Available online at www.sciencedirect.com
ScienceDirect
Animal Feed Science and Technology
148 (2009) 93–106
ANIMAL FEED SCIENCE AND TECHNOLOGY
www.elsevier.com/locate/anifeedsci

Effects of total nonstructural carbohydrates and nitrogen balance on voluntary intake of goats and digestibility of gamagrass hay harvested at sunrise and sunset

A.K. Sauvé [a], G.B. Huntington [a,*], J.C. Burns [a,b]

[a] *Department of Animal Science, North Carolina State University, Raleigh, Box 7621 Raleigh, NC 27695-7621, USA*
[b] *U.S. Department of Agriculture, Agricultural Research Service, and Department of Crop Science, North Carolina State University, Raleigh, NC 27695-7621, USA*

Received 23 October 2007; received in revised form 15 February 2008; accepted 4 March 2008

Abstract

We evaluated differences in composition of Iuka gamagrass (*Tripsacum dactyloides* L.) hay harvested at 06:00 (AM harvest) or 18:00 h (PM harvest), and measured how protein supplementation and time of harvest interact to affect the voluntary intake, digestibility, and N balance of goats. Boer cross wethers ($n = 28$; 24 kg) were randomly assigned to be fed supplement (310 g/kg of crude protein (CP), fed at 110 g/kg of dry matter (DM) intake, 14 goats) or no supplement (14 goats). Within supplemented or not supplemented groups, goats were randomly assigned to a crossover design of AM harvest (seven goats) or PM harvest (seven goats), and housed individually in metabolism crates with free access to water and mineral blocks. They were fed twice daily, with supplement offered 30 min prior to the morning feedings. After a 7-d adaptation, voluntary intake (goats were offered 1100 g/kg of previous day's intake) was measured for 14 d, followed by a 4-d adjustment phase to equalize DM offered between periods, and finally a 5-d digestion and balance phase. After Period 1, goats were switched to their new hay harvest times, and the protocol was repeated. Compared to

Abbreviations: ADF, acid detergent fiber; BW, bodyweight; CP, crude protein; DM, dry matter; NDF, neutral detergent fiber; NIRS, near infrared reflectance spectroscopy; TNC, total nonstructural carbohydrates.

* Corresponding author. Tel.: +1 919 513 1693; fax: +1 919 515 4463.
E-mail address: gerald_huntington@ncsu.edu (G.B. Huntington).

0377-8401/$ – see front matter
doi:10.1016/j.anifeedsci.2008.03.001

the AM harvest, the PM harvest had higher (P<0.03) proportions of total nonstructural carbohydrates (TNC, 70.8 g/kg DM *versus* 59.0 g/kg DM), monosaccharides (37.0 g/kg DM *versus* 28.6 g/kg DM), di- and polysaccharides (18.5 g/kg DM *versus* 15.4 g/kg DM) and less neutral detergent fiber (NDF, 700 g/kg *versus* 710 g/kg). Crude protein (79 g/kg DM) and starch (15.2 g/kg DM) were similar for the PM and AM harvest. Dry matter digestibility was higher (P<0.03) for the PM *versus* AM harvests (555 g/kg DM *versus* 531 g/kg DM) and for supplemented *versus* not supplemented (563 g/kg DM *versus* 522 g/kg DM). Voluntary gamagrass DM intake (550 g/d *versus* 548 g/d) and calculated total digestible DM intake (327 g/d *versus* 313 g/d) were similar for the PM and AM harvest. However, total digestible DM intake during the digestion and balance phase was higher (P<0.01) for the PM *versus* AM harvest (317 g/d *versus* 299 g/d). Time of harvest did not affect N intake, digestion, or calculated retention. Compared to no supplementation, the supplement improved (P<0.01) N digestion (6.1 g/d *versus* 3.7 g/d) and retention (2.2 g/d *versus* 1.1 g/d). The PM harvest increased DM digested, largely TNC and digestible DM intake by goats due to increased TNC and not because of a 2% increase in DM intake. Providing a protein supplement had very limited effects on intake and digestibility of gamagrass.

Keywords: Goats; Gamagrass hay; Nonstructural carbohydrates; N metabolism

1. Introduction

Harvest of tall fescue (*Festuca arundinacea* Schreb.), alfalfa (*Medicago sativa* L.), and switchgrass (*Panicum virgatum* L.) in the PM *versus* AM increased total nonstructural carbohydrate (TNC) concentration in hays (Fisher et al., 1999, 2002, 2005; Huntington and Burns, 2008). Forages with increased TNC had higher apparent dry matter (DM) digestibility when offered to goats (Burns et al., 2005) or steers (Huntington and Burns, 2008). Cattle, sheep and goats preferred PM harvested tall fescue (Fisher et al., 1999) and alfalfa (Fisher et al., 2002) when pairs of AM harvested and PM harvested hays were offered side-by-side in preference studies. In these short-term studies, preference was measured as an increase in DM intake over several meals. Based on these results, and others (*i.e.*, Buntinx et al., 1997; Orr et al., 1997; Mayland et al., 2000), the increased preference for forages harvested or grazed in the PM is attributable to the increase in the TNC fraction. Steers fed PM harvested *versus* AM harvested alfalfa hay (Burns et al., 2005), or gamagrass (*Tripsacum dactyloides* (L.) L.) preserved as baleage (forage ensiled in large, round bales covered with plastic, Huntington and Burns, 2007), had increased DM intake over a 3-week period. However, time of harvest did not affect DM intake of steers fed switchgrass hay harvested in the PM or AM (Huntington and Burns, 2008).

Increased dietary protein supply, specifically increased supply of ruminally degradable protein, increased apparent digestibility of crude protein (CP) with warm-season grass hay or pasture (Olson et al., 1999; Bodine et al., 2000; Bodine and Purvis, 2003; Huntington and Burns, 2008). Further, synchronization of degradable protein and fermentable carbohydrates increased ruminal microbial yield *in vitro* (Argyle and Baldwin, 1989), production of organic acids *in vitro* (Hall and Weimer, 2007) and *in vivo* ruminal concentrations of organic acids in dairy cattle (Aldrich et al., 1993).