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The effect of dried apple pomace as a replacer for maize in the concentrate for Jersey cows grazing ryegrass pasture on production and rumen metabolism

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ABSTRACT

Ryegrass pasture is characterised as having a high crude protein content (214–298 g/kg DM) but a low fibre content (390–550 g NDF/kg DM). Additional supplementation of energy based concentrates is provided to ensure profitable milk production. The high starch content in these supplements could negatively impact the rumen environment; lowering rumen pH and inhibiting pasture degradability. Dried apple pomace (DAP) is a possible alternative energy source to maize for dairy cows grazing pasture; however, little information is available on the effectiveness of this high fibre by-product for milk production from pastures. The aim of this study was to determine the potential use of DAP as an energy source for Jersey cows grazing ryegrass pasture. Seventy six lactating Jersey cows were blocked according to milk yield, days in milk and lactation number. Cows within blocks were randomly allocated to one of four treatments. Treatments were: NDAP-0% dried apple pomace and 75% maize; LDAP-25% dried apple pomace and 50% maize; MDAP-50% dried apple pomace and 25% maize; HDAP-75% dried apple pomace and 0% maize. Cows received 6 kg as is of the allocated concentrate in the milking parlour daily. Cows of all four treatments strip grazed perennial ryegrass pasture over an area of 8.6 ha. Additionally, four ruminally cannulated cows were used to monitor treatment effect on rumen activity and health. Each cow was randomly allocated to one of four treatments and subjected to a four period crossover. The 4% fat corrected milk yield was lower for cows in treatment HDAP than for cows in treatments NDAP and LDAP, differences ranging between 1.7 and 2.3 kg/day. The milk protein content was lowest for cows in treatments NDAP and MDAP, showing a cubic trend ($P = 0.005$), with milk fat content increasing as the level of maize substituted by DAP increased. Treatment had no effect on rumen metabolism parameters. Replacing maize with DAP is a viable option for cows grazing ryegrass pasture; however, the decrease in 4% fat corrected milk yield and the potential economic impact should not be overlooked.

1. Introduction

In the southern Cape of South Africa, ryegrass pasture (annual and/or perennial) is the most common pasture available for grazing during the winter and spring months (Botha et al., 2008). Ryegrass pasture is characterised as a pasture high in CP content (214–298 g/kg DM; Joubert, 2012) but low in NDF content (390–550 g/kg DM; Van der Colf, 2011). To ensure high production

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outputs of cows, additional energy sources are also fed, usually in the form of a high energy concentrate supplement (Allen and Knowlton, 1995; NRC, 2001). These supplements often contain high levels of maize as the main energy source, which is also high in starch. A high starch content has a limiting effect on the rumen microbial population due to the production of lactic acid; which is associated with the degradation of starch in the rumen, leading to a decrease in ruminal pH (Calsamiglia et al., 2010; Poulsen et al., 2012; Jacobs, 2014). The decreased microbial activity due to low ruminal pH also negatively affects pasture degradation and lowers VFA production, which impacts negatively on milk production. Alternatively, it could be possible to sustain milk production of cows grazing ryegrass pasture by supplementing with an energy source low in starch but high in sugar and NDF content, such as dried apple pomace (DAP). Dried apple pomace is a by-product of the apple juicing industry and contains (on a DM basis) 483–612 g/kg NDF, 7.8–11.6 MJ/ kg ME and 77–80 g/kg CP (NRC, 2001; Edwards and Parker, 1995; Mirzaei-Aghsaghali et al., 2011). The chemical composition of DAP depends on the processing methods applied as well as the specific apple variety and how it was managed post-harvest (Kennedy et al., 1999). A few studies have evaluated the use of apple pomace, either dried or ensiled, for use as an energy source for dairy cows; however, those that are available were implemented on TMR systems (Edwards and Parker, 1995; Abdollahzadeh et al., 2010) and limited information is available on DAP fed as the main energy source for pasture based cows. The aim of this study was to determine the potential use of DAP as an energy source for Jersey cows grazing ryegrass pasture.

2. Materials and methods

2.1. Location and general management

The study was carried out at the Outeniqua Research Farm, situated in the Western Cape province of South Africa (22° 25′ 16” E and 33° 58′ 38” S) during late winter and early spring, over a period of 84 days. The mean minimum and maximum temperatures and total rainfall during the study period were 9.63 °C, 20.3 °C and 135.9 mm, respectively (ARC, 2016). An area of 8.6 ha of perennial ryegrass (*Lolium perenne*, cv. Arrow) planted into a kikuyu (*Pennisetum clandestinum*) pasture base at a seeding rate of 18 kg/ha using an Aitcheson seeder, was used as roughage source. Ryegrass pasture was predominantly available to cows (68%) instead of kikuyu (2.5%), which is mainly dormant during the winter months. The rest of the pasture consisted of 12.5% legumes and 17% other grasses. The study area used for grazing was fertilised with 42 kg of N/ha post-grazing using limestone ammonium nitrate (280 g N/ kg) and the soil in this area was characteristic of a Witfontein soil form (Swanepoel et al., 2013). Ethical clearance was granted by the Research Ethics Committee of Stellenbosch University, South Africa (SU-ACUD15-00094).

2.2. Treatment description and experimental design

The study consisted of four treatments. Treatments where defined according to the level of DAP included into the concentrate supplement, creating a gradient of starch and sugar content. The treatment concentrates were also formulated to be isonitrogenous (110 g CP/kg DM) and have similar mineral contents. Treatments were as follows (Table 1):

- NDAP – 0% Dried apple pomace in concentrate,
- LDAP – 25% Dried apple pomace in concentrate,
- MDAP – 50% Dried apple pomace in concentrate,
- HDAP – 75% Dried apple pomace in concentrate.

Seventy-six lactating Jersey cows were used for a production study where treatment effect on milk yield, milk composition, body

Table 1
Ingredient composition (g/kg DM) of the four concentrate supplements used in the study.

Parameter	Treatment[a]			
	NDAP	LDAP	MDAP	HDAP
Ground maize	750	500	250	0
Dried apple pomace	0	250	500	750
Soya oil cake meal	50	50	50	50
Wheat bran	145	122	98	75
Molasses (liquid)	20	40	60	80
Feed lime	25	23	21	19
Salt	6	6	6	6
Urea	0	3	6	9
Premix[b]	1	1	1	1
Magnesium oxide	3	3	3	3
Mono-Calcium Phosphate	0	2	5	7

[a] NDAP – 0% dried apple pomace (DAP); LDAP – 25% DAP; MDAP – 50% DAP; HDAP – 75% DAP.
[b] Premix – 4 mg/kg copper; 10 mg/kg manganese; 20 mg/kg zinc; 0.34 mg/kg iodine; 0.2 mg/kg cobalt; 0.06 mg/kg selenium; 6 × 106 IU vitamin A; 1 × 106 IU vitamin D3; 8 × 103 IU vitamin E (Supplier: Cape Feed and Grain, George East, 6539, South Africa).