Journal of Camel Research and Production
Journal homepage:
http:// journals.sustech.edu

[Type text]

Proximate Analysis and Rumen Degradation of Some Common Feeds in Camels, Khartoum State , Sudan

Hassna[*, 1]. A . Elsaid . , Mohamed [2]. E . Elimam . , Nuha[1]. H . Talib. and Salwa [3]. M . Elbasheer

1. Animal Production Research Centre, Khartoum North, Hillat Kuku - Sudan.
2. Faculty of Agricultural Sciences, University of Gezira, Wad Medani – Sudan.
3. *Central Veterinary Research Laboratory, Khartoum State , Soba – Sudan.*

***Corresponding Author:** hassna35648@gmail.com.*

ABSTRACT:
The new ruminant protein systems require information on feeds degradation characteristics. Currently in Sudan the information on rumen degradation in camels is not available. Therefore, this study aimed to determine the rumen degradation and degradation characteristics of some common feeds namely; *Medicago sativa* (Barseem)**,** *Sorghum bicolor* (Sorghum Feterita grains), *Arachis hypogaea* **(**Groundnut cake) , *Gossypium barbadense* (Cottonseed cake) and Sorghum husks ("Seewa"). In addition the concentrate ration fed to the camels . The study was conducted at the Central Veterinary Research Laboratory (CVRL), Soba, Khartoum State. The proximate analysis of the feed samples was determined. Three rumen fistulated camels were used to study the rumen degradation. The animals were fed *Medicago sativa* (Barseem) *ad lib* . and 2kg concentrate ration daily. Artificial fibre bags (18x14cm) were incubated in the rumen for different times and degradation characteristics were calculated. The effective degradability at different rates of outflow from the rumen of the feed samples was calculated. Results showed that the feed samples varied in proximate analysis and degradation characteristics. Crude protein (CP) was highest in *Arachis hypogaea* (40.6%) while the least value was in ("Seewa") (7.5%). The highest CP potential degradability was observed in *Sorghum bicolor* while the least was shown in *Gossypium barbadense*. The effective degradability varied in feed samples and decreased with increasing rates of outflow from the rumen. It is concluded that camels have high feeds rumen degradation, therefore, we recommend the use of common feeds for grazing camels in the dry season.

Keywords: Common feeds, rumen, degradation characteristics, camels

Introduction

Dairy products and meat demand and prices increased substantially in the Sudan in the last decades due to the increased human population and urbanization and improved education, income, living standards and nutritional awareness. It is vital to produce cheap and high quality meat and dairy products by improving conventional animal species performance and exploiting neglected species. Camels are attractive for meat and milk production due to high population ranking 2nd to Somalia in world population (FAO,2009). They are efficient producers of

Journal of Camel Research and Production
Journal homepage:
http:// journals.sustech.edu

[Type text]

high quality milk and meat in arid and semi-arid environments where it is difficult to rear other meat and milk producing animals (Farah *et al*., 1992). They have many valuable and distinguished products including milk, meat, hides and waber (Albert, 2002). In addition they are used for riding, racing and packing. Nutrition is a main constraint
for camels production in the Sudan due to many factors. Rangeland generally deteriorated due to haphazard agricultural expansion and reduced area, successive droughts, over grazing and seasonal variations in feeds quantity and quality leading to serious shortages in the dry season affecting animals performance and health (Ali,2003). Agro-industrial by-products are abundant in the Sudan and important in animal nutrition and are exploited to fill the nutritional gap, especially in the dry season. The variations in degradation characteristics among feeds DM, OM, CP and CF were mainly genetic. Similar variations in degradation characteristics among feeds were found by many workers. It was found in rangeland plants in goats in Abu Haraz area (Elimam *et al*.,2013b). It was also found for browses in goats in the Gezira State (Elimam *et al* ., 2013b). In addition it was found for plant residues in goats in the Gezira State (Hamed, 2007). The new protein systems (ARC,1982) are based on microbial yield and feeds rumen degradation. Estimates of these two parameters are not available for camels in the Sudan to apply modern nutritional system in camels nutrition. Consequently, this study was conducted to determine the rumen degradation and degradation characteristics of some common feeds to improve camels nutrition and production .

Materials and Methods

Study Site

This study was conducted at the Central Veterinary Research Laboratory (CVRL), Animal Resources Research Corporation (ARRC), Ministry of Animal Resources, Fishers and Rangelands in Soba, Khartoum State, Sudan.

Experiment

Animals

Three Arabian fistulated camels , two females and one male at 5-8 years old and 291- 383kg live body weight were used in this study. They were injected with Ivomec **(**Ivermctine) against internal and external parasites.

Housing

The animals were allocated at random to three individual pens shaded with corrugated iron sheets. The pens were 3.95 x 2.95 m in dimensions and were 3m high. Each pen has feeder and water trough.

Surgical preparation

The animals were fasted of feed and water for 24 hrs before the operation. The animals were fitted with the rumen fistulae in November 2015 as described by Brown *et al* . (1968).

Anaesthesia

Xylazine (2%) at 0.25 ml/100kg body weight was injected intramuscularly to sedate the animals. The animals were then anesthetized with Lidocaine (2%) for local infiltration and paravertebral nerve block.

Journal of Camel Research and Production
Journal homepage:
http:// journals.sustech.edu

[Type text]

Fistulation technique

Cannulae

The cannulae were 10.5 cm long tubes and were 4.5 cm in diameter. They were made from Teflon. They had a flang at one end to prevent it from coming outside the rumen. The other end of the cannulae was screwed to secure a cover. Ascrewed ring was used to fix each cannulae in the animals after fistulation. In addition two hard plastic rings were used to secure the cannulae in position and one was intact with the skin.

Post operative care

To avoid the post operative infection, the animals were injected with a broad spectrum antibiotic (Penivet Forte) intramuscularly for 7 days. The wounds were cleaned daily with Potassium Permanganate and Iodine. Pencillin powder was applied on wounds. The fistulated animals healed without problems and were ready for the experiment after 4 - 6 weeks from the surgery. The cannulae were cleaned regularly with a disinfectant.

Feeding

Each animal was offered 2kg concentrate ration and *Medicago sativa* (Barseem) *ad lib.* in one meal in the morning at 8.0 am. The concentrate ration ingredients and calculated composition and energy are shown in Table1**.** In addition the animals were offered minerals and vitamins blocks. Clean water was available all the time.

Feeds for rumen degradation

Five feed samples were collected from Khartoum State in November 2015 including *Medicago sativa* (Barseem)**,** *Sorghum bicolor* (Sorghum Feterita grains), *Arachis hypogaea* **(**Groundnut cake) , *Gossypium barbadense* (Cottonseed cake) and Sorghum husks ("Seewa"). In addition the concentrate ration fed to the camels were used for rumen degradation.

Degradation procedure

Feeds degradability was conducted in the three fistulated camels using the nylon bags technique as described by Orskov *et al.* (1980) .

Bags preparation

Artificial fibre bags (18 x 14 cm) and weighing 2.5 - 3g were made from fibre filter cloth from a new military Parachute. They were manufactured according to Orskov *et al* . (1980). The empty bags were numbered, washed and oven dried at 100 ºc for 24 hrs. They were then individually weighed and their weights were recorded . Five grams of each air dried feed sample were weighed into the bag , tied with a nylon string about 50 cm long and introduced into a 6 cm plastic tube above the fistula level to ease the bags movement in the rumen. About 4 - 6 bags were incubated at a time in the rumen of the fistulated camels. The bags were soaked in tap water before incubation in the rumen.

Bags incubation

The bags were incubated for different periods including 3 , 9 , 15 , 21 , 33 , 45 , 57 , and 69 hrs . The bags were immediately removed at the end of each incubation period , washed under running tap water and dried in an oven at 100 ºc for 24 hrs. They were then removed and weighed. The residues in the bags in the

Journal of Camel Research and Production
Journal homepage:
http:// journals.sustech.edu

three animals for every incubation period for each feed were mixed and stored for laboratory analysis.

Calculations

Feeds DM losses (degradation) percentages were calculated from the following equation **:**

$$\frac{\text{Incubated sample dry weight – residue dry weight after incubation}}{\text{Incubated sample dry weight}} \times 100$$

Feeds degradation kinetics was described by curve - linear regression of DM , OM , CP and CF losses from the incubated bag with time (Orskov and McDonald, 1979).

$$P = a + b\,(1 - e^{-ct}) \ldots (i)$$

Where :

P = Potential degradability

t = Incubation time

a = Axis intercept at time zero represents the soluble and completely degradable substrate rapidly washed out of the bag .

b = The difference between the intercept (a) and the asymptote and represents the insoluble but potentially degradable substrate degraded by the microorganism according to first order kinetics .

c = Rate constant of b function

a , b , c are constants fitted by an interactive least squares procedure .

Equation (i) provides curve constants that can be used for a specified diet to estimate the effective degradability .

$$\text{Effective degradability} = a + \frac{bc}{c+k}$$

Where :

a , b and c are constants as defined in equation (i)

k = Rumen small particle outflow rate.

Then a gragh was plotted by the fitted values of dry matter disappearance (%) against time of incubation in hrs to form a curve.

Laboratory analysis

Feeds proximate analysis including dry matter (DM) , crude protein (CP) , crude fibre (CF) , ether extract (EE) and ash was determined according to the procedure described by AOAC (2000). Nitrogen free extract (NFE) was calculated by subtracting the sum of CP, CF , EE and ash from 100. The organic matter (OM) was calculated by subtracting ash from 100.

Statistical analysis:

Data were analyzed using descriptive statistics.

Table 1. The ingredients and calculated composition of the concentrate ration fed to the fistulated camels.

Ingredients	(%)
Sorghum grains (Feterita)	47
Groundnut cake	10
Wheat bran	40
Minerals / Mixed	02
Salt	01
CP	18.9
ME (MJ/Kg DM)	12.6

Results and Discussion

Table.2 shows the proximate analysis of some common feeds in the Sudan. The variations in common feeds proximate analysis are well documented in the Sudan (eg Hamed, 2007) and abroad (Feedipedia, 2016). The highest CP in Groundnut cake followed by Cottonseed cake was because they are protein

Journal of Camel Research and Production
Journal homepage:
http:// journals.sustech.edu

[Type text]

concentrates. The least CP in (”Seewa”) was because it is a cereal crop residue. The crude protein in (“Seewa”) (7.5%) is above the minimum for normal rumen microflora and fermentation (Orskov, 1982) and suggested it is a good crop residue if properly upgraded and supplemented. (”Seewa”) highest CF (23.8%) was mainly because it is a crop residue with high CF. The least CF in Groundnut cake was because it is a protein concentrate. The highest EE in Groundnut cake followed by Cottonseed cake was because they are protein concentrates. The least EE in Barseem (1.2%) was because it is a leguminous roughage. The highest ash in (“Seewa”) was mainly due to soil contamination during harvest, seeds seperation, storage and feeding**.** The least ash in Sorghum (Feterita) (2.8%) was because it is a grains . The highest OM in Sorghum Feterita was due to low ash content. The high OM in concentrate ration (97.1%) was due to low ash. The least OM in (“Seewa”)(88.6%) was due to high ash due to contamination in different production stages. The highest NFE in Sorghum Feterita (65.7%) was because it is a grains with high starch. Concentrate ration high NFE was due to Feterita level in concentrate ration. The least NFE in Groundnut cake was because it is a protein concentrate . (“Seewa”) highest CF and ash and least CP and OM was because it is a crop residue with high fibres and low CP. Crude protein , EE and ash in Sorghum Feterita in this study were close to those reported by Ibrahim *et al.*(2016). However, NFE was lower than their value. Cottonseeds cake proximate analysis in this study differed from that recorded by Ibrahim *et al.* (2016). (”Seewa”) proximate analysis was not in line with that found by Mousa (2016) and Elimam *et al.* (2017).

Degradation characteristics

Table 3. shows the degradation characteristics of some common feeds in the rumen of camels. Degradation characteristics varied among common feeds. Concentrate ration highest DM soluble fraction was associated with high CP, NFE and OM and low CF. (“Seewa”) least value was associated with high CF , moderate NFE and low CP. High CF may depressed (a) value. Sorghum Feterita grains highest DM value of (b) was associated with high NFE, moderate CP and CF. (“Seewa”) least value of (b) was associated with high CF, moderate NFE and low CP and was expected due to high CF. Groundnut cake highest DM value of (P) was associated with high CP and low CF and NFE. (“Seewa”) least value of (P) was associated with high CF, moderate NFE and low CP. High CF and low CP may reduced (P) value. (”Seewa”) highest DM value of (c) was associated with high CF, moderate NFE and low CP which was not expected due to high CF. Sorghum Feterita grains least DM value of (c) was associated with high NFE, moderate CP and CF which was not expected due to high NFE and could be due to antinutritional factors. Groundnut cake highest CP soluble fraction was associated with high CP and low CF and NFE. (“Seewa”) least CP value of (a) was associated with high CF, moderate NFE and low CP and it was due to high CF. (”Seewa”)highest CP value of (b) was associated with high CF, moderate NFE and low CP. Groundnut cake least value of (b) was associated with high CP

Journal of Camel Research and Production
Journal homepage:
http:// journals.sustech.edu

[Type text]

and low CF and NFE and it may due to antinutritional factors. Sorghum Feterita grains highest CP value of (P) was associated with high NFE, moderate CP and CF. Cottonseed cake least CP value of (P) was associated with high CP and moderate CF and NFE and was not expected due to high CP and moderate NFE. Groundnut cake highest CP value of (c) was associated with high CP and low CF and NFE. (”Seewa”) least CP value of (c) was associated with high CF , moderate NFE and low CP and was expected due to high CF. Cottonseed cake highest CF value of (a) was associated with high CP and moderate CF and NFE. (”Seewa”) least CF value of (a) associated with high CF, moderate NFE and low CP. High CF may reduced (a) value. Groundnut cake and Sorghum Feterita grains highest CF value of (b) was associated with high CP and low CF and NFE in Groundnut cake and high NFE, moderate CP and CF for Sorghum Feterita grains. Cottonseed cake least CF value of (b) was associated with high CP and moderate CF and NFE. Groundnut cake highest DM potential degradability was associated with high CP and low CF and NFE. The least value in (“Seewa”) was associated with high CF, moderate NFE and low CP. The highest degradation rate in (“Seewa”) was associated with high CF, moderate NFE and low CP. The least value in Sorghum Feterita grains was associated with high NFE, moderate CP and CF which was not expected due to high NFE and could be due to antinutritional factors . Groundnut cake and concentrate ration highest OM soluble fraction was associated with high CP and low CF and NFE in Groundnut cake and high CP, NFE and OM and low CF in concentrate ration. The least value in (“Seewa”) was associated with high CF, moderate NFE and low CP. The value of (b) was highest in Sorghum Feterita grains due to high NFE, moderate CP and CF and least in (“Seewa”) due to high CF, moderate NFE and low CP. The potential degradability in OM was highest in Sorghum Feterita grains due to high NFE, moderate CP and CF and was least in (“Seewa”) due to high CF, moderate NFE and low CP. The degradation rate in OM was highest in Groundnut cake due to high CP and low CF and least in Barseem with moderate CP and NFE and low CF. It is interesting that (“Seewa”) had the least (a), (b) and (P) and the highest degradation rate in DM.

Effective degradability

Table 4 . shows the effective degradability of the feed samples at different rates of outflow from the rumen in camels. The effective degradability varied in the feeds and decreased with increasing rates of outflow from the rumen. The decreased effective degradability with increased rates of outflow from the rumen were reported by many authors (Orskov, 1982 ; Elimam, 1983). The feed samples varied in response to rates of outflow due to genetic factors and proximate analysis and the variations in feeds ranking order at different rates of outflow from the rumen reflecting the variations in degradation characteristics.

Conclusions

It was concluded that camels generally high rumen degradation and recommended to use common feeds for grazing camels in the dry season due to high rumen degradation. Moreover, Further studies are required on camels rumen degradation to adopt modern

Journal of Camel Research and Production
Journal homepage:
http:// journals.sustech.edu

[Type text]

ruminants nutrition systems in camels nutrition for efficient feeding and production.

References

Albert, E . O . (2002). The Past, Present and Future extension on Camels Production in Kenya. Paper presented at the 8th Kenya Camels Forum, 11–15 March, 2002, Mile 46, Kajiado, Kenya.

Ali, M . A . (2003). The Performance of Desert Sheep in Kordofan, Sudan. Ph.D. Thesis. Faculty of Agricultural Sciences. University of Gezira. Wad Medani. Sudan.

AOAC , (2000) . Official Methods of Analysis , 17 th ed. A ssociation of Official Analytical Chemists , Washington , DC.

ARC , (1982). Report of the protein group of the ARC working party on the nutrient requirements of ruminant livestock .

Brown , G . F . ; Armstrong , D . G . ; Macrae , J . C . (1968) . The establishment in one operation of a cannulae into rumen and re-entrant cannulae into the duodenum and ileum of the sheep . Br . vet . J . 124 : 78 - 81 .

Elimam, M . E . (1983). Measurements of and Factors affecting the outflow of dietary proteins from the rumen of sheep and lactating dairy cows. Ph.D. Thesis. University of Aberdeen.U.K.

Elimam, M . E . ; Mohamed, A . H . ; Dafalla, B . F. M . (2013b). The nutritive value and goat preference of pasture plants in the Butana Plain, Sudan. Sudan Journal of Agricultural Research 21: 57-72.

Elimam, M . E. ; Ombabi, Y.A.; Osman, A. B. (2017). Characterization of Shami goat. Final research report. Ministry of higher education and scientific research. Khartoum. Sudan.

FAO, (2009). Quarterly Bulletin of Statistic. Food and Agriculture Organization. UN. Rome. Italy.

Farah, Z . Rellenmayer, R . ; Atkins, D. (1992). Vitamin A content of camels milk. Int. J. Vitamin Nut. Res. 62 : 30-33.

Feedipedia, (2016). Cottonseed meal / Feedipedia . http://www. Feedipedia. org/node/550[09/12/2016 14:14:08] .

Hamed, A . H . M . (2007). Upgrading and the utilization by Nubian goats of some crop residues in the Sudan. Ph.D. Thesis. Faculty of Agricultural Sciences. University of Gezira. Wad Medani. Sudan.

Ibrahim , M . O . ; Ahmed , F . A . ; Sulieman , Y . R . (2016) . The chemical composition of sudanese feedstuffs in central and Eastern sudan . Animal Resources Research Corporation (ARRC). Animal Production Research Center , Kuku . Khartoum . Sudan .

Mousa , A . S . A . (2016) . Effects of different levels of dried Sugar Beet Pulp Concentrates on performance and carcass characteristics of Nubain Goat male kids. M.Sc. Thesis . University of Gezira . Wad madani. Sudan .

Orskov , E . R . and McDonald , I . (1979) . The estimation of protein degradability in the rumen from incubation measurements weighed according to rate of passge . J . Agric . Sci . Camb 92 : 499 - 503 .

Orskov , E . R . ; Deb Howell , F . D . ; Mould , F . (1980) . The use of the nylon bag technique for the evaluation of feedstuffs . Trop . Anim . Prod . 5 : 195-213 .

Orskov, E . R . (1982). Protein nutrition in ruminants . Academic Press Inc ., London, New York .

Journal of Camel Research and Production
Journal homepage:
http:// journals.sustech.edu

[Type text]

Table 2. The proximate analysis (%DM) of some common feeds in the Sudan.

Feeds	DM	CP	CF	EE	Ash	NFE	OM
Barseem	94.0	15.3	19.7	1.2	07.5	56.3	**92.5**
Sorghum grains(Feterita)	92.0	10.3	18.4	2.8	02.8	65.7	**97.2**
Groundnut cake	96.0	40.6	08.6	7.3	06.7	36.8	**93.3**
Cottonseed cake	94.0	25.1	19.7	6.4	03.8	45.0	**96.2**
Concentrate ration	97.0	18.0	11.2	3.2	02.9	64.7	**97.1**
("Seewa")	95.0	07.5	23.8	1.9	11.4	55.4	**88.6**

Journal of Camel Research and Production
Journal homepage:
http:// journals.sustech.edu

[Type text]

Table 3 . The degradation characteristics of some common feeds in the rumen of camels.

Feeds	D M				CP				CF				OM			
	a	b	P	c	a	b	P	c	a	b	P	c	a	b	P	c
Barseem	27.0	40.0	67.0	0.0331	20	67.0	87.0	0.0344	18	58	76	0.0384	24	48.0	72.0	0.0167
Groundnut cake	25.0	64.0	89.0	0.0372	32	56.2	88.2	0.0487	30	67	97	0.0329	28	54.0	82.0	0.0453
Cottonseed cake	17.0	31.8	48.8	0.0385	20	57.5	77.5	0.0328	64	31	95	0.0434	15	31.8	46.8	0.0367
Sorghum (Feterita)	15.0	68.4	83.4	0.0324	20	74.3	94.3	0.0416	10	67	77	0.0354	14	68.9	82.9	0.0310
Concentrate ration	30.0	52.0	82.0	0.0336	32	61.8	93.8	0.0382	34	61	95	0.0400	28	53.8	81.8	0.0345
(“Seewa”)	04.5	27.2	31.7	0.0390	10	82.0	92.0	0.0307	2	55	57	0.0200	05	20.2	25.2	0.0343

a = soluble fraction (%), b = portion degraded with time (%)

p = potential degradability (%) , c = rate constant of b function.

Journal of Camel Research and Production
Journal homepage:
http:// journals.sustech.edu

[Type text]

Table 4. The effective degradability of some common feeds at different rates of out flow from the rumen in camels.

Feeds	K	DM	CP	CF	OM
Barseem	0.01	57.7	71.9	64.0	54.0
	0.04	45.1	50.9	46.4	38.1
	0.07	39.8	42.0	38.5	33.2
	0.10	36.9	37.1	34.0	30.9
Groundnut cake	0.01	75.4	78.6	81.4	72.2
	0.04	55.8	62.9	60.2	56.7
	0.07	47.2	55.0	51.4	49.2
	0.10	42.4	50.4	30.1	44.8
Cottonseed cake	0.01	42.2	64.0	89.2	39.9
	0.04	32.6	45.9	80.1	30.2
	0.07	28.3	38.3	75.9	25.9
	0.10	25.8	34.2	73.4	23.5
Sorghum (Feterita)	0.01	67.3	79.9	62.2	66.0
	0.04	45.6	57.9	41.5	44.0
	0.07	36.6	47.7	32.5	35.1
	0.10	31.7	41.8	27.5	30.3
Concentrate ration	0.01	70.0	80.9	82.8	69.7
	0.04	53.7	62.2	64.5	52.9
	0.07	46.9	53.8	56.2	45.8
	0.10	43.0	49.0	51.4	41.8
("Seewa")	0.01	26.1	71.8	38.7	20.6
	0.04	17.9	45.6	20.3	14.3
	0.07	14.2	34.9	14.2	11.6
	0.10	12.1	29.3	11.2	10.2

K = Rumen outflow rate/hr.

Effective degradability = $a + \frac{bc}{c+k}$