

<http://www.pjbs.org>

PJBS

ISSN 1028-8880

**Pakistan
Journal of Biological Sciences**

ANSI*net*

Asian Network for Scientific Information
308 Lasani Town, Sargodha Road, Faisalabad - Pakistan

Seasonal Variation in Botanical and Chemical Composition of Plants Selected by One-Humped Camel (*Camelus dromedarius*)

¹Alia S.A. Amin, ²Khalid A. Abdoun and ²Abdalla M. Abdelatif

¹Department of Physiology and Biochemistry,

Faculty of Veterinary Science, University of Nyala, Sudan

²Department of Physiology, Faculty of Veterinary Medicine, University of Khartoum, Sudan

Abstract: The present study has been conducted in order to investigate the seasonal variation in the botanical and chemical composition of plant parts consumed by camels (*Camelus dromedarius*). The study has been conducted on 210 indigenous Arabian camel of different age (1-18 years) and sex and kept under natural range in southern Darfur, Sudan. The findings of the present study indicate that camels are selective browser rather than grazer. Furthermore, they are selective feeder to the parts of pasture plants they consume. The percentages of Crude Protein (CP), Crude Fibre (CF) and Nitrogen Free Extract (NFE) of pasture plants selected by camels were significantly higher, while ash percentage was significantly lower during the dry season.

Key words: Camel, pasture plants, season

INTRODUCTION

The dromedary camels adapted themselves to the ecosystems of dry and arid zones where they are subjected to harsh conditions in addition to the severe fluctuations in the nutritional status, which in turn affect their general performance (Wardeh, 2004). Camels can adapt to the seasonal variation in the quantity and quality of available forage by either increased selectivity for high quality plant material or by more efficient digestion of poor quality materials (Schwartz and Dioli, 1992). Accordingly, we hypothesized that camels could overcome the harsh conditions and the poor nutritional status during the dry season, when the herb layer disappear, by selectively browsing plant species and plant parts of higher nutritive value.

In southern Darfur, the natural pasture is classified into three main regions according to the natural use (Babiker *et al.*, 1999). The first region is the northern region which is located between 11-13° N in the semi arid. The rainfall in this region ranges between 200 and 300 mm. This region is considered to be a good pasture in the rainy season (autumn habitats/Makharif). The predominant grasses and herbs in this region are *Cenchrus biflorus*, *Dactyloctenium aegyptium* and others, while the predominant trees and bushes include *Combretum aculeatum*, *Grewia tenax*, *Cadaba forinosa*, *Acacia mellifera* and *Acacia senegal*. The second region is the middle region which is located in sandy soil

between 10-11° N in the low land savanna area. The rainfall in this region ranges between 300 and 600 mm. The predominant grasses in this region are *Echinochloa colonum*, *Cenchrus biflorus*, *Dactyloctenium aegyptium* and others, while the predominant evergreen trees include *Acacia senegal*, *Acacia seyal*, *Acacia nilotica*, *Balanites aegyptiaca*, *Guiera senegalensis*, *Ziziphus spina-christi*, *Dichrostachys glomerata*, *Tamarindus indica* and *Albizia amara*. This region is also considered as autumn habitat (Makharif). The third region is the southern region, which is located in the wood savannah between 8-10° N and which is characterized by its clay soil. The rainfall in this region ranges between 600 and 1000 mm. This region is characterized by a pasture rich in grasses and trees such as *Acacia sieberana*, *Bauhinia rufescens*, *Celtis integrifolia*, *Acacia seyal* and *Balanites aegyptiaca*. This region is considered as a traditional summer habitats (Masaif).

The climate influences both distribution of animals and the chemical composition and nutritive value of pasture plants (Parker and Blowey, 1976). Moreover, it has been reported that forage quality influences feeding patterns of camels, where the time available for grazing under adverse pasture conditions would be a limiting factor to their Dry Matter (DM) and nutrient intake (Kassily, 2002). Very low Crude Protein (CP) content of forage has been reported during dry season (Abdelrahman *et al.*, 1998). The protein content of the diets selected by other animals was higher and

correspondingly the crude fibre content was lower during the green season compared to the dry season. However, camels were consistently able to select best qualities of minor differences between dry and green season (Schwartz and Dioli, 1992). Within the wide variety of pastures grazed by dromedaries, the plant species high in moisture, electrolyte and oxalate content such as *Acacia* spp. and other species which are thorny in nature and bitter in taste were preferred by dromedary. However, this preferred diet is largely ignored by other animals (Williamson and Payne, 1978). Osman and Fadl-Alla (1974) reported that the long term maintenance of positive nitrogen balance in camels during the dry season could be supported by the browsing on leguminous shrubs or by the high efficiency of low-protein diets utilization. The salty plants such as *Dactyloctenium* spp. are more abundant in the wet season. It has been reported that camels tend to take the advantage of these plants during wet season before they shed off their leaves (Kuria *et al.*, 2004). The nutritive value of tropical grasses has been reported to be of low protein and mineral contents (Daugall *et al.*, 1964). However, El Shami *et al.* (1990) reported that the mineral content of the browse plant is adequate in terms of Ca, Mg and K, while deficiencies in Ca, P and Na level in forage during dry season were reported by Abdelrahman *et al.* (1998).

It was the intention of this study to investigate the seasonal variation in the botanical and chemical composition of plants selected by camels during the dry and green season and to explore how camels adapt to the seasonal variation in the quantity and quality of available forage. In this context, the plant species and plant parts browsed by dromedary camels during both dry- and green season were collected, classified and subjected to proximate analysis.

MATERIALS AND METHODS

Survey background: This study was carried out in southern Darfur state, Sudan (Latitudes 8 and 13° North, Longitudes 22 and 28° East). It was conducted both during the dry season (March-May, 2003) in camels' summer habitat (Masaif) and during green the season (August-September, 2003) in camels' autumn habitat (Makharif). The camel herds (1-18 years old) were naturally ranging and have had no feed supplementation except the provision of common salt (NaCl), where approximately 1 pound of salt was added to 20 L of water during the dry season as a traditional practice of nomads during this season. The camels have had access to water every 5-9 days during the dry season, while water was available ad libitum during the green season.

Samples of parts of trees, bushes and grasses browsed or grazed by camels were also collected during both dry and green season. The samples were air dried and kept in clean small plastic bags for subsequent analysis. The types of plant species browsed or grazed by camels were recorded based on several field trips in Southern Darfur. The specific names of plant species were obtained from the National Herbarium, Nyala and cited from previous reports (Andrews, 1950, 1952, 1956; Von Maydel, 1986).

Plants analysis: Plants dry matter content, ether extract using Soxhlet apparatus, crude protein content using Kjeldahl method, crude fibre content and ash content were determined according to the method of AOAC (1984). Nitrogen free extract was calculated by subtracting Ether Extract (EE), Crude Protein (CP), Crude Fibre (CF) and ash from Dry Matter (DM).

Statistical analysis: The statistical analysis was performed using windows based SPSS (Version 10.01, 1999). Student's t-test was used to evaluate the effect of season on the composition of plants parts that were browsed or grazed by camels.

RESULTS AND DISCUSSION

General observations on the browsing and grazing behavior of camels: The observations revealed that camels are suitable selective browser rather than grazer. Camels prefer to feed on bushes and trees due to their anatomical adaptations. The mobile and prehensile split upper lip, the long tongue, the horny nature of the oral cavity, the stretched neck and the extended heads to grasp thorny twigs constitute anatomical adaptations that enable camels to browse more than to graze.

The results obtained in this study show that camels are selective feeders not only with regard to plants but also in respect to the consumed plant parts (Table 1 and 2). This selectivity could serve as an adaptation mechanism to the seasonal fluctuations in forage quality (Schwartz and Dioli, 1992). The observations indicate that camels select different plant species from one season to another; whereas 15 different plant species have been browsed by camels only during the dry season, but not during the green season (Table 1 and 2). This could be due to their unique natural mutual protection against arid environment, since plant species such as *Acacia* spp. which are thorny in nature and bitter in taste, do not deter the dromedary and are considered as preferred diet (Williamson and Payne, 1978). These plant species could be cultivated and protected as special ranges for camels to overcome the harsh conditions and the sever fluctuation in the nutritional status during the dry season.

Table 1: Trees and shrubs species selected by free ranging camels during the dry season in southern Darfur

Family	Botanical name	Vernacular name	Part(s) consumed
Anacardiaceae	<i>Sclerocarya birrea</i>	Hummaid	Fresh branches+fruits
Balanitaceae	<i>Balanites aegyptiaca</i>	Higeleeg	Fresh leaves+twigs
Caesalpinaceae	<i>Bauhinia rufescens</i>	Kulkul	Fresh leaves+ pods
	<i>Piliostigma reticulatum</i>	Kharrub	Fresh leaves+branches
Combretaceae	<i>Tamarindus indica</i>	Aradaib	Fresh twigs+branches
	<i>Combretum aculeatum</i>	Shihhait	Fresh leaves+twigs
	<i>Combretum glutinosum</i>	Habbeil	Fresh leaves+branches
	<i>Güiera senegalensis</i>	Khibbaish	Fresh leaves+twigs
Capparidaceae	<i>Cadaba farinosa</i>	Sirraih	Fresh leaves
Ebenaceae	<i>Diospyros mespiliformis</i>	Jokhan	Fresh leaves+branches
Mimosaceae	<i>Acacia nilotica</i>	Sonot	Fresh leaves+branches +fruits
	<i>Acacia seyal</i>	Talih	Fresh leaves+twigs
	<i>Acacia sieberiana</i>	Kuk	Fresh leaves+young shoots
	<i>Acacia senegal</i>	Hashab	Fresh twigs+fresh leaves
	<i>Albizzia amara</i>	Arad	Fresh twigs
	<i>Faidherbia albida</i>	Haraz	Fresh twigs
	<i>Dichrostachys cinerea</i>	Kadad	Fresh twigs
Olaceae	<i>Ximena americana</i>	Midaica	Fresh leaves+young shoots
Papilionaceae	<i>Dalbergia melanoxylon</i>	Babanus	Fresh leaves
Rhamnaceae	<i>Ziziphus spina-christi</i>	Sidir	Fresh leaves+young shoots
Rubiaceae	<i>Gardenia lutea</i>	Abungawi	Fresh leaves+flowers
Tiliaceae	<i>Grewia tenax</i>	Giddaim	Fresh twigs+flowers
Ulmaceae	<i>Celtis integrifolia</i>	Mahajiria	Fresh leaves+branches

Table 2: Forage species selected by free ranging camels during green season in southern Darfur

Family	Botanical name	Vernacular name	Part(s) consumed
A) Trees and shrubs			
Balanitaceae	<i>Balanites aegyptiaca</i>	Higeleeg	Fresh leaves+twigs
Bombacaceae	<i>Adansonia digitata</i>	Tabaldi	Fresh leaves+young shoots
Caesalpinaceae	<i>Bauhinia rufescens</i>	Kulkul	Fresh leaves
	<i>Tamarindus indica</i>	Aradaib	Fresh twigs+branches
Capparidaceae	<i>Caparis decidua</i>	Tundub	Fresh branches
Combretaceae	<i>Anogeissus lelocarpus</i>	Sahab	Fresh twigs+flowers
	<i>Combretum aculeatum</i>	Shihhait	Fresh leaves
Mimosaceae	<i>Acacia mellifera</i>	Kittir	Fresh leaves+young shoots
	<i>Acacia nubica</i>	Laoat	Fresh twigs
	<i>Acacia nilotica</i>	Sonot	Fresh twigs
	<i>Acacia senegal</i>	Hashab	Fresh twigs+flowers
	<i>Acacia tortilis</i>	Sayal	Fresh twigs+young shoots
	<i>Albizzia amara</i>	Arad	Fresh twigs+branches
Meliaceae	<i>Khaya senegalensis</i>	Muhogani	Fresh leaves+young shoots
Rhamnaceae	<i>Ziziphus spina-christi</i>	Sidir	Fresh leaves
B) Grasses and herbs			
Convolvulaceae	<i>Ipomea</i> spp.	Hantut	Green entire plant
Cucurbitaceae	<i>Cucumis sativus</i>	Abujour	Fruit+green entire plant
Fabaceae	<i>Arachis hypogaea</i>	Ful Sudani	Green entire plant
Poaceae	<i>Cenchrus biflorus</i>	Huskaneet	Green entire plant
	<i>Dactyloctenium aegyptium</i>	Abuasabi	Green entire plant
	<i>Echinochloa cololum</i>	Diffra	Green entire plant
Zygophyllaceae	<i>Tribulus terrestris</i>	Deraisah	Green entire plant

Seasonal variation in plants chemical composition: In the present study, Crude Protein (CP), Crude Fibre (CF) and Nitrogen Free Extract (NFE) contents of plant parts browsed by camels during the dry season were significantly ($p < 0.05$) higher compared to those browsed during the green season (Table 3). These results show that camels are highly selective browsers, especially during the dry season, where they select mostly green material from deep rooted bushes and trees. Schwartz and Dioli (1992) reported that camels are consistently able to select best qualities with minor differences between

Table 3: Seasonal variation in the chemical composition (%) of plant species selected by free ranging camels

Contents	Dry season	Green season	p-value
Crude protein	6.79±0.12 ^a	4.90±0.34 ^b	0.001
Crude fibre	13.11±0.44 ^a	11.49±0.32 ^b	0.006
Nitrogen free extract	68.04±0.46 ^a	65.25±0.74 ^b	0.001
Ash	4.82±0.08 ^a	11.39±0.53 ^b	0.001

seasons. However, the ash content of the plant parts browsed by camels during the green season was significantly ($p < 0.05$) higher compared to those browsed during the dry season (Table 3). This could be attributed to the increase in the available salty plants during wet

season (Kuria *et al.*, 2004). Dry Matter (DM) content of the plant parts selected by camels during the dry- and green season were 94.55 ± 0.22 and 95.00 ± 0.16 and Ether Extract (EE) content were 2.09 ± 0.10 and $2.15 \pm 0.01\%$, respectively.

CONCLUSION

This study clearly shows that camels are highly selective browser, especially during the dry season where they select mostly green materials from deep rooted bushes and trees rich in crude protein and nitrogen free extract as an adaptation mechanism to the seasonal variation in the quantity and quality of available forage.

ACKNOWLEDGMENT

Financial assistance from the University of Nyala to the first author is gratefully acknowledged.

REFERENCES

- Abdelrahman, M.M., R.L. Kincaid and E.A. Elzubeir, 1998. Mineral deficiencies in grazing dairy cattle in Kordofan and Darfur Regions in western Sudan. *Trop. Anim. Health Prod.*, 30: 123-135.
- Andrews, F.W., 1950. The flowering plants of anglo-Egyptian Sudan (I). T. Buncle and Co Ltd., Arbroath, Scotland.
- Andrews, F.W., 1952. The flowering plants of anglo-Egyptian Sudan (II). T. Buncle and Co Ltd., Arbroath, Scotland.
- Andrews, F.W., 1956. The flowering plants of anglo-Egyptian Sudan (III). T. Buncle and Co. Ltd., Arbroath, Scotland.
- AOAC., 1984. Association of Official Agriculture Chemists. Official Methods of Analysis. 14th Edn., Washington DC, USA.
- Babiker, A.M., M.E. Hamattu, A.A. Mohamed, H.A. Abdel Samad, M.T. Abdelrahman and M.N. Ahmed, 1999. Natural Resources Enumerate and Study, Vol. 1. Localities Development Fund, Research and Study Committee. Nyala, Southern Darfur, Sudan.
- Daugall, H.W., U.M. Drysdale and P.E. Glouer, 1964. The chemical composition of Kenya browses and pastures herbage. *East Afric. Wildlife J.*, 2: 86-121.
- El Shami, E., O.F. Idris and A.G. Abdelrahim, 1990. Comparative studies on the utilization of some browse plants by camels and goats in eastern Sudan. *Sudan J. Vet. Res.*, 9: 29-35.
- Kassily, F.N., 2002. Forage quality and camel feeding patterns in central baringo, Kenya. *Livestock Prod. Sci.*, 78: 175-182.
- Kuria, S.G., M.M. Wanyoike, C.K. Gachuri and R.G. Wahome, 2004. Indigenons camel mineral supplementation knowledge and practices on manyatta based camel herds by the Randille pastoralists of marsabit district, Kenya. *Livestock Res. Rur. Develop.*, 16: Art. 51.
- Osman, H.E. and B. Fadl-Alla, 1974. The effect of level of water intake on some aspects of digestion and nitrogen metabolism of desert sheep of the Sudan. *Camb. J. Agric. Sci.*, 84: 61-69.
- Parker, B.N. and R.W. Blowey, 1976. Investigations into the relationship of selected blood components to nutrition and fertility of the dairy cows under commercial farm conditions. *Vet. Rec.*, 98: 394-404.
- Schwartz, H.J. and M. Dioli, 1992. The one-humped camel in eastern Africa. A pictorial guide to diseases, health care and management. Verlag Josef-Margraf, Weikersheim, Germany.
- Von Maydel, H.J., 1986. Trees and shrubs of the Sahel. Verlag Josef-Margraf, Weikersheim, Germany.
- Wardeh, M.F., 2004. The nutrient requirements of the Dromedary Camel. *J. Camel. Sci.*, 1: 37-45.
- Williamson, G. and W.J.A. Payne, 1987. An Introduction to Animal Husbandry in the Tropics. 3rd Edn., Longman, London, pp: 755.