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CHEMICAL COMPOSITION AND GAS PRODUCTION CHARACTERISTICS OF SOME CAMEL FEEDS IN BUTANA AREA OF SUDAN

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ABSTRACT

Thirty- six samples of 12 feed stuffs were evaluated for nutritive value by *in vitro* gas production technique using rumen fluid collected from camel and cattle. The results found indicated that the highest rate of gas production during 3 – 96h readings was significantly (p<0.05) recorded with feed stuffs that incubated with buffered rumen fluid from camels. In the soluble fractions (a-values) of *Ipomoea cordofana, Sonchus oleraceus*, *Clitoria ternata* and *Plepharis edulis* had significantly (p<0.05) more a-values when incubated with buffered rumen fluid from camel compared to that of cattle, while there was no significant differences among the rest plant species. Six out of 12 studied plants, *Convolulus fatmensis*, *Plepharis edulis*, *Leucaena glauca*, peanut cake, sesame cake and baggasse reached significantly (p<0.05) high (b-values) when incubated with buffered rumen fluid from camel compared to that of cattle, whereas there was no significant variation among the rest plant species except *Acacia seyal* which had significantly (p<0.05) higher values (a and a+b) when incubated with buffered rumen fluid from cattle. The (a+b) values of *Convolulus fatmensis*, *Sonchus oleraceus*, *Clitoria ternata*, *Plepharis edulis*, groundnut cake and baggasse were found significantly (p<0.05) higher when incubated with buffered rumen fluid from camel compared to that of cattle. The c-values were only found higher (p<0.05) in *Clitoria ternata* and *Plepharis edulis* when incubated with buffered rumen fluid from cattle while, *Convolulus fatmensis*, *Ipomoea cordofana*, *Sonchus oleraceus*, *Acacia seyal,* sorghum grain and sesame cake recorded highest C-values (p<0.05) on camel fluid. No significant variation between the other plant species was detected. It was observed that there are considerable differences between cattle and camel in terms of a, b, a+b, and c values. The predicted metabolisable energy (ME) profile of camel are varied widely (4.12 – 9.59 MJ/KG DM) when compared to that of cattle, which ranged between (3 – 7.29 MJ/KG DM). The organic matter digestibility (OMD %) of studied individual feed stuffs, which incubated with buffered rumen fluid from cattle ranged between (24.07 – 63.54%) and that from camel ranged between (31.33 – 71.07%). OMD% of camel was significantly (p<0.05) higher in sesame cake, while, there are no significant differences between the rest studied plant species except in both *Acacia seyal* and baggasse which significantly (p<0.05) had lower values of OMD% in both cattle and camel trials. It is noticeable that, there are considerable variations in metabolisable energy contents and organic matter digestibilities values of camel compared to that of cattle.

Key words: Camelids, *chorioptes,* mange, parasitic disease, s*arcoptes*

Camel of Sudan are distinguishably raised and produced majorly adopting of natural grazing and husbandry by the nomads in an almost full pastoral live observed distinctly throughout the Sudanese camel inhabitant belt a Western, Central (Butana area) and Eastern regions. The communities are totally dependent on this precious beast which represent the base of their difficult and harsh live in terms of food, socio-economics and many other essential and important miscellaneous benefits.

The nutritive value of ruminant feeds is determined by the concentration of its chemical, composition, as well as rate and extent of digestion in the rumen.

In vitro gas production is an alterative technique used to determine the nutritive value of feed stuffs, since rate and extent of degradation and rumen fermentation can be easily determined by measurement of cumulative gas production (Khazaal *et al*, 1995; Dhanoa *et al*, 2000; Sommant *et al*, 2000). The gas production technique therefore should be considered for use in nutritive evaluation in developing countries.

The objective of this study is to evaluate the nutritive value of some pasture grasses, forbs, trees, concentrates and agricultural by-products from Butana area and to compare between camels and cattles in terms of their digestibilities obtained from *in vitro* gas production using rumen fluids.

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Materials and Methods

Feed stuffs

Convolulus-fatmensis, Ipomoea-cordofana, Sonchus-olraceus, Clitoria-ternata, Plepharis – edulis, Sesbania – sesaban, Leucaena – glauca, Acacia seyal, Ziziphus spin-christi, sorghum grain, sesame cake, groundnut cake and baggasse were collected at the end of the rainy season (October – November, 2007).

The samples were ground in mills to pass 1 mm sieve prior to chemical analysis and *in vitro* gas production measurements.

Chemical analysis

Approximate composition of the feedstuff samples were analysed according to the AOAC (1984), for crude protein (CP), crude fat (CF), ash, nitrogen free extract (NFE), organic matter (OM), crude fibre. Neutral detergent fibre (NDF), acid detergent fibre (ADF), and acid detergent lignin (ADL) were determined according to Van Soest *et al* (1991).

In vitro gas production

In vitro gas production was undertaken according to the procedure described by Menke and Steingass (1988). Buffer and mineral solution were prepared and placed in a water bath at 39°C under continuous flushing with CO_2. Rumen fluid was collected by a manually operated vacuum pump from 2 slaughtered she camels at Wadelbashir Slaughter House (Western Khartoum State) and also from one fistulated calf fed berseem and sorghum hay into a pre-wormed thermos flask and immediately transferred to the laboratory. The rumen fluid was filtered and flushed with CO_2 and the mixed and CO_2 flushed rumen fluid is added to the buffered mineral solution (1:2 v/v), which was maintained in a water bath at 39°C and combined.

Samples (200 mg) of the air-dry feed stuffs were accurately weighed into syringe fitted with plungers. Buffered rumen fluid (30 ml) was pipetted into each syringe, containing the feed samples, and the syringes were immediately placed into the water bath at 39°C. Pistons were lubricated with Vaseline and inserted into the syringes. Two syringes with only buffered rumen fluid are incubated and considered as the blank. Each incubation was completed using 12 individual feed stuffs for camel, cattles, and each run were repeated. The syringes were gently shaken every 2 – 4 h. The incubation terminated after recording the 96 h gas volume. The gas production was recorded after 3, 6, 12, 24, 48, 72 and 96 h of incubation. Total gas values are corrected for the blank incubation and reported gas values are expressed per 200 mg DM.

The metabolisable energy (MJ/kg DM) content of feeds was calculated using equations of (Menke and Steingass, 1988) as:

$$ME\ (MJ/kg\ DM) = 2.20 + 0.136\ GP + 0.057\ CP + 0.0029\ CF^2$$

The organic matter digestibility per cent (OMD) of feeds was calculated using equations of (Menke and Steingsss, 1988) as:

$$OMD\% = 14.88 + 0.889GP + 0.45CP + \text{Ash content}$$

Where GP is 24 net gas production (ml/20 mg DM); CP, CF and CA are crude protein, crude fat, and crude ash (% DM), respectively.

Statistical analysis

Data were subjected to analysis of variance following the completely randomised design.

Results and Discussion

Chemical Composition

The chemical compositions of the investigated feed stuffs were presented in table 1. The crude protein (CP) content of the studied plant species ranged from 2.44 to 43.96%. The content of CP in both peanut cake and sesame cake showed significantly ($p<0.05$) higher values among the other individual feed stuffs, while there was no significant differences between, *Convolulus fatmensis, Ipomoea cordofana, Sonchus oleraceus and Clitoria ternate.*

Sesbania sesaban, sorghum grain and baggasse contained the lowest level of CP, whereas *Leucaena glauca* contained a moderate level of CP when compared with the different feed stuffs. This result was in agreement with Wardeh *et al* (1991), who stated that the protein content of the plant species consumed by camels ranged from 8.54 to 14.89%. Such a relatively high proteins content would satisfy most of the protein requirements of camels to perform their various physiological functions (Wardeh and Farid, 1990).

The ether extract (EE) content of the 2 varieties of cakes (peanut and sesame) with *Leucaena glauca* was significantly ($p<0.05$) high among the other individual feed stuffs, while there were no significant differences between the rest feed stuffs except baggasse which contained the lowest content of EE.

The fibre fractions NDF, ADF and Lignin differed significantly ($p<0.05$) among the feed stuffs, while the results of fibre fractions of cellulose and hemi cellulose showed no significant differences mentioned. Baggasse had a significantly higher fibre fractions content compared with the all investigated feed stuffs.

The ash content of *Convolulus fatmensis, Leucaena glauca and Sesbania sesaban* was significantly ($p<0.05$) high among the other plant species, while sorghum bicolor, sesame cake and baggasse showed the lowest level of ash content.

There are many factors affecting chemical composition of the feed stuffs such as stage of growth maturity, species or variety (Vonkeyserlingk *et al,* 1990; Agbagla-Dohnani *et al,* 2001; Promkot and Wanapat 2004), dry method, growth environment (Mupangwa *et al,* 1997) and soil types (Thu and Preston, 1999). Those factors may partially explain differences in chemical composition between this study and other.

Gas production

Table 2 and 3 showed the cumulative gas production profiles, corrected for blank fermentation of 12 individual feed stuffs samples that were incubated in buffered rumen fluid from both cattle and camel.

The samples which incubated in buffered rumen fluid from camel showed a fast initial gas production without lag time in all investigated feed stuffs, while that incubated in buffered rumen fluid from cattle showed only lag time in *Convolulus fatmensis*

Table 1. Chemical composition of the various species of feed stuffs.

Species	CP	EE	NDF	ADF	Cellulose	Hemi-cellulose	Lignin	Ash
Convolulus fatmensis	18.38^{c}	2.77^{cdef}	50.24^{c}	24.43^{de}	11.73^{d}	25.81^{a}	12.70^{bc}	19.13^{a}
Ipomoea cordofana	17.75^{c}	1.79^{def}	58.34^{b}	41.51^{b}	32.58^{ab}	16.83^{bc}	8.93^{de}	10.61^{cd}
Sondus deraceus	16.94^{c}	2.13^{def}	45.07^{cd}	29.64^{cd}	22.53^{c}	15.43^{bc}	7.11^{ef}	14.96^{b}
Sesbania sesabon	13.07^{de}	3.80^{c}	25.89^{f}	20.13^{e}	8.88^{d}	5.76^{d}	11.25^{cd}	16.23^{ab}
Clitoria ternate	19.24^{c}	2.96^{cde}	49.09^{c}	34.69^{bc}	26.71^{bc}	14.40^{bc}	7.97^{de}	7.24^{de}
Plepharis edulis	8.67^{f}	1.61^{ef}	43.01^{d}	28.71^{cd}	12.99^{d}	14.30^{bcd}	15.71^{b}	12.95^{bc}
Leucaena glauca	25.300^{b}	6.005^{b}	28.765^{f}	17.985^{ef}	7.075^{d}	10.780^{cd}	10.910^{cd}	15.490^{ab}
Acacia seyal	16.16^{cd}	3.22^{cd}	36.91^{e}	20.43^{e}	7.34^{d}	16.48^{bc}	13.09^{bc}	7.85^{de}
Sorghum grain	12.27^{e}	2.69^{cdef}	26.04^{f}	9.85^{g}	6.30^{d}	16.19^{bc}	3.55^{f}	2.96^{f}
Groundnut cake	43.96^{a}	7.87^{a}	23.31^{f}	12.77^{fg}	71.12^{d}	10.54^{cd}	5.64^{ef}	10.14^{cd}
Sesame cake	43.72^{a}	6.51^{ab}	39.98^{de}	28.87^{cd}	24.77^{c}	11.11^{cd}	4.10^{f}	5.26^{ef}
Baggase	2.44^{g}	1.42^{f}	85.21^{a}	63.88^{a}	36.12^{a}	21.32^{ab}	27.76^{a}	3.80^{ef}

^{abc} Mean on the same column with different superscripts differ significantly at $p<0.05$.
SE: Standard Error.

Table 2. Camel/gas production volumes (3 – 96 h).

Species	3	6	12	24	48	72	96
Convolulus fatmensis	1.00^{ghi}	4.50^{hijk}	13.66^{fghi}	24.33^{efgh}	30.66^{efg}	42.66^{c}	43.66^{ef}
Ipomoea cordofana	2.33^{ghi}	8.50^{defgh}	17.66^{cdefg}	24.16^{efgh}	31.50^{ef}	36.16^{de}	37.16^{gh}
Sondus deraceus	7.66^{bcd}	16.00^{b}	26.00^{ab}	33.33^{abcd}	37.83^{cd}	43.83^{c}	44.83^{de}
Sesbania sesabon	7.00^{bcd}	11.83^{bcd}	16.16^{defgh}	27.16^{defgh}	33.83^{de}	35.50^{def}	37.50^{fgh}
Clitoria ternate	14.33^{a}	22.83^{a}	30.33^{a}	39.16^{a}	44.16^{b}	51.83^{ab}	52.83^{bc}
Plepharis edulis	3.8^{efg}	9.83^{def}	22.33^{bc}	35.83^{ab}	42.16^{bc}	57.50^{a}	58.16^{ab}
Leucaena glauca	5.5^{def}	10^{cdef}	15.50^{efghi}	21.16^{hij}	26^{fgh}	28.16^{ghi}	30.66^{ijk}
Acacia seyal	3.83^{efg}	5.83^{fghij}	10.33^{ij}	17.83^{ijk}	30.33^{efg}	32.83^{efgh}	35.50^{hij}
Sorghum grain	3.83^{efg}	7.50^{defgh}	18.50^{cdef}	39.16^{a}	53.66^{a}	57.66^{a}	60.66^{a}
Groundnut cake	9.00^{b}	14.33^{bc}	21.00^{bcd}	28.00^{defg}	30.00^{efg}	31.00^{efghi}	32.00^{hijk}
Sesame cake	8.66^{bc}	15.00^{b}	25.33^{ab}	35.16^{abc}	39.66^{bcd}	40.66^{cd}	42.16^{efg}
Baggase	1.66^{ghi}	2.83^{ijk}	4.66^{k}	14.00^{k}	25.50^{fghi}	31.16^{efghi}	32.50^{hijk}

^{abc} Mean on the same column with different superscripts differ significantly at $p<0.05$.
SE: Standard Error.

and baggasse species. This likely due to the micro-organism which it takes a longer period of time to being growing and dividing.

The highest rate of gas production was significantly ($p<0.05$) recorded with feed stuffs that incubated with buffered rumen fluid from camel. Sorgum grain and *Clitoria ternata* showed highly significant differences values of gas production when incubated with buffered rumen fluid of camel to that of cattle during (3 - 96 h). Seven out of the studied plant species (*Convolulus fatmensis*, *Clitoria ternate, Leucaena glauca*, sorghum grain, peanut cake, sesame cake and baggasse) produced significantly ($p<0.05$) more gas production at (24 – 96 h) when incubated with buffered rumen fluid from camel in comparison with that from cattle. A study by (Cone *et al,* 1997), showed that gas production could be divided into 3 phases, representing gas production caused by fermentation of the water-soluble fraction, the non-soluble fraction and microbial turnover. Generally, there are considerable differences in cumulative gas production profiles between different individual feed stuffs incubated with buffered rumen fluid of camel to that of cattle.

Rate of gas production is association with the rapid growth phase of micro-organism and in a mixed culture system rate of fermentation will be a result of the interactions between the micro-organism present and the manner in which they digest the particular feed within the system.

In vitro gas production parameters on plant species

The parameters of gas production are presented in table 4. The soluble fractions (a-values) of *Acacia-seyal* and sesame cake recorded significantly ($p<0.05$) more rapid degraded values when incubated with incubated with buffered rumen fluid from cattle compared to that of camel. In contrast, *Ipomoea cordofana, Sonchus oleraceus, Clitoria ternata and Plepharis edulis* had significantly ($p<0.05$) more a-values when incubated with buffered rumen fluid from camel compared to that of cattle, while there was no significant differences among the rest plant species. This showed that the soluble fraction in these plant species was degraded or released faster than the others. (Stefanon *et al,* 1996) found differences between forages, alfalfa and brome hay, in the gas production contribution from the soluble fractions and the rate of digestion of this fraction. Also (Schofield and Pell, 1995) studying the degradation of the neutral detergent soluble fraction in grasses and legumes found the presence of faster digestion material in legumes. The presence of soluble but not digestible materials may be a factor which can contribute to low gas production.

Six out of 12 studied plants, *Convolulus-fatmensis, Plepharis- edulis, Leucaena glauca*, peanut cake, sesame cake and baggasse reach significantly ($p<0.05$) high (b-values) when incubated with buffered rumen fluid from camel compared to that of cattle, whereas there was no significant variation among the rest plant species except *Acacia- seyal* which had significantly ($p<0.05$) higher (a) and (a+b) values when incubated with buffered rumen fluid from cattle. It appeared that the insoluble material of *Acacia seyal* was less fermentable when incubated with buffered rumen fluid from camel, while it was more fermentable when incubated with buffered rumen

Table 3. Cattle/gas production volumes (3 – 96 h).

Species	3	6	12	24	48	72	96
Convolulus fatmensis	0.00^{i}	1.50^{jk}	4.33^{k}	13.33^{k}	15.33^{k}	17.16^{k}	18.50^{l}
Ipomoea cordofana	3.33^{hi}	4.66^{ghijk}	11.66^{hi}	24.00^{fghi}	25.00^{ghi}	27.83^{ghi}	29.00^{k}
Sondus deraceus	3.16^{efgh}	10.33^{cde}	29.00^{a}	29.33^{cdef}	31.16^{efg}	33.66^{efg}	34.33^{hijk}
Sesbania sesabon	5.50^{def}	8.00^{defgh}	13.00^{ghi}	21.50^{hij}	27.50^{fgh}	29.16^{fghi}	29.50^{jk}
Clitoria ternate	3.83^{efg}	10.16^{cdef}	20.00^{cdf}	29.33^{cdef}	30.00^{efg}	32.16^{efgh}	34.50^{hijk}
Plepharis edulis	2.66^{fghi}	6.00^{efghi}	14.33^{fghi}	30.33^{bcde}	34.83^{de}	35.66^{de}	36.33^{ghi}
Leucaena glauca	5.66^{cdef}	9.00^{defg}	11.83^{hi}	14.00^{k}	19.50^{ijk}	20.16^{jk}	20.50^{l}
Acacia seyal	6.00^{bcde}	8.66^{defgh}	11.16^{ghi}	16.33^{jk}	19.66^{ijk}	25.66^{ij}	32.33^{hijk}
Sorghum grain	0.66^{hi}	1.16^{k}	5.16^{jk}	23.00^{ghi}	39.33^{bcd}	46.66^{bc}	50.33^{cd}
Groundnut cake	7.33^{bcd}	9.33^{def}	11.16^{hi}	14.16^{k}	18.16^{jk}	18.66^{K}	19.16^{l}
Sesame cake	7.00^{bcd}	10.00^{cdef}	12.50^{ghi}	16.66^{jk}	23.66^{hij}	26.66^{hij}	28.83^{k}
Baggase	0.00^{i}	0.50^{k}	1.00^{k}	4.83^{l}	6.66^{l}	9.00^{l}	11.33^{m}

[abc] Mean on the same column with different superscripts differ significantly at $p<0.05$.
SE: Standard Error.

fluid from cattle. This is attributed to the fact that the greatest concentration of antinutritional factor exist in *Acacia seyal*.

The (a+b) values of *Convolulus fatmensis, Sonchus oleraceus, Clitoria ternata, Plepharis edulis,* peanut cake and baggasse were significantly ($p<0.05$) more when incubated with buffered rumen fluid from camel compared to that of cattle, but there was no significant differences among the other individual feed stuffs.

The c-values were significantly ($p<0.05$) greatest only in *Clitoria ternata* and *Plepharis edulis* when incubated with buffered rumen fluid from cattle compared to that of camel, while, from camel, there are 7 plant species, *Convolulus fatmensis*, *Ipomoea cordofana*, *Sonchus oleraceus*, *Acacia seyal*, sorghum bicolor and sesame cake had significantly ($p<0.05$) highest c-values, while there was no significant variations between the other species. It indicated considerable differences between cattle and camel in terms of a, b, a+b, and c values.

Energy contents and organic dry matter digestibility

The predicted metabolisable energy (ME, MJ/KG DM) and organic dry matter digestibility (OMD) per cent from gas production of the studied feed stuffs incubated in rumen fluid from both cattle and camel are presented in table 5.

The predicted metabolisable energy (ME) profile of cattle did not vary widely being particularly high in *Clitoria ternata, Sonchus oleraceus* and sesame cake, followed by *Plepharis edulis*, peanut cake and *Ipomoea cordofana*, while the other 6 plant species had significantly ($p<0.05$) lower values of ME.

The predicted metabolisable energy (ME) profile of camel varied widely (4.12 – 9.59 MJ/KG DM) when compared to that of cattle, which ranged between (3 – 7.29 MJ/KG DM). As ME profile of cattle, sesame cake and *Clitoria ternata* with peanut cake had significantly ($p<0.05$) high values of ME among the studied plant species. Baggasse and *Acacia seyal* together had significantly ($p<0.05$) lower values of ME in both cattle and camel. Research under taken by Guerouali and Zine Filali (1992) opined that camels require less comparative energy for maintenance than sheep or cattle whilst Gihad *et al* (1992) found that camel protein requirements are at least 30% less than that dairy cattle, sheep or goats. Wardeh (1990) reported that the contents of energy releasing entities (crude fibre, nitrogen free extracts and ether extracts) of such plants were high enough to insure the maintenance and certain production requirements, if camel can ingest enough dry matter from the small amounts of feed available in the area.

Table 4. *In vitro* gas production parameters on species (ml/200 ml/kg).

Species	Camel				Cattle			
	A	B	a+b	C	a	B	a+b	c
Convolulus fatmensis	-2.65^{fgh}	49.04^{cde}	46.39^{cd}	0.030^{hij}	-3.75^{ghij}	22.09^{jkl}	18.35^{j}	0.048^{fg}
Ipomoea cordofana	-3.01^{ghi}	39.88^{ef}	36.87^{defgh}	0.056^{ef}	-7.36^{j}	35.34^{fgh}	28.18^{hij}	0.073^{cd}
Sondus deraceus	1.093^{de}	41.25^{def}	43.18^{cd}	0.065^{de}	-16.79^{k}	49.61^{cd}	32.82^{efgh}	0.157^{a}
Sesbania sesabon	2.44^{cde}	34.97^{fghi}	37.40^{defgh}	0.047^{fg}	1.02^{def}	29.06^{ghij}	30.08^{ghi}	0.048^{fg}
Clitoria ternate	10.95^{a}	41.14^{def}	52.10^{bc}	0.048^{fg}	-5.85^{hij}	38.54^{fg}	32.69^{efgh}	0.093^{b}
Plepharis edulis	-0.87^{efg}	60.63^{ab}	59.77^{ab}	0.035^{ghij}	-6.64^{ij}	43.39^{def}	36.75^{defgh}	0.064^{de}
Leucaena glauca	2.61^{cde}	27.02^{hij}	29.63^{ghi}	0.050^{fg}	4.37^{bc}	16.64^{kl}	21.01^{ij}	0.044^{fgh}
Acacia seyal	-0.05^{efg}	38.59^{fg}	38.54^{defg}	0.028^{ijk}	6.95^{bcd}	55.79^{bc}	62.74^{a}	0.007^{l}
Sorghum grain	-6.64^{ij}	68.90^{a}	62.20^{a}	0.042^{fghi}	-6.97^{j}	65.27^{ab}	58.30^{ab}	0.025^{jk}
Groundnut cake	2.43^{cde}	28.81^{hij}	31.24^{gh}	0.088^{bc}	5.93^{bc}	13.57^{l}	19.50^{j}	0.042^{fghi}
Sesame cake	-0.22	41.53^{def}	41.31^{def}	0.078^{bc}	5.67^{bc}	25.75^{ijk}	31.42^{fgh}	0.025^{fgk}
Baggase	-2.44^{fgh}	49.38^{def}	41.31^{def}	0.021^{jkl}	-0.85^{efg}	21.52^{jkl}	20.68^{ij}	0.014^{kl}

Animal	A	b	a + b	C
Camel	0.369^{A}	43.011^{A}	43.380^{A}	0.0535^{A}
Cattle	-2.023^{B}	34.733^{B}	32.710^{B}	0.0488^{B}

^{abc} Mean on the same column with different superscripts differ significantly at $p<0.05$.

SE: Standard Error

Animal effect ^{AB} mean on the same column with different superscripts differ significantly $p<0.05$.

Table 5. Metabolisable energy and organic matter digestibility from gas production.

Species	ME / Cattle	ME / Camel	OMD% Cattle	OMD% Camel
Convolulus fat mensis	5.08[ef]	6.58[fg]	48.13[cd]	63.91[abcde]
Ipomoea cordofana	6.48[bc]	7.10[def]	54.82[b]	58.81[def]
Sondus deraceus	7.15[a]	7.70[bcde]	63.54[a]	67.09[abc]
Sesbania sesabon	5.90[cd]	6.68[efg]	56.10[b]	61.21[cde]
Clitoria ternate	7.29[a]	8.64[bac]	56.85[b]	65.59[abcd]
Plepharis edulis	6.82[ab]	7.57[dcef]	58.69[ab]	63.58[bcde]
Leucaena glauca	5.62[de]	6.63[efg]	54.64[bc]	60.64[cde]
Acacia seyal	4.87[f]	5.57[g]	46.50[d]	51.09[f]
Sorghum grain	6.05[cd]	8.25[bcd]	43.80[d]	58.18[ef]
Groundnut cake	6.80[ab]	8.69[ab]	57.39[ab]	69.69[ab]
Sesame cake	7.07[a]	9.59[a]	54.62[bc]	71.07[a]
Baggase	3.00[g]	4.12[h]	24.07[e]	31.33[g]

[abc] Mean on the same column with different superscripts differ significantly at $p<0.05$.
SE: Standard Error

The organic matter digestibility (OMD) per cent of studied individual feed stuffs, which incubated with buffered rumen fluid from cattle ranged between 24.07 – 63.54% and that from camel ranged between 31.33 – 71.07%.

The OMD per cent of the studied individual feed stuffs which incubated with buffered rumen fluid from cattle, was significantly ($p<0.05$) higher in *Sonchus oleraceus*, while, there are no significant variations between *Plepharis edulis*, peanut cake, *Clitoria ternata, Sesbania sesaban, Ipomoea cordofana, Leucaena glauca* and sesame cake.

The OMD per cent of camel was significantly ($p<0.05$) higher in sesame cake, while, there were no significant differences between the rest studied plant species except in both *Acacia seyal* and baggasse which significantly ($p<0.05$) had lower values of OMD per cent in both cattle and camel trials.

There were considerable variations in metabolisable energy contents and organic matter digestibilities values of camel compared to that of cattle. These results were in consonance to the findings of El-Shami (1985), Bhattacharya *et al* (1985) and Gihad *et al* (1988) who stated that camels can digest dry matter and crude fibre of range plants, alfalfa, straw and trifolium better than ruminants. This high dry matter and crude fibre digestibility was attributed to the unique movement of the forestomach and the longer retention time of the large feed particles in the forestomach of the camel (Engelhardt *et al*, 1988).

Digestibility of proteins of feed stuffs was found lower in camel than in sheep. However, camels utilise proteins better than sheep or goats in case of poor feeds such as straw, mainly due to urea recycling. Camels retain higher amounts of nitrogen (19.87%) than sheep (15.14%) and goats (12.68%) from the same diet. The proportions of retained nitrogen to digestible protein were 42.17% in camels, 32.63% in sheep and 27.98% in goats (Gihad *et al,* 1988). In addition, the microbial composition within the forestomach of camels is thought to aid in the more efficient digestion a poor quality forages and of high tannin feeds.

References

Agbagla-Dohnani, Noziere P, Clement G and Dotreau M (2001). *In sacco* degradability chemical and morphological composition of 15 varieties of European rice straw. Animal Feed Science and Technology 94:15-27.

Bhattacharya AN, Al-Motairy S, Hashimi A and Economides S (1985). Studies on energy and protein utilization of alfalfa hay and barley grain by yearling camel calves. The British Society for Animal Production 74:481-485.

Cone JW, VanGelder AH, Driehuis F (1997). Description of gas production profiles with a three – phasic model. Animal Feed Science and Technology 66:31-45.

Dhanoa MS, Lopez S and Dijkstra J (2000). Estimating the extent of degradation of ruminant feeds from adescreption of their gas production profiles observed invitro : comparision of models. British Journal of Nutrition 83:131-142.

El-Shami EM (1985). Comparative study of utilization of browse plants by camels and goats. in: Annual Report. Camel Research Unit, Faculty of Vet. Sci, University of Khartoum. pp 173-182.

Engelhardt WV, Lechner-Doll M, Heller R, Schwartz HJ, Rutagwenda T and Schultka W (1988). Physiology of the forestomach in camelides with particular reference to adaptation to extreme conditions. A comparative approach. Seminaire sur la Digestion la Nutrition et l'Alimentation du Dromadaire. Feb. 8-29. 1988. Ouargla, Algerie.

Gihad EA and El-Bovevy TM (1992) 'Protein requirements for maintenance by camels.' Proceedings of the First International Camels Conference. pp 412. R&W Pub., Newmarket.

Gihad EA, El-Gallad TT, Sooud AE, Abou El-Nasr HM and Farid M (1988). Feed and water intake, digestibility and nitrogen utilization by camels compared to sheep and goats fed low protein desert by products. Seminaire sur la Digestion, la Nutrition et l'Alimentation du Dromadaire. Feb. 8-29, Ouargla, Algerie.

Guerouali A and Zine Filali R (1992). 'Maintenance energy requirements of the dromedary camel.'Proceedings of the First International Camel Conference. R&W Pub., Newmarket. pp 251-354.

Khazaal K, Dentinho MT, Ribeiro JM and Ørskov ER (1995). Prediction of apparent digestibility and voluntary feed intake of hays fed to sheep: comparison between using fibre component, in vitro digestibility or characteristic of gas production or nylon bag degradation. Animal Science 61:521-538.

Menke KH and Steingass H (1988). Estimation of the energetic feed

Mupangwa JF, Ngongoni NT, Topps JH and Ndlovu P (1997). Chemical composition and dry matter of forage legumes cassia rotundiforlia cv.Wynn, lablab purpureus cv. Highworth and Macroptilium atropurpureum cv. Siratro at 8 weeks of growth (pre-anthesis). Animal Feed Science and Technology 69:167-178.

Promkot C and Wanapat M (2004). Ruminal degradation and intestinal digestiol of crude protein of tropical resources using nylon bag and three-steps in vitro procedure in dairy cattle. In: proceedings of the Agricultural seminar, Animal Science/Animal Husbandry. Held at Sofitel Raja Orchid Hotel 27-28 January 2004.

Schofield P and Pell AN (1995). Measurement and kinetic-analysis of the neutral detergent-soluble carbohydrate fraction of legumes and grasses.Journal of Animal Science 73(11):3455-3463.

Sommart K, Parker DS, Rowlinson P and Wanapat M (2000). Fermentation characteristics and microbial protein synthesis in an *in vitro* system using cassava, rice straw and dried ruzi grass as substrates. Asian-Australasian Journal of Animal Science 13:1084-1093.

Stefanon B, Pell AN and Schofield P (1996). Effect of maturity on digestion kinetics of water-soluble and water-insoluble fractions of alfalfa and brome hay. Journal of Animal Science 74(5):1104-1115.

Thu NV and Preston TR (1999). Rumen environment and feed degradability in swamp buffaloes fed different supplements. Livestock Research for Rural Development 11:1-7.

Value obtained from chemical analysis and *in vitro* gas production using rumen fluid. Animal Research and Development 28:7-55.

Van Soest PJ, Robertson JB and Lewis BA (1991). Methods for dietary fibre, neutral detergent fibre, and nonstarch polysaccharides in relation to animal nutrition. Journal of Dairy Science 74:3583

Von Keyserlingk MAG, Swift ML, Puchala R and Shelford V (1990). Degradability characteristics of dry matter and crude protein of forages in ruminants. Animal Feed Science and Technology 57:291-311.

Wardeh MF (1990). The nutrient requirements of the dromedary camels. Third International Symposium: Relationship of Feed Composi-tion to Animal Production. The International Network of Feed Information Centres (lNFlC). June 25-29, 1990. University of Saskatchewan. Saskatoon, Canada. ACSAD /ADS/P 110/1990.

Wardeh MF and Farid MF (1990). The energy and protein requirements of the camel (*Camelus dromedarius*). Symposium on Animal Science Division in the Arab Universities. and Workshop on Development of Camel Production. March 4-7,1990. The University of the United Arab Emirates. CSAD/ AS/ P103/1990.

Wardeh MF Dawa M and Ould Al-Mostafa MM (1991). The nutritive value of plant species eaten by camels (Camelus dromedarius). In: Wardeh, M.F., R.T. Wilson and A.A. Zaied (eds.). Proceeding of International Conference Camel Production and Improvement. Dec. 10-13, 1990. Tobruk, Libya. ACSAD/Camel1/P1 /1991. Damascus. pp 126-145.