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EFFECTS OF FEEDING DIFFERENT LEVELS OF *Balanites aegyptiaca* (*HEGLIG*) KERNEL CAKE ON CATTLE RUMEN ENVIROMENT

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ORIGINAL ARTICLE

ABSTRACT: *The present experiment aimed to investigate the effects of replacing groundnut cake with Balanites aegyptiaca kernel cake up to 15% on rumen environment in local kenana cattle. The study was conducted at the experimental unit of Veterinary Medicine and Animal Production College, Sudan University of Science and technology at Hillat Kuku. Traits studied were rumen pH ammonia concentration (NH3), volatile fatty acids concentration (VFAs) and bacterial count (BC). No significance difference was observed for pH, NH3, VFAs and BC between treatments. Generally, NH3 and VFAs was increased with time post feeding. But, BC decreased with time post feeding. It was concluded that incorporation of B. Aegyptiacua kernel cake at 5, 10, 15% to replace equal percentages of groundnut cake did not significantly (P<0.05) affected rumen environment.*

Key words: *Ammonia, Bacteria Balanites aegyptiaca, Cake*

INTRODUCTION

Balanites aegyptiaca is used for firewood, charcoal, poles, timber, utensils, tool handle, food, medicine, fodder, mulch, shade, windbreak and gum (Guinand and Lemessa, 2001). This plant contributes up to 30% of the dry matter intake of goats in the dry season in Burkina Faso (Hall and Walker, 1991). Kernel meal, the residue remains after oil extraction was used for fattening of sheep in Sudan (Elkhidir et al., 1983) and in other animals in Senegal (Vogt, 1995) and as stock feed in Uganda (Katende et al., 1995). In Sudan it is more likely the species with widest natural range (Badi et al., 1989). It makes up to one third of the total tree population in central region of Sudan (NRC, 2008). The rumen is essentially a fermentation chamber in which the resident microbial population helps to digest the diet. Hungate (1975) reported that, in order to sustain constant microbial population, the rumen environment must fulfil certain conditions. Among these conditions are that the rumen must be warm (39-42°C) and anaerobic. He also mentioned that the rumen must have chemical reducing environment and it must be rich in organic matter. Types of microorganisms (Bacteria, protozoa, and fungi) that populate the rumen are severely affected by temperature, reduction potential and PH (Smith and Oldham, 1983). The microbial ecosystem in the rumen varies within animals, with time after feeding and between days in the same animal (Preston and Leng, 1987). They also mentioned that rumen environment is largely affected by type and quality of food eaten. The optimal pH for rumen proteolytic enzyme, range from 5.5 to 7.0 (Kopency and Wallace, 1982). Ruminal acidosis, which is a common digestive disorder reflect imbalance between microbial production, microbial utilization and ruminal absorption of organic acids (Nagaraja and Titgemeyer, 2007). It was observed that when ruminal pH decreases beyond 5.6 volatile fatty acids absorption was enhanced because they became more protonated or undissociated (Bergman, 1990). But this rapid absorption of VFAs is accompanied by shift in rumen microbes in producing more lactic acid which is more readily absorbed and will impair VFAs absorption (Giesecke and Stangassinger, 1980). Microbes in the rumen are plant material fermenters, and to digest straw carbohydrates they need to be supplied quantitatively with many nutrients one of them is ammonia (Hegarty et al., 1996). Rumen NH3 level varies widely throughout the day and its level depends largely on the feeding regime and feed quality (Ciszuk, 1973). Ruminal NH3 concentration is inversely related to carbohydrate availability in the rumen (Russel et al., 1983; Hristov et al., 1997; Heldat et al., 1999). This is so because decreased energy lead microbes to degrade food protein into NH3 and ammonia uptake by microbes will be impaired (Nocek and Russel, 1988; Hristov et al., 1997). Taragi et al. (1964) stated that the highest level of urea in the blood was reached five hours after the rumen

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attained its highest NH3 concentration. Ammonia is combined with hydrogen ions in the rumen fluid to form ammonia ions. This process depends on ruminal pH (Kajanapruthipong and Leng, 1998). Ruminal microbacteria form the key link between the ruminant and its diet because VFA and microbial protein from feed degradation account for the majority of nutrients utilized by the host (Sutton, 1985). The objectives of the present study were to investigate the effects of feeding steers kernel cake of *Balanites aegyptiaca* on rumen cattle ecology.

MATERIAL AND METHODS

Experimental animals

Three castrated local Kenana bulls at 3-3.5 years old were used in this experiment. Animals were fitted with rumen cannulae as described by Brown et al. (1968). Animals were fed twice daily and had free access to clean water and salt licks during the study.

Experimental feeds

Four rations based on sorghum, molasses and wheat bran were formulated in such a way to provide experimental levels of *Balanites aegyptiaca* oil cake (0, 5, 10, and 15 %) as ground nut cake was replaced (Table 1).

Table 1 - Ingredients of experimental rations and chemical composition (DM basis) as %

Ingredients	*Balanites aegyptiaca* kernel cake (%)			
Time	0	5	10	15
Sorghum (feterita)	30.00	30.00	30.00	30.00
Wheat bran	19.00	19.00	19.00	19.00
Molasses	30.00	30.00	30.00	30.00
Groundnut cake	20.00	15.00	10.00	5.00
Salt (NaCl)	01.00	01.00	01.00	01.00
Total	100	100	100	100
Chemical analysis				
DM	87.30	86.90	86.60	86.30
CP	18.20	18.30	18.30	18.40
Crude fiber	5.50	5.40	5.30	5.20
Crude fat	3.10	2.90	1.30	1.10
NFE	60.50	60.30	61.70	61.60
MEMJ/Kg	11.89	11.81	11.51	11.43

*DM: Dry matter, CP: crude protein, NFE: Nitrogen free extract, MEMJ/kg; Metabolizable energy

Experimental design

The trial design was according to Latin square design with four treatments and four experimental periods. Each period lasted seven days. The adaptation period was six days to allow bulls to adapt the experimental diet; this was followed by ten days of sample taking.

Traits Studied

Rumen pH: A sample of about 60 cc of rumen liquor was taken using a 20 cc syringe. Electronic pH meter was used to read the rumen pH

Ammonia determination: Ammonia concentration was determined as described by Conway method (1967) using Conway unit and then NH3 in rumen liquor=T×N×100 (mg/100 ml of sample volume).

T= Titration, N= Normality of acid.

Volatile fatty acids: Volatile fatty acids were determined as described by Kroman et al. (1967).

Bacterial count: Rumen fluid was obtained from the three fistulated calves rumen in calibrated glass syringes following the procedures of menke and Steingass (1988). 10 ml of the collected rumen liquor were shaken to precipitate rumen content and protozoa at the base of the syringe. 1 ml of the upper part of the syringe was taken for bacterial count. One ml of this solution after mixed in formal solution was used for culture in nutrient agar at room temperature. Then after growth the colonies were counted according to Hungate (1969).

Statistical Methods

Data was analyzed by SPSS computer program version 17 (univariate analysis of variance and multiple comparisons) to obtain means, standard deviations and to compare means.

RESULTS AND DISCUSION

Table 2 shows that there was no significant difference ($P<0.05$) in pH value for different rations studied. This is in agreement with Sehgal and Makkar (1994), Narasa et al. (1986) and Tiwari (2001) who stated that there was no difference in rumen pH due to feeding different isonitrogenous diets based on different natural protein sources.

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On the other hand, Kopency and Wallance (1982) reported that the optimum rumen pH for its proteolytic enzymes to be active fall in the range of 5.5 to 7.0. Generally animals fed control diet showed numerically lower values at all post-feeding time.

Table 2 - Rumen pH (means±SD) in different incubation time (0-9 hrs.) for cattle fed different level of *B. aegyptiaca* cake

Treatment	*Balanites aegyptiaca* kernel level (%)				
Time	0	5	10	15	Significant
0 hrs	6.63±0.48	6.30±0.20	6.30±0.32	6.60±0.12	NS
3 hrs	5.73±0.05	6.10±0.15	6.00±0.30	6.10±0.15	NS
6 hrs	5.93±0.06	6.36±0.27	6.16±0.31	6.03±0.16	NS
9 hrs	5.86±0.08	6.00±0.10	5.90±0.12	5.93±0.17	NS

SD= standard deviation; *NS: Non significant at (P<0.05)

Table 3 shows the various ammonia concentrations for rations at different *B. aegyptiaca* cake levels and at different time post-feeding. There was no significant difference (P<0.05) among treatments, this agreed with Sehgal and Makkar (1994) and Tiwari (2001). Generally ammonia concentration increased with time past feeding. It was also noticed that the control diet (0% *B. aegyptiaca*) showed the lowest ammonia concentration, while animals on diet containing 5 and 10 % *B. aegyptiaca* showed the highest concentrations of ammonia.

Table 3 - Rumen ammonia concentration (NH3 mg/100 ml) (means±SD) in different incubation time (0-9 hrs.) for cattle fed different level of *B. aegyptiaca* cake

Treatment	*Balanites aegyptiaca* kernel level (%)				
Time	0	5	10	15	Significant
0 hrs	5.80±2.87	6.00±3.96	5.79±3.25	7.37±5.11	NS
3 hrs	2.69±0.34	3.67±0.83	2.76±0.21	3.85±0.51	NS
6 hrs	4.43±2.13	6.41±3.19	6.30±3.95	5.39±0.85	NS
9 hrs	6.00±3.07	6.99±3.36	6.89±2.59	6.43±4.31	NS

SD= standard deviation; *NS: Non significant at (P<0.05)

Table 4 shows the various volatile fatty acid concentrations for rations at different *B. aegyptiaca* cake levels and at different time post-feeding. There was no significant difference (P<0.05) among treatments. Obtained results agreed with Trei et al. (1970) and Murphy et al. (1994). There was a general trend for volatile fatty acids concentration to increase with time post-feeding.

Table 4 - Rumen volatile fatty acid concentration (VFAs mg/100 ml) (means±SD) in different incubation time (0-9 hrs.) for cattle fed different level of *B. aegyptiaca* cake

Treatment	*Balanites aegyptiaca* kernel level (%)				
Time	0	5	10	15	Significant
0 hrs	0.371±0.072	0.431±0.060	0.455±0.031	0.431±0.060	NS
3 hrs	0.352±0.093	0.364±0.010	0.431±0.010	0.457±0.120	NS
6 hrs	0.470±0.061	0.473±0.080	0.424±0.145	0.480±0.061	NS
9 hrs	0.492±0.061	0.476±0.114	0.411±0.175	0.401±0.021	NS

SD= standard deviation; *NS: Non significant at (P<0.05)

Table 5 shows the various Bacterial counts for rations at different *B. aegyptiaca* cake levels and at different time post-feeding. There was no significant difference (P<0.05) among treatments. In this trial bacterial count seemed to fluctuate (decrease or increase) with time. The bacterial count tends to decrease with time post-feeding. The highest count observed at zero time post- feeding. However, Leedle et al. (1982) found that bacterial numbers to be lowest 2 to 4 hour after feeding and to gradually increase until 16 hours post-feeding. Warner (1966) found that very little fluctuation in the numbers of bacteria in the rumen when sheep were fed every three hours.

Table 5 - Bacterial count (means±SD) in different incubation time (0-9 hrs.) for cattle fed different level of *B. aegyptiaca* cake

Treatment	*Balanites aegyptiaca* kernel level (%)				
Time	0	5	10	15	Significant
0 hrs	$16.77\times10^6\pm282$	$16.14\times10^6\pm190$	$17.93\times10^6\pm371$	$16.93\times10^6\pm141$	NS
3 hrs	$13.45\times10^6\pm500$	$13.75\times10^6\pm350$	$13.15\times10^6\pm355$	$13.87\times10^6\pm288$	NS
6 hrs	$14.02\times10^6\pm183$	$14.90\times10^6\pm322$	$14.57\times10^6\pm252$	$14.67\times10^6\pm131$	NS
9 hrs	$14.53\times10^6\pm735$	$15.73\times10^6\pm241$	$15.29\times10^6\pm333$	$15.03\times10^6\pm196$	NS

SD= standard deviation; *NS: Non significant at (P<0.05)

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CONCLUSION

From the present study it was concluded that incorporation of *Balanites aegyptiaca* kernel cake at levels of 5, 10 and 15% to replace equal quantities of groundnut cake had no adverse significant effects on rumen environment pH NH3, VFAs and bacterial count).

REFERENCE

Badi KH, Elhouri A and Bayoumi AM (1989). The forests of the Sudan. Agricultural research Council, Khartoum, Sudan.

Bergman EN (1990). Energy contributions of volatile fatty acids from the gastrointestinal tract in various species: Physiology Review, 70: 1580–1588.

Brown GF, Armestrong DG and MacRae JC (1968). The establishment in one operation of a cannula into the rumen and reentrant canulae into the duodenum and ileum of the sheep. British Veterinary Journal, 124: 78.

Ciszuk P (1973). On the relations between rumen ammonia and blood urea in adult sheep. Swedish Journal of Agricultural research, 3: 167-174.

Conway EJ (1967). Microdiffusion analysis and Volumetric Error 4th ed, London, Crosby, Lock- wood and Son Ltd.

ElKhidir OM, Guma AY, Fangali OA and Badir NA (1983). The uses of Balanites kernal cake in the feed diet for fattening sheep. Animal Feed Science and Technology, 9(4): 301-306.

Giesecke D and Stangassinger M (1980). Lactic acid metabolism: Pages 523-539 in Digestive Physiology and Metabolism in ruminants. Y. Ruckebusch and P. Thivend. Ed AVI Publication. Co. Wesr-port. CT.

Guinand Y and Lemessa D (2001). Wild food plants in Ethiopia: Reflections on the role of wild foods and famine foods at a time of drought: In Kenyatta C and Henderson A (2001). The potential of indigenous wild foods, Workshop proceedings,USAID/OFDA, Mombassa- Kenya.

Hall JB and Walker DH (1991). Balanites aegyptiaca: A monograph, School of Agricultural and Forest Sciences Publication, University of Wales, No. 3.

Hegarty R, Godwin I and Nolan JV (1996). Animal metabolism digestion and nutrition. Department of Animal Science, University of New England. Armidale, Australia.

Heldat JS, Cochran RC, Mathis CP, Woods, BC, Olson KC, Titgemmeyer EC, Nagaraja TG, Vanzant ES and Johnson DE (1999). Effects of level and source of carbohydrate and level of degraded protein on intake and digestion of low quality tall-grass-prairie hay by beef steers. Journal of Animal Science, 77: 2846-2854.

Hristov AN, Mc-Allister TA and Cheng KJ (1997). Effect of carbohydrate level and ammonia availability on utilization of α-amino nitrogen by mixed ruminal microorganism in virto, Proceedings, Western section, American Society of Animal Science, 48: 186-189.

Hungate RE (1975). The rumen microbial ecosystem. Annual review of Ecology and systematic . 6: 39-66.

Hungate RE (1969). A roll tube method for cultivation of strict anaerobes, p. 117-132. In J. R. Norris and D. W. Ribbons (ed.), Methods in microbiology, vol. 3B. Academic press Inc., New York.

Kanjanapruthipong J and Leng RA (1998). The effects of dietary urea on microbial populations in the rumen of sheep. Journal of Animal Science, 11(6): 2190-2196.

Katende A, Birne Ann and Tengnas Bo (1995). Useful trees and shrubs for Uganda: Identification, propagation and management for agriculture and pastoral communities. Mampala and Niarobi regional soil conservation unit. RSCU/SIDA,Technical handbook Series 10.

Kopency J and Wallace RJ (1982). Cellular location and some properties of proteolytic enzymes of rumen bacteria. Applied Environmental Microbiology, 43: 1026-1033.

Kroman RP, Meyer JH and Stielau WJ (1967). Steam distillation of volatile fatty acids in rumen digesta. Journal of Dairy Science, 50: 73-76.

Leedle JAZ, Bryant MP and Hespell RB (1982). Diurnal variations in bacterial numbers and fluid parameters in ruminal contents of animals fed low- or high-forage diets. Applied Environmental Microbiology, 44: 402-412.

Menke KH and Steingass H (1988). Estimation of energetic feed value obtained from chemical analysis and gas production using rumen fluid. Animal Researches Development, 28: 7-55.

Murphy TA, Fluharty FL and Loerch SC (1994). The influence of intake level and corn processing on digestibility and ruminal metabolism in steers fed all- concentrate diets. Journal of Animal Science, 72: 1608-1615.

Nagaraja TG and Titgemeyer EC (2007). Ruminal acidosis in beef cattle: The current microbiological and nutritional outlook. Journal of Dairy Science, 90 (E.Suppl.): E17–E38.

Narasa Reddy V and Raj M (1986). Effects of ammoniation and processing of cotton as the sole source of roughages in complete feeds on rumen characteristics with Murrah buffaloes. Animal feed science and technology, 14: 95-102.

National Research Council (2008). Lost Crops of Africa: Volume III, Fruits, Development, Security and Cooperation, The National Academies Press, Washington, D.C.
Nocek JE and Russel JB (1988). Protein and energy as integrated system: Relationship of ruminal protein and carbohydrate availability to microbial synthesis and milk production. Journal of Dairy Science, 71: 2070-2107.
Preston TR and Leng RA (1987). Matching Ruminant production System with available: Resources in the tropics and sub- Tropics. Renambul Books, Armidale, NSW, 1987. ISBN 0-9588290-12. Australia Pp. 245.
Russel JB, Sniffen CJ and Van Soet PJ (1983). Effect of carbohydrate limitation on degrdadation and utilization of casein by mixed rumen bacteria .Journal of Dairy Science, 66: 763-775.
Sehgal JP and Makkar GS (1994). Protein evaluation in ruminants. 1. In vitro, in sacco, in vivo protein degradability and microbial efficiency of different protein supplements in growing buffalo calves. Animal Feed Science and Technology, 45: 149-165.
Smith RH and Oldham JD (1983). Rumen metabolism and recent developments: In International Atomic Energy Agency (Ed.) Nuclear Techniques for assessing and improving ruminant feeds. Pp. 1-35. Vienna, Austria.
Sutton JD (1985). Digestion and absorption of energy substrate in the lactating cow. Journal of Dairy Science, 68: 3376-3393.
Tartagi H, Door Y, Ascarelli I and Bondi A (1964). The influences of levels of protein and starch in ration of sheep on the utilization of protein. British Journal of Nutrition, 18: 333-356.
Tiwari CM, Chandramoni MAS, Jadhao SB, Gowda SK and Khan MY (2001). Studies on blood biochemical constituents and rumen fermentation in growing buffalo calves fed ammoniated straw-based rations supplemented with different protein sources Available online 9 February 2001, Izatnagar, 243, 122, India.
Trei J, Hale WH, Vaghari PM and Patel PM (1970). Effect of grain processing on in vitro gas production. Journal of Animal Science, 30: 825-831.
Vogt K (1985). A field guide to the identification propagation and uses of common trees and shrubs of dry land, Sudan. SOS, Sahel International (UK).
Warner ACI (1966). Periodic changes in the concentrations of microorganisms in the rumens of sheep fed to appetite in pens or on pasture. Journal of General Microbiology, 45: 237-242.

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