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Chemical Composition, Nutritive Value and Ruminal Degradability of the Leaves of *Avicennia marina* (Mangrove) in Dromedary Camels: Comparison with *Atriplex canescens*.

Abstract. The objective of this work was to, qualitatively and quantitatively, determine and compare some chemical constituents of two salt-tolerant plants *Avicennia marina* and *Atriplex canescens*, and their nutritive value in the desert dromedary (*Camelus dromedarius*) using the nylon bag technique. The crude protein content in the leaves of the two plants was similar (%10.6 – 10. 7). However, the non-nitrogen content and ash in *A. marina* represented %1.0 and %20.9 , compared to %4.3 and %28.2 , respectively, in *Atriplex canescens*. The crude fat was %2.9 in the former plant and% 1.2 in the latter. The rest of the values in the two plants were similar (crude fibre 18 – 18.9, cellulose 17.8 – 18.8, lignin %4.1–4.8). The dry matter in A. marina was significantly higher in the insoluble but fermented matter. The concentration of some essential elements (Cu, Zn and Mn) and macro-elements (Ca, Mg, K and Na) were measured in the leaves of *A. marina* leaves, and they were found to be poor in some trace elements.

Key words: *Avicennia marina, Atriplex canescens,* camels, mangrove, nutrition, Ruminal bags, essential metals.

المكونات الكيميائية و القيمة الغذائية و التكسر الكرشي لاوراق نبات القرم في الإبل: دراسة مقارنة مع نبات القطف

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المستخلص: تمت في هذه الدراسة مقارنة كمية و نوعية بعض المكونات الكيميائية في أوراق نباتين مقاومين للملوحة، هما القرم و القطف و قيمتهما الغذائية في الإبل، وذلك باستعمال طريقة الأكياس البلاستكية المدخلة جراحياً في كرش الحيوان. كانت قيم البروتين الخام متساوية تقريباً في أوراق النباتين (10.6%- 10.7%) و لكن كانت نسبة البروتين غير النيتروجيني و الرماد في نبات القرم 10% و 2.9 % على التوالى مقارنة مع 4.3% و 28.5. % في نبات القطف. و كانت نسبة الدهن الخام في نبات القرم 2.9% و في نبات القطف 1.2%. و تساوت النسب الأخرى بالنسبة للألياف الخام و السيلولوز و الليقنين. كانت نسبة المواد الجافة في نبات القرم أعلى في الجزء غير الذائب. تم قياس تركيز بعض المعادن (مثل النحاس و الزنك و المانجنيز و الكالسيوم و والماغنيزيوم و الصوديوم و البوتاسيوم) في أوراق نبات القرم و تبين أن هذا النبات فقير في بعض العناصر الهامة.

كلمات مدخلية: أوراق نبات القرم، نبات القطف، غذاء الإبل، مكونات كيميائية، قيمة غذائية.

Introduction

Avicennia marina (Forsk.) Vierh. (family Avicenniaceae) is a salt excreting type of mangrove that is commonly found along seacoasts including that of the Gulf region (Western, 1989). The plant has some folk medicinal uses (El-Ghonemy, 1993; Ali and Bashir, 1998). The chemical composition of *Avicennia* species has been reported in India, Pakistan, Egypt and Singapore (Kotmire and Bhosale, 1980; Khatib *et al.* 1987; Heneidy, 1996; Ito *et al.* 2000). The composition of *Avicennia* leaves was found to vary considerably in different locations and at different seasons.

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Atriplex canescens (family Chenopodiaceae) grows in desert areas and is commonly grazed by livestock. The chemical composition and nutritive value of several *Atriplex* species have been evaluated in many countries (e.g. de Mucciarelli *et al.* 1985; Gonzalez-Lopez *et al.*1990). Unlike *Atriplex canescens,* the leaves of *A. marina* are not usually used as an animal feed, but could be utilized for this purpose by animals only in drought-striken areas. However, consumption has been reported to result in some mineral deficiency in camels in Djibouti (Faye *et al.* 1992; Faye and Theix, 1993). As far as we are aware there are no reports on the chemical analysis or the nutritive value of any part of these two plants growing in our region. Therefore, in the present work we have qualitatively and quantitatively determined the chemical constituents of the leaves of the two plants leaves, and further studied their proximate composition and nutritional value in camels (*Camelus dromedarius*).

Materials and Methods

Plant material

The plant material was collected form the Um Al Quwain coast in the UAE during the month of September 1995. The two plants were collected by Mr. Omer Al Basheer and botanically authenticated at the National Herbarium of the U.A.E. University, where voucher specimens (n = 4) were deposited (Voucher number 1221).

Essential elements analysis

For analysis of the metals [copper (Cu), magnesium (Mg), manganese (Mn), zinc (Zn), sodium (Na) and potassium(K)], the leaves were washed with deionized water, oven dried and digested in a nitric-perchloric acid mixture (4:1) by heating on a hot plate at a temperature 70-80 °C, till almost dryness. The digested ash was diluted to desired volume with deionised water and used for analysis on Atomic Absorption Spectrophotometer. (GBC 906, Australia) equipped with background corrector, auto-samples and recorder. Analysis of the various elements was carried out in triplicate.

All reagents used were of analytical grade (BDH, England and Merck, Germany). Standard stock solutions of 1000 ppm were also procured from BDH, England. Deionized water was used throughout the study. To avoid contamination, all containers and other materials used in the analysis were glass and polyethylene. Glassware was washed and subsequently treated with HNO_3 for 3-4 hrs. with a final repeated rinse with deionised water.

Nutritional analysis

A. marina and *Atriplex canescens* leaves were milled either through a 1.mm sieve for chemical analysis or through a 2 mm sieve for nylon bag degradation. Dry matter, crude protein, crude fat, crude fiber and ash according to AOAC (1990). Neutral detergent fiber (NDF), acid detergent fiber (ADF), lignin, cellulose and silica by procedures of Goering and Van Soest (1970).

DM degradation was determined by incubating 4 grams air-dry samples in nylon bags in three cannulated female dromedary camels (8-10 years old). Camels were fed *ad libitum* Rhodes grass hay plus a 4 kg pelleted concentrate diet. Nylon bags measuring 20 x 10 cm with an average pore size of 50 μm were used to estimate dry matter degradation of *A. marina* and *Atriplex canescens* leaves.

Duplicate sample bags at each time point were incubated in each camel for five incubation times (6, 12, 24, 48 and 72hrs.) in reverse order before the morning feeding. Bags were suspended using a nylon cord that was tied to the cannulae cap. The cord had a weight at the other end to aid in submersion of bags into the ventral of the first compartment.

Bags were washed immediately after removal from first compartment, with tap water until the wash water was clear and then oven-dried at 50°C for the 48 hrs. and then weighed. The remaining dry matter was determined.

Statistics

Results are represented as means ± SEM and subjected to analysis of variance (ANOVA) (SAS, 1985), using the least significant difference for comparing differences between means.

Results

Essential metals

The concentration of certain essential metals (Zn, Mg, Ca, Mn, Cu) and electrolytes (Na and K) found in the leaves of *A. marina* are shown in Table 1 and are compared with findings obtained by other workers in Djibouti and India.

Nutritional analysis

The chemical analysis of *A. marina* and *Atriplex canescens* leaves are presented in Table 2. The leaves of *A. marina* s and *Atriplex canescens* were, on the whole, similar in the chemical composition except for their ash content (20.9 and 28.2%, respectively). Our present results on *A. marina* were compared with those obtained on the same plant in Pakistan and Egypt.

Ruminal degradation

Fig 1 depicts the DM degradation of *A. marina* and *Atriplex canescens* leaves *in situ* over 72 hrs. The DM degradation after 24, 48 or 72 hrs. incubation and the degradation characteristics obtained by fitting the DM Degradation to the exponential equation are presented in Table 3. The insoluble but fermentable matter appear to indicate a better nutritional value for *A. marina* leaves compared to *Atriplex canescens* leaves.

Table 1. The concentration of some metals and electrolytes in leaves of *Avicennia marina*

Element	Concentration(g/100g dry weight)		
	This work*	Faye *et al*, 1992 (Djbouti)	Kotmire & Bhosale, 1980 (India)
Zinc	0.0034	0.102×10^{-2}	N.D
Magnesium	detection limit	0.45	0.03 ± 0.002
Calcium	0.72	0.41	0.03 ± 0.01
Manganese	0.10	0.501×10^{-2}	0.87 ± 0.04
Copper	0.95×10^{-4}	0.38×10^{-4}	N.D
Sodium	7.84	N.D	3.82 ± 0.24
Potassium	0.33	1.37	0.98 ± 0.02

*Values in our work were obtained from 2 determinations.
*The Leaves were washed with deionised water and oven-dried before analysis.

Table 2. Chemical composition (% dry matter basis) of *Avicennia marina* and *Atriplex leaves.*

Content	*A. marina*			*Atriplex*
	This work	Khatib *et al* 1987 (Pakistan)	Heneidy 1996 (Egypt)	
Crude protein	10.6	9.5	6.5	10.7
True protein	9.6			6.4
Non-nitrogen protein	1.0			4.3
Crude fat	2.9	4.9	7.64	1.2
Crude fiber	18.0	13.7	30.02	18.9
NDF	36.7			40.5
ADF	22.9			23.9
Cellulose	18.8			17.8
Lignin	4.1			4.8
Silica(insouluble ash)	0.98			1.8
Ash	20.9	15.8	28.52	28.2
NFE*	47.6	56.10	21.32	41.0

Each Value is mean of 2 analyses.
*Nitrogen-free extract= 100 - (crude protein +crude fat+crude fiber+as)

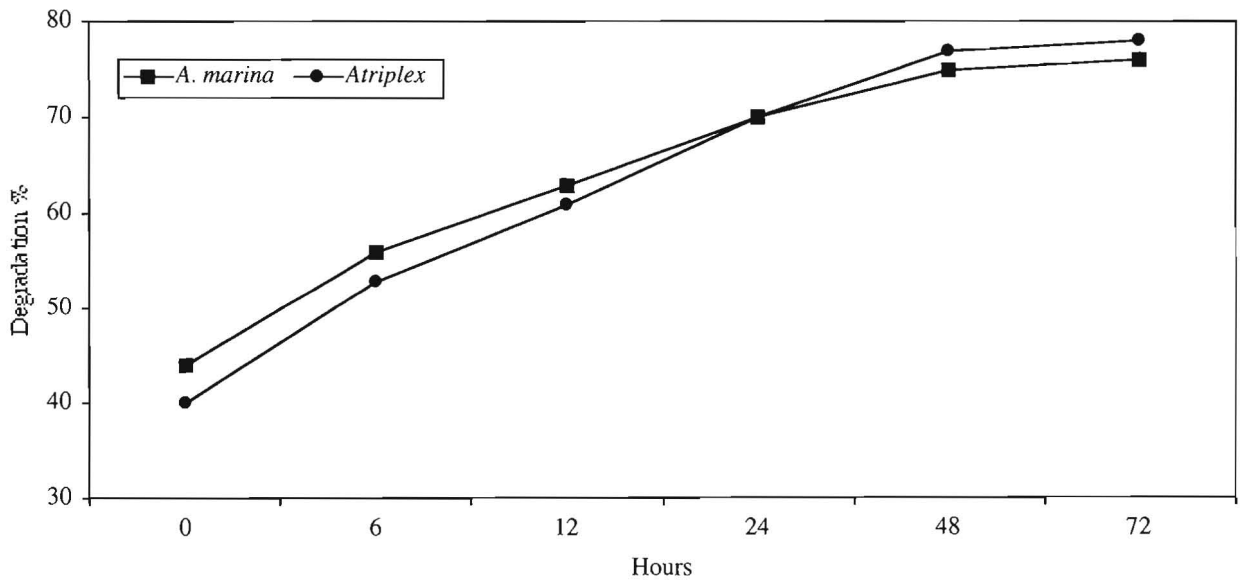

Figure 1. In situ DM degradation kinetics of *A. marina* and *Atriplex*

Table 3 In situ dry matter degradation (%) of *A. marina* and Atriplex leaves after 24 , 48 , 72hrs and sample degradation characteristics defined by the equation $P = a + b (1-e^{-ct})$

Sample	*A. marina*	*Atriplex*
DM degradation after		
24 h	73.4	71.4
48 h	75.6	73.1
72 h	76.6	75.9
DM degradability calculation		
A	41.6	43.7
B	36.0[a]	31.7[b]
a+b	77.6	75.4
C	0.07	0.07
Residual s.d.	2.55	1.29

A = The washing loss and B the insoluble but fermentable matter.
B = (a+b)- A . a, b and c are constants in the exponential equation
P = a+b (1-e-ct) . a + b = potential DM degradation, (C)= rate of DM degradation. Residuals. d. is after fitting the data to the exponential equation.

Discussion

Exposure to heavy metals is well known to induce a variety of toxic effects in humans and animals. Some of these heavy metals are considered essential elements for normal physiological functions, but higher levels may be toxic or harmful. Extensive studies have been carried out to determine the toxicity and bio-accumulation of these metals in marine flora and fauna (e.g. Nickless *et al.* 1972). Our work on heavy metals analysis was stimulated by the report that feeding animals with *A. marina* generated specific polydeficiencies (Cu, Zn, Mg) and chronic undernutrition. This was particularly observed in camels fed solely on such forage (Faye and Theix, 1993).

Our results show that *A. marina* is poor in some trace elements such as Mg and Zn. This is in agreement with Faye *et al* (1992). However, *A. marina* growing in U.A.E. showed a comparatively high level of the trace element Cu. In our work Na^+ and Ca^{++} concentrations were about double, and K^+ was about one third of that reported by Kotmire and Bhosale (1980) in India. It is reported that the daily needs for growing camels to be 15-20 mg of copper and 8-12 mg of zinc per kg of mangrove (Faye *et al*, 1992). Providing complements of certain minerals (salt-lick, or minerals incorporated into the concentrate) may be needed for maintaining the livestock in good health if fed solely on *A. marina* leaves.

The chemical composition of *A. marina* and the traditional animal feed *Atriplex canescens* leaves was found to be more or less similar, except that *A. marina* leaves has a low percentage of non nitrogen protein. Regardless of the time of ruminal exposure, *A. marina* leaves showed a degradation pattern similar of *Atriplex canescens*. However, *A. marina* always exceeded the value of the *Atriplex canescens* during the 24, 48 or 72hrs. of incubation. The insoluble but fermentable matter was significantly higher in *A. marina*. On the whole, our results show that *A. marina* has a better nutritive value than the *Atriplex canescens*. In this work we used the nylón bag method for studying ruminal degradability. Khazal *et al.* (1993) reported that feed intake and apparent digestibility characteristics of the feed were slightly more accurate using the nylon bag method than the gas production method.

The antinutirtive contents in the two plants have not been studied here, and warrant further study.

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