Morning and afternoon sampling and herbage chemical composition of rotationally stocked elephant grass cv. Napier

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Introduction

Nutrient intake by grazing animals depends on the amount of dry matter consumed and its chemical composition. Forage grasses, as with any other plants, produce assimilates during the day via photosynthesis to sustain live tissues, plant growth and organic reserves (Taiz and Zeiger 2013). In that context, herbage chemical composition may vary according to variations in the photosynthesis-respiration balance throughout the day. From dawn to dusk the balance increases and herbage dry matter content as well as concentration of soluble carbohydrates increase, the reverse happening from dusk to dawn. That could interfere with nutritive value and nutrient intake of grazing animals (Delagarde 2000), since for a given bite volume the amount of herbage and its composition could vary depending on the time of the day. That could have implications for rotationally managed pastures, indicating a potential effect of time of changing animals from one paddock to the other as a management strategy. Against that background, the objective of this experiment was to evaluate dry matter (DM) content and the concentration of soluble carbohydrates (SC), crude protein (CP), neutral (NDF) and acid (ADF) detergent fibre in herbage samples harvested during the morning and afternoon periods from rotationally stocked elephant grass cv. Napier.

Methods

The experiment was carried out at E.S.A. "Luiz de Queiroz" (ESALQ), University of São Paulo, Piracicaba, SP, Brazil (22°43' S, 47°25' W and 554 m a.s.l.), from October 2011 to April 2012 (mid spring and summer). Treatments corresponded to combinations between two post- (post-grazing heights of 35 and 45 cm) and two pre-grazing conditions (95% and maximum canopy light interception during regrowth – $LI_{95\%}$ and LI_{Max}), and were allocated to experimental units (850 m^2 paddocks) according to a 2x2 factorial arrangement and in a randomised complete block design, with four replications. Monitoring of canopy light interception was carried out using a canopy analyser LAI 2000 (LI-COR, Lincoln, Nebraska, USA). Herbage samples (one composite 1000 g sample per paddock) were harvested by hand plucking at the pre-grazing condition late in the afternoon before grazing (06:00 pm) and early in the morning in the grazing day (06:00 am). Samples were separated into two subsamples, weighed, and one put to dry in a forced draught oven at 65°C until constant weight and the other frozen at -18°C for future chemical analysis. In this case samples were lyophilised and ground using a 1 mm sieve in preparation for laboratory analysis of concentrations of soluble carbohydrates (SC) using the total 80% Ethanol-Soluble Carbohydrate method (Hall 2000), neutral (NDF) and acid (ADF) detergent fibre (Van Soest *et al*. 1991) and crude protein (CP) (Leco Corporation, St. Joseph, MI, EUA). Analysis of variance was carried out using SAS® (*Statistical Analysis System*), version 8.2 for Windows® using time of the day (morning and afternoon sampling) as the only cause of variation (n=16), since there was no treatment effect. When appropriate, means were calculated using the "LSMEANS" statement and comparisons made with the Student t-test and a 5% significance level.

Results

Dry matter content ($P<0.0001$) and concentration of soluble carbohydrates ($P<0.0001$) and crude protein ($P=0.0048$) varied between morning and afternoon sampling ($P<0.0001$), with lower values of DM and SC and higher values of CP recorded during the morning. There was no variation in NDF and ADF content (Table 1). The results reflect the absence of photosynthesis during the night period relative to respiration (Taiz and Zeiger 2013), a condition that results in carbohydrate

Table 1. Dry matter content (DM) and concentrations of soluble carbohydrate (SC), crude protein (CP), neutral (NDF) and acid (ADF) detergent fibre in herbage samples harvested during the morning and afternoon period from rotationally stocked elephant grass cv. Napier

Period of the day	DM (%)	Chemical composition (%)			
		SC	CP	NDF	ADF
Afternoon	20.5	7.6	16.7	56.8	30.2
Morning	16.8	4.1	18.9	57.9	31.5
SEM*	0.21	0.25	0.45	0.35	1.26
P-value	<0.0001	<0.0001	0.0048	0.0549	0.4558

*Standard error of the mean

consumption (Lunn and Hatch 1995) and decrease in SC and DM. Further, the decrease in SC results in an increase in CP, and explains the differences between the morning and afternoon sampling. The 22magnitude of variations results in large changes in the CP/SC ratio (4.6 and 2.2 for the morning and afternoon sampling, respectively) that associated with % increase in dry matter content in the afternoon sampling may have an impact on nutrient intake considering the circadian rhythm and foraging strategies of grazing animals (Delagarde 2000).

Conclusion

Time of the day influences dry matter content and chemical composition of the consumed herbage, particularly the CP/SC ratio. That could interfere with nutrient intake of grazing animals, particularly when subjected to rotational stocking management, suggesting potential benefits of changing animals to a new paddock in the afternoon period.

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