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# Growth Performances and Carcass Characteristics of Indigenous Lambs Fed Halophyte *Sporobolus virginicus* Grass Hay

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**ABSTRACT :** The objective of the present study was to compare feed and water intakes, growth performance and carcass characteristics of indigenous lamb fed diets containing various levels of halophyte Sporobolus grass hay. Forty male and female lambs were randomly and equally allotted with 5 lambs of each sex per treatment to four dietary treatment groups, which were initially formulated to have 100, 70, 30 or 0.0% Sporobolus grass hay, as a source of forage replacement for conventional Rhodes grass commonly used in the region. The lambs receiving 0.0% Sporobolus grass hay (100% Rhodes grass hay) served as the control. Feed and water were offered *ad libitum*. Male lambs were slaughtered at the end of the feeding trials. The average daily feed intake was significantly ($p<0.05$) higher for the animals fed different levels of Sporobolus grass hay than for the control animals. Feed conversion ratio (FCR), i.e., kg feed/kg BW, was similar in all treatment groups. Although lambs fed the diet with 70% Sporobolus grass hay had heavier carcass weights, the differences were not significant. In conclusion, growth performance or carcass characteristics of fattening indigenous lambs were not influenced by the inclusion of different levels of Sporobolus grass hay in the diet. Because of this, Sporobolus grass hay represents an alternative forage resource for sustaining small ruminant production in the saline coastal and sub-coastal areas of the world. (**Key Words** : Halophyte, Sporobolus Grass, Indigenous Lambs, Growth Performance, Carcass Characteristics)

## INTRODUCTION

Sheep numbers in the United Arab Emirates (UAE) have been estimated at about one million out of a total livestock population of over three million head (Ministry of Environment and Water, 2005). In the UAE, indigenous sheep constitute about 30-35% of the total sheep population (Al-Shorepy, 2001). Conventional production of sheep in the UAE depends primarily on feeding Rhodes grass hay and concentrates. However, fresh water available for irrigated Rhodes grass forage is under intense demand, while plenty of saline water is available for producing certain forages. Salt-tolerant forages, especially grasses that could grow well under saline irrigation, would be potentially valuable alternative forage resources and could play a major role in sustaining livestock production (Glenn and O'Laeary, 1985; Gihad, 1993; Gihad and El Shaer, 1994; Masters et al., 2007).

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The general nutritional characteristics of salt-tolerant forages have been well defined and the nutritional composition varies by species, stage of maturity and salinity of the irrigation source (Alhadrami et al., 1998; Robinson et al., 2004). However, many researchers reported that animals fed salt tolerant forage might have lower appetite and growth rate than animals fed on conventional forages (Gihad and El Shaer, 1994; Glenn et al., 1994; Miyatmoto et al., 1994; Alhadrami et al., 2004). Intensive livestock production, integrated with mixed feeding of formulated rations offers other opportunities for the use of salt tolerant forages (Swingle et al., 1996; Kraidees et al., 1998; Abouheif et al., 2000).

Recently, attention has been given to the possibility of growing halophytes as irrigated crops on a large scale (Glenn and Watson 1993; Miyatmoto et al., 1994; Alhadrami et al., 2004; Al-Dakheel et al., 2006). Sporobolus grass (*Sporobolus virginicus*), well known for its high salt tolerance, has been grown as irrigated forage under high salinity condition in the UAE (Alhadrami et al., 2004; Al-Dakheel et al., 2006). Unlike other salt-tolerant plants which tend to accumulate a high content of salt in their leaves, Sporobolus grass excludes salt at the root level

(Gallagher, 1985; Glenn, 1987). This characteristic would make Sporobolus grass an attractive alternative forage for hay production in the saline coastal and sub-coastal areas of the world. Several studies were conducted in the UAE University to evaluate the effect of feeding salt-tolerant grass on the performance of livestock such as camels, sheep and goats (Alhadrami, 2003; Alhadrami et al., 2004; Al-Shorepy, 2005). It was found that the performance of these animals was not affected by replacing Rhodes grass hay with Sporobolus grass hay either partially or completely. Thus, the objective of the present study was to assess the effects of inclusion of Sporobolus grass hay as a source of forage into whole-mixed diets on growth, feed and voluntary water intake and carcass composition of indigenous lambs.

## MATERIALS AND METHODS

### Experimental animals, feeds and management

This study was carried out at the College of Food and Agriculture Experimental Station, UAE University, located in Al Foah area, 20 km north of Al Ain City. A total of 20 male and 20 female indigenous lambs, weighing an average of 15.7 and 12.7 kg respectively were used to evaluate the effect of dietary inclusion of Sporobolus grass hay on growth performance and carcass characteristics. The animals were treated against internal and external parasites before commencement of the experiment. Five lambs of each sex were randomly and equally allotted to each of four dietary treatment groups, which were initially formulated to have 100, 70, 30 or 0.0% Sporobolus grass hay, as a source of forage replacement for the conventional Rhodes grass commonly used in the region. The group receiving 0.0 Sporobolus grass hay (100% Rhodes grass hay) served as the control. Sporobolus grass was grown in saline desert lands and irrigated with groundwater of high salt content (20,000 ppm). After cutting, the Sporobolus grass was sun dried till moisture content reached about 15%. The hay was baled into rectangular bales with an average weight of 11 kg per bale. Rhodes grass hay was obtained from local commercial sources. The chemical composition of both Rhodes grass and Sporobolus grass is presented in Table 1. The diet was formulated using chopped Sporobolus grass hay and/or Rhodes grass hay and commercial concentrate to provide a ratio of 40:60 forage and concentrate, respectively. The lambs were fed in groups of the same sex. The composition of the diets offered as a total mixed ration is presented in Table 2.

**Table 1.** Chemical composition of Rhodes and Sporobolus grass (DM basis)

| Item | Rhodes grass | Sporobolus grass |
|---|---|---|
| Crude protein | 10.10 | 7.28 |
| Acid detergent fiber | 35.90 | 32.93 |
| Neutral detergent fiber | 73.21 | 72.48 |
| Ash | 10.70 | 13.45 |

Animals were subjected to the experimental diets for an adaptation period of 7 days before the commencement of the experiment. The amount of feed offered each time to the lambs was recorded daily. Refusals and wastage were weighed on the following morning. The total weight of the feed offered, adjusted for refusal and wastage, provided an estimate of the average feed consumed by each group per day throughout the study. The animals had free access to water and the volume of water offered each time was recorded daily and that remaining was recorded on the following morning. Daily water intake, corrected for losses, provided an estimate of the average water intake per day for each group. Animals were weighed on a weekly basis before offering fresh feed allowance. Samples of feed were collected biweekly for proximate analyses (AOAC, 1990).

### Slaughtering procedures

At the end of a 63-day period, the male lambs (20) were slaughtered according to Islamic tradition. The lambs were fasted for at least 12 h and body weight (BW) was recorded before slaughter. After slaughtering, head, skin, feet and

**Table 2.** Ingredients of the experimental diets

| Item | Treatment (% Sporobolus) | | | |
|---|---|---|---|---|
| | 0.0 | 30 | 70 | 100 |
| Ingredient (%) | | | | |
| Sporobolus grass hay | 0.0 | 13.6 | 26.4 | 40.0 |
| Rhodes grass hay | 40.0 | 26.4 | 13.6 | 0.0 |
| Barley grain | 28.0 | 28.0 | 28.0 | 28.0 |
| Wheat Bran | 17.0 | 17.0 | 17.0 | 17.0 |
| Soya bean meal | 13.0 | 13.0 | 13.0 | 13.0 |
| Di-calcium | 1.0 | 1.0 | 1.0 | 1.0 |
| Vitamin and minerals | 0.5 | 0.5 | 0.5 | 0.5 |
| Trace mineralized salt | 0.5 | 0.5 | 0.5 | 0.5 |
| Crude protein of the diet (on DM Basis) | 13.8 | 13.4 | 13.2 | 13.1 |

offal were removed and weighed. The reticulo-rumen was weighed both full and empty and gut content was calculated as the difference between the two weights. Empty body weight (EBW) was computed by subtracting the weight of digesta from live weight. The weights of other components of offal or non-carcass parts such as kidney and pelvic fat and different organs (liver, spleen, heart, kidneys, lung and trachea, diaphragm and testes) were recorded. The weight of the non-carcass components was expressed as a percentage of EBW. The dressing percentage was calculated as follows: dressing percentage = carcass weight/weight at slaughter; real dressing percentage = carcass weight/EBW. The carcass was then split longitudinally into two halves following the dorsal mid-line. From the left side, the 9th, 10th and 11th ribs were cut laterally to the vertebral column and parallel to the rib and subcutaneous fat thickness over *M. longissimus dorsi* (LD) muscle was measured with a caliper. At the same point, LD area was drawn on acetate paper and measured with a planimeter.

**Measurements**

The following measurements were recorded or calculated: average daily gain (ADG, g/d) was calculated as (final BW-initial BW/days on feed); intake was calculated on a DM basis (DMI, g/d); feed conversion ratio (FCR) was calculated by dividing DMI/weight gain; water consumption per unit feed intake (l/kg) was calculated as (TWI/DMI).

**Statistical analysis**

Data were statistically analyzed using the General Linear Model procedures of SAS (1999). The linear model included effects of dietary treatment, sex of the lamb and their interaction in a 4×2 factorial design. A linear model that included only the effect of dietary treatment was used to analyze slaughtering characteristics for males. Significant differences among treatment means for dietary effect on growth and carcass parameters were analyzed using the least significant difference (LSD) method (Steel and Torrie, 1986). Significance was declared at $p<0.05$.

## RESULTS AND DISCUSSION

**Feed and water intakes**

Feed and water intakes for the indigenous male and female lambs are presented in Table 3. The average daily feed intake per animal for both males and females was significantly higher ($p<0.05$) for animals fed the diet containing 100% Sporobolus grass hay than for those fed either 30 or 0.0% Sporobolus grass hay. On average, animals fed 100% Sporobolus grass hay consumed 13% more than animals fed the control diet (100% Rhodes grass

**Table 3.** Least square means of feed and water intakes in indigenous lambs fed different levels of Sporobolus grass hay

| Sporobolus (%) | Sex | Daily feed intake (kg) | Daily water intake (L) | Water intake/feed (L/kg) |
|---|---|---|---|---|
| 0.0 | Male | $0.94^{b}$ | $2.31^{d}$ | $2.48^{bc}$ |
| 30.0 | Male | $0.98^{b}$ | $3.35^{b}$ | $3.44^{a}$ |
| 70.0 | Male | $1.10^{a}$ | $3.72^{a}$ | $3.52^{a}$ |
| 100.0 | Male | $1.10^{a}$ | $2.65^{c}$ | $2.617^{b}$ |
| 0.0 | Female | $0.72^{c}$ | $2.03^{b}$ | $2.84^{c}$ |
| 30.0 | Female | $0.79^{b}$ | $2.66^{a}$ | $3.38^{b}$ |
| 70.0 | Female | $0.74^{c}$ | $2.74^{a}$ | $3.79^{a}$ |
| 100.0 | Female | $0.83^{a}$ | $2.62^{a}$ | $3.191^{b}$ |
| Pooled SEM | | 0.01 | 0.05 | 0.07 |
| Main effect | | | | |
| Sex | Male | $1.02^{a}$ | $3.01^{a}$ | $3.01^{b}$ |
| | Female | $0.77^{b}$ | $2.52^{b}$ | $3.30^{a}$ |
| Pooled SEM | | 0.01 | 0.04 | 0.06 |
| Diet type | 0.0% Sporobolus | $0.83^{c}$ | $2.17^{d}$ | $2.66^{d}$ |
| | 30.0% Sporobolus | $0.88^{b}$ | $3.007^{b}$ | $3.41^{b}$ |
| | 70.0% Sporobolus | $0.91^{ab}$ | $3.24^{a}$ | $3.66^{a}$ |
| | 100.0% Sporobolus | $0.94^{a}$ | $2.64^{c}$ | $2.904^{c}$ |
| Pooled SEM | | 0.01 | 0.06 | 0.07 |
| Probabilities | | | | |
| Sex | | 0.001 | 0.001 | 0.001 |
| Diet type | | 0.001 | 0.001 | 0.001 |
| Diet type×sex | | 0.001 | 0.001 | 0.03 |

Values in columns within each subcategory with different superscripts are significantly different ($p<0.05$).

hay). Daily water consumption per animal was significantly higher ($p<0.05$) for animals receiving the diet containing 70% Sporobolus grass hay compared to the control treatment. The volume of water intake per unit of feed was higher ($p<0.05$) for animals fed 70% Sporobolus grass hay than for the other groups.

Similar results have been reported by Alhadrami et al. (2004), who observed higher feed intake for ewe lambs fed a diet containing 100% Sporobolus grass hay. Swingle et al. (1996), reported higher dry matter intake for lambs fed a diet containing halophyte forages than for lambs fed the control diet (Bermuda grass). Also, Swingle et al. (1996) found that lambs fed diets containing halophyte forages consumed up to 110% more water per day and 50% more water per kilogram of dry matter intake than those fed diets containing Bermuda grass. The increased water consumption of the lambs fed diets containing Sporobolus grass hay probably reflected a higher amount of sodium in the diet. The increased voluntary water intake is most likely due to the homeostatic requirement to excrete excess sodium (Reffett and Boling, 1985).

**Growth rate and feed conversion ratio**

Growth rate of indigenous lambs is presented in Table 4. Both initial and final weights and average daily gains of animals were not significantly different between groups. However, lambs fed diets containing Sporobolus grass hay tended to gain weight faster than those on the control treatment (100% Rhodes grass hay). The rate of growth for all diets was linear throughout the study (Figure 1).

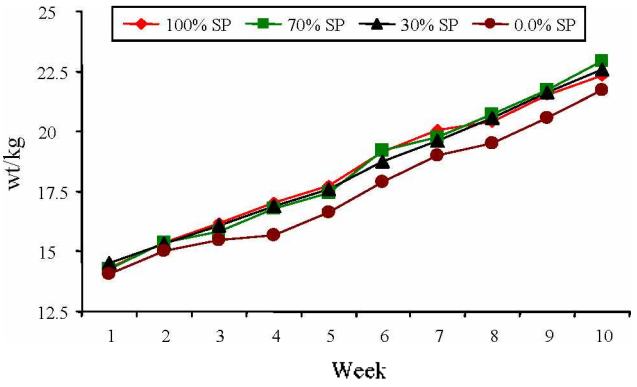


**Figure 1.** Growth rate of indigenous lambs fed different levels of Sporobolus grass hay.

In general, live-weight growth of indigenous lambs in the current study was comparable with better-known tropical breeds at similar age and given a traditional forage (Gatenby, 1986; Singh et al., 2003). Swingle et al. (1996) found that inclusion of halophyte forages supported the same weight gain of lambs as *cynodon* (Bermuda grass) hay.

**Table 4.** Least square means of growth rate and feed efficiency in indigenous lambs fed different levels of Sporobolus grass

| Sporobolus % | Sex | Initial body weight (kg) | Final body weight (kg) | Average daily gain (g) | Feed conversion ratio |
|---|---|---|---|---|---|
| 0.0 | Male | 15.4 | 24.7 | 147.6 | 6.5 |
| 30 | Male | 15.3 | 24.8 | 150.8 | 6.7 |
| 70 | Male | 16.4 | 27.2 | 171.4 | 6.4 |
| 100 | Male | 16.1 | 25.1 | 142.8 | 7.8 |
| 0.0 | Female | 12.7 | 18.7 | 95.2 | 8.1 |
| 30 | Female | 13.7 | 20.4 | 106.3 | 7.6 |
| 70 | Female | 12.1 | 18.7 | 104.8 | 7.2 |
| 100 | Female | 12.5 | 19.6 | 112.7 | 9.3 |
| Pooled SEM | | 0.34 | 0.37 | 2.36 | 0.84 |
| Main effect | | | | | |
| Sex | Male | 15.8 | 25.4[a] | 153.2[a] | 6.86 |
| | Female | 12.7 | 19.3[b] | 104.8[b] | 8.06 |
| Pooled SEM | | 0.78 | 0.88 | 5.81 | 0.57 |
| Diet type | 0.0% Sporobolus | 14.1 | 21.7 | 121.4 | 6.9 |
| | 30% Sporobolus | 14.5 | 22.6 | 128.6 | 6.9 |
| | 70% Sporobolus | 14.2 | 22.9 | 138.1 | 6.6 |
| | 100% Sporobolus | 14.3 | 22.3 | 127.8 | 7.5 |
| Pooled SEM | | 1.25 | 1.63 | 11.51 | 0.82 |
| Probabilities | | | | | |
| Sex | | 0.62 | 0.001 | 0.001 | 0.16 |
| Diet type | | 0.98 | 0.90 | 0.57 | 0.49 |
| Diet type×sex | | 0.85 | 0.71 | 0.46 | 0.96 |

Values in columns within each subcategory with different superscripts are significantly different ($p<0.05$).

Kraidees et al. (1998) reported that Najdi lambs fed diets containing Salicornia stems tended to gain weight faster than those fed diets containing Rhodes grass hay. It was assumed that the improvement in body weight gain might be related to increased body-water retention and accumulation of sodium (Kraidees et al., 1998; Masters et al., 2005).

Feed conversion ratio (FCR; kg feed/kg BW) was lower for animals fed 70% Sporobolus grass hay than in the other three treatment groups. Though not significant, lambs fed a diet containing 100% Sporobolus grass hay had the highest FCR. FCR in the current study was similar to tropical (Al-Dabeeb, 2005) and temperate (Butterfield, 1988) sheep. The values of FCR obtained in the current study for animals fed diets containing Sporobolus grass hay were comparable to those reported for similar breeds. Mahgoub et al. (2000) recorded a FCR of 8.47 and 7.3 in sheep fed medium and high energy diets, respectively.

**Carcass characteristics**

Ram lambs fed various levels of Sporobolus grass hay and slaughtered at the end of the experiment at about 145 days of age had similar weights at slaughter and for hot carcass and empty body weights (EBW) (Table 5). Though not significant, lambs fed 70% Sporobolus grass hay tended to have higher slaughter weight compared with those lambs which received 0% Sporobolus grass hay (100% Rhode grass hay). Lambs fed 100% Sporobolus grass hay had significantly ($p<0.05$) lower digestive tract contents than those fed either 0 or 30% Sporobolus grass hay. Expressed as % EBW, there were no differences in non-carcass components between lambs fed different levels of Sporobolus grass hay. Both physical and chemical composition of ribs were not influenced by the inclusion of different levels of Sporobolus grass hay in the diets.

Very little literature is available concerning effects of feeding Sporobolus grass hay on carcass characteristics. However, Swingle et al. (1996) concluded that inclusion of halophyte forages did not affect the carcass value of all experimental lambs. Kraidees et al. (1998) found that replacing Rhodes grass by Salicornia stems in the diet did not have any adverse effect on carcass characteristics of growing Najdi lambs if fresh water was available. The results found in this study were comparable to those

**Table 5.** Least squares means for proportion of non-carcass components and carcass measurements for indigenous lambs fed different levels of Sporobolus grass hay

| | Treatment (% Sporobolus) | | | | Pooled SEM | p |
|---|---|---|---|---|---|---|
| | 0.0 | 30 | 70 | 100 | | |
| Slaughter weight (kg) | 24.9 | 25.2 | 27.3 | 25.2 | 2.11 | 0.84 |
| Empty body Weight[a] (kg) | 20.32 | 21.0 | 22.6 | 21.3 | 1.96 | 0.86 |
| Hot carcass weight (kg) | 10.6 | 10.6 | 11.5 | 10.7 | 1.11 | 0.92 |
| Hot dressing percentage (%) | 42.2 | 41.9 | 42.0 | 41.9 | | |
| Digestive tract content (kg) | 4.6[a] | 4.2[ac] | 4.7[a] | 3.9[bc] | 0.25 | 0.16 |
| Proportion (%) on EBW[b] | | | | | | |
| Hot carcass | 51.8 | 50.5 | 50.8 | 49.8 | 0.99 | 0.56 |
| Skin and limbs | 14.8 | 14.4 | 14.9 | 14.3 | 0.55 | 0.86 |
| Heart, lungs and liver | 3.9 | 3.9 | 3.9 | 3.8 | 0.21 | 0.95 |
| Fat (total) | 7.2 | 6.5 | 8.2 | 7.0 | 0.84 | 0.52 |
| Full digestive tract | 32.9 | 30.4 | 30.3 | 28.1 | 2.12 | 0.47 |
| Empty digestive tract | 9.9 | 9.7 | 9.3 | 9.1 | 0.54 | 0.72 |
| Head | 7.3 | 7.1 | 7.0 | 7.4 | 0.21 | 0.62 |
| Physical dissection of rib cut | | | | | | |
| Rib weight (gm) | 254.0 | 286.0 | 286.0 | 254.0 | 28.61 | 0.68 |
| Rib area (cm) | 9.7 | 9.3 | 9.4 | 11.1 | 0.89 | 0.48 |
| Lean (%) | 54.2 | 43.3 | 50.2 | 52.0 | 10.74 | 0.94 |
| Fat (%) | 21.7 | 21.8 | 22.7 | 20.0 | 6.10 | 0.98 |
| Bone (%) | 16.7 | 22.0 | 19.1 | 21.5 | 2.84 | 0.53 |
| Chemical composition of *L. Dorsi* muscle (% DM) | | | | | | |
| Protein | 83.1 | 83.9 | 81.6 | 83.4 | 0.95 | 0.86 |
| Ether extract | 11.5 | 11.1 | 12.9 | 12.0 | 1.04 | 0.91 |
| Ash | 4.2 | 4.0 | 4.1 | 4.0 | 0.12 | 0.94 |

Values in columns within each subcategory with different superscripts are significantly different ($p<0.05$).

[a] Whole empty body = Live weight minus stomach and intestinal contents.

[b] The weight of an organ or tissue relative to that of the whole empty body weight as a percentage.

reported for the Omani breed of sheep. Mahgoub and Early (2000) reported that hot carcass as a proportion of EBW ranged from 52-53%. Moreover, Mahgoub et al. (1998) found that slaughter weight of Omani lambs fed Rhodes grass hay at 162 days of age was 28.3 kg. Alhadrami et al. (1997) reported similar rib cut results for lambs of the same breed fed a diet containing 60% concentrate.

In the absence of mineral content of the Sporobolus hay, it appears that the rate of passage of digesta may have accelerated in lambs fed diets containing different levels of Distichlis grass hay. This implied a reduction of digesta-residue time in the rumen which might have increased the flow of dietary protein and soluble nutrients to the small intestine and resulted in increased absorption of nutrients of dietary origin, thereby accounting for the lower feed conversion efficiency and higher gain. This is consistent with the findings of Kraidees et al. (1998) who reported a higher gain for lambs fed Salicornia stems than on the control treatment. They further concluded that the changes in gain were presumably a direct consequence of higher mineral intake on the Salicornia diets. In addition, Kellaway et al. (1977) found that inclusion of Na up to 20 g/kg DM was well tolerated by calves; the growth rate was 44% greater at 20 g Na/kg DM in comparison to 2 g Na/kg DM. Moreover, Tomas et al. (1973) reported that, on mixed hay and concentrate diets, increased dilution rate in the rumen enhanced the efficiency of microbial protein synthesis. Findings of the current study indicated that diets based on 70% Sporobolus grass hay gave little advantage to experimental lambs over either Rhodes grass or other diets. This was reflected by higher daily gains, better feed conversion ratios (less feed per kg weight) and better slaughtering characteristics.

## CONCLUSION

Findings of the present study suggest that inclusion of up to 100% Sporobolus grass hay in the diet did not have an adverse effect on growth performance or carcass characteristics of growing indigenous lambs. Therefore, Sporobolus grass could become an important forage resource for sustaining small ruminant production in the saline coastal and sub-coastal areas of the world. Although the water requirement of the animals is higher when feeding this grass, the net saving of fresh water is substantial.

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