Small Ruminant Research 125 (2015) 43–55

Contents lists available at ScienceDirect

Small Ruminant Research

journal homepage: www.elsevier.com/locate/smallrumres

Effects of supplementation and body condition on intake, digestion, performance, and behavior of yearling Boer and Spanish goat wethers grazing grass/forb pastures

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ARTICLE INFO

Article history:
Received 2 December 2014
Received in revised form 12 February 2015
Accepted 15 February 2015
Available online 23 February 2015

Keywords:
Behavior
Goats
Grazing
Performance

ABSTRACT

Sixteen Boer and 16 Spanish (Span) yearling wethers were used, with eight of each breed in different initial body condition (IBC; High and Low). Initial BW was 40, 25, 29, and 22 kg (SE = 1.4) and body condition score (BCS; 1 = extremely thin and 5 = very obese) was 3.9, 2.4, 3.6, and 2.7 (SE = 0.12) for Boer-High, Boer-Low, Span-High, and Span-Low, respectively. There was one wether per breed × IBC treatment in each of eight 0.4-ha grass/forb pastures. Wethers in four control (Con) pastures were not supplemented with concentrate, whereas those in supplement (Sup) pastures received 0.9% BW (DM basis) of concentrate. The experiment was 126 days, with four periods 39, 28, 37, and 22 days in length. Forage mass was 2466, 2496, 3245, and 2495 kg/ha for Con and 2226, 2378, 3100, and 2724 kg/ha for Sup in periods 1, 2, 3, and 4, respectively (SE = 199.0). The difference in intake of digested OM between breeds was much greater with than without supplemental concentrate (485 and 741 g/day for Boer and 413 and 561 g/day for Span without and with supplementation, respectively; SE = 23.2). In accordance, supplementation increased ($P < 0.05$) ADG by Boer but not Span wethers (6, 32, 82, and 51 g for Boer-Con, Span-Con, Boer-Sup, and Span-Sup, respectively; SE = 13.1). There was a trend ($P = 0.070$) for greater ADG by Low vs. High IBC wethers (56 vs. 30 g; SE = 0.4), in agreement with overall greater ($P < 0.05$) total DM intake relative to BW by Low IBC wethers (3.16 and 2.78% BW; SE = 0.065). However, converse to the breed comparison, IBC and supplement treatment did not interact in ADG. Grazing time was less ($P < 0.05$) with than without supplementation (5.8 vs. 6.9 h; SE = 0.22) and greater ($P < 0.05$) for Boer vs. Span in period 1 (8.0, 6.9, 6.3, and 7.2 h for Boer and 4.7, 5.9, 5.7, and 6.4 h for Span in periods 1, 2, 3, and 4, respectively; SE = 0.45), although IBC did not influence grazing time (6.2 and 6.6 h for High and Low, respectively; SE = 0.22) despite the difference in ADG and greater total DM intake relative to BW. In conclusion, supplementation increased ADG by Boer but not Spanish wethers and lessened grazing time, low IBC resulted in compensatory growth with increased DM intake relative to BW and ADG without affecting grazing time, and supplementation interacted with breed though not IBC.

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http://dx.doi.org/10.1016/j.smallrumres.2015.02.011

1. Introduction

The amount of energy ruminants expend in the activity of grazing can be appreciable. One of the many factors that could influence this cost is time spent grazing (Sahlu et al., 2004; NRC, 2007; Beker et al., 2009, 2010; Tovar-Luna et al., 2011). A variety of factors may affect grazing time, one being the nutrient requirements of an animal. For example, nutrient needs or potential for use are greater for Boer goats than for goats of other meat breeds that have less growth potential. Initial BW and level of condition can also influence nutrient demand, such as greater expected nutrient use per unit of BW by animals expressing compensatory growth assuming adequate diet quality (NRC, 2007). Supplementation also could have effect by satisfying part of nutrient requirements and, thereby, potentially decreasing forage consumption. Another important consideration is climatic conditions, which can have marked impact on total time spent in behaviors such as grazing as well as temporal patterns during the day. Furthermore, interactions among such factors are likely.

Grazing studies are more challenging to conduct than ones in confinement because of less controlled conditions. However, for both types of experiments results are sometimes extrapolated to other settings without ample justification of little or no impact of differing conditions. Examples of such conditions include those noted above. Relatively greater effects of treatments on behaviors that could influence nutrient intake and digestion and, thus, performance are expected in grazing than confinement settings. Therefore, objectives of this experiment were to determine effects of breed, concentrate supplementation, and initial body condition on performance and behavior of meat goats grazing grass/forb pastures.

2. Materials and methods

2.1. Animals and treatments

The protocol for the experiment was approved by the Langston University Animal Care Committee. Animals resided in eight 0.4-ha pastures during the experiment. Pastures contained a variety of forages, with ones most predominant being bermudagrass (*Cynodon dactylon* L.) and ragweed (*Ambrosia artemisifolia* L.). Although botanical composition data of forage available for grazing are not presented, composition information from previous studies with these pastures can be highlighted. Animut et al. (2005) listed over 25 plant species present, but a lesser number given by Yiakoulaki et al. (2007) included grasses of bermudagrass and johnsongrass (*Sorgum halepense* (L.) Pers.) and forbs such as ragweed, silverleaf nightshade (*Solanum elaeagnifolium* Cav.), and Carolina horsenettle (*Solanum carolinense* L). Secondary grasses were *Bromus tectorum* L., *Dichanthelium oligisanthes* (J.A. Schultes) Gould, *Eragrostis* spp., *Cyperus echinatus* (L.) Wood, *and Setaria glauca* (L.) Beauv., while other forbs present were *Trifolium campestre* Schreb., *Medicago sativa* L., *Rumex crispus* L., *Lactuca canadensis* L., *Schrankia uncinata* Willd., and *Conyza canadensis* (L.) Cronq. Of forage present after grazing periods in the study of Animut et al. (2005), 50–74% was grass, with ragweed accounting for 49–88% of forbs. Similar data were presented by Goetsch et al. (2007, 2014), including relatively small contributions of johnsongrass compared with bermudagrass. Water and commercially available trace mineralized salt blocks (NaCl: 96.5–99.5%; Zn: 4000 mg/kg; FE; 1600 mg/kg; Mn: 1200 mg/kg; Cu: 260–390 mg/kg; I: 100 mg/kg; Co: 40 mg/kg) were available at all times and each pasture contained a shelter. Animals were treated with Cydectin® (Fort Dodge Animal Health, Fort Dodge, IA, USA) before the experiment began.

Sixteen Boer and 16 Spanish yearling wethers were used. In a 4-month preliminary period, eight wethers of each breed were managed to have different initial levels of body condition (IBC), High and Low. Low IBC was achieved by offering a low-quality grass hay ad libitum while on pasture without supplementation, and High IBC was from feeding a higher quality grass hay and supplementation with 1.35% BW (DM) of concentrate. Wethers were managed as two IBC groups, with Boer and Spanish wethers in each pasture. The IBC was assessed by body condition score (BCS) determined as described by Ngwa et al. (2007), with 1 being extremely thin and 5 very obese and no influence of digesta mass in the gastrointestinal tract. A description is also available at: http://www2.lureset.edu/goats/researchbcshowto.html. Primary areas evaluated are the lumbar region (i.e., area containing the loin muscle), sternum, and rib cage. These areas are felt with fingers to assess the mass of both fat and lean tissue present. A BCS of 3.0 indicates that tissue mobilization has not occurred because of a limited plane of nutrition and, likewise, that there has not been excessive adipose tissue accretion in response to high energy and nutrient intake. Initial BW was 40, 25, 29, and 22 kg (SE = 1.4) and BCS (1 = extremely thin and 5 = very obese) was 3.9, 2.4, 3.6, and 2.7 (SE = 0.12) for Boer-High, Boer-Low, Spanish-High, and Spanish-Low, respectively.

Pastures were randomly allocated to two treatments, Control (Con) and Supplementation (Sup). Wethers in Con pastures were not supplemented with concentrate, whereas those in Sup pastures received a mixture of 75% ground corn and 25% soybean meal at 0.9% BW (DM basis). The composition of the supplement was simple, with only two common ingredients, so that results could be easily extrapolated to other settings. The supplement was similar in composition to many commercial concentrate-based products providing primarily energy but with some additional protein so as to prevent creation of a deficiency of ruminally available nitrogenous compounds for microbial utilization. The amount of supplement was based on the most recent determination of BW. There was one wether per breed × IBC treatment in each pasture.

2.2. Measurements

The experiment was 126 days, beginning on May 20, 2007. Therefore, the study occurred in the summer when the predominant forages were growing, depending on climatic conditions such as temperature and rainfall and soil fertility. In regards to the latter factor, pastures had not been fertilized in recent years as is common for low-input ruminant livestock production systems in many areas. There were four periods 39, 28, 37, and 22 days in length. Sunrise was at 06:12 and 07:21 h and sunset was at 20:48 and 19:19 h at the beginning and end of the experiment, respectively. Wethers were weighed and BCS determined at the beginning of the experiment and end of each period at 08:00 h. Other animal measures occurred during 2 wk in the middle of each period. Animals in two pastures of each supplement treatment were grouped into two animal sets, with one used for activity measures and the other for collecting feces in the first week. In the second week measures were switched for the two sets. Feces were collected over a 4- or 5-day period by use of canvas fecal bags with perforated bottoms. After weighing feces daily, a 10% aliquot sample was saved to form a composite that was kept frozen between and after days of sampling.

An IceTag activity monitor of IceRobotics Limited (Midlothian, Scotland, UK) was attached to a rear leg of wethers of the other set to estimate the number of steps and time spent standing, lying, and active. Time standing encompasses both grazing/eating and non-grazing/eating periods, and active is walking at a pace faster than typical of grazing periods. Lying time is solely or predominantly without grazing. To estimate horizontal distance traveled and time the head was in a down position, the Model 3300SL GPS unit, also with a *x*–*y* motion sensor, of Lotek Wireless (Newmarket, Ontario, Canada) was placed on the neck. The head-down determination arises from a motion/position sensor. The collars were scheduled to acquire a GPS fix every 5 min. Fixes were downloaded and processed using proprietary software (N4, Lotek Wireless) and base station files from the Perry, OK, USA continuously operating reference station (OKPR, 36°16′34.46428″ N, 97°19′17.97610″ W). Corrected fixes were then imported into ArcMap 9.3 (ESRI, Redlands, CA, USA). Boundaries of the eight plots including a 7-m external buffer were constructed as shapefiles using a coordinate system of WGS 1984 UTM 14 N. *x* and *y* coordinates in meters were calculated for each fix. Only fixes within the boundary and buffer shapefiles were exported. Distance between consecutive fixes was calculated using Euclidean geometry. In the second measurement week, the equipment systems were placed on wethers of the other set.