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Wet faeces produced by sheep fed dried spineless cactus pear cladodes in balanced diets

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Abstract

Cactus pear cladodes in ruminant diets are characterized by the production of wet faeces and assumed to be diarrhoea. Incremental levels of sun-dried and coarsely ground spineless cactus pear (*Opuntia ficus-indica* var. Algerian) cladodes were used to substitute part of the lucerne hay in balanced sheep diets. Feed and water intake and faeces and urine excretion were determined with 24 Dorper wethers. The four diets (T0, T12, T24 and T36) comprised respectively (air dry basis) 0, 120, 240 or 360 g/kg sun-dried, coarsely ground *Opuntia* cladodes; 660, 535, 410 or 285 g/kg coarsely ground lucerne hay; 300 g/kg yellow maize meal; 0, 5, 10 or 15 g/kg feed grade urea; and 40 g/kg molasses meal. The wethers drank significantly more water with increasing inclusion of *Opuntia* in the diets, while urine excretion showed little increase. Food intake and faeces dry matter (DM) excreted remained the same for all diets, but the DM content of the faeces decreased with higher levels of *Opuntia* inclusion. The wetter faeces produced by the sheep lacked the customary foul smell associated with diarrhoea and this is ascribed to the water-binding capacity of the mucilage in *Opuntia*. Although more definitive research is needed, it is concluded that the wetter faeces produced by the sheep on diets T12, T24 and T36 were not diarrhoea induced by the sun-dried and coarsely ground *Opuntia* cladodes, but the result of larger quantities of water that were not reabsorbed from the lower digestive tract.

Keywords: Cactus pear, diarrhoea, feed intake, mucilage, water intake
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Introduction

The cladodes of spiny and spineless cactus pears are used as feed for livestock during the frequent periods of food shortages or droughts in many arid and semi-arid regions (De Kock & Aucamp, 1970; Felker, 1995; Pretorius *et al.*, 1997; Ben Salem *et al.*, 2002; Tegegne, 2002b; Batista *et al*., 2003). Spineless cactus pears are valued by many farmers because of their drought resistance, high biomass yield, palatability and adaptability to a range of soils and climatic regions (Ben Salem *et al*., 1996; Batista *et al*., 2003). Spineless cactus pear cladodes have a very high water content (Felker, 1995) and when fed to animals little, if any, additional water is needed. However, a distinct concern when feeding spineless cactus pear cladodes to ruminants is the production of very wet faeces or diarrhoea, presumably caused by its laxative effect (Ben Salem *et al*., 2002).

Spineless cactus pear (*Opuntia ficus-indica*) varieties are grown in South Africa for fruit production aimed at export markets and have recently increased considerably (Claassens & Wessels, 1997). Production of *Opuntia* fruits is stimulated by annual pruning and creates the opportunity to utilize the large quantities of cladodes as livestock feed. An important challenge is to dry the large volume of cladodes effectively, thus enabling it to be transported to where it is needed as livestock feed. A practical drying method will also enable farmers with small cactus pear orchards to store pruned material as a feed for their livestock.

A study was conducted to evaluate the inclusion of incremental levels of sun-dried and coarsely ground *O. ficus-indica* var. Algerian cladodes in balanced sheep diets as partial substitution of coarsely ground lucerne hay. Use of substantial quantities of sun-dried and coarsely ground O*puntia* cladodes may turn a waste product into a valuable livestock feed. However, excretion of very wet faeces makes O*puntia* less attractive as a feed source, especially when animals are confined to kraals or feedlots. This report aims to create a perspective on the phenomenon of wet faeces produced by O*puntia* in balanced sheep diets.

Materials and Methods

Cladodes produced during the growing seasons of 2002/2003 and 2003/2004 were pruned on 12 May 2004 from 10 trees in a fruit bearing *O. ficus-indica* var. Algerian orchard in the Bloemfontein district. The cladodes yielded 1 159 kg fresh plant material. The cladodes were cut lengthways by hand into strips of about 20-25 mm wide using a sharp, long bladed butcher's knife and the strips were packed in a single layer on wire racks and dried in the sun. This facilitated air movement around the cladode strips to promote faster drying. After a week of drying in the winter sun (second half of May 2004), the cladode strips were curled up and the cut wounds covered with white callus material, which reduced the effectiveness of the drying process to some extent. The partially dried cladode strips were then ground to pass through a 20 mm sieve in a hammer mill. A sieve with a fairly large aperture size of 20 mm was used in this study (Zeeman, 2005) and not, as suggested by Nefzaoui & Ben Salem (2000), a sieve with a much smaller aperture size of 6 mm. Cut cactus pear cladode pieces should dry within a week (Terblanche *et al*., 1972). However, in this study all the material was not completely dry even after a week, therefore, the freshly ground material was spread out again on a clean, dry cement floor in the sun for further drying. The ground and partially dried material was turned over occasionally to prevent it from moulding. During the first grinding, larger pieces of cladode strips were still relatively moist and flexible enough to pass unchanged through the 20 mm sieve. Therefore, the ground plant material was ground a second time after further drying through the 20 mm sieve. This more homogenous material was used to substitute part of ground lucerne hay in balanced sheep diets (Table 1). The lucerne hay was also ground to pass through the 20 mm, while the coarsely ground yellow maize meal, feed grade urea and molasses meal were included in the diets in the physical form in which they were acquisitioned. This was done to formulate and constitute diets which could be applied with a minimum of further processing and with direct application on farms. Diets were mixed thoroughly with a garden spade on a clean cement floor.

Table 1 The air dry (g/kg feed) composition of the four treatment diets with incremental inclusion levels of sun-dried and coarsely ground *Opuntia* cladodes

Feeds	Treatment diets*			
	T0	T12	T24	T36
Coarsely ground *Opuntia* cladodes (kg)	0	120	240	360
Coarsely ground lucerne hay (kg)	660	535	410	285
Yellow maize meal (kg)	300	300	300	300
Feed grade urea (kg)	0	5	10	15
Molasses meal (Calori 3000) (kg)	40	40	40	40

* Inclusion levels of coarsely ground *Opuntia* cladodes: T0 – 0%; T12 – 12%; T24 – 24%; and T36 – 36%

Twenty four young Dorper wethers (body weight of 36 ± 3.49 kg) were stratified according to body weight and randomly allocated to four treatments (T0, T12, T24 and T36). Each treatment group was adapted to its diet over a period of nine days: after an initial adaptation period of five days outdoors in pens, they were weighed and randomly housed in individual metabolism crates for the last four days of adaptation to the diets and especially to get accustomed to the environment in metabolism crates. Feed intake and digestibility, as well as water intake and urine excretion were determined over 10 days; the metabolism crates were designed specifically to separate and collect the faeces and urine of male sheep separately. The wethers were fed in 24-hour cycles, starting at noon, followed by feeding at 16:30 and then at 08:30 the following morning. Based on a 3-day moving average of air dry feed intake of the preceding three days and a 15% refusal level, the air dry feed of each wether for the next 24 hours was weighed in paper bags. If a wether ate all its weighed feed before the end of a 24-hour cycle, more feed was weighed and provided.

Three days into the 9-day adaptation period, most wethers on diets T24 and T36 began to produce wet faeces, reminiscent of diarrhoea. A dietary prophylactic of 0.7 g kaolin (hydrated aluminium silicate, Al_2O_3 $2SiO_n$ $2H_2O$) was given to all the wethers at every feeding to prevent excretion of wet faeces. This measure had no visible effect in reducing the excretion of wet faeces, but was routinely administered three times per day over the feed for the duration of the trial.

The DM of faeces, feed refusals and composite feed samples were determined by drying in a force draught oven at 100 °C (AOAC, 2000). Samples were analysed for: organic matter (OM) content by incineration in a muffle furnace at 550 °C (AOAC, 2000); nitrogen (N) content in a Leco® Nitrogen analyser (Leco, 2001) and N content converted to crude protein (CP) by a factor of 6.25; ether extract (EE) according to the AOAC (2000) procedures but by using hexane as solvent; and the acid detergent fibre (ADF) and neutral detergent fibre (NDF) according to the procedures described by Goering & Van Soest (1970) and Robertson & Van Soest (1981). The data was statistically analysed using GLM procedures of SAS (2001).

Results and Discussion

The DM content of the diets (Table 2) decreased with the increasing inclusion levels of *Opuntia* cladodes. Cactus pears are succulent plants and the material does not dry easily. This is ascribed to the mucilage, a hydrophilic mucus-like compound that has a high water-binding capacity (Cárdenas *et al.*, 1997; Tegegne, 2002a; Sáenz *et al*., 2004). The precise function of the mucilage is not known, however, it is generally believed that it helps to retain water inside the cactus (Mindt *et al*., 1975; Sudzuki Hills, 1995); the ability of cacti to retain water under less favourable climatic conditions of prolonged drought is due in part, at least, to the water-binding capacity of mucilage (Mindt *et al*., 1975). It may in part explain the lower DM content of diets T24 and T36 (Table 2).

Table 2 Dry matter (DM) content and chemical composition of the four treatment diets with incremental inclusion levels of sun-dried and coarsely ground *Opuntia* cladodes

	Treatment diets*			
	T0	T12	T24	T36
Dry matter (g DM/kg feed)	905.5	904.3	886.1	881.7
Organic matter (g/kg DM)	904.6	885.0	890.0	869.3
Crude protein (g/kg DM)	167.9	180.9	165.4	168.0
Ether extract (g/kg DM)	23.5	24.9	25.8	27.0
Acid detergent fibre (g/kg DM)	304.0	265.6	239.2	207.2
Neutral detergent fibre (g/kg DM)	470.8	410.2	410.0	315.0

* Inclusion levels of coarsely ground *Opuntia* cladodes: T0 – 0%; T12 – 12%; T24 - 24%; and T36 – 36%

Wethers drank significantly (P > 0.05) more water with increased inclusion of Opuntia in the diets, while urine excretion showed little increase (Table 3). Food DM intake and faeces DM excreted remained the same for all diets (Table 3), but the DM content of the faeces decreased with higher levels of Opuntia inclusion. The wetter faeces produced by the wethers lacked the customary foul smell associated with diarrhoea and this is ascribed to the water-binding capacity of mucilage contained in Opuntia. Wethers on diet T36 drank about 900 mL water/day more than those on diet T0, but only excreted 171 mL more urine.

Table 3 Mean (± s.e.) feed intake (g DM/day) and water intake (mL/day) and urine (mL/day) and faeces (g DM/day) excreted by Dorper wethers on diets with incremental inclusion levels of sun-dried and coarsely ground *Opuntia* cladodes

	Treatment diets*			
	T0	T12	T24	T36
Feed intake (g DM/day)	$1148.3^{a} \pm 66.2$	$1119.2^{a} \pm 153.5$	$1104.3^{a} \pm 118.8$	$1085.9^{a} \pm 162.7$
Water intake (mL/day)	$2235.5^{b} \pm 190.6$	$2695.3^{ab} \pm 595.5$	$2949^{ab} \pm 592.0$	$3189.3^{a} \pm 775.6$
Urine excreted (mL/day)	$779.1^{a} \pm 150.3$	$811.8^{a} \pm 212.4$	$844.8^{a} \pm 160.2$	$949.7^{a} \pm 191.4$
Faeces excreted (g DM/day)	$375.9^{a} \pm 22.6$	$365.8^{a} \pm 61.2$	$343.1^{a} \pm 41.5$	$308.1^{a} \pm 50.9$
DM intake (g/kg $W^{0.75}$/day)	$78.4^{a} \pm 6.5$	$75.1^{a} \pm 9.2$	$73.8^{a} \pm 7.3$	$73.9^{a} \pm 8.9$

[a,b] Row means with common superscripts do not differ (P > 0.05)
* Inclusion levels of coarsely ground *Opuntia* cladodes: T0 – 0%; T12 – 12%; T24 – 24%; and T36 – 36%

Conclusions

The sun-dried and coarsely ground *Opuntia* cladodes induced a higher water intake. Although more definitive research is needed, it is concluded that the wetter faeces produced by the wethers on diets T12, T24 and T36 was not diarrhoea induced by the *Opuntia* cladodes, but the result of larger quantities of water that were not reabsorbed from the lower digestive tract.

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