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Qualitative characteristics of some *Atriplex* species and *Cassia sturtii* at two sites in South Africa

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Abstract

Leaves of three *Atriplex* spp. and *Cassia sturtii* grown in two different locations in South Africa were analysed for certain nutritive characteristics. Crude protein values ranged from 176 to 234 g/kg DM for the *Atriplex* spp. and for *C. sturtii* from 114 to 147 g/kg DM. The *in vitro* digestible organic matter concentrations for the *Atriplex* spp. varied from 718 to 773 g/kg DM and for *C. sturtii* from 529 to 574 g/kg DM. The neutral detergent fibre concentration ranged from 295 to 407 g/kg DM for the *Atriplex* spp. and for *C. sturtii* from 223 to 250 g/kg DM. Higher acid detergent lignin concentrations than expected were noted and varied for the *Atriplex* spp. from 98 to 139 g/kg DM and for *C. sturtii* from 71 to 75 g/kg DM. Both species proved to have a fair potential as fodder crops for livestock.

Keywords: *Atriplex*, *Cassia sturtii*, IVDOM, NDF, ADL
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Introduction

According to Bransby (1988), the performance of ruminants is determined by the animal itself on the one hand, and by the properties of the feed on the other. Animal factors, which influence performance directly, are those related to efficiency of utilisation of absorbed nutrients by the body. These are in turn determined by characteristics such as breed, sex and physiological condition, inherent ability and by external environmental factors such as weather. Nutrient absorption by the body from the alimentary canal also influences animal performance directly. Although this process will be affected by animal and environmental factors it is determined largely, and influenced directly, by two properties of the feed namely, nutrient content and digestibility. The aim of this study was to evaluate the interspecies and location variation in chemical composition of certain qualitative parameters between *Atriplex canescens, A. halimus, A. nummularia* and *Cassia sturtii*.

Materials and Methods

Leaves were collected from two experimental sites differing in ecological conditions of *Atriplex canescens* (Pursch.) cv. Santa Rita (Fourwing Saltbush) (Origin: North America), *A. halimus* L. (Origin: Asia, Mediterranean), *A. nummularia* L. (Oldman Saltbush) (Origin: Australia) and *Cassia sturtii* (Origin: Australia). Site one was at the Experimental Farm of the University of Pretoria, Gauteng, South Africa (coordinates 025°15'28.9"E, 25°45'03.6" S). It is a summer rainfall area with a precipitation of 650 mm per annum. The soil type is a Hutton form (MacVicar *et al*., 1977), well drained, slightly acidic and consists of a good nutrient status. The Hutton type is a deep clay-loam soil with approximately 25% clay and an effective depth of 600 mm+. According to soil analysis, the soil $pH_{(H2O)}$ was 5.7, P, K, Ca, Mg and Na status were 25, 200, 800, 400 and 40 mg/kg, respectively.

Site two was at the farm Lovedale in the Kenhardt district, Northern Cape province, South Africa (coordinates 019°44'0.57" E, 29°18'58.8" S). It is a summer rainfall area with an average annual rainfall of approximately 130 mm. According to MacVicar *et al*. (1977), the soil type is also a Hutton form, slightly alkaline and consists of a good nutrient status ($pH_{(H2O)}$ 8.4, P, K, Ca, Mg and Na status of 14, 337, 3445, 136 and 179, respectively). This type is a shallow calcareous sandy soil with less than 10% clay and an effective depth of not more than 300 mm.

Sample material randomly collected for each species on both sites was from approximately five year old plants. Samples of each plant of the same species in each replication were kept apart and not pooled.

Samples were dried in a force draught oven for 24 hours at 60 °C and milled through a 1 mm screen of a Beaver mill for chemical analysis to determine qualitative measurement.

Crude protein (CP) and ash concentrations were determined according to AOAC (2000) and neutral detergent fibre (NDF) and acid detergent lignin (ADL) concentrations according to the method of Van Soest & Wine (1967). *In vitro* digestible organic matter (IVDOM) was done according to the method of Tilley & Terry (1963) as modified by Engels & Van der Merwe (1967).

A model was tested for each of the dependant variables. An analysis of variance with the Proc GLM model (SAS, 1994) was used to determine the significance between species, locations and first order interactions for the dependant variables. The level of significance between least square means was tested with the help of the Bonferroni's test according to Samuels (1989).

Results and Discussion

Significant differences between the three *Atriplex* spp. and *C. sturtii* with respect to the nutritive value are evident, and also between the species at Hatfield and Lovedale (Table 1). A number of authors also reported high CP values for *A. nummularia*, as in this study (Smit & Jacobs, 1978; Khalil *et al.*, 1986; Malan, 2000). According to Welch & Monsen (1981), genetic variation plays an important role in the protein concentration in *Atriplex* spp., while season and soil fertility will also have a major effect on CP concentration (McArthur *et al.*, 1981). It has to be kept in mind that up to 60% of the CP fraction in plants, may be non protein nitrogen (Benjamin *et al.*, 1992).

Table 1 The crude protein (CP), *in vitro* digestible organic matter (IVDOM), neutral detergent fibre (NDF) and acid detergent lignin (ADL) concentrations (g /kg DM) of leaf material for *Atriplex canescens, A. halimus, A. nummularia* and *Cassia sturtii* at two different locations (hand cut samples)

Location	Parameter	Species			
		A. canescens	*A. halimus*	*A. nummularia*	*Cassia sturtii*
Hatfield	CP	176_1^a (± 22)*	187_1^a (± 48)	208_1^a (± 10)	147_1^a (± 31)
	IVDOM	738_1^b (± 9)	718_1^b (± 45)	738_1^b (± 19)	574_1^a (± 65)
	NDF	378_2^c (± 9)	328_2^b (± 4)	407_2^c (± 13)	250_1^a (± 25)
	ADL	139_2^b (± 6)	131_1^b (± 9)	138_1^b (± 12)	75_1^a (± 5)
Lovedale	CP	198_1^b (± 7)	206_1^a (± 38)	234_1^b (± 10)	114_1^a (± 26)
	IVDOM	716_1^b (± 20)	773_1^b (± 4)	757_1^b (± 42)	529_1^a (± 88)
	NDF	295_1^b (± 6)	297_1^b (± 20)	332_1^b (± 10)	223_1^a (± 23)
	ADL	98_1^b (± 1)	131_1^c (± 3)	137_1^c (± 2)	71_1^a (± 06)

[abcd]Means within a row for the same parameter followed by the same letter are not significantly different (P > 0.05)
[1,2]Means within a column, for the same parameter in different locations followed by the same number are not significantly different (P > 0.05)
*(Standard deviation)

Due to significant interactions, no pooled results for site comparison are presented. No significant differences in IVDOM occurred between the *Atriplex* spp. at both sites as well as between sites. *Cassia sturtii* had significantly lower IVDOM values than the *Atriplex* spp. The same tendency was found for NDF. The values of Malan (2000) for *Atriplex* spp. supported these results. The IVDOM range of all the plants at both sites fell within the range (and even above) (up to 690 g/kg) of *in vitro* DM digestibility noted for tropical browse plants (Sawe *et al.*, 1998) and *in vivo* OM digestibilities in goats (Kibria *et al.*, 1994). As NDF is more closely associated with intake then digestibility (Meissner *et al.*, 1989) one can conclude from the relatively low NDF values of the leaves of both *Atriplex* spp. and *C. sturtii* in this experiment, that fairly high intakes by small stock should be possible.

The ADL concentrations of the *Atriplex* spp. at both sites were significantly higher than those of *C. sturtii*. Only *A. canescens* differed significantly in terms of ADL concentration between the two sites. Acid detergent lignin values of 145 g/kg reported by Kaitho *et al.* (1998) for *A. halimus* agreed with those reported in this experiment for the *Atriplex* spp. Lower values for *A. nummalaria* (93 g/kg) were reported by Abou El Nasr *et al.* (1996).

Conclusion

All the species evaluated in this experiment proved to have a fair potential as fodder crops. High CP and IVDOM concentrations as well as fairly low NDF values are proof of this.

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