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IN Situ dm, FIBER DEGRADATION AND *IN VITRO* GAS PRODUCTION OF SEA WATER IRRIGATED GRASS (*Spartina alterniflora Lois.*) BY ARABIAN CAMEL

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SUMMARY

*The objective of this study was to evaluate the nutritive value of spartina grass (*Spartina alterniflora*) irrigated with sea water. Three adult cannulated she-camels were used to determine DM and fiber degradation. Rhodesgrass (*Chloris gyana*); irrigated with fresh water was used as a control. Spartina grass was irrigated with sea water using flood irrigation system. Samples of spartina grass were collected from Dhabiyah Research Station. Treatments were: 1) Spartina grass (no washing; SPT1); 2) Spartina grass (washed with fresh water after cutting; SPT2); 3) Spartina grass washed with sea water before cutting: SPT3); 4) Spartina grass washed with sea water before and after cutting; SPT4); 5) Spartina grass (steam treated at ٢٠٠^{o}C, 17 Bar for 2 min.; SPT5). Chemical analyses indicated that Rhodes grass and spartina grass had similar protein content. Ash content of spartina (SPT1) was 35.3% vs. 9.2% in Rhodes grass. As a result of washing and steam treatment, the total ash content was reduced in SPT2, SPT4 and SPT5 to (24.4, 24.8 and 25.6%), respectively. Also, sodium and hemicellulose of steam treated spartina deceased to 4.0 and 7.3%, respectively. On the other hand, ADIN percentage significantly increased. Dry matter degradation up to 72 hr of incubation was significantly (P<.05) higher in SPT2 and SPT4 compared to the other treatments. However, in vitro gas production (ml/ 0.2 g DM) of Rhodes grass was significantly higher than spartina grass treatments after 72 hrs of incubation. It could be concluded that spartina grass has a potential as a source of forage if washed with fresh water after cutting or with sea water before and after cutting.*

Keywords: Spartina grass, fiber degradation, gas production, Arabian camels

INTRODUCTION

Because of the difficulty in meeting forage demand from cultivation in arid and semi arid lands as a result of drought, salinity and/or desertification (most of Arabic region), previous studies have underlined the potential role of halophytes (salt tolerant plants) as an alternative source of forage for livestock (Ahmed 1993, Garduno 1993, Katting *et al.,* 1993, Riley and Abdalla, 1993 and Ben Salem *et al.,* 1994). Spartina grass (*Spartina alterniflora*) classified as perennial grass that belongs to C4 halophyte (euhalophyte), tolerate salinity up to 58 ds/m (more than sea

water salinity) and yields about 9 tons green forage/acre (Aronson, 1989). This grass has been introduced into United Arab Emirates by Zaied International Agricultural and Environmental Program (Lieth and Lieth, 1993). This grass is of interest because it grows well under harsh environment of drought and salinity and might have a potential as forage for livestock. Lieth and Lieth (1993) stated that *Spartina alterniflora* successfully grows under 3.5% salinity which equals to sea water. Prediction of animal performance on marginal quality roughages by using simple, reliable and cheap techniques becomes very important in animal nutrition. Measurement of the degradability of roughages incubated in nylon bags in the rumen (*in sacco* method) is now widely used and reported to be generally well correlated with animal performance (Ørskov, 1989). In addition, Menk and Steingass (1988) developed the gas production technique (*in vitro*) to evaluate the nutritive value of foodstuffs.

High salt content of halophytes has been reported to limit their use as forage, however, there are some means to overcome such problem. Blending with other components in prepared feed mixtures is one of the possible solutions (O'leary and Gleen, 1994). Salt tolerant plants have different mechanisms to get rid of slat stress resulting from growth in saline habitat or irrigation with saline water. Spartina grass follows definite mechanism by secreting salts through salt glands or bladders that are located on the leaf surface (Hamad, 2000), and this salt could be easily removed by washing with running water. Ash content of such grass is almost one-third of the dry matter content. The main objective of this study was to alleviate salt stress by removing the accumulated salt crystals on grass leaves through washing and to study its impact on *in situ* degradation of dry matter, crude protein and fiber fractions and *in vitro* gas production compared with the commonly used grass Rhodes grass (*Chloris gyana*).

MATERIALS AND METHODS

Study area

The evaluated slat marshes grass (*Spartina alterniflora*) was collected from Aldabeia Research Station of 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.

Animals and Treatments

Three adult dromedary she-camels weighting an average 450 Kg fitted with first compartment cannulae were used to investigate the *in situ* nutrient degradability comparison among RH; Rhodes grass hay (fresh water irrigated; the common roughage imported from Saudia Arabia) and different treatments of Spartina grass hay which could be classified as follows: SPT1; spartina grass hay, as is (not washed), SPT2; spartina grass hay washed with fresh water after cutting, SPT3; spartina grass hay washed with sea water before cutting, SPT4; spartina grass hay washed with sea water before and after cutting, and SPT5; SPT4 + steam pressure treatment (200^{o}C/ 17 par / 4 min.).

Experimental procedures

A.O.A.C., 1984 procedures were followed for determining the proximate analysis; ash, CP and EE. The non structural carbohydrates which include NDF,

ADF, cellulose, lignin and hemicellulose (by difference; NDF-ADF) and also the acid detergent insoluble nitrogen (ADIN) were determined according to Georing and Van Soest (1970. Silica was determined as the residue after the crucible has been combusted for lignin determination. Wide range of mineral analysis (Na, K, Ca, Mg in % and Cu, Fe, Mn, Zn, Cd, Pb, P in Mg %) was measured according to Chapman and Pratt (1961. Ruminal disappearance of DM, CP, NDF and ADF was determined using artificial fiber bags technique as described by Mehrez and Ørskov (1977. Five gram 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 . The bag was made from nylon filter cloth. Camels were fed ad libitum Rhodes or spartina 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 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 compartment. Bags were removed simultaneously and washed immediately with tap water until the water drains was clean. Ten bags were oven-dried at 55^{o}C for 48 h and weighed to determine DM. Residue was removed from the bags and duplicates at each point of time 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 previously mentioned and added to buffer solution at ratio (1:2) as described by Menke *et al.*(1979). After weighing, about 0.20 g of air-dry and milled (1mm) sample was into calibrated glass syringes (100 ml) with pistons were lubricated with vaseline to ease the sliding of pistons and prevent gas escape. The syringes were rewarmed at 40^{o}C before dispending 30 ml of rumen liquor and buffer mixture followed by incubation in shaking water bath at 39^{o}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 Completely Randomized Design (RCD); one factor was the statistical design used. The data pooled was statistically manipulated using MSTAT-C (Nissen, 1989) 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

As shown in Table 1, ash content of spartina grass hay (SPT1) is much higher compared to Rhodes grass hay (almost 4 times). While, ash content of the other treated spartina exceeds Rhodes grass by 2 to 3 times . This means that washing of spartina grass either with fresh water or sea water after cutting or steam treatment was a good means of getting rid of most of the ash content, from 35.7% to 16.9%, with 28% average reduction. This result confirmed that found by Gleen *et al.,* 1992.

Table 1. Chemical composition and mineral content (DM basis) of Rhodes grass hay and spartina grass hay

Item	Rhodes	SPT1	SPT2	SPT3	SPT4	SPT5
Chemical Composition, %						
Ash	9.2	35.3	24.4	30.3	24.8	25.6
CP	8.2	8.6	8.4	7.6	8.7	8.2
EE	0.5	1.0	1.	1.0	2.0	3.3
ADF	33.9	25.0	30.5	27.9	28.8	33.9
NDF	41.1	48.7	58.8	53.0	58.2	41.1
Cellulose	29.2	18.7	23.8	21.0	22.0	26.5
Hemicellulose	7.2	23.8	28.6	25.1	29.4	7.3
Lignin	8.7	3.6	3.8	3.8	4.4	7.3
Silica	1.1	1.6	2.0	1.6	0.8	0.6
ADIN	3.2	3.0	3.0	2.8	3.1	6.4
Mineral Content:						
Sodium, %	0.9	8.9	5.5	7.1	6.5	4.0
Potassium, %	0.8	0.8	0.8	0.8	0.9	0.8
Calcium, %	0.6	1.0	1.0	1.3	0.9	0.9
Magnesium, %	0.3	0.7	0.7	0.9	0.7	0.7
Phosphorus, mg%	42.2	23.8	28.0	26.04	22.0	31.5
Copper, mg%	10.0	10.0	10.0	10.0	10.0	10.0
Iran, mg%	255	295	235	335	230	240
Manganese, mg%	20.0	60	65	60	50	50
Zinc, mg%	40	20	30	40	60	80
Cadmium, mg%	0.0	0.0	0.0	0.0	0.0	0.0
Lead, mg%	45	55	50	45	40	45

Crude protein content of Rhodes grass hay and the other treated spartina is almost the same and matched the findings of Leith and Leith (1993). Ether extract of SPT1, SPT2, SPT3 is higher than Rhodes grass hay by 2 to 4 folds and by 6 to 7 folds in SPT5 compared to Rhodes grass hay (RH). Concerning fiber content; the acid detergent fiber (ADF) of Rhodes grass hay (RH) was higher compared with that determined in SPT1, SPT2, SPT3 and SPT4 and the fractions of ADF (cellulose and lignin) followed the same trend. On the other hand, neutral detergent fiber (NDF) and hemicellulose of Rhodes grass hay were approximately 75% and 32.5% of that calculated for SPT1, SPT2, SPT3 and SPT4. The steam treatment of spartina grass hay at high pressure (15 par / min) resulted in drastic changes of fiber fraction contents and that ADF, cellulose and lignin were increased (Castro, et al., 1995, Castro, et al. 1994 and Broderick, et al., 1993). The same observation was obtained by Fadel (1992) with Lucerne heated to 20 hr at 100^{o}C. In contrast, Rai and Mudgal (1987) reported that there was insignificant changes for all fiber fractions of steamed rice straw at 2kg / cm^{2} for 2 hr.

The NDF, hemicellulose and silica of steamed spartina grass hay (SPT5) appreciably decreased *vs*. non-steamed saprtina grass hay a result which agrees with the findings of Zelenak et al. (1990) and only partially regarding hemicellulose with that reported by Hagemeister and Ahrens (1986), Broderick *et al.* (1993) and Castro, *et al.* (1995).

The most remarkable change caused by steam treatment was the extensive hydrolization of hemicellulose and the remained material consisting mainly of cellulose and lignin (Zelenak *et al.,* 1990 and Castro *et al.,* 1995). In addition, the acid detergent insoluble nitrogen (ADIN) was doubled in spartina grass hay by steam treatment as that reported by (Fadel, 1992, Broderick *et al.,* 1993, Castro *et al.,* 1994, and Nishino *et al.,* 1994). The sodium content of spartina grass hay varied from 7 to10 times than that determined for Rhodes grass hay, while all the other minerals; potassium, calcium, magnesium, phosphorus, copper, iron, manganese, zinc, cadmium and lead were almost comparable for all treated spartina and Rhodes grass hay as shown in Table 1.

In Situ DM and CP degradation

The data obtained from *in situ* degradation (Table 2) indicated that there was slight significant difference (P<.05) among SPT1, SPT2, SPT3, and SPT4 in DM degradation up to 24 hr of incubation but significantly higher difference for those calculated for both Rhodes grass hay (RH) and steamed spartina (SPT5). From 24 hr up to 48 hr, there was a slight increase of DM degradation for SPT1, SPT2, SPT3 and SPT4 but significant differences were still observed among them especially SPT1 which was very slowly increased. However, both (RH) and (SPT5) insignificantly differed and were sharply increased but still significantly (P<.05) lower than SPT1, SPT2, SPT3 and SPT4. After 72 hr of incubation, all the treatments recorded very slight increases except for (RH) which showed an accelerating increase but was still significantly (P<.05) lower than SPT2, SPT3 and SPT4 and did not significantly differ from SPT1 and SPT5. At 96 hr., RH showed insignificant DM degradation compared with SPT2, SPT3 and SPT4, and consequently a wide significant difference between (RH) and both SPT1 and SPT5 were detected. At the end of incubation period, DM degradation of RH was extremely the highest compared to the other treatments which tended to show stable degradability after 72 hr of incubation.

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

Time (hr)	DM Degradation, %						±SE
	Rhodes	SPT1	SPT2	SPT3	SPT4	STP5	
6	2.0^{d}	10.5^{bc}	13.4^{ab}	12.2^{ab}	13.8^{a}	8.0^{c}	0.96
12	7.9^{c}	18.4^{a}	22.3^{a}	18.5^{a}	20.4^{a}	13.0^{b}	1.62
24	14.3^{c}	29.3^{b}	34.8^{a}	32.0^{ab}	35.8^{a}	15.6^{c}	1.30
48	29.6^{c}	36.0^{b}	43.7^{a}	41.1^{ab}	44.0^{a}	29.8^{c}	1.81
72	38.2^{b}	38.0^{b}	45.9^{a}	43.8^{a}	45.2^{a}	34.6^{b}	1.76
96	45.7^{a}	39.6^{b}	46.6^{a}	44.5^{a}	45.3^{a}	34.8^{c}	0.95
120	49.1^{c}	48.4^{a}	54.1^{b}	44.3^{b}	36.0^{c}	27.4^{b}	0.59

Means in the same row followed by different letters differ significantly (P<.05).

It could be concluded from the *in situ* experiment that the DM degradation of RH was started very low and went slowly up to 24 hr and *vise versa* for SPT2, SPT3 and SPT4. After 24 hr, the degradability pattern was inversed, but the same DM degradability percent was obtained for SPT2 and SPT4 *vs.* RH at 48 and 96 hr, respectively. The high DM degradability of SPT2 and SPT4 *vs* RH could be understood through the fiber fractions content in Table 1, where the easy degradable

fiber fraction (hemicellulose) of SPT2 and SPT4 is almost 4 times that of RH and *vise versa* for the hard degradable fractions (lignin and cellulose) which were approximately 2 times in RH comparing with SPT2 and SPT4.

Crude protein degradation as shown from Table 3 indicated that there were significant differences among SPT2, SPT3 and SPT4 and the other treatments at 6 hr of incubation. The CPD of SPT2 was significantly the highest compared with the other treatments for all incubation times followed by SPT3. Rhodes grass degradable protein showed the same trend noticed with DMD having slow degradability up to 24 hrs and then gone faster up to 96 hr, but recorded the lowest CP degradation *vs* the other treatments. The more reasonable explanation for this result is that the high degradation of easy degradable fibers for SPT2 and SPT3 assist the rumen microflora to use the energy produced to utilize the degraded crude protein at early hours of incubation and *vise versa* for CPD of Rhodes grass hay where energy utilization stared later. At 24 hr of incubation, the CPD percent of SPT2, SPT3 and SPT4 was approximately 5.1, 4.0 and 3.9 times as that of RH, respectively. At 48 hr of incubation, the ratio became 2.1, 1.9 and 1.9 times, respectively, while, at 72 hr of incubation, the ratio was 1.6, 1.5 and 1.3 times, respectively.

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

Time (hr)	CP Degradation, %						±SE
	Rhodes	SPT1	SPT2	SPT3	SPT4	STP5	
6	1.4^{c}	4.2^{b}	5.4^{ab}	6.5^{a}	6.8^{a}	0.74^{c}	1.85
12	2.7^{d}	8.6^{b}	16.8^{a}	9.7^{b}	9.2^{b}	4.71^{c}	2.11
24	5.2^{c}	16.0^{b}	26.4^{a}	20.8^{b}	20.5^{b}	6.5^{c}	1.54
48	15.5^{d}	23.2^{bc}	33.0^{a}	28.9^{ab}	27.7^{ab}	20.2^{cd}	2.05
72	21.9^{c}	25.1^{c}	35.8^{a}	32.4^{ab}	29.2^{b}	24.9^{c}	1.10
96	25.2^{b}	26.5	36.5^{a}	33.2^{a}	28.2^{b}	25.2^{b}	1.43
120	26.1^{b}	37.3^{a}	33.3^{a}	27.4^{b}	26.4^{b}	26.3^{b}	1.37

Means in the same row followed by different letters differ significantly (P<.05).

Concerning the effect of steam treatment on DM and CP degradability values, both of them were significantly lower compared with the untreated spartina hay due to the increase of digestible nitrogen loss which associated with fiber composing acid detergent insoluble nitrogen (ADIN) complex as described by Castro *et al*. (1994). Nishino *et al.* (1994) who reported that IVDMD and *in situ* CPD were significantly decreased by heating alfalfa hay at 120^{o}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^{o}C/15 min. Broderick *et al.* (1993) reported 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 resultant 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).

Millard reaction products had an adverse effect on rumen microbes viability and protecting protein from microbial degradation and in some cases decrease the volatile fatty acids production (Kostyukovsky and Marounek, 1995). In Contrast, Raiy and Mudgal (1987 reported slight improvement of rice straw IVDMD by steam treatment

(2 kg / cm^2 / 2hr). The present results also coincide with the findings of Zelenak *et al.,* 1990 who reported that *in situ* DMD of barley straw and other fibrous by-products was significantly increased by steam treatment. Values of low protein degradability at 120 hr compared with 96 hr of incubation time might be attributed to influx of microbial populations as they possibly can modify degradation conditions based on the bag pore size as indicated by Michalet-Doreau and Ould-Bah (1992).

In Situ NDF and ADF degradation:

The *in situ* degradation pattern for NDF and ADF of SPT1, SPT2, SPT3, SPT4, and SPT5 at 6, 12, 24, 48, 72 and 96 hr of incubation was almost the same as that shown in Tables 4 and 5. However, NDF and ADF degradation of SPT5 at 24 hr was significantly lower *vs* SPT1, SPT2, SPT3, and SPT4, but a sharp increase occurred at 48 hr to match with the previous treatments. On the other hand, the NDF and ADF degradability values of Rhodes grass hay (RH) were significantly (P<.05) lower than the other treatments at similar incubation intervals.

Table 4. *In Situ* NDF degradation of Rhodes grass hay *vs.* spartina grass hay in cannulated camels

Time	NDF Degradation, %						±SE
(hr)	Rhodes	SPT1	SPT2	SPT3	SPT4	STP5	
6	0.9^{b}	13.3^{a}	14.7^{a}	11.2^{a}	13.6^{a}	18.4^{a}	2.17
12	8.5^{b}	30.1^{a}	29.0^{a}	23.5^{a}	24.3^{a}	27.4^{a}	2.59
24	16.3^{c}	45.8^{a}	51.2^{a}	47.5^{a}	50.1^{a}	31.1^{b}	2.41
48	34.7^{b}	62.2^{a}	62.9^{a}	62.8^{a}	62.2^{a}	59.6^{a}	2.78
72	45.0^{b}	65.7^{a}	66.0^{a}	66.9^{a}	64.4^{a}	68.8^{a}	2.58
96	54.7^{b}	69.0^{a}	67.6^{a}	68.2^{a}	65.4^{a}	69.5^{a}	1.30
120	58.9^{d}	68.3^{b}	96.1^{b}	69.7^{ab}	64.1^{c}	71.7^{a}	0.78

Means in the same row followed by different letters differ significantly (P<.05).

Table 5. *In Situ* ADF degradation of Rhodes grass hay *vs.* spartina grass hay in cannulated camels

Time	ADF Degradation (%)						±SE
(hr)	Rhodes	SPT1	SPT2	SPT3	SPT4	STP5	
6	1.5^{b}	1.2^{b}	13.6^{a}	13.5^{a}	13.6^{a}	12.2^{a}	2.72
12	4.5^{b}	8.5^{b}	26.8^{a}	23.0^{a}	25.1^{a}	21.4^{a}	2.96
24	13.7^{c}	23.2^{b}	44.4^{a}	43.9^{a}	47.9^{a}	26.9^{b}	2.40
48	35.5^{b}	39.1^{b}	55.8^{a}	56.7^{a}	59.7^{a}	55.8^{a}	3.24
72	46.1^{b}	42.9^{b}	57.8^{a}	60.9^{a}	61.5^{a}	64.1^{a}	2.14
96	46.2^{b}	47.0^{b}	60.4^{a}	62.1^{a}	63.4^{a}	65.1^{a}	3.30
120	61.6^{b}	45.6^{c}	61.4^{b}	63.5^{ab}	62.2^{b}	67.1^{a}	1.28

Means in the same row followed by different letters differ significantly (P<.05)

The increase of NDF degradability values of spartina was 1.16 times *vs.* RH at 6, 12, 24, 48, 72, 96 and 120 hr, respectively. While, ADF increases were 6.48, 4.67, 2.72, 1.70, 1.25, 1.29 and 0.97 times *vs.* RH at 6, 12, 24, 48, 72, 96 and 120 hr, respectively. In addition, the depression of Rhodes NDF and ADF degradation at 24 hr was associated with the depression of CP degradability at the same time as shown

in Tables 3, 4 and 5. Regarding the impact of steam pressure treatment of spartina hay (SPT5) on NDF and ADF degradation; there was insignificant influence except for at 24 hr which significantly (P<.05) declined compared with SPT1, SPT2, SPT3 and SPT4. The present results agree with the findings of Kostyukousky and Marounek (1995) who indicated that the Millard reaction products (MRPs) generated by autoclaving may decrease availability of sugars in feedstuffs for microorganisms as an easy source of energy.

Also Fedel (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 that 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. Degradability of CF was significantly increased by steam pressure (1 kg / cm2 / 1hr) of wheat straw (Rai and Mudgal, 1988) and by heating of rice straw at 190^{o}C/10-16 min. / 12 Par as concluded by Hagemeister and Ahrens (1986). Rai and Mudgal (1986) and Zelenak, *et al.* (1990) confirmed those that *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).

In vitro gas production

The data obtained from gas production showed a different pattern from that found from *in situ* DM, CP, NDF and ADF degradation as shown in Table 6.

Table 6. *In Vitro* gas production (ml/0.20 g DM) of Rhodes grass hay *vs.* spartina grass hay

Time (hr)	Gas Production, ml						±SE
	Rhodes	SPT1	SPT2	SPT3	SPT4	STP5	
3	1.3	1.3	0.7	0.7	1.3	1.3	0.72
6	4.0^{ab}	3.3^{b}	4.0^{ab}	4.0^{ab}	3.3^{b}	5.3^{a}	0.52
12	8.0^{b}	6.0^{c}	8.7^{b}	4.7^{d}	8.7^{b}	10.3^{a}	0.39
24	20.3^{b}	16.3^{c}	17.7^{bc}	12.0^{d}	17.0^{c}	25.3^{a}	1.00
48	37.0^{a}	24.0^{b}	28.3^{b}	18.3^{c}	27.3^{b}	34.0^{a}	1.32
72	43.7^{a}	24.7^{cd}	31.0^{b}	22.0^{d}	30.0^{bc}	36.0^{b}	1.85

Means in the same row followed by different letters differ significantly (P<.05)

Gas production (ml) of all treated spartina insignificantly differ at 3 hr of incubation, whereas at 6, 12 and 24 hr the value of gas produced by SPTS was significantly (P<.05) higher than the other treatments. Comparing Rhodes grass hay with the other treatments (with exception of STP5), the measured gas indicated that there were insignificant changes up to 12 hr, but an obvious significant increased of gas volume was measured from 24 hr up to 72 hr of incubation. The gas production profile of RH and SP5 is almost the same as in *in situ* DM, CP, NDF and ADF all of which appreciably increased after 24 hr of incubation. The closest gas production to RH and SPT5 was SPT2 and SPT4. The present results concerning the effect of steam treatment on 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, compared to 41.6% in the present investigation.

Zelenak, *et al.* (1990), Broderick, *et al.* (1993) and Zhao *et al.* (1996) stated that insignificant changes occurred in ruminal total volatile fatty acids of livestock fed an heated or steamed roughages.

CONCLUSION

Based on the approximate analysis and *in situ* nutrient degradation and *in vitro* gas production it could be concluded that; SPT2, SPT3 and SPT4 were always the best for *in situ* DM, CP, NDF and ADF degradability. As a result of washing and steam treatment, the total ash content was reduced in SPT2, SPT4 and SPT5 by 30% in average. So there is no need to do the steam treatment which is sometimes expensive and not applicable. Hemicellulose of spartina grass is considerably higher than Rhodes grass, accordingly the cellulose and lignin of Rhodes hay is higher compared with saprtina hay, speculating that spartina is more fermentable as indicated by *in vitro* gas production. Additional *in vivo* experiments and palatability studies are required to carry out on spartina grass hay to be approved as non-conventional feed resource for livestock in arid lands and coastal regions.

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تكسير المادة الجافة والألياف الخام بطريقة أكياس النايلون وإنتاج الغاز معملياً لحشيشة (*Spartina alterniflora Lois.*) المروية بماء البحر بكرش الإبل العربية

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هدفت الدراسة إلى تقييم القيمة الغذائية لحشيشة (*Spartina alterniflora Lois.*) المروية بماء البحر بنظام الغمر. إستخدمت ثلاثة نوق بالغة ذات فتحة مستديمة بالكرش لقياس تكسير المادة الجافة والألياف الخام. أستخدمت حشيشة الرودس (*Chloris gyana*) المروية بالماء العذب للمقارنة. تم جمع عينات حشيشة *Spartina* من محطة بحوث الذهبية. كانت المعاملات كالتالى: ١- حشيشة *Spartina بدون غسيل (SPT1*)، ٢- حشيشة *Spartina* مغسولة بالماء العذب بعد قطعها (*SPT2*)، ٣- حشيشة *Spartina* مغسولة بماء االبحر قبل قطعها (*SPT3*)، ٤- حشيشة *Spartina* مغسولة بماء االبحر قبل وبعد قطعها (*SPT4*)، ٥- – حشيشة *Spartina* معاملة بالبخار، ٢٠٠ درجة مئوية/١٧ ضغط جوى/ ٢ دقيقة (SPT5). أوضحت التحليلات الكيميائية تقارب المحتوى البروتينى لكل من حشيشة*(SPT1*)، وحشيشة الرودس، وكان محتواهما من الرماد ٣٥.٣% ، ٩.٢٠%، على التوالى. إنخفض المحتوى الكلى من الرماد فى المعاملات SPT2, SPT4 , SPT5 إلى ٢٤.٤، ٢٤.٨ و ٢٥.٦% على التوالى كنتيجة للغسيل والمعاملة بالبخار. كذلك إنخفض تركيز كل من الصوديو والهمى سيليولوز لحشيشة Spartina المعاملة بالبخار إلى ٤ و ٧.٣% على التوالى. ومن ناحية أخرى، زادت نسبة الأزوت المرتبط بالألياف الغير ذائبة فى محلول الغسيل الحامضى (ADIN) معنوياً. كان تكسير المادة الجافة حتى ٧٢ ساعة من التحضين بالكرش أعلى معنوياً فى المعاملة SPT2, SPT4 مقارنة بالمعاملات الأخرى. بينما كان إنتاج الغاز معملياً (مل/٠.٢ جم مادة جافة) أعلى معنوياً لحشيشة الرودس عن معملات حشيشة Spartina بع ٧٢ ساعة من التحضين. يستنتج من ذللك أنه يمكن إستخدام حشيشة Spartina كمصدر علف حيوانى إذا تم غسلها بالماء العذب بعد قطعها أو بماء البحر قبل وبعد قطعها.