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Ruminal fermentation and degradability of sorghum cultivar whole crop, and grains, using an in vitro gas production technique

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Abstract

The purpose of the study was to determine fermentation and degradability of eight sorghum cultivars, being 8050-Agromen, 8118-Pioneer, 8419-Pioneer, BR306, BR700, BRS305, BRS701, Saara-Monsanto at different stages of growth, and to determine effects of condensed tannins (CT) in sorghum grain using a bio-assay. Cultivars were planted in 5 m × 4.5 m plots in a randomized block design. Whole plants were harvested 30, 60, 90 and 120 days post-sowing, but grains (cobs) were harvested only at 120 days from plants other than those harvested as whole plant. Samples were analyzed for ash, acid detergent fibre and crude protein. In vitro gas production determinations of whole plant samples and grains were completed on oven dried (40 °C for 48 h) samples ground to pass a 1 mm screen. Grain samples assayed for CT, and their interference in gas production, was determined with addition of polyethylene glycol. Differences (P<0.05) in chemical composition occurred among cultivars at and after 60 days. Grains of cultivars with low CT levels had higher apparent dry matter degradability (ADMD; P<0.05). In the bio-assay, grains had increased gas production with PEG addition, and correlations (P<0.05) occurred between CT content and gas increment following PEG addition as well

Abbreviations: ADMD, apparent DM degradability; CT, condensed tannins; DM, dry matter; GP, gas production; PEG, polyethylene glycol; N, nitrogen

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as ADMD. Grain cultivars had as good or better fermentation parameters and ADDM when harvested at 60, 90 and 120 days post-sowing as did forage cultivars at the same maturities.

Keywords: Feed evaluation; Forages; Ruminant; Sheep; Tannins

1. Introduction

Sorghum plants have potential to improve ruminant production in Brazilian pasture systems, mainly in regions with adverse climates where it is difficult to cultivate other forages (Restle et al., 2002). Despite increased use of sorghum, few studies have been conducted to investigate its nutritional characteristics and the best ways to use it as a ruminant feed (Campos et al., 2003; Souza et al., 2003).

Although sorghum has excellent potential in ruminant production systems, some cultivars possess higher levels of secondary compounds, such as phenolic acids, flavonoids and tannins (Hahn and Rooney, 1986). Among these compounds, condensed tannins (CT) play an important role in ruminant nutrition because of their negative, and positive, effects on rumen fermentation and nutrient digestion (McNeill et al., 1998; Aerts et al., 1999). Tannins form complexes with other nutrients and can inhibit feed intake, microbial growth and N utilization in the rumen.

Negative effects of tannins on rumen fermentation can be studied using in vitro techniques, including measurement of gas production (GP). A bio-assay methodology developed by Makkar et al. (1995), is based on use of polyethylene glycol (PEG) to determine effects of CT on in vitro GP. As PEG is an inert molecule with a high molecular weight and high affinity for tannins, it neutralizes some negative effects of tannins in rumen fermentation and results in increased GP (Makkar et al., 1995; Getachew et al., 2000).

The purpose of this study was to analyze fermentation aspects and degradability of eight sorghum cultivars harvested at several stages of growth, as well as to evaluate the grains of these cultivars for CT content and their possible effects on in vitro ruminal fermentation using the bio-assay technique of Makkar et al. (1995).

2. Materials and methods

2.1. Forage samples and chemical analysis

Eight sorghum cultivars used in Brazil and classified as being primarily for forage or grain, according to its main agronomic characteristics, were used. They were 8050 (grain-Agromen), 8118 and 8419 (grain-Pioneer), BR700 and BR701 (forage-EMBRAPA), BRS305 and BRS306 (grain-EMBRAPA), and Saara (grain-Agroceres/Monsanto).

The experiment was conducted on a research farm of the University of São Paulo, in Piracicaba (22°41′S, 47°41′W), in the southeast of Brazil in 2001. A completely randomized block design with four replications was used. Cultivars were seeded in five row plots 5 m in length, at a seeding rate of 10,000 seeds/ha with 90 cm row spacing. Study plots were