IN SITU DRY MATTER, CRUDE PROTEIN, FIBER DEGRADATION AND *IN VITRO* GAS PRODUCTION OF HALOPHYTIC GRASS (*Sporopolus virginicus*) BY ARABIAN CAMEL

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SUMMARY

Three cannulated dromedary camels weighting an average of 450 kg were used to estimate dry matter (DM), neutral detergent fiber (NDF), and acid detergent fiber (ADF) degradation of halophytic grass (Sporobolus Virginicus) compared to Rhodes grass (Chloris gayana) as a control fodder. In Vitro gas production was used to compare sporobolus grass as a tested one with Rhodes grass as a common one. Sporobolus grass was irrigated with sea water using a sprinkler irrigation system. Samples were collected in 12 plastic bags (2 kg/bag) from Dhabiyah Research Station in Bupqal Island. Treatments were: 1) Rhodes grass (control; RH) which was collected in 4 plastic bags (2 kg / bag) from the Faculty Farm, Al-Ain district, 2) Sporobolus grass (no washing; SPO1), 3) Sporobolus grass (Washed with fresh water after cutting; SPO2), and 4) Sporobolus grass (steam treated at 130^{o} C, 17 Bar for 2 min.; SPO3). Chemical composition showed that hemicellulose was extensively hydrolyzed during steam treatment in sporobolus grass. Sodium percentage (g/kg DM) was 14.3 in sporobolus grass, while was reduced to be 6.5 in steam treated sporobolus. Whereas the crude protein percent was (6.26%) in sporobolus grass, while it was more than two folds in Rhodes grass comparing to sporobolus grass. Both SPO1 and SPO2 showed the highest dry matter and crude protein disappearance comparing to Rhodes grass (RH) and steam treated sporobolus (SPO3). Neutral detergent fiber disappearance was the best for Rhodes grass incubation periods compared to the other treatments, while SPO1 showed the higher significance of neutral detergent fiber degradation and followed by Rhodes grass up to 120 hrs of incubation time. On the contrary, the overall In vitro gas production technique in Rhodes grass was significantly higher (1.5 fold) more (43.67 ml/0.2 g DM) comparing to the rest of treatments of Sporobolus. It is concluded that, Sporobolus has a potential as new source of forage for camels, where fresh water is scarce. In addition, In vitro gas production technique is good indicator for estimating the quality of salt tolerant grasses, especially with steam treatment under vacuum.

Keywords: Sporobolus, Camel, In situ ingredients degradation, and Gas production

INTRODUCTION

Halophytes are a long neglected resource in arid and semi- arid regions, while they are promising and have the potential of being superior animal feed resources (Gihad and El Shaer, 1994). Halophytes include several fodder, salt tolerant grasses and legumes of high productivity and suitable nutritive value (El Shaer, 1995). Al-Shorepy *et al*. (2010) indicated that Sporobolus grass (*S. virginicus* (L.) Kunth) is a halophytic, perennial grass with buried rhizomes and erect branches to 25–30cm tall. The grass is well adapted to a variety of different soils from clays to sands. *S. virginicus* produces seeds in which few of it is viable. However, the practical method of propagation is by vegetative rhizomatous slips. The grass is highly salt and wind tolerant, where the irrigation systems containing a high salt content (20,000 ppm). Alhadrami *et al*. (2003) compared the yield, chemical composition and feed intake by camels and sheep of Sporobolus and Rhodes. Rhodes grass (*Chloris gayana*) is a sub-humid tropical and subtropical perennial grass, which may be irrigated with ground water of low salinity (2500 ppm). The chemical composition of the two grasses was similar, except that the crude protein content was greater in Rhodes compared to Sporobolus. Promising results have been obtained in some countries in the region with rehabilitation of potential halophytic species (Nemati, 1976). Several investigators recommended that cultivation of salt and drought tolerant fodder shrubs and salt and drought tolerant grasses and legumes may be an appropriate solution for filling the gap in feed production in arid and saline areas (El Shaer, 2006 and Hanafy *et al*., 2007). The arid and semi- arid areas that are more suitable for the salt accumulating shrubs require a different management system. The plants still have the ability to provide green feed, often during the dry season, at a time of feed scarcity, but livestock production is limited by the low feed intakes associated with high salt content (David *et al*., 2007). Halophytic forage shrubs such as saltbush are grown for ruminant feed across a range of saline and arid production environments where they are generally used as a drought reserve or to fill annual feed shortages within grazing systems (Le Houerou, 1992). Saltbush fodder is used to fill the summer/autumn feed gap typical of Mediterranean-type climates (Papanastasis *et al*., 2008), and the ability of animals to grow when grazing saltbush-dominate pastures is limited by low digestible energy levels and high salt levels which limits intake

(Norman *et al*., 2010). Halophytes and other salt-tolerant plants may provide sensible alternatives for many developing countries (Squires and Ayoub, 1994). There are many halophytes and salt-tolerant shrubs, grasses and legumes which could be established in saline lands and have economic potentialities in the arid and semi-arid areas (Zahran, 1993 and El Shaer, 1999). Halophytes and salt-tolerant plants have been used as feed resources in arid and semi-arid regions for millennia (Glenn *et al*., 1999 and El Shaer, 1999). Many of the halophytic plant species and salt-tolerant fodder species provide a valuable reserve feed for grazing animals particularly under drought conditions or fill regular gaps in feed supply caused by seasonal conditions (Glenn *et al*., 1999 and Khan, 2007). On the other hand, Al Khalasi *et al*. (2010) indicated that salinity-tolerant sorghum forage grown with irrigated water of up to 9 dS/m salinity (6030 ppm) could be used as a complete roughage source without affecting the health or performance of Omani sheep. In addition, Al-Shorepy *et al*. (2010) concluded that *Sporobolus virginicus* have the economic and environmental potential as an integrated forage-livestock system particularly in marginal environments with low quality soil and water resources. Results of the feeding experiments suggest that inclusion of Sporobolus grass hay up to 100% of the forge component in the diet did not have any adverse effect on growth performance or carcass characteristics of both sheep and goats. Moreover, animals fed a diet composed of 2/3 Sporobolus grass hay performed the best and the performance was similar and sometimes better than animals fed a conventional feed (Rhodes grass). El Shaer (2004) indicated that feeding halophytes particularly to camels is a feasible solution to minimize the problem of feed shortage. Camels as well as other livestock have adapted microorganisms in their rumen, which can make use of the non-protein nitrogen in halophytes. Camels exhibited a large daily consumption of Rhodes compared with Sporobolus. Cultivation of salt-tolerant crops, or halophytes, on saline soil has significant social and economic potentials that need to be further explored and developed in arid and semi- arid regions (El Shaer, 2004).

The objective of the current study was to estimate the expected feeding value and the potential of halophytic or slat tolerant grass (*Sporobolus Virginicus*) to be as alternative to Rhodes grass (*Chloris gayana*) for camels, which is irrigated with fresh water in the arid and semi- arid regions. The in situ degradation and in vitro gas production have been exploited throughout the whole experiment.

MATERIALS AND METHODS

Treatments:

Three adult dromedary she-camels weighing an average 450 Kg fitted with first compartment cannula were used to investigate the *in situ* nutrient degradability of dry mater (DM), crude protein (CP), neutral detergent fiber (NDF), and acid detergent fiber (ADF). The comparison for times of 3, 6, 12, 24, 48, 72, 96 and 120 hours between one common grass used for livestock feeding (Rhodes grass) and the newly tested salt tolerant grass (*Sporobolus virginicus*) was conducted. In addition, the total produced ruminal *in vitro* gas production was measured for all treatments at times 3, 6, 12, 24, 48, and 72 hours. There were four treatments being used; 1) Rhodes grass hay, fresh water irrigated (RH); 2) Sporobolus grass hay (no washing; SPO1), 3) Sporobolus grass hay (Washed with fresh water after cutting; SPO2), and 4) Sporobolus grass hay (steam treated at 130^{o} C, 17 Bar for 2 min.; SPO3). The evaluated salt marshes grass (*Sporopolus Virginicus*) was collected from Aldabeia Research Station which related to Zayed International Agricultural and Environmental Research program, UAE University, UAE. The grass was grown under 3.5% salinity and harvested at approximate 45-50 cm height.

Experimental procedures:

The proximate analysis of ash, crud protein and ether extract were determent according to the A.O.A.C. (1984) procedures. The nonstructural carbohydrates that included NDF and ADF were determined according to Georing and Van Soest (1970). Wide range of mineral analysis (Sodium, Calcium, Phosphorus, Magnesium, Potassium in g/Kg DM and Copper, Molybdenum, Iron, Aluminum, Zink and Manganese, in mg / Kg DM) were measured as reported by Chapman and Pratt, 1961. Ruminal disappearance of DM, CP, NDF and ADF were determined using artificial fiber bags technique as described by Mehrez and Ørskov, 1977. Five grams air dry samples milled through a Wiley mill (Arther H. Thomas, Philadelphia, PA) to pass a 2 mm screen were inoculated in the rumen of three she-camels as animal replicates. The size of the bag was 170x100 mm with an average pore size of 50 µm was made from nylon filter cloth. Camels were fed ad libitum Rhodes or Sporobolus grass hay supplemented with 4 Kg concentrate diet for three weeks, followed by the incubation period. Duplicate sample bags at each time were inoculated in each camel for seven incubation times (6, 12, 24, 48, 72, 96 and 120 hours) in reverse order before the morning feeding. Bags were suspended using a nylon cord which was tied to the cannula cap. The cord had a weight at the other end to aid in submersion of bags into the ventral portion of the first bags were removed simultaneously and washed immediately with tap water until the water drains was clean. Ten bags oven-dried at 55^{o}C for 48 h and weighed to determine DM. Residue was removed from the bags and duplicates at each time point were composited and analyzed for CP, ADF and NDF. For *in vitro* gas production measurement, rumen liquor was obtained from three she-camels on the same diet that was previously mentioned and added to buffer solution at ratio (1:2) as described by Menke *et al.* (1979). After weighing approximately 0.20 g of air-dry and milled (1mm) sample into

calibrated glass syringes (100 ml), the pistons were lubricated with vaseline to ease the sliding of pistons and prevent gas escape. The syringes were warmed at 40°C before dispending 30 ml of rumen liquor and buffer mixture, and followed by incubation in shaking water bath at 39°C. Readings were recorded after incubation periods of 3, 6, 12, 24, 48, and 72 hr. Duplicates of each sample were used for each cannulated animal run.

Statistical analysis

The Randomized Completely Design (RCD); one factor was the statistical design which was used to fit the experimental data. The pooled data was statistically manipulated using The SAS System version 9.0 for Windows (2002) according to the following model, $Y_{ij} = \mu+T_i + e_{ij}$, were μ is the overall means of Y_{ij} , T_i is the effect of treatment and e_{ij} is the experimental error. Duncan's Multiple Range Test was used at alpha level < 0.5 to separate and compare means.

RESULTS AND DISCUSSION

Chemical Composition:

The chemical composition and some minerals analysis (Table 1) show higher crude protein of Rhodes grass compared to sporobolus grass (15.3 % vs. 6.26%). Neutral detergent fiber was almost the same for both Rhodes and sporobolus grass, while lower in steam treated sporobolus. These findings are confirmed by Al-Shorepy *et al*. (2010). Phosphorus, Potassium, copper content in rhodes grass were almost two folds more than the corresponding minerals in sporobolus grass. On the contrary, sporoblous zinc was almost four times higher than rhodes grass. The reduction in crude protein content in sporobolus grass encourages using other protein supplement in feeding farm animals (Mears *et al*., 1996 and Holst *et al*, 2001). The steam treatment of sporobolus grass hay at high pressure (15 par / min) resulted in sever changes of fiber fractions content, where ADF was increased and was confirmed by the findings of (Castro *et al*., 1995& 1994 and Broderick *et al*., 1993). The same observation was obtained by Fadel (1992) with Lucerne heated for 20 hr at 100° C.

The high salt tolerant halophytic plants may also accumulate other minerals as a tool for tolerating high salt levels in water and soil, as *Sporobolus Virginicus* do. Norman *et al*. (2002b) reported that potassium, calcium and magnesium can be above or close to the maximum tolerable levels of 2, 1.5 and 0.6%, respectively for ruminants (National Research Council, 2005).

In Situ DM and CP Degradation:

Dry matter degradation was significantly different among all treatments for all incubation times (Table 2). It was significantly (P<0.05) increased for sporobolus grass washed with fresh water after cutting (SPO2), then by sporobolus grass washed by fresh water (SPO2), and rhodes grass hay (RH). The steamed sporobolus grass showed the lowest significant (P<0.05) in situ dry matter degradation for all the times. Increasing the acid detergent fiber and on the contrary decreasing the neutral detergent fiber after steam treatment could be the reason for the significant reduction in situ DM degradation. Rhodes grass, SPO1 and SPO2 showed the highest DM degradation after 120 hours of incubation, while the highest DM degradation for SPO3 was after 48 hours of incubation. The DM degradation in rhodes grass increased more gradually and stable than that with SPO1 and SPO2. The dry matter degradation is almost similar for rhodes grass and both SPO1 and SPO2. In numerous cases, rhodes grass hay alone can hardly cover the nutritional requirement of any ruminants, except for maintenance and it must be supplemented with another protein supplement (Mero *et al*., 1998; Mtenga *et al*., 1990; Mupangwa *et al*., 2000 and Osuga *et al*., 2012). By feeding camels on native desert plants or hay instead of alfalfa and rhodes grass, valuable freshwater could be saved as these species have a better Water Use Efficiency (WUE) (PeACoCk *et al*., 2003[a] and böer, 2006). Similarly, fresh water could also be saved by growing Sporobolus spp. and other salt tolerant palatable species.

On contrary to dry matter disappearance, there were no significant differences among all treatments for in situ crude protein degradation through the first two ensiling times (6 and 12 hours). Both Sporobolus grass washed with fresh water after cutting (SPO2), and the one that was not washed (SPO 1) were always similar and significantly (P < 0.05) higher than the Rhodes grass *in situ* crude protein degradation. There were no significant differences for crude protein degradation of Rhodes, SPO1 and SPO2 starting from 96 hours of incubation. On contrary, the steam treated sporobolus grass crude protein degradation was significantly (P < 0.05) the worst one among all treatments. It was almost below the 50% of all the other treatments. Having low crude protein degradation with steam and pressure treated sporobolus could be attributed to linking protein with the acid detergent fiber through heating and pressure, which make it insoluble and less degradable in the rumen liquor. Concerning the effect of steam treatment on DM and CP degradability values, both of them were significantly lower compared with the untreated sporobolus grass hay due to the increase of digestible nitrogen loss which is associated with fiber composing acid detergent insoluble nitrogen (ADIN) complex as described by Castro *et al*. (1994). Nishino *et al*. (1994) reported that IVDMD and *In situ* CPD were significantly decreased by heating alfalfa hay at 120°C and this trend was confirmed by the findings of Kaankuke *et al*. (1996) who found that nitrogen degradability of full fat soybean was decreased by cooking at 100°C/15 min. Broderick *et al*. (1993) clarified that in vitro degradation was decreased by heat treatment of alfalfa hay. On the other hand there is another suggestion that steam treatment produces some anti-nutritional factors resulting from Brown

reaction or Millard reaction like furfural which has irritant effect for the mucosal membrane of animal's nose (Irvin, 1980 and Castro *et al*., 1994).

Crude proteins levels can also be misleading. These are usually calculated from nitrogen analysis and assume all nitrogen in the plants is in the form of protein. In reality, many salt tolerant plants contain high levels of non-protein nitrogen. For example Benjamin *et al*. (1992) reported that 42% of the nitrogen in *Atriplex barclayana* was non-protein nitrogen. This nitrogen will only be available for conversion to microbial protein in the rumen if a good supply of metabolizable energy is available or if added to a protein deficient feed (Masters *et al*., 2001).

Table 1. Chemical and mineral composition of Rhodes grass hay, Sporobolus grass and steam evacuated Sporobolus grass

Item	Treatment		
	Rhodes	**Sporobolus**	**Steamed Sprorobolus**
Chemical Composition, %			
Crude protein (CP)	15.30	6.26	6.62
Ether extract (EE)	1.23	1.92	2.93
Neutral detergent fiber	75.97	79.75	52.01
Acid detergent fiber	33.50	37.49	45.65
Ash	14.48	16.40	17.78
Mineral Content/ Kg DM			
Calcium, g	5.3	8.0	7.2
Sodium, g	10.3	14.3	6.5
Phosphorus, g	3.8	1.2	2.1
Potassium, g	14.1	7.4	7.3
Magnesium, g	3.5	3.1	3.2
Copper, mg	4.2	2.1	2.1
Molybdenum, mg	1.1	1.0	0.9
Iron, mg	108	140	112
Aluminum, mg	63	94	80
Zinc, mg	22	24	95
Manganese, mg	21	20	17

Table 2. *In Situ* dry matter degradation of rhodes grass hay *vs.* Sporobolus grass hay in cannulated camels.

Time (hrs)	RH	SPO1	SPO2	SPO3	±SE
6	2.00^{b}	9.87^{a}	10.75^{a}	2.22^{b}	1.29
12	7.90^{b}	16.29^{a}	19.86^{a}	9.17^{b}	1.63
24	14.31^{b}	29.00^{a}	32.21^{a}	18.25^{b}	2.38
48	29.60^{bc}	36.72^{ab}	41.63^{a}	26.02^{c}	2.19
72	38.13^{a}	40.73^{a}	45.09^{a}	26.25^{b}	2.29
96	45.70^{a}	43.31^{a}	47.32^{a}	26.86^{b}	2.56
120	49.09^{a}	46.75^{a}	48.34^{a}	26.03^{b}	2.98

$^{a, b, c.....}$ Means in the same row with different superscript are significantly different (P<0.05).

Table 3. *In Situ* crude protein degradation of rhodes grass hay *vs.* Sporobolus grass hay in cannulated camels.

Time (hrs)	RH	SPO1	SPO2	SPO3	±SE
6	1.40^{a}	3.59^{a}	4.72^{a}	1.25^{a}	0.82
12	2.66^{a}	5.43^{a}	7.24^{a}	3.67^{a}	1.17
24	5.18^{b}	13.89^{ab}	18.59^{a}	11.52^{ab}	2.10
48	15.54^{b}	24.32^{a}	26.26^{a}	13.37^{b}	1.90
72	21.86^{b}	26.30^{ab}	28.51^{a}	14.25^{c}	1.82
96	25.16^{a}	30.04^{a}	29.73^{a}	13.57^{b}	2.26
120	27.39^{a}	30.33^{a}	31.12^{a}	12.88^{b}	2.57

$^{a, b, c.....}$ Means in the same row with different superscript are significantly different (P<0.05).

In Situ NDF and ADF Degradation:

For *in situ* neutral detergent fiber (NDF) degradation, it was significantly higher ($P < 0.05$) for sporobolus grass hay harvested and not washed (SPO1), and followed by that washed with fresh water after harvesting (SPO2), and finally by Rhodes grass hay (RH) and steam treated sporobolus (SPO3). This could indicate higher soluble and ready fermentable carbohydrate content of sporobolus grass *vs.* that of Rhodes grass hay. The steam treated sporobolus grass hay showed a significant reduction ($P< 0.05$) for *in situ* NDF degradation specially for the incubation times 72, 96, and 120 hours. Fadel (1992) and Deinum and Maassen (1994) demonstrated that drying of ryegrass and maize silage at 105^{o}C significantly decreased in vitro cell wall content disappearance (IVCWCD) and the prolonged heat was detrimental to the nutritive value of lucerne and almond hulls. In contrast, Castro *et al*. (1995) stated that steam treatment of eucalyptus significantly improved CWCD by rumen microbes.

It was almost contradicting with in situ ADF degradation, that it was insignificantly changed among all treatments for the incubation times 72 and 96 hours. On the other hand, sporobolus *in situ* ADF degradation rate was significantly higher than Rhodes grass hay for the incubation times 6, 12, 24 and 48 hours. Rai and Mudgal (1986) and Zelenak *et al*. (1990) confirmed those *in vitro* ADF, NDF, cellulose and hemicellulose digestibilities were significantly increased when the poor quality roughage was treated with steam pressure. Insignificant changes of ADF and NDF digestibility after steam treatment were reported by Zhao *et al*. (1996) and Rai and Mudgal (1987).

Table 4. *In Situ* NDF degradation of rhodes grass hay *vs.* Sporobolus grass hay in cannulated camels.

Time (hrs)	RH	SPO1	SPO2	SPO3	±SE
6	2.60^{b}	12.27^{a}	10.66^{a}	3.88^{b}	1.31
12	8.46^{c}	24.09^{a}	21.62^{ab}	16.88^{b}	1.96
24	16.30^{b}	37.58^{a}	38.45^{a}	34.99^{a}	3.21
48	34.74^{b}	51.99^{a}	49.03^{a}	47.36^{a}	2.29
72	44.97^{b}	55.77^{a}	53.45^{ab}	49.12^{ab}	1.76
96	54.67^{ab}	60.05^{a}	55.43^{ab}	50.99^{b}	1.20
120	58.89^{a}	60.00^{a}	56.50^{a}	49.48^{b}	1.46

$^{a, b, c.....}$ Means in the same row with different superscript are significantly different ($P<0.05$).

Table 5. *In Situ* ADF degradation of rhodes grass hay *vs.* Sporobolus grass hay in cannulated camels.

Time (hrs)	RH	SPO1	SPO2	SPO3	±SE
6	1.74^{b}	6.80^{a}	7.90^{a}	7.95^{a}	0.99
12	6.14^{b}	16.30^{a}	18.29^{a}	19.86^{a}	2.05
24	13.71^{b}	30.94^{a}	34.38^{a}	37.35^{a}	3.40
48	35.46^{b}	48.06^{a}	42.57^{ab}	49.46^{a}	2.27
72	46.13^{a}	50.10^{a}	46.99^{a}	51.24^{a}	1.43
96	46.20^{a}	53.34^{a}	51.23^{a}	52.52^{a}	2.10
120	61.56^{a}	51.72^{b}	47.73^{b}	51.76^{b}	1.76

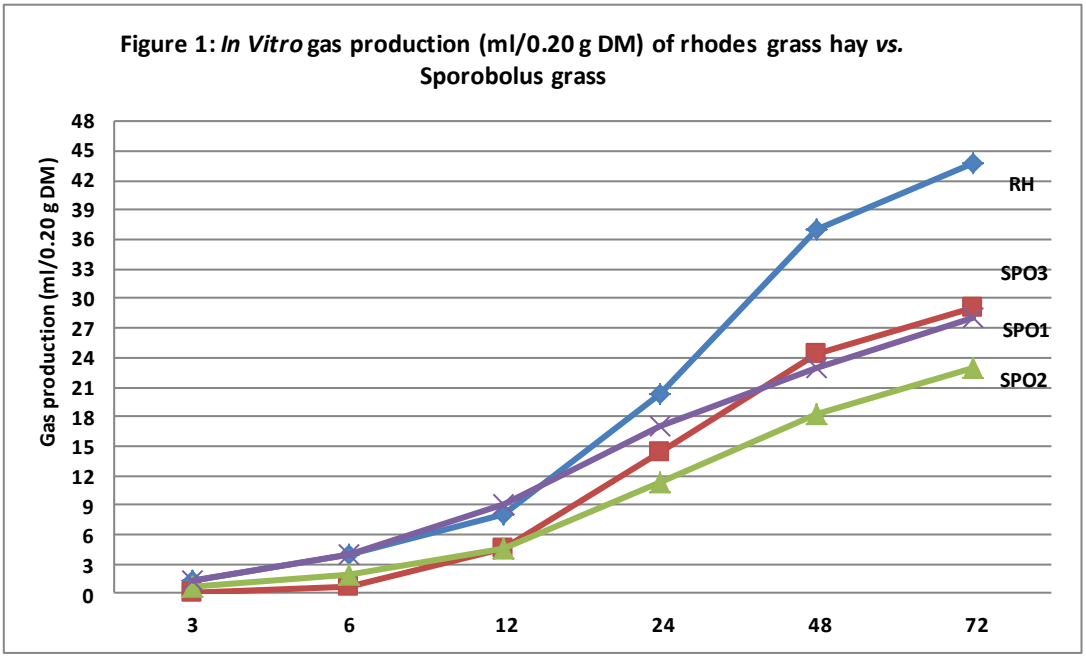
$^{a, b, c.....}$ Means in the same row with different superscript are significantly different ($P<0.05$).

In Vitro gas production:

Gas production (ml) from 0.2 gram dry matter of the tested grasses (Rhodes, SPO1, SPO2 and SPO3) is presented in figure (1). Gas production has been measured in incubation times of 3, 6, 12, 24, 48, and 72 hours to indicate the potential of each grass for being fermented and ready for producing the rumanial gases. Gas production from Rhodes grass hay was significantly ($P<0.05$) higher than the other treatments for all the incubation hours. Steam treated sporobolus showed the best gas production after Rhodes grass, in particular for the first 24 hours of incubation, and then being comparable to SPO1. The potential of gas production as a measure for rumen fermentation is being much remarkable for Rhodes grass through the period of 24 into 72 hours. Rhodes grass gas production was almost two folds of SPO2 and almost one and half fold of SPO1 and SOP3. As a result of steam treatment, the gas production was increased almost 160% of the non-steam treated and washed with Sea water sporobolus (SPO2). The present results concerning the effect of steam treatment on the gas production is confirmed by the results of Castro *et al.* (1994) who indicated that the volume of gas produced after 48 hr of steamed wheat straw (19 par / 3 min. / 120^{o}C) was 160.4% of control one (no steam treated). In Castro (1994) doctoral thesis indicated that both low and high temperature steam treatment are efficient methods for releasing fermentable sugars from the hemicellulose matrix and for depolymerizing lignin. However, high temperature treatments lead to higher losses of both fermentable sugars and dry matter. Much higher improvement in cell wall bio-availability was

obtained with the high temperature steam treatment at 134 C. This trend is clearly illustrated by the changes in solubilized hemicelluloses and in Sacco total degradability. In addition, Castro(1994) indicated that decreasing the levels of NDF content and degradability, is always correlated with significant increase of in vitro gas production of steam treated samples (r = - 0.589), which is matching the results of the current experiment.

Since *in vitro* gas production and nutritive value are well correlated (Menke and Steingass, 1988) the results discussed by Castro (1994) suggested that inhibitory compounds present in steam-treated wheat straw do have a deleterious effect on rumen microbial fermentation. That was confirmed by the effect of substrate loading on in vitro degradability with different loading weights (500 and 1,000 mg) *in vitro* degradability of control samples were not affected (Tilley and Terry method, 1963). In Castro (1994), the *in vitro* gas production (48 hrs) was 54 ml for the incubation of furfural at 2 % of control DM, while it was 51.1 ml in vitro gas production for the control diet without furfural addition. This means that producing furfural through the steam treatment of the sporobolus may not have deleterious effect on the in vitro gas production. That means, *In vitro* assays showed that rumen microbes are tolerant to and can quickly metabolize both furfural and hydroxyl-methyl-furfural, within the range of concentrations normally detected in steam-treated samples.



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CONCLUSION

It could be concluded that, using sporobolus should be combined with another protein additives to compensate the low protein level for feeding livestock. *In situ* nutrient degradation and *in vitro* gas production could be concluded that, both in situ SPO1 and SPO2 dry matter, crude protein, NDF and ADF degradation was insignificantly ($P < 0.05$) different than those of Rhodes grass as a control. Steam treatment of sporobolus grass increased its potential for in vitro gas production comparing to SPO1 and SPO2, but still significantly lower than Rhodes grass in times of 48 and 72 hours of incubation. Camels have the ability to utilize such halophyte as being salt tolerant animal and able to uptake, digest and excrete its digesta without health or nutritional disorder.

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تكسير المادة الجافة والبروتين الخام والألياف الخام بطريقة أكياس النايلون وإنتاج الغاز معملياً لحشيشة متحملة الملوحة (S*poropolus virginicus*) بالإبل العربية

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تناولت هذة الدراسة التقييم الغذائي بطريقة أكياس النايلون وإنتاج الغاز معملياً لأحد الحشائش المتحملة للملوحة والتي رويت بماء البحر بنظام الغمر وهي حشيشة (*Sporopolus virginicus*). إستخدمت ثلاثة نوق بالغة ذات فتحة مستديمة بالكرش وأكياس النايلون لقياس تكسير المادة الجافة والبروتين الخام وبعض مكونات الألياف الخام، كما تم قياس حجم الغاز الناتج معمليا. أستخدمت حشيشة الرودس (*Chloris gyana*) المروية بالماء العذب والمستخدمة في المزارع للمقارنة. تم جمع عينات حشيشة سبوروبولس *sporobolus* من محطة بحوث الذهبية. كانت المعاملات كالتالى: ١) دريس حشيشة نبات الرودس (RH) كعينة كنترول تم الحصول عليها من مزرعة الكلية كعلف خشن اساسي لتغذية الحيوان، ٢) حشيشة نبات سبوروبولس تم ريها بماء البحر ولم يتم غسلها (SPO1)، ٣) حشيشة نبات سبوروبولس تم ريها بماء البحر ثم غسلت بماء البحر بعد الحش، أم العليقة الرابعة ٤) حشيشة نبات سبوروبولس معاملة بالبخار، ١٣٠ درجة مئوية/١٧ ضغط جوى/ ٢ دقيقة (SPO3). أوضحت النتائج الخاصة بتحليل المادة الغذائية إرتفاع محتوى البروتين الخام في الرودس (١٥.٣%) مقارنة بحشيشة سبوروبولس (٦.٢٦%)، بينما كانت نسبة الصوديوم ١٤.٣ % في سبوروبولس، ١٠.٣% في الرودس بينما كانت ٦.٥% في سبوروبولس المعامل حرارياً. أوضحت كل من SPO1 , SPO2 أعلى درجة تكسر للمادة الجافة والبروتين الخام مقارنة بنبات الرودس، في حين جاءت SPO3 منخفضة التكسر لكل منهما. أوضحت العينة SPO1 درجة قريبة من تكسر الألياف الخام الذائبة في المحاليل المتعادلة NDF مقارنة بنبات الرودس. أوضح إنتاج الغاز معملياً زيادة قدرها ١٥٠% مقارنة بأنواع حشيشة سبوروبولس وكان نبات SPO3 أفضل من كل من SPO1& SPO2. أوضحت التجربة إمكان إستخدام نبات سبوروبولس كعلف بديل للإبل مع ضرورة إستخدام مصادر أخرى إضافية للبروتين الخام. كما أوضح إنتاج الغاز معمليا قدرة حشيشة سبوروبولس المعاملة حراريا تحت ضغط على إنتاج قدر أكبر من الغازات من باقي عينات سبوروبولس.