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Comparison of chemical composition of *Atriplex* spp. grown under South African conditions with regard to site, species and plant parts

W.A. van Niekerk#, P.J. Vermaak, N.F.G. Rethman[1] and R.J. Coertze
Department of Animal & Wildlife Sciences, University of Pretoria, Pretoria 0002, South Africa
[1]Department of Plant Production & Soil Science, University of Pretoria, Pretoria 0002, South Africa

Abstract

The aim of this study was to evaluate the nutritional value of *Atriplex* spp. for small stock production. Selected plants were harvested and analysed for crude protein, *in vitro* digestibility and leaf to stem ratio. Significant differences in nutritional value were noted between leaves and stems as well as between sites for the three *Atriplex* spp. Significant seasonal effects were noted in terms of composition of leaves and stems between the two sampling seasons for *A. canescens* (Veld Reserve I) and *A. canescens* (Santa Rita) but not for *A. nummularia.*

Keywords: *Atriplex*, crude protein, *in vitro* digestibility
#Corresponding author. E-mail: willem.vanniekerk@up.ac.za

Introduction

Considerable information on the chemical composition and nutritional characteristics of the *Atriplex* spp. is available in the literature (Chatterton *et al*., 1971; Smit & Jacobs, 1978; Davis, 1981). However, such information on *Atriplex* spp. grown under South Africa conditions is lacking. The objective of this study was to determine the seasonal changes in chemical composition of leaves and stems of different *Atriplex* spp. as well as the difference in quality between localities in semi-arid areas in South Africa.

Materials and Methods

Mature *Atriplex* species were selected for this study from three sites in South Africa during March and July 2002. The sites were Hatfield, Pretoria (Gauteng), Mier, (Northern Cape) and Lovedale (Northern Cape). Samples collected from each species consisted of small branches with stems not larger than 5 mm in diameter.

Mature leaves and twigs were collected from *A. nummularia*, *A. canescens* (Santa Rita) and *A. canescens* (Veld Reserve I). After collection the samples were dried at 60 °C for 48 hours, the leaves separated from the stems and then ground through a 1-mm screen using a mill. By weighing the leaves and stems, a leaf to stem ratio was calculated. Organic matter digestibility (IVOMD) was estimated by the *in vitro* method described by Tilley & Terry (1963) as modified by Engels & Van der Merwe (1967). Crude protein (CP) concentration was determined by Kjeldahl (AOAC, 2000). Analyses of variance with the Proc GLM model (SAS, 1994) were used to determine the significance between different species of *Atriplex* in different locations, seasons and plant parts. Means and standard deviations (s.d.) were calculated. Significance of difference (5%) between means was determined by Bonferroni's test (Samuels, 1989).

Results and Discussion

The crude protein, IVOMD and leaf to stem ratio of the three *Atriplex* spp. collected at three different sites are presented in Table 1. The CP concentration varied from 93.8 g/kg in *A. canescens* (Veld Reserve 1) to 194.6 g/kg in *A. nummularia* (Mier). The CP values correspond well with those reported by Senock *et al.* (1991) for *A. canescens.* The CP concentration for all the species was the highest at Mier. In most cases there was a significant difference in the CP concentration for a specific species between sites. *Atriplex nummularia* had the highest CP concentration at all the studied localities.

Except for *A. nummularia* there were no significant differences in the IVOMD values for different localities. The IVOMD values for *A. nummularia* were in all cases higher ($P < 0.05$) than the other species. Significant differences were observed for leaf to stem ratios for different species and different sites.

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Except for *A. nummularia*, significant differences were observed between March (summer) and July (winter) with respect to the CP and IVOMD concentration of the species concerned (Table 2).

Table 1 Differences in the mean (± s.d.) chemical composition (g /kg DM) and leaf to stem ratio of three *Atriplex* spp. between localities and species

Species		Location		
		Hatfield	Mier	Lovedale
A. canescens (Santa Rita)	CP	$110^{a}{}_{1}$ (± 12)	$143^{b}{}_{1}$ (± 14)	$126^{a}{}_{1}$ (± 9.6)
	IVOMD	$467^{a}{}_{1}$ (± 22)	$496^{a}{}_{1}$ (± 10)	$474^{a}{}_{1}$ (± 21)
	leaf to stem ratio	$53.49^{a}{}_{1}$ (± 2.1)	$76.03^{b}{}_{1}$ (± 2.4)	$59.60^{a}{}_{1}$ (± 3.6)
A. canescens (Veld Reserve 1)	CP	$94^{a}{}_{1}$ (± 11)	$149^{b}{}_{1}$ (± 14)	$119^{c}{}_{1}$ (± 10.1)
	IVOMD	$463^{a}{}_{1}$ (± 24)	$503^{a}{}_{1}$ (± 18)	$471^{a}{}_{1}$ (± 26)
	leaf to stem ratio	$35.92^{a}{}_{2}$ (± 1.8)	$56.55^{b}{}_{2}$ (± 1.9)	$44.05^{ab}{}_{2}$ (± 2.4)
A. nummularia	CP	$124^{a}{}_{2}$ (± 11)	$195^{b}{}_{2}$ (± 13)	$183^{b}{}_{2}$ (± 14)
	IVOMD	$487^{a}{}_{1}$ (± 26)	$599^{b}{}_{2}$ (± 21)	$591^{b}{}_{2}$ (± 25)
	leaf to stem ratio	$54.13^{a}{}_{1}$ (± 1.4)	$68.45^{b}{}_{12}$ (± 1.3)	$70.17^{b}{}_{1}$ (± 1.5)

^{abc}Row means with common superscripts do not differ (P > 0.05)
^{12}Column means with common subscripts do not differ (P > 0.05)
CP – crude protein
IVOMD – *In vitro* organic matter digestibility

The CP concentration of *A. nummularia* differed significantly from the other species in both seasons. The CP concentration of *A. canescens* (Santa Rita) and *A. canescens* (Veld Reserve 1) did not differ from each other. The IVOMD of *A. nummularia* did not show significant differences compared to the other species with respect to seasonal trends and only the leaf to stem ratio of *A. canescens* (Veld Reserve1) showed significant differences in the two seasons studied. In addition, the stem to leaf ratio of the species concerned also differed significantly. The same trend was reported by Sparks (2003).

Table 2 Differences in the mean (± s.d.) chemical composition (g /kg DM) and leaf to stem ratio of three *Atriplex* spp. between species and seasons

Species		Seasons	
		March (Summer)	July (Winter)
A. canescens (Santa Rita)	CP	$136^{a}{}_{1}$ (±11)	$119^{b}{}_{1}$ (±6)
	IVOMD	$515^{a}{}_{1}$ (±12)	$443^{b}{}_{1}$ (±13)
	leaf to stem ratio	$65.93^{a}{}_{1}$ (±2.1)	$60.15^{a}{}_{1}$ (2.6)
A. canescens (Veld Reserve 1)	CP	$129^{a}{}_{1}$ (±3)	$112^{b}{}_{1}$ (±6)
	IVOMD	$506^{a}{}_{1}$ (±16)	$452^{b}{}_{1}$ (±14)
	leaf to stem ratio	$54.75^{a}{}_{2}$ (±3.6)	$36.27^{b}{}_{2}$ (2.9)
A. nummularia	CP	$172^{a}{}_{2}$ (±11)	$163^{a}{}_{2}$ (±9)
	IVOMD	$562^{a}{}_{2}$ (±14)	$556^{a}{}_{2}$ (±11)
	leaf to stem ratio	$63.99^{a}{}_{1}$ (±2.0)	$64.50^{a}{}_{1}$ (±2.2)

^{abc}Row means with common superscripts do not differ (P > 0.05)
^{12}Column means with common subscripts do not differ (P > 0.05)
CP – crude protein
IVOMD – *In vitro* organic matter digestibility

The results in Table 3 show that the CP values for the leaves were in all cases higher (P < 0.05) than the stems. The leaf and stem CP-values of *A. nummularia* were also higher (P < 0 05) than the other species. The leaf IVOMD of all species was higher (P < 0.05) than that of the corresponding stems. In addition the

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IVOMD of the leaves and stems of *A. nummularia* were higher than the other species studied. Peterson *et al*. (1987) noted the same trend for fourwing saltbush.

Table 3 Differences in the mean (± s.d.) chemical composition (g /kg DM) of three *Atriplex* spp. between species and plant parts

Species		Plant part	
		Leaves	Stems
A. canescens	CP	$171^{a}{}_{1}$ (± 18)	$82^{b}{}_{1}$ (± 12)
(Santa Rita)	IVOMD	$673^{a}{}_{1}$ (± 18)	$285^{b}{}_{1}$ (± 36)
A. canescens	CP	$169^{a}{}_{1}$ (± 16)	$73^{b}{}_{1}$ (± 16)
(Veld Reserve 1)	IVOMD	$705^{a}{}_{1}$ (± 15)	$233^{b}{}_{1}$ (± 48)
A. nummularia	CP	$217^{a}{}_{2}$ (± 14)	$117^{b}{}_{2}$ (± 16)
	IVOMD	$732^{a}{}_{12}$ (± 30)	$386^{b}{}_{2}$ (± 21)

[abc]Row means with common superscripts do not differ (P > 0.05)
[1,2]Column means with common subscripts do not differ (P > 0.05)
CP – crude protein
IVOMD – *In vitro* organic matter digestibility

Conclusion

Significant differences between leaves and stems, seasonal growth and location of the three species studied were noted, demonstrating the importance of these factors when planning fodder budgets.

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