



University of Kentucky
UKnowledge

International Grassland Congress Proceedings

XXIV International Grassland Congress /
XI International Rangeland Congress

Nutritive Composition and *In Vitro* Dry Matter Digestibility of the Most Browsed Forage Species by Lactating Camels

Lucy W. Ikanya
University of Nairobi, Kenya

J. G. Maina
University of Nairobi, Kenya

C. K. Gachuiiri
University of Nairobi, Kenya

W. O. Owino
Jomo Kenyatta University of Agriculture and Technology, Kenya

José C. B. Dubeux Jr.
University of Florida

Follow this and additional works at: <https://uknowledge.uky.edu/igc>



Part of the [Plant Sciences Commons](#), and the [Soil Science Commons](#)

This document is available at <https://uknowledge.uky.edu/igc/24/2/31>

This collection is currently under construction.

The XXIV International Grassland Congress / XI International Rangeland Congress (Sustainable Use of Grassland and Rangeland Resources for Improved Livelihoods) takes place virtually from October 25 through October 29, 2021.

Proceedings edited by the National Organizing Committee of 2021 IGC/IRC Congress

Published by the Kenya Agricultural and Livestock Research Organization

This Event is brought to you for free and open access by the Plant and Soil Sciences at UKnowledge. It has been accepted for inclusion in International Grassland Congress Proceedings by an authorized administrator of UKnowledge. For more information, please contact UKnowledge@lsv.uky.edu.

NUTRITIVE COMPOSITION AND *IN VITRO* DRY MATTER DIGESTIBILITY OF THE MOST BROWSED FORAGE SPECIES BY LACTATING CAMELS

Ikanya L.W, Maina J.G, Gachuri C.K, Owino W.O*, Dubeux Jr.J.C.B**

Department of Animal Production, College of Agriculture and Veterinary Sciences, University of Nairobi,
P.O Box 29053-00625, Kangemi, Kenya

Lucy.ikanya@gmail.com

*Department of Food Science and Technology, College of Agriculture, Jomo Kenyatta University of
Agriculture and Technology, P.O Box 62000-00200 Nairobi, Kenya

**University of Florida, North Florida Research and Education Center, Marianna, FL, USA.

Abstract

Camels are both grazers and browsers of a broad spectrum of forages. The objective of this study was to identify and to determine the chemical composition of the most preferred forage species by lactating Somali camels in Laikipia County, Kenya. Lactating Somali camels and their calves were observed during the wet and dry seasons while browsing for a period of two weeks. The forage species were ranked based on the bite count. The most browsed forages identified through observation were sampled for identification by the local and scientific names and laboratory analysis. They were analyzed for proximate composition, detergent fiber fractions, and *in vitro* dry matter digestibility. The most browsed forage species were *Acacia nubica*, *Acacia seyal*, *Cucumis aculeatus*, *Euclea divinorum*, *Hibiscus parrifolia* in the wet season and *Barleria acanthoides*, *Balanites aegyptiaca*, *Cynodon dactylon*, *Lycium europium*, *Pollichia campestris* in the dry season. Shrubs constituted 60%, trees 30%, and grasses 10% of the most preferred forage species. The preferred browsed species had high crude protein (7.1 ± 0.4 to $25.7 \pm 1.2\%$) and low neutral detergent fiber concentrations (29.1 ± 2.7 to $74.0 \pm 7\%$). The results of the study show camels fed on different types of forage species and that the forage nutritive value affected the selection.

Key Words: bite count; Somali dromedary; forage species; feeding behavior

Introduction

Camels under pastoral systems have mixed feeding behavior where they are both grazers and browsers of a broad spectrum of forages. Their diets are varied (Dereje & Uden, 2005) and include halophytic (salty), bitter and hard-thorny herbs, shrubs, grasses, and trees that grow naturally in Arid and Semi-Arid Lands (Iqbal & Baidar Khan, 2001). Forage quality affects the feeding activity patterns of camels (Kassilly, 2002). Camels forage preference varies with season and forage nutritive value. This study was conducted to determine the chemical composition and *in vitro* dry matter digestibility of the most browsed forages by lactating Somali camels in Laikipia County, Kenya.

Materials and Methods

Description of the Study Site

The study site was at Doldol in Laikipia County, Kenya. The area is semi-arid and is deemed too dry for cultivation. It comprises relatively intact and natural habitat (Jong, 2014), which is mainly a wildlife habitat. It is at an altitude ranging from 1166 to 2122m above sea level, and geographical coordinates 0.3932° N and 37.1632° E, with an annual average rainfall of 554mm with two rainy seasons (GOK & UNDP, 2013). The climate is hot steppe climate with the annual temperature ranging from a minimum of 24.6° C to a maximum of 33.3° C.

Identification of preferred forage species

Eight Somali lactating camels of parity one to three and in early stage of lactation were selected and ear-tagged with a Button electronic ear tag, Raybaca brand; model RBC-ET01 LF. Camels were observed for forage identification during the wet and dry seasons for 84 days between 1000h and 1800h.

Sampling involved picking parts of the forage species consumed by the camels during the field observation.

Laboratory Analysis

It involved determination of dry matter concentration; proximate composition using the standard procedures (AOAC, 1998); calcium through the atomic absorption spectrophotometric method (Bellanger & Lamand, 1975); phosphorous through calorimetric methods (Kitson & Mellon, 1944). The fiber

fractions (Van Soest *et al.* 1991); *in vitro* dry matter digestibility (Tilley & Terry, 1963) method. Artificial saliva was prepared according to McDougall (1947).

Statistical Analysis

Data was entered in Microsoft Office Excel 2010 spread sheet. Frequencies and percentages for bite counts were then computed using the Statistical Package for Social Sciences (SPSS).

Results

Most preferred forage species

Table 1: Most preferred forage species by Somali lactating camels

Season	Local name	Botanical name	Category	Bite counts	% of total	LSmeans±SE
Dry	Suchei	<i>Barleria acanthoides</i>	Shrub	149	22.9	37.2 ± 0.5
	Lokwai	<i>Balanites aegyptiaca</i>	Tree	101	15.5	25.2±0.8
	Nkigit	<i>Cynodon dactylon</i>	Grass	76	11.7	19±1.3
	Ngoki	<i>Lycium europeum</i>	Shrub	208	32.0	52.0±2.9
	Nkaekuch	<i>Pollichia campestris</i>	Shrub	116	17.8	29.0±0.7
	Total			650	100	
Wet	Jakwai	<i>Acacia nubica</i>	Tree	198	22.6	49.5±2.5
	Oltepesi	<i>Acacia seyal</i>	Tree	414	47.3	103.5±3.6
	Sengeti	<i>Cucumis aculeatus</i>	Shrub	63	7.2	15.8±0.9
	Olkinyei	<i>Euclea divinorum</i>	Shrub	97	11.1	24.2±0.5
	Nkarani	<i>Hibiscus parrifolia</i>	Shrub	104	11.9	26.0±1.8
	Total			876	100	

Chemical composition of the most preferred forage species

Table 2: Chemical composition (% DM) of the most preferred forage species by lactating camels

Scientific Name	% Mean±SD					
	DM	CP	Ash	EE	Ca	P
<i>Acacia seyal</i>	39.0±0.2	17.9±1.3	8.2±0.1	2.0±0.1	1.7±0.1	0.3±0.0
<i>Balanites aegyptiaca</i> leaves	51.5±0.2	12.5±2.2	16.3±0.5	2.1±0.1	1.4±0.0	0.1±0.0
<i>Balanites aegyptiaca</i> pods	41.5±0.5	7.1±0.4	5.9±0.1	3.3±0.8	0.7±0.0	0.3±0.0
<i>Barleria acanthoides</i>	72.2±0.1	7.4±0.8	19.3±1.2	0.9±0.2	3.4±0.0	0.2±0.0
<i>Cynodon dactylon</i>	54.9±0.2	10.4±0.8	11.8±2.2	2.5±0.7	0.9±0.0	0.3±0.0
<i>Euclea divinorum</i>	51.0±0.2	7.6±0.4	6.6±0.2	1.5±0.9	1.6±0.3	0.2±0.0
<i>Lycium europeum</i>	20.5±0.2	25.7±1.2	22.9±0.5	2.2±0.2	2.0±0.0	0.3±0.0
<i>Pollichia campestris</i>	53.1±0.1	8.2±0.4	9.3±1.0	1.5±0.2	1.3±0.0	0.2±0.0

DM-Dry matter, CP-Crude protein, EE- Ether Extract, Ca-Calcium, P-Phosphorus

Fibre fractions and *in vitro* dry matter digestibility

Table 3: Fiber fractions (%DM) and *in vitro* dry matter digestibility (%) of the most preferred forage species by lactating camels

Scientific Name	% Mean±SD			
	IVDMD	NDF	ADF	ADL

<i>Acacia seyal</i>	64.2±1.3	29.1±2.7	15.2±0.9	6.6±0.4
<i>Balanites aegyptiaca leaves</i>	72.0±1.4	36.0±3.5	24.4±0.7	13.9±1.6
<i>Balanites aegyptiaca pods</i>	48.6±3.3	65.0±4.4	40.5±2.3	11.5±0.3
<i>Barleria acanthoides</i>	48.5±1.3	58.6±2.1	46.3±2.9	20.1±0.7
<i>Cynodon dactylon</i>	48.5±0.8	74.0±7	38.5±5.0	13.4±1.4
<i>Euclea divinorum</i>	76.6±0.8	32.4±1.3	28.3±0.4	19.5±0.4
<i>Lycium europeum</i>	81.6±0.3	34.2±2.1	15.7±0.9	7.0±1.5
<i>Pollichia campestris</i>	43.4±0.2	73.6±1.9	47.8±2.8	18.5±2.0

NDF-Neutral detergent fibre, ADF-Acid detergent fibre, ADL- Acid detergent lignin, IVDMD- Invitro-dry matter digestibility

Discussion

The acacia spp., *Balanite aegyptiaca*, *Lycium europium*, and *Barleria* spp. were also observed to be among the most preferred forage species by Kuria *et al.*, (2004) in North Eastern Kenya.

The CP concentration of the forages observed in this study was greater than the values reported by Kuria *et al.*(2005) and Kuria *et al.*(2012), who reported ranges of 12.1±3.7% and 3.7 to 13.2 %, for the most preferred forage species by camels in Upper Eastern Kenya and North Eastern Kenya, respectively. The variation may have been attributed by the difference in geographical location and soil type (Lee,2018). The ash concentration ranged from 5.9 to 22.9%, similar to the values reported by Lakhdariet *al.*(2015), who determined 15 to 27% ash for forage species preferred by dromedaries in arid rangelands of Algeria. The similarity could be that Camels prefer halophytic forages that have high ash concentration (Medila *et al.*, 2015). Camels prefer browsing on forages that are high in calcium even where such forages are poor in phosphorus (Medila *et al.*, 2015). Moreover, camels prefer forages with high mineral content (Towhidi, 2007).

The *Acacia seyal* fibre fractions of 29.1% NDF and 15.2%ADF was within the range 20-35%NDF and 12-25%ADF respectively (Heuze *et al.*, 2011). *Acacia seyal* in Baringo County was reported to contain 23%NDF and 16.8%ADF respectively (Abdulrazak *et al.*, 2000). These plants had low fibre concentrations and high *in vitro* dry matter digestibilities making them more palatable. Low NDF concentration is a characteristic of good forage quality and high *in vitro* dry matter digestibility (Jassim, 2017), with expected positive effect on camel performance (Bakshi & Wadhwa, 2004; Osuga *et al.*, 2008)

Conclusion

The results of the study showed that the camel exhibits a mixed feeding behavior with the most preferred forage species comprising of trees, shrubs, and grasses. However, trees and shrubs with high crude protein and low neutral detergent fiber concentrations were more preferred, indicating that forage nutritive value affected the forage preference by the camels.

Recommendations

To overcome the challenge of inadequate feed resources, there is need to strengthen the knowledge of camel keepers on the preferred forage species during the wet and dry seasons. This information can be used to optimize grazing management and supplementation to lactating camels, particularly during dry seasons.

Acknowledgments

The authors wish to sincerely thank the University of Nairobi for laboratory facilities and dryGrow Foundation for funding this study. Also, treasures the pastoral communities in Laikipia County for allowing their camels to be used for field grazing observations.

References

- Abdulrazak, S.A., Fujihara, T., Ondiek, J.K., & Orskov, E.R. 2000.** Nutritive evaluation of some acacia tree leaves from Kenya. *Anim. Feed Sci. Technol.* 85, 89-98.
- AOAC, I. 1998.** *AOAC: Official Methods of Analysis (Volume 1)*. 1(Volume 1).
- Bakshi, M. P. S., & Wadhwa, M. 2004.** Evaluation of forest tree leaves of semi-hilly arid region as livestock feed. *Asian-Australasian Journal of Animal Sciences*, 17(6), 777–783.
- Dereje M., Uden P. 2005.** The browsing dromedary Camel I. Behavior, plant preference and quality of forage selected. *Anim Feed Sci Tech* 121: 297-308.
- GoK, UNDP, 2013.** Kenya National Development report; Climate Change and Human Development, Works cited Harnessing emerging opportunities. Government of Kenya, United Nations Development Programme. Nairobi.
- Heuzé V., Iran., Boval M., 2015.** *Shitimwood (Acacia seyal)*, Feedipedia, a programme by INRAE, CIRAD, AFZ and FAO.
- Iqbal, A., & Baidar Khan, B. 2001.** *Feeding Behaviour of Camel Review*. 38(1978), 3–4.
- Jassim, R. A. 2017.** *Camel Nutrition and Feeding*.
- Jong, T. M. & Yvonne A. D. 2014.** Primate Conservation in the Rangeland Agroecosystem of Laikipia County, Central Kenya. *The Journal of the IUCN SSC Primate Specialist Group*, (28).
- Kassilly, F. 2002.** Forage quality and camel feeding patterns in Central Baringo, Kenya. *Livestock Production Science - LIVEST PROD SCI*, 78, 175–182.
- Kitson, R. E., & Mellon, M. G. 1944.** Colorimetric Determination of Phosphorus as Molybdivanadophosphoric Acid. *Industrial & Engineering Chemistry Analytical Edition*, 16(6), 379–383.
- Kuria, S.G. 2004.** *Mineral nutrition on settlement (manyatta)-based milk camel herds among the Rendille community of northern Kenya*.
- Kuria, S. G., Wanyoike, M. M., Gachuri, C. K., & Wahome, R. G. 2005.** Nutritive Value of Important Range Forage Species for Camels in Marsabit District, Kenya. *Tropical and Subtropical Agroecosystems*, 5, 15–24.
- Kuria, S. G., Tura, I. A., Amboga, S., & Walaga, H. K. 2012.** Forage species preferred by camels (*Camelus dromedarius*) and their nutritional composition in North Eastern Kenya. *Livestock Research for Rural Development*. Volume 24, Article 145.
- Lakhdari, K., Belhamra, M. & Mayouf, R. 2015.** Forage species preferred by dromedaries and their chemical composition in arid rangelands of Algeria. *Livestock Research for Rural Development*. Volume 27, Article 205.
- Lee, M.A. 2018.** A global comparison of the nutritive values of forage plants grown in contrasting environments. *J Plant Res* 131, 641–654.
- Medila, I., Adamou, A., Arhab, R., & Hessini, K. (2015).** Nutritional specificities of some halophytes, eaten by camel, native from Algerians salt ecosystems. *Livestock Research for Rural Development*. Volume 27, Article b48.
- McDougall E.I. 1947.** THE COMPOSITION AND OUTPUT OF SHEEP'S SALIVA. *Institute of Animal Pathology, University of Cambridge*.
- Osuga, I. M., Wambui, C., Abdulrazak, S., & Ichinohe, T. 2008.** Evaluation of nutritive value and palatability by goats and sheep of selected browse foliages from semiarid area of Kenya.
- Tilley, J., & Terry, R. A. 1963.** A Two-Stage Technique for the in vitro Digestion of Forage Crops. *Grass and Forage Science*, 18, 104–111.
- Towhidi A. 2007.** Nutritive value of some herbage for dromedary Camel in Iran. *Pakistan Journal of biological sciences*, 10(1):167-170
- Van Soest, P. J., Robertson, J. B., & Lewis, B. A. 1991.** Methods for Dietary Fiber, Neutral Detergent Fiber, and Nonstarch Polysaccharides in Relation to Animal Nutrition. *Journal of Dairy Science*, 74(10), 3583–3597.