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Determination of nutritive value of six species of halophyte plants used by camel in East South Iran

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ABSTRACT: This study carried out to determine chemical composition and nutritive value of five species of range plants in Konarak including *Panicum turgidum, Penniserum oriental, Cappari decidues, Tavernicria glabr, Suaeda nudiflora* and *Indigofera interical* by *in vitro* gas production technique. Samples were collected by systematic and random sampling procedure in autumn according to standard methods. Chemical composition, cumulative gas production at 2, 4, 6, 12, 24, 48, 72 and 96 h were determined. The results of this experiment showed that, there are significant difference in terms of chemical compositions of these samples (P<0.05). The crude protein, ADF and NDF contents were between 5.67 and 9.92, 41.95 and 49.45% and 46.60 and 69.00% respectively. There was significant difference (P<0.05) between these species in different incubation times. The maximum cumulative gas volume at 96 hours and b fraction ware related to *Cappari decidues*. Also, organic matter digestibility and metabolisable energy in *Cappari decidues* species were higher than other species. The results of chemical composition and gas production showed that in these plants, *Cappari decidues* species has the highest nutritive value and also, these species can use as feed for camel.

***Keywords*:** Nutritive value, Digestibility, Sistan and Balochestan, Camel

INTRODUCTION

The first step for determining the nutritive value of feedstuff for camels is to analyze the chemical composition of different species of plants preferred by camels, and then to measure their digestibility and palatability. The chemical composition of many foods has been measured from different ecosystems in the Arab region of Asia and Africa (Wardeh, 1990). In Iran, Javan (2001) reported the digestibility of some arid-rangeland plants using bovine rumen liqure. Towhidi (2007) reported the nutritive value of 11 plant species from the province of Yazd and also, Yousef Elahi, (2012a, b) reported nutritional quality of some halophytes species from Sistan area, Iran, but in general little information is known about the nutritive value of range herbage consumed by camels in the arid and semi-arid zones of Iran.

The nutrient value of range forage is dependent on botanical composition. Botanical and chemical composition and season of growth affect the digestibility of pasture, and the nature and quantities of the products of digestion. Generally, legumes have higher protein content than grasses and this declines only slowly with maturity (Norton, 1982). Corbett (1987) believed that desirable forage is green, leafy, and leguminous. These are the components of pasture preferred by animals.

Halophytes represent a major part of the natural ranged and particularly the perennials and shrubby ones. These plants can grown in saline to extremely saline habitats and have particular characteristics which enable them to evade and/or tolerate salinity by various eco-physiological mechanisms. The fodder quality of these plants depends on a combination of climatic, soil, and plant factors (El Shaer, 2010). It is worthy to note that halophytes and other salt-tolerant plants can constitute a major part of the feeding program of sheep, goats, and camels in the arid and

semi arid regions (Squires and Ayoub, 1994; El Shaer, 1997). So, the objective of this study was to determine the chemical composition and nutritive value of *Panicum turgidum, Penniserum oriental, Cappari decidues, Tavernicria glabr, Suaeda nudiflora* and *Indigofera interical* by using *in vitro* gas production technique.

MATERIALS AND METHODS

Sampling zone and collection

This experiment was conducted using halophyte plants from the south-eastern part of Iran. Plant samples were collected in autumn 2012 using stratified random sampling from the rangelands of Sistan region in Iran. Studied species were *Panicum turgidum, Penniserum oriental, Cappari decidues, Tavernicria glabr, Suaeda nudiflora* and *Indigofera interical*.

Samples were with 5 replicates. For each replicate 5 individual plants of each species were cut and mixed (25 individual plants for each species). Considering homogeneity samples of each species were collected in the vegetation community that species was dominant. Samples were dried in room temperature in laboratory and were ground to pass through 1.0 mm sieve for subsequent analyses.

Chemical composition

Dry matter was determined by drying the samples at 105^{oC} overnight and ash by igniting the samples in a muffle furnace at 550^{oC} for 8 h. Nitrogen content was measured by the Kjeldahl method (AOAC, 1990). Crude protein was calculated as N × 6.25. Concentrations of neutral detergent fibre (NDF) and acid detergent fibre (ADF) of samples were determined by the method of Van Soest et al. (1991). All chemical analyses were carried out in triplicate.

Gas production

Rumen fluid was obtained from three fistulated native cattle fed twice daily on a diet containing lucern hay (60%) and concentrate (40%). About 200 mg of sample were incubated *in vitro* with 30 ml of rumen fluid-buffer mixture (ratio of 1:2) in calibrated glass syringes in a water bath kept at 39.0^{oC} in triplicate, following the procedures of Menke and Steingass (1988). Blanks with buffered rumen fluid were also included in the incubations. The syringes were prewarmed at 39.0^{oC} before the injection of 30ml rumen fluid-buffer mixture into each syringe followed by incubation in a water bath at 39 ^{oC}. Reading of gas production was recorded before incubation zero and 2, 4, 6, 8, 10, 12, 24, 48, 72 and 96 h after incubation. Total gas values were corrected for blank incubation. Cumulative gas production data were fitted to the exponential equation: $p= b(1-e^{-ct})$(Ørskov and McDonald, 1979): where p is the gas production at time t; b is the potential gas production (ml), c is the gas production rate constant, t incubation time (h).

The metabolisable energy (ME; Mj/kg DM) of samples was calculated using equation of Menke, (1979) as follows: ME (MJ/kg DM)= 2.20 + 0.136GP + 0.057CP (R2= 0.94) where, GP is 24 h net gas production (ml/200 mg), CP is Crude protein (%), the *in vitro* organic matter digestibility (IVOMD) of foliages was calculated using equation of Menke et al. (1979) as follows: IVOMD (%) = 14.88 + 0.889GP + 0.45 CP + 0.0651XA where, GP is 24 h net gas production (ml/200 mg), CP is Crude protein (%) and XA is ash content (%).

Statistical Analysis

Data on chemical composition, *in vitro* gas production kinetics, OMD and ME contents of samples were subjected to the random completely design using General Linear Model (GLM) of SAS (2002). Data were analyzed as and the statistical model was: $Y_{ijk} = \mu + S_i + e_{ijk}$ where Y_{ijk} represents the general observation on chemical composition, *in vitro* gas production kinetics, OMD and ME contents, S_i the $_i$th effect of species on the observed parameters and e_{ijk} the standard error term common for all observations. Significant differences between individual means was identified using the Turkey's Multiple Range Test. Mean differences were considered significant at $P<0.05$. Standard errors of means were calculated from the residual mean square in the analysis of variance.

RESULTS AND DISCUSSION

Chemical composition

Table 1 show the chemical composition of different plant species. There was a considerable variation between species in terms of chemical composition ($p<0.05$). The DM content of analyzed species varied between 49.08% DM for Pennisetum oriental until 93.09% DM for Cappari deciduas ($p<0.05$). Towhidi et al. (2007) Reported DM content for nine plant species for camel between 936 and 954 g/kg DM. Crude protein contents of plants ranged from 5.20 to 9.60% DM. The crude protein of Cappari deciduas was higher than in the other species ($p<0.05$). Feeds containing less than 80 g/kg DM crude protein are considered deficient since they cannot provide the minimum ammonia levels

required by rumen micro-organisms to support optimum activity (Norton, 2003). So, Indigofera intericata, and Suaeda nudiflora aren't useful plants for providing of maintenance requirements of ruminants.

Towhidi (2007) reported that the CP contents of 11 different plant species were 55.0 g/kg DM in Atemisia siberi to 183.0 g/kg DM in Tamarix aphyila. Laudadio, (2009) reported a similar range of CP content in present study. The cell wall content (NDF and ADF) which represents the most important fraction of dry matter for all forages, ranged from 46.60 to 69.00 and from 41.95 to 49.45% DM, respectively. The NDF and ADF contents of these species weren't similar to those reported by Arzani et al. (2006). As shown in Table 1, it clearly deduces the non-existence of a relationship between CP contents of the halophytes plants and its structural carbohydrates content (NDF and ADF). The variations between our species and other species in the chemical composition contents can be attributed to due to any or all of the vegetative stage (Makkar and Singh, 1993), method of storage (Makkar and Singh, 1993), drying conditions (Makkar and Singh, 1991), species (Makkar and Singh, 1993; Makkar et al., 1991) and habital (Goncalves-Alvim, 2004).

Table 1. Chemical composition (%) of experimental species

Plant species	DM	OM	ASH	EE	CP	NDF	ADF	ADL
Indigofera Intericata	91.40^{b}	94.38^{b}	5.61^{d}	11.01^{a}	7.76^{c}	46.60^{f}	44.30^{e}	13.75^{b}
Suaeda nudiflora	87.40^{c}	90.41^{c}	9.59^{c}	8.17 ^{b}	9.69^{b}	61.25^{c}	48.45^{b}	9.14^{e}
Tavernicria glabra	90.61^{b}	94.13^{b}	5.57^{d}	8.32^{b}	6.13^{d}	56.7^{e}	49.45^{a}	17.45^{a}
Cappari deciduas	93.09^{a}	95.16^{a}	4.84^{e}	11.46^{a}	11.03^{a}	59.45^{d}	41.95^{f}	8.07^{f}
Pennisetum oriental	49.08^{e}	85.71^{d}	14.30^{b}	8.12^{b}	5.67^{e}	69.00^{a}	45.05^{d}	11.24^{c}
Panicum turigidum	66.64^{d}	75.96^{e}	24.03^{a}	8.09^{b}	9.92^{b}	67.8^{b}	47.15^{c}	10.50^{d}
SEM	*617*0.	0.259	0.259	0.592	0.24	0.269	0.358	0. 273
P value	0.001<	0.001<	0.001<	0.001<	0.001<	0.001<	0.001<	0.001<

The means within a row without common letter differ (p<0.05)

In vitro gas production

Cumulative gas production profiles from the in vitro fermentation of experimental species are shown in Figure 1 and the estimated parameters are given in Table 2. There were significantly differences (p<0.05) in gas production volumes among species at different incubation times (Figure 1). The cumulative volume of gas production increased with increasing time of incubation. Gas produced after 96 h incubation ranged between 22.86 and 38.15 ml/200 mg DM. Wood, (1998) reported that there was gas production differences significantly (p<0.05) in samples of different regions. Odeyinka, (2003) compared nutritive value of some different plant species by gas test technique. Results showed that the effect of plant species on the gas production is significant. Abdulrazak, (2000) reported that there are some variations between gas productions of different species.

Potential gas production (b fraction) was significantly different among species (p<0.05). Cappari deciduas has the highest potential gas production and Tavernicria glabr had the lowest potential gas production.

The results from Table 2 show that the predicted ME and OMD profile were widely varied in six plant species. Cappari deciduas has a higher ME and OMD contents than other species (p<0.05). The lowest ME and OMD values of Tavernicria glabr can be associated with high ADF content and low CP content. Hosseini Nejad, (2012) studied on the five halophytes species and reported that OM digestibility these species were from 66.13 to 76.24 g/kg DM. These results are higher than present study.

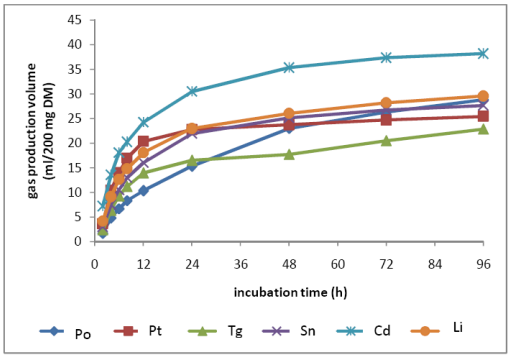

Figure1. Gas production volume (ml/200mg DM) of experimental species in different incubation times. Po: Penniserum oriental, Pt: Panicum turgidum, Tg: Tavernicria glabr, Sn: Suaeda nudiflora , Cd: Cappari decidues, Li: Indigofera interical.

Table 2. Gas production volume (ml/200 mg DM) in 96 h incubation time and gas production parameters of experimental species

	Plant species						
	Indigofera interical	Suaeda nudiflora	Tavernicria glabr	Cappari decidues	Penniserum oriental	Panicum turgidum	SEM
Time incubation (h)							
2	2. 40^{d}	3.02^{c}	2.40^{d}	7.19^{a}	1.66^{e}	3.62^{b}	0.24
4	7.38^{c}	7.48^{c}	6.36^{d}	13.55^{a}	4.83^{e}	10.41^{b}	0.35
6	11.85^{c}	10.51^{d}	9.28^{e}	18.07^{a}	6.65^{f}	14.03^{b}	0.52
8	15.28^{c}	13.00^{d}	11.17^{e}	20.24^{a}	8.32^{f}	16.93^{b}	0.62
12	19.23^{b}	16.03^{c}	13.92^{d}	24.26^{a}	10.32^{e}	30.32^{bc}	0.67
24	23.87^{b}	21.91^{c}	16.50^{d}	30.45^{a}	15.31^{d}	22.74^{bc}	0.89
48	27.82^{b}	25.12^{c}	17.70^{e}	35.31^{a}	22.97^{d}	23.72^{dc}	1.03
72	29.54^{b}	26.73^{c}	20.46^{a}	37.32^{a}	26.30^{c}	24.69^{c}	1.17
96	30.92^{b}	27.68^{dc}	22.86^{e}	38.15^{a}	28.80^{bc}	25.41^{d}	1.28
Gas production parameters							
b	29.57^{b}	26.68^{a}	20.26^{e}	36.38^{a}	29.94^{b}	23.96^{d}	0.78
c	0.08^{a}	0.07^{a}	0.09^{a}	0.10^{a}	0.13^{a}	0.13^{a}	0.07
OMD	43.23^{d}	44.95^{c}	35.92^{f}	55.19^{a}	40.34^{e}	50.05^{b}	0.79
ME	6.97^{b}	5.99^{b}	4.89^{c}	7.30^{a}	4.69^{c}	6.13^{b}	0.12

b: the asymptotic gas production (ml/200 mg DM), c: the rate of gas pruction(/h), OMD: organic matter digestibility (g/kg DM) and, ME: Metabolisable energy (Mj/ kg DM). Different superscripts following means within species in the same row indicate differences at $p<0.05$

CONCLUSION

This study has provided information on the value of a number of plant species adapted to arid environments for use as camel feed. This information may prove useful for herders, farmers and ruminant's nutritionists in feeding strategies for camels in the dry season. There were no consistent patterns between the chemical compositions with gas production of studied plants. It is suggested to evaluate of antinutrients such as tannins and saponin in these species.

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