suggested a greater degree of preweaning anemic that could be detrimental to doe performance and survival. Sire breed affected ($p < 0.05$) prolificacy as indicated by litter size at kidding being higher ($p < 0.05$) for V- and K-sired does than for S-sired does (Table 1). Sire breed effects on litter size dissipated by weaning.

The whole-herd evaluation consistently demonstrated better performance ($p < 0.05$) for M-sired does compared to V-sired does (Table 1). The K- and S-sired does were also better ($p < 0.05$) than V-sired does for fertility (i.e., kidding rate) and survivability and did not differ from M- for any of the whole-herd measurements (Table 1). Evaluation of straightbred does in this laboratory had shown consistently lower whole-herd performance levels for Boer does compared to K and S does (Browning et al., 2011; Pellerin & Browning, 2012; Wang et al., 2017). The M influence performed more favorably compared with K and S as a sire breed in the current study than as straightbred does where whole-herd values for M does were inferior to K and S does (Wang et al., 2017).

Early results from the current study raise concerns regarding the use of V sires to produce replacement does. The daughters of V sires generally trended lower for merit across the range of fitness traits compared with the other sire breeds. Relative maternal values of V goats have not been reported up to this point. A genetic assessment by Visser et al. (2004) showed that V goats are genetically close to Boer goats, an observation that may have relevance in explaining the performance of V-sired does in the current study. Conversely, daughters of M sires performed favorably across the series of fitness traits recorded. The inclusion of crossbred daughters in this sire evaluation probably enhanced to profile of the M influence when compared to the evaluation of straightbred M does in Wang et al. (2017). The K and S breeds have consistently demonstrated similar and desirable fitness levels when compared to other breed options in this and past studies across a range of production environments (Blackburn, 1995; Browning et al., 2011; Pellerin & Browning, 2012; Rhone et al., 2013; Wang et al., 2017). The M and S are heritage, landrace types in the US that have not been exposed to the pressures of artificial selection for increased production. Each represents a valuable genetic resource to consider for enhanced doe herd performance.
<table>
<thead>
<tr>
<th>Trait</th>
<th>Kiko</th>
<th>Myotonic</th>
<th>Savanna</th>
<th>Spanish</th>
</tr>
</thead>
<tbody>
<tr>
<td>Doe weight, kg</td>
<td>34.4 (1.2)a</td>
<td>30.9 (1.7)ab</td>
<td>33.4 (1.3)ab</td>
<td>30.7 (1.3)b</td>
</tr>
<tr>
<td>FEC(^2), eggs/g</td>
<td>406 (-)bc</td>
<td>262 (-)c</td>
<td>691 (-)a</td>
<td>602 (-)ab</td>
</tr>
<tr>
<td>PCV(^3), %</td>
<td>22.2 (1.1)</td>
<td>23.1 (1.3)</td>
<td>21.1 (1.1)</td>
<td>21.3 (1.1)</td>
</tr>
<tr>
<td>LS at kidding, n kids</td>
<td>1.54 (0.09)a</td>
<td>1.52 (0.12)ab</td>
<td>1.53 (0.11)a</td>
<td>1.20 (0.08)b</td>
</tr>
<tr>
<td>LS at weaning, n kids</td>
<td>1.45 (0.08)</td>
<td>1.30 (0.08)</td>
<td>1.43 (0.09)</td>
<td>1.24 (0.07)</td>
</tr>
<tr>
<td>Kidding rate, % does</td>
<td>80.5 (3.7)a</td>
<td>86.2 (3.2)a</td>
<td>52.4 (3.8)b</td>
<td>75.9 (3.9)a</td>
</tr>
<tr>
<td>Weaning rate, % does</td>
<td>53.9 (7.0)ab</td>
<td>79.0 (3.8)a</td>
<td>36.2 (5.5)b</td>
<td>61.1 (6.6)ab</td>
</tr>
<tr>
<td>Kid crop born, % kids</td>
<td>127.6 (14.6)a</td>
<td>132.9 (16.9)a</td>
<td>86.0 (11.2)b</td>
<td>94.3 (9.7)ab</td>
</tr>
<tr>
<td>Kid crop weaned, % kids</td>
<td>75.0 (10.3)ab</td>
<td>96.1 (13.2)a</td>
<td>54.7 (8.0)b</td>
<td>71.7 (9.7)ab</td>
</tr>
<tr>
<td>Survival rate, % does</td>
<td>67.4 (1.2)a</td>
<td>87.1 (5.2)a</td>
<td>44.0 (8.0)b</td>
<td>67.6 (5.2)a</td>
</tr>
</tbody>
</table>

\(^1\)Least squares means (± se)
\(^2\)Fecal egg count, geometric (i.e., back-transformed) means
\(^3\)Packed cell volume
\(^4\)Litter size
\(^*\)Means within a row not sharing a common superscript differ (p < 0.05)

Conclusion

Maternal breed-type choices can affect meat goat herd productivity. Sire breed options need to be assessed for replacement doe performance. More research is needed to better assess the comparative fitness of meat goat breeds for dam-side contributions to commercial breeding herds managed under varied and stressful environmental conditions.

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List of References


