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Substitution of ryegrass pasture with a high fibre concentrate supplement to grazing Jersey cows to overcome winter roughage shortages

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ABSTRACT

The low growth rate of ryegrass pasture in the southern Cape area of South Africa during the winter months results in a gap in the fodder flow plan. The objective of this study was to determine whether roughage shortages during the winter months could be overcome by the substitution of pasture with a high fibre concentrate (HFC). This was determined by feeding varying levels of the HFC to cows grazing ryegrass pasture. Treatments were: Low concentrate (LC), where each cow received 4 kg concentrate and 10 kg dry matter (DM) pasture per day; medium concentrate (MC), where each cow received 7 kg concentrate and 7 kg DM pasture per day; high concentrate (HC), where each cow received 10 kg concentrate and 5 kg DM pasture per day. Forty eight lactating Jersey cows were blocked according to days in milk, lactation number and 4% fat corrected milk yield, to determine the effect of treatments on production. Cows within blocks were randomly allocated to one of three treatments. Eight ruminally cannulated Jersey cows were randomly allocated to the LC and HC treatments in a cross-over design, to determine the effect of treatments on rumen health. The metabolisable energy (ME), crude protein (CP) and neutral detergent fibre (NDF) contents of the HFC was 10.9 MJ/kg, 145 g/kg and 231 g/kg, respectively. Cows in the three treatments grazed separately, allowing for the restriction of pasture intake according to treatments specifications. The ruminally cannulated cows grazed with the production study cows, in their respective treatments, throughout the study. The mean daily milk yield was higher for treatment HC (18.1 kg/d) than for treatment LC (16.2 kg/d), while treatment MC (17.3 kg/d) remained intermediate. The mean milk fat content was lower for treatment HC (45.9 g/kg) compared to treatment MC (49.6 g/kg) and treatment LC (49.2 g/kg). Rumen activity of cows in the HC treatment was inhibited. Rumen pH of cows in the HC treatment spent a longer time below pH 5.8 (7.43 h) compared to cows in the LC treatment (6.24 h). Pasture NDF degradation coefficient after 30 h of incubation and rumen acetate concentration was higher for the LC treatment (0.42 and 75.11 mM/L) than for the HC treatment (0.39 and 64.96 mM/L). It was concluded that restricting pasture intake and feeding higher levels of a HFC is a viable option to overcome pasture shortages during winter months.

Abbreviations: ADF, acid detergent fibre; ADL, adic detergent fibre; NH_3-N, ammonia nitrogen; BCS, body condition score; CP, crude protein; DM, dry matter; HC, high concentrate; HFC, high fibre concentrate; LW, live weight; LC, low concentrate; MC, medium concentrate; ME, metabolisable energy; NDF, neutral detergent fibre; RPM, rising plate meter; VFA, volatile fatty acids.

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1. Introduction

Kikuyu (*Pennisetum clandestinum*) over-sown with ryegrass (*Lolium* sp.) is the most widely used pasture system in the southern Cape region of South Africa. As kikuyu remains dormant during the winter months (June to August), annual ryegrass (*Lolium multiform*) is over-sown to fill the fodder flow gap during these months. Annual ryegrass types are preferred over perennial ryegrass (*Lolium perinea*) types, as the perennial ryegrass only establishes well into the spring and is unable to support intensive grazing during the coldest of the winter months (Dickinson et al., 2004; Van der Colf, 2011). Due to the low temperatures and low light intensities experienced in the southern Cape region during the winter months, the growth of the ryegrass pasture is inhibited and daily growth rates can be as low as 30 kg DM/ha, while it could be as high as 70 kg DM/ha during the summer (Fulkerson and Donaghy, 2001; Dickinson et al., 2004; Van der Colf, 2011).

Due to the low winter growth rate of ryegrass pasture, pastures have a longer growth cycle and take longer to mature, resulting in roughage shortages during the winter months. Two main feeding strategies have been developed over the years to overcome such shortages, namely feeding of lucerne hay or pasture silage. In addition to receiving lucerne hay or silage, cows are put out to graze for half of the day and fed a concentrate in the milking parlour. Practical and financial challenges associated with these feeding strategies warrant research into other possible solutions.

It has been shown that high starch concentrates may be replaced with less digestible high fibre concentrates, without negatively impacting milk production or rumen health, for cows grazing ryegrass pasture during the winter months (Lingnau, 2011). The lower digestibility and high neutral detergent fibre (NDF) content of high fibre concentrates would help to maintain an optimal rumen pH, thus increasing microbial activity. Therefore it is theoretically possible to feed high fibre concentrates at higher levels than high starch concentrates, at the expense of pasture intake (Bargo et al., 2003). This could be beneficial during winter months when fodder flow is under pressure. The aim of the study was thus to determine whether the feeding of high levels of a HFC and the restriction of pasture allowance would overcome winter roughage shortages, while maintaining milk production and rumen health.

2. General materials and methods

2.1. Location and general management

The study was carried out at the Outeniqua Research Farm near George in the Western Cape province of South Africa. The farm is situated at 22°25′16″E and 33°58′38″S. The study was conducted during the winter and early spring months, from July 2011 to October 2011, during which time the mean maximum and minimum temperatures were 18.85 °C and 7.92 °C, respectively, and the total rainfall was 247 mm (ARC, 2011). An area of 8.88 ha of kikuyu over-sown with annual Italian ryegrass (*Lolium multiforum var. italicum*), cv. Jeanne, at 20 kg/ha using an Aitcheson seeder, was used. The kikuyu component of the pasture remained dormant during the research period; therefore ryegrass was the dominant pasture available to cows. The study area was characterised by a Katspruit soil form, of the family Lammermoor. Paddocks were fertilised with 42 kg of N (limestone ammonium nitrate)/ha after each grazing. Ethical clearance was obtained through the Western Cape Department of Agriculture, South Africa.

Cows were milked twice daily at 07:00 and 14:00. Once cows had been brought in from the pasture they were separated into their respective treatment groups and fed the HFC in the milking parlour according to the treatment specifications. After milking, cows went back to the pasture where they were separated into treatment groups once more and turned to their respective paddocks.

2.2. Treatment description

The study consisted out of three treatments. All treatments consisted out of the same high fibre concentrate (HFC), fed in a pelleted form. Treatments were differentiated according to the level of HFC fed and the level of pasture allocated. The HFC was supplied by NOVA feeds, George, South Africa and the composition is presented in Table 1. Treatments were as follows:

- Low concentrate (LC): 4 kg HFC and 10 kg DM pasture/cow daily,
- Medium concentrate (MC): 7 kg HFC and 7 kg DM pasture/cow daily,
- High concentrate (HC): 10 kg HFC and 5 kg DM pasture/cow daily.

3. Production study

3.1. Materials and methods

Forty eight lactating Jersey cows from the Outeniqua Research Farm where used in the production study. A complete randomised block design was used to assign cows to three treatments and cows were blocked according to days in milk (mean ± S.D.) (104 ± 62.66 d), lactation number (4.38 ± 1.82) and 4% fat corrected milk yield (19.1 ± 2.23 kg).