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Herbage selection, intake and digestibility in grazing beef cattle

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ABSTRACT

The objectives of this study were to measure voluntary herbage intake in kg of dry matter (DM) per day and in proportions of plant species and components (leaf, stem, dead material) of nonlactating Angus cows under grazing conditions and compare DM herbage intakes to intakes of the same cows when they were nursing their calves. Twenty nonlactating Angus cows (50 ± 12 mo of age, 525 ± 55 kg weight) were selected from a larger herd to create 4 groups of 5 cows with average DM intakes that ranged from 11 to 15 kg/d during lactation. The cows were allocated for 28 d as a group on the pasture that contained 5540 kg DM/ha as tall fescue (*Festuca arundinacea*), bermudagrass (*Cynodon dactylon* var. Tifton-85), red clover (*Trifolium pratense*) and other plants. Pasture composition was measured by visual appraisal and manual separation of pasture clippings. Daily allocations provided approximately 2.5 kg DM/100 kg BW. Each cow was individually fed 0.82 kg supplement DM daily that contained 498 mg of the *n*-alkane dotriacontane (C32) and 448 mg hexatriacontane (C36) during the last 14 d. Fecal grab samples were collected from each cow during the last 5 d. Grazing intake (8.92 ± 1.5 kg DM/d) was calculated for each cow from C32 intake and ratios of tritriacontane (C33):C32 in feces and did not differ ($P=0.97$) among cow groups. Individual cow intakes during lactation and after weaning, during grazing, were not correlated. Measured sward and calculated intake proportions of tall fescue (0.58 and 0.65), bermudagrass (0.38 and 0.33), and red clover (0.02 and 0.01) indicated cows selected slightly more tall fescue and less bermudagrass and red clover than was on offer. Manual separations of sward and calculated intake proportions of dead material and stem (0.89 and 0.95), green leaf (0.10 and 0.02) and other material (0.01 and 0.04) were similar. *N*-alkanes provided credible calculations of intake by grazing cows. Intakes of lactating cows did not predict their intake after weaning.

1. Introduction

Approximately one-half of the energy input for beef production from conception to slaughter is used for maintaining the breeding female (Ferrell and Jenkins, 1982). Improving efficiency of beef production through selection of breeding females requires information on the individual grazing cow's selection of herbage from the sward, voluntary intake, and apparent dry matter (DM) digestibility. Various techniques and approaches have be used to measure these components in grazing situations, including sampling of herbage on offer before and after grazing, internal or external markers, and inference from production parameters, such as weight gain and milk production (Macoon et al., 2003; Undi et al., 2008). Calculated intakes using *n*-alkanes, as internal and external

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markers are not significantly different from measured intakes in cattle fed hay (Unal and Garnsworthy, 1999; Ferreira et al., 2004; Chavez et al., 2011) or intakes determined by other indirect methods with grazing cattle (Undi et al., 2008). Their use as markers provides the opportunity to measure selection, intake, and digestibility in grazing cattle (Molina et al., 2004; Smit et al., 2005; Ferreira et al., 2007).

The objectives of this study were use the *n*-alkane technique to measure voluntary herbage intake in kg of dry matter (DM) per day and in proportions of plant species and components (leaf, stem, dead material) of nonlactating Angus cows under grazing conditions and compare DM herbage intakes to intakes of the same cows when they were nursing their calves.

2. Materials and methods

Procedures were reviewed and approved by the Animal Care and Use Committee of North Carolina State University. The experiments were conducted at the Upper Piedmont Research Station, Reidsville, NC (36°23′16.04″N 79°41′54.54″W).

A study was conducted from January to June 2011 to evaluate DMI of a group of 120 purebred Angus cows averaging 525 kg of BW and 49 months of age during the lactation period. Cows were allocated in pens equipped with electronic recognition Calan doors system (American Calan, Northwood-NH) and received a fescue grass hay-based diet (DM:90%; CP:10%; NDF:52%; TDN:58% and EM:2.09 Mcal/kg DM). The DMI during lactation period was measured as the difference between the fescue hay offered (kg DM/d) and the orts (kg DM/d). From this group, 20 cows were selected to create 4 intake groups of 5 cows ranging from 11 kg to 15 kg of DMI/d. The intake groups formed had the following age, BW and DMI: group 1 (38 months 486 kg; 10.85 kg/d), group 2 (48 months; 514 kg; 12.45 kg/d), group 3 (48 months; 492 kg; 13.14 kg/d) and group 4 (65 months; 608 kg; 15.08 kg/d). During the non-lactation period (from July to August), the group of 20 cows (previously selected during lactation phase) was allocated to graze as a herd for 28 d (14 d on an adaptation field and 14 d on the test field) for alkane DMI evaluation. The mouth, tongue and teeth of the cows were examined to verify absence of injuries or abnormalities. The cows were weighed and body condition score recorded at start and end of the experiment. The test field was 0.68 ha, and visual appraisal of randomly placed 0.25 m^2 quadrats by 3 persons indicated that the composition of the sward was 58% tall fescue (*Festuca arundinacea*), 38% bermudagrass (*Cynodon dactylon* var. Tifton-85), 2% red clover (*Trifolium pratense*) and 2% other plants. Samples from 0.25 m^2 quadrats clipped to the soil surface were collected before the experiment to estimate the 5540 kg of herbage DM/ha of the field.

2.1. Pasture allocation, alkane dosing, and sample collection

Based on the sampling information and on visual characteristics of the test field, daily allocations of field area were calculated to provide 2.5 kg DM/100 kg BW, approximately 12 kg/DM/d for each cow. A temporary electrified fence was used to control access to the allocation, with no restriction to access to areas previously grazed. Water was available ad libitum. Each cow was individually fed 0.82 kg of supplement DM daily. The daily protocol was to separate the cows at 0630 h to allow individual feeding and consumption of supplement, and collection of a fecal sample from each cow. Oliván et al. (2007) found that alkane concentrations in fecal grab samples collected at 0830 h, the time of daily dosing alkanes to cattle, were representative of alkane concentrations in total fecal collections. Fecal samples were collected in aluminum plans, covered with lids, and stored frozen for later analysis. Each day, 2 or 3 quadrats were clipped and collected from the pasture allocation to be provided. Then the electrified fence was moved, and the cows were allowed access to the new allocation at approximately at 0900 h. The following morning, 3 to 4 quadrats were clipped and collected from the same pasture allocation.

Herbage from the quadrats was stored in a refrigerator until samples from each allocation were composited, and then divided into subsamples. The first subsample was analyzed for determination of DM, nutrient composition and alkane composition and the second subsample was manually separated in green leaf, stem, dead material, seed head, and other material. The supplement for each cow contained dotriacontane (C32) and hexatriacontane (C36). The alkanes were dissolved in warm heptane and sprayed on soy hulls as they were turning in a paddle mixer. Alkanes were sprayed on the hulls to provide 1.197 g of C32 and 1.079 g C36/kg soyhulls DM. After drying for several days at room temperature to evaporate the heptane, the soy hulls were mixed 1:1 with ground corn. Each cow received 0.45 kg of that mixture which was hand-mixed with 0.45 kg of pelleted corn-gluten feed before feeding. There were orts in 6 of the 280 supplement feedings; those orts were collected, but later deemed insignificant (they were 50 g or less at collection, which included salivary contamination) and ignored in calculations of intake.

2.2. Sample analysis

Feed, orts, and fecal samples were dried to a constant weight at 55 °C to determine DM content. Analysis for alkane concentrations were done as described by Chavez et al. (2011), except fecal samples were ground through a 1 mm screen instead of a 0.5 mm screen. Feedstuff nutrient content (Table 1) was determined by the samples sent to the North Carolina Department of Agriculture and Consumer Services, Raleigh NC. Herbage and supplement samples were analyzed for analytical DM and ash (methods 930.15; 942.05; Association of Official Analytical Chemists (AOAC), 2006), total N (LECO Trucmac Determinator; LECO Corp., St Joseph, MI), individual minerals (Ca, P, Mg, Cu, Zn) (method 985.01; Association of Official Analytical Chemists (AOAC), 2006), neutral detergent fiber (NDF) and acid detergent fiber (ADF) (Ankon Technology methods 6 and 5; Fairport, NY, solutions as Van Soest et al., 1991).

2.3. Calculations and statistical analyses

Herbage DM intake (DMI) was calculated daily from fecal and supplements concentrations of alkanes using