*Egyptian J. Nutrition and Feeds (2009) 12 (2) : 229-241*

# INTAKE AND NUTRITIVE VALUE OF SOME SALT TOLERANT FODDER GRASSES FED TO SHEEP UNDER SALINE CONDITIONS OF SOUTH SINAI.

**A.A. Fahmy, K. M. Youssef and H. M. El-Shaer**

*Animal Nutrition Department, Desert Research Center.*

***(Received 3/2/2009, Accepted 5/4/2009)***

## SUMMARY

Utilization of salt tolerant plants has become an appropriate approach to solve the problems of animal feed shortage. This study aimed to evaluate the palatability and nutritional values of three cultivated salt tolerant grasses (Sudan grass, Pear millet and Sorghum grass) irrigated with two levels of water salinity ( level 1, L1, 4000 ppm and level 2, L2, 7000 ppm total salts). Six equal number groups of adult Barki rams were offered one of the three grasses for each group. A palatability trial followed by a digestibility trial was conducted where some nutritional measurements were evaluated. The results showed that grasses irrigated with L1 and L2 water salinity appeared to be nutritious for sheep since it contained enough concentrations of CP with low contents of ADF and ADL. The VFI of the grasses was slightly affected by the level of water salinity. Digestion of all nutrients were varied and affected to some extents by levels of water salinity. Digestion of DM, CF and NFE were higher for animals of L1 compared to those of L2. The nutritive values of the grasses were influenced by the levels of water salinity. All grasses irrigated by L2 attained significant higher DCP values than those irrigated byL1. Regardless plant species, animals fed the grasses of L2 retained around 38% more nitrogen than those of L1. Sheep fed the three grasses irrigated with L2, generally, retained positive various amounts of copper, zinc and cobalt but they should be supplemented with such trace elements if they fed on grasses irrigated with L1. The forages production for all grasses of L1 was greater than those of L2.

*Keywords: sheep, salt tolerant grasses, feeding value, grass yield, salinity*

## INTRODUCTION

Salinity is a global problem worldwide in particular in arid and semi- arid zones in countries of North Africa and the Near East regions. Saline soils of various nature and degree occupy over 80 million hectares in the Mediterranean basin (Anon, 2006). The cultivation of salt-tolerant crops or halophytes on saline soil has significant social and economic potential that needs to be further explored and developed. The problems confronting farmers in Egypt are associated with how to prevent salinification and to produce economic fodder crops to overcome the problems of feed shortage and high feeding costs. Promising results have been obtained in different countries in the region with rehabilitation of potential halophytic species (Nemati, 1976 and El Shaer, 2004) particularly for fodders production. Several investigators concluded that cultivation of salt and drought tolerant fodder shrubs (i.e, *Atriplex spp, Acacia saligna and kochia indica* etc.) and salt and drought tolerant grasses and legumes (sorghum, pearl millet, sudan grass, alfalfa, sanfoin, etc.) may consider the appropriate solutions for filling the gab of feed deficiency in arid and saline areas (El Shaer, 2006; Khafaga, 1999 and Hanfy, *et al.*, 2007). This study aimed to evaluate the palatability and nutritional values of three annual salt tolerant grasses irrigated with two levels of salinity in ground water using sheep. The biomass production of the grasses and the nutritional performance of sheep were tested.

## MATERIALS AND METHODS

The study was undertaken at South Sinai Research Station, Desert Research Center, Sinai Peninsula, (200 Km southeast of Cairo) during late summer of 2007.

***Cultivation and preparation of experimental plants:***

Three annual salt tolerant grasses: Sudan grass *(Sorghum sudanonse)*, Pearl millet grass (*Pennisetum americanum*) and Sorghum grass (*Sorghum bicolor)* were cultivated in the salt affected soil of South Sinai Research Station. Two levels of underground water salinity were used for irrigation: level 1 (L1, 4000 ppm) and level 2 (L2, 7000 ppm total salts). Chemical composition of irrigation water is shown in Table 1. The daily harvested plant materials were mechanically chopped into small pieces( averaged 10 cm length) to be offered to the experimental animals. The total fresh and dry yields of the cultivated grasses were determined and recorded. Salinity concentration (EC) in level 2 of salinity (L2) was almost doubled that of the level 1 (L1) most of minerals of L2 such as Na, K and Cl concentrations were higher than those of the L1. The soil of the field in the Research Station is characterized as loamy sand texture where EC was around 10 ds/m which was considered as strongly saline. The CaCO3, Cl, Na, Ca, Mg and K concentrations were : 40, 42, 11.6, 15.2, 10.8 and 7.5 mg/ 100mg, respectively.

**Table (1): Averages of chemical analysis of ground water irrigation at South Sinai Research Station.**

| Item | Level 1 of salinity* | Level 2 of salinity* |
|---|---|---|
| pH | 7.67 | 7.39 |
| EC, ds/m | 7.53 | 13.9 |
| $Na^{+}$ mg/100 mg | 30.3 | 40.2 |
| $Ca^{++}$ mg/100 mg | 20.6 | 23.94 |
| $Mg^{++}$ mg/100 mg | 11.9 | 16.6 |
| $K^{+}$ mg/100 mg | 0.99 | 2.88 |
| Cl mg/100 mg | 29.1 | 42.43 |
| $HcO_3$ mg/100 mg | 3.28 | 3.28 |
| $So_4$ mg/100 mg | 20.2 | 24.3 |

**Level 1 of salinity (L1) and Level 2 of salinity (L2).*

***Animal feeding and measurements:***

Eighteen adult Barki rams were used in six groups (3 rams per group) in a randomized design (two by three factorial designs: two salinity levels X three plant species). Each rams group was offered one of the following six grasses: Sudan grass, pear millet and sorghum grass irrigated with L1 and L2 ground water salinity (Group 1, Group 2 and Group 3, Group 4, Group 5 and Group 6, respectively). The animals were housed in separate shaded pens for 30 days period in a palatability trial, and then moved to individual metabolic cages for additional 15 days as digestibility trials. During the palatability trial, the initial live body weight of rams were 38.7±2.03, 39.3±2.92, 39.7±4.34 ,40.5±1.38, 40.7±1.83, 41.1±3.84 Kg for $1^{st}$, $2^{nd}$, $3^{rd}$, $4^{th}$, $5^{th}$ and $6^{th}$ group, respectively. All animals were individually offered weighed amount of each grasses *ad libitum* twice daily at 08:00 and 16:00 and concentrate feed mixture (CFM) was given, as feed supplement, to cover 50% of their energy maintenance requirements according to the recommendations of Kearl ( 1982). The CFM consisted of 30% cotton seed cake, 47% yellow corn, 20% wheat bran, 2% limestone and 1% common salt; which contained: 91.2, 8.2, 20.8, 11.1, 6.9 and 53 % for DM, Ash, CP, CF, EE, NFE, respectively. The daily voluntary feed intake (VFI) of grasses was calculated for each animal. All animals were weighed at the beginning of the experiment and every other week and biweekly body weight changes were recorded. Drinking water was offered free choice.

***Metabolism trials:***

At the end of palatability period, the animals were moved to the metabolism cages for two weeks, the first week was an adaptation period followed by another week as a collection period where 90% of the VFI of each grasses were offered to animal according to their groups and total feed intakes was recorded. Drinking water was available for one hour daily, measured and recorded. Composite samples from each grass species was collected, oven dried at 65 °C for 48 hours and ground, then kept for proximate chemical analyses and mineral composition .Urine and feces were collected , measured and sampled for proximate analysis.

***Analytical and statistical analyses:***

Proximate analysis of diets (grasses and CFM), faeces were tested A.O.A.C, (1990). Total nitrogen in urine was determined by the micro Kijeldahl methods. Fiber constituents (neutral detergent fiber, NDF, acid detergent fiber, ADF, acid detergent lignin, ADL) were determined according to Goering and Van Soest, 1970. Hemicellulose and cellulose values were calculated by difference. Sodium (Na) and potassium( K) were determined in feed, refusal, faeces, urine and drinking water by using the standard flame photometry (Jackson, 1958) while Copper (Cu), Zinc (Zn) and Cobalt (Co) concentrations were tested using atomic absorption techniques.

The data were statistically analyzed using two way analysis of variance (2 levels of salinity X 3 forage species factorial design). Data were subjected to the statistical analysis system according to SAS (1993). Differences in mean values among groups were compared by Duncan' s Multiple Range Test, (Duncan, 1955).

## RESULTS AND DISCUSSION

***Chemical and mineral composition of the experimental diets:***

Regardless the plant species, as illustrated in (Table 2) plants irrigated with L2 contained higher CP, ADL, ash and the trace elements (Cu, Zn and CO) contents in comparison with those irrigated with L1 of water salinity. On the other hands, CF, EE, and NDF, Na, K concentrations were not affected by salinity levels in irrigation water.

**Table (2): Chemical composition, fiber constituents and mineral contents of the experimental fodder grasses.**

| Item | level 1 of salinity (L1) | | | Level 2 of salinity (L2) | | |
|---|---|---|---|---|---|---|
| | Sudan Grass | Pearl Millet | Sorghum | Sudan Grass | Pearl Millet | Sorghum |
| **Chemical composition, %** | | | | | | |
| DM | 91.1 | 91.7 | 90.4 | 88.2 | 89.1 | 88.5 |
| Ash | 10.4 | 14.9 | 10.9 | 12.6 | 14.4 | 14.5 |
| CP | 12.3 | 13.4 | 11.8 | 13.6 | 13.6 | 13.2 |
| CF | 24.1 | 25.8 | 24.9 | 24.3 | 26.1 | 24.9 |
| EE | 2.1 | 2.8 | 1.65 | 1.85 | 1.49 | 2.86 |
| NFE | 51.1 | 43.1 | 50.75 | 47.65 | 44.41 | 44.56 |
| **Fiber constituents, %** | | | | | | |
| NDF | 76.8 | 81.2 | 77.0 | 73.1 | 82.4 | 76.6 |
| ADF | 32.8 | 32.3 | 37.6 | 29.7 | 33.5 | 28.3 |
| ADL | 3.13 | 2.32 | 2.58 | 4.10 | 4.90 | 3.20 |
| **Mineral contents :** | | | | | | |
| Sodium (Na ), % | 2.1 | 1.8 | 1.7 | 2.1 | 2.1 | 1.9 |
| Potassium (K ), % | 3.7 | 3.0 | 2.5 | 3.8 | 3.1 | 2.5 |
| Cobalt (Co), PPM | 81 | 85 | 88 | 91 | 105 | 102 |
| Zinc (Zn) , PPM | 78 | 53 | 48 | 81 | 80 | 80 |
| Cupper (Cu), PPM | 12 | 11 | 14 | 15 | 18 | 16 |

Regardless the level of salinity, CP content was relatively similar in all forage species (averaged 13.0, 13.5 and 12.5 % for Sudan grass, Pear millet and Sorghum grass, respectively whereas Pear millet grass attained more concentrations of ash and CF. Comparable values were obtained by several investigators using Pearl millet (El Shaer *et al.*, 1987; Messman *et al.*, 1992 and Fahmy, 2001), Sorghum (Gabra, 1984) and Sudan (Moawd, 1998). The experimental grasses irrigated with two salinity levels L1 and L2 appeared to be nutritious for small ruminants since it contained enough contents of CP (averaged 13%) to cover their protein requirements with low concentrations of ADF and ADL (averaged 31.0 and 3.62% for Sudan grass; 32.9 and 3.61% for Pearl millet; 33.0 and 2.39 % for Sorghum grass, respectively). All grasses irrigated with L2 of water salinity attained higher concentrations of all minerals particularly the trace elements. However the grasses contained more than enough of the tested minerals ( Na.,K and Zn) with moderate concentrations of Cu and Co . Although some minerals concentrations (Na, K and Zn) were higher than the recommended levels, they were still within the maximum tolerance levels and far from the toxic levels for sheep (Kearl, 1982).

***Voluntary feed intake (VFI) of grasses:***

During the palatability trial, the VFI's of the grasses were affected to some extents by level of salinity in the irrigated water. The VFI were slightly improved when fed the grasses irrigated with L1 as shown in (Table 3). All animals in different groups appeared to consume enough amounts (approximately 2 % of their body weight) of the grasses to cover their nutritional requirements and also tended to gain appreciable weight (Kearl, 1982 and Fahmy 2001). The highest value (approximately 23g DM/Kg BW) was recorded for sheep fed on Sorghum irrigated with L1, whereas Sudan grass attained the highest (about 21g DM/ Kg BW) among the grasses irrigated with L2.

**Table (3): Voluntary feed intake (FVI) and body weight changes of sheep fed the grasses during the palatability trial.**

| Item | *L1 | | | *L2 | | |
|---|---|---|---|---|---|---|
| | Sudan grass | Pearl millet | Sorghum | Sudan grass | Pearl millet | Sorghum |
| No. of animals | 3 | 3 | 3 | 3 | 3 | 3 |
| Initial live weight, Kg | 38.7 | 39.3 | 39.7 | 40.5 | 40.7 | 41.1 |
| Final body weight, kg | 40.6 | 40.7 | 41.2 | 41.8 | 42.2 | 42.5 |
| Body weight change, Kg | 1.90 | 1.40 | 1.50 | 1.30 | 1.50 | 1.40 |
| VFI, g DM/Kg BW | 21.2 | 21.0 | 22.9 | 20.7 | 19.2 | 19.6 |

** Level of water salinity (L1, L2)*

***Feed intake, digestibility and nutritive values:***

Data in Table (4) revealed that all animal groups tended to consume comparable amounts of each grass irrigated by both L1 and L2 with averages of 18.9, 18.4 and 19.2 g DM/kg BW, respectively. Regardless the plant species, it seems that the consumption of grasses was not affected significantly (19.72 vs. 17.99 g DM/ Kg BW) by irrigated water salinity. Dry matter intake from Sudan grass, pearl millet and sorghum grasses irrigated with L1 of salinity were 21.2, 21 and 22.9g/KgBW. These findings are in agreement with those obtained by Mowad (1998) found that dry matter intake by sheep fed *ad libitium* from first and second cuts of pearl millet were 27.3 and 25.2 g/Kg BW. Similar trends were reported for crude protein intake.

Digestion of DM, CP, CF and other nutrients were varied and affected to some extents by levels of salinity of irrigation. Digestion of DM, CF and NFE were higher for animals fed the grasses irrigated by L1compared to those with L2, whereas CP digestion was superior without significant differences for animals fed grasses irrigated by L2 (66.2 vs. 60.6 %) due to high content of CP in grasses irrigated by L2 water salinity. As presented in table 4, the nutritive values of the grasses, in terms of total digestible nutrients (TDN) and digestible crude protein (DCP) values were significantly ($P<0.05$) influenced by the levels of salinity in irrigation water but did not varied significantly among the plant species. All grasses irrigated by L2 water salinity attained significant higher DCP values than the other grasses (10.5 vs. 9.37 %). Such results supported by the earlier trends of sheep and goats fed Pearl millet and sorghum in studies conducted by Gabra (1984), Messman, *et al.* (1992) and Abd el Baky, *et al.* (1994). Regardless salinity level, the present values of TDN (57.3%) for pearl millet are nearly similar to those (60.6%) obtained by Mowad (1998).

**Table (4): Feed intake (g/kg BW), digestibility coefficients and nutritive value by sheep fed the experimental salt tolerant grasses**

| Item | L1* | | | L2* | | | Plants | | | Salinity | | ±SE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Sudan grass | Pearl millet | Sorghum | Sudan grass | Pearl millet | Sorghum | Sudan grass | Pearl millet | Sorghum | L1 | L2 | |
| No. of animals | 3 | 3 | 3 | 3 | 3 | 3 | 6 | 6 | 6 | 9 | 9 | |
| Initial body weight, kg | 40.6 | 40.7 | 41.2 | 41.8 | 42.2 | 42.5 | 40.8 | 42.2 | 42.2 | 41.4 | 41.8 | |
| **Dry matter intake:** | | | | | | | | | | | | |
| Grasses | 19.3 | 19.2 | 20.5 | 18.6 | 17.5 | 17.9 | 18.9 | 18.4 | 19.2 | 19.72 | 17.99 | 0.59 |
| Concentrate | 7.75 | 7.62 | 7.67 | 7.72 | 7.64 | 7.56 | 7.93 | 7.63 | 7.62 | 7.68 | 7.64 | 0.048 |
| Total | 27 | 26.8 | 28.2 | 26.3 | 25.1 | 25.4 | 26.7 | 26 | 26.8 | 27.4 | 25.6 | 0.62 |
| Crude protein intake: | | | | | | | | | | | | |
| Roughage | 2.37 | 2.58 | 2.42 | 2.5 | 2.38 | 2.36 | 2.45 | 2.48 | 2.39 | 2.46 | 2.42 | 0.72 |
| Concentrate | 1.61 | 1.59 | 1.59 | 1.61 | 1.59 | 1.57 | 1.61 | 1.58 | 1.58 | 1.59 | 1.58 | 0.010 |
| Total | 3.99 | 4.16 | 4.02 | 4.14 | 3.97 | 3.93 | 4.065 | 4.066 | 3.97 | 4.056 | 4.014 | 0.077 |
| **Digestibility coefficient, %:** | | | | | | | | | | | | |
| DM | 59.5 | 59.7 | 60.7 | 55.8 | 58.5 | 55.7 | 57.7 | 59.1 | 58.2 | 60.0 | 56.7 | 0.997 |
| CP | 53.4 | 63.5 | 65 | 67.2 | 67.4 | 63.9 | 60.3 | 65.4 | 64.5 | 60.6 | 66.2 | 1.98 |
| CF | 58.2 | 63.4 | 65.5 | 53.5 | 59.8 | 55.9 | 55.9 | 61.6 | 60.7 | 62.4$^{a}$ | 56.4$^{b}$ | 1.42 |
| EE | 75.8 | 787 | 73.9 | 74.7 | 75.8 | 78 | 75.3 | 77.3 | 75.9 | 76.2 | 76.2 | 1.26 |
| N | 61.1 | 59.6 | 61.8 | 55.2 | 59.1 | 56.8 | 58.2 | 59.4 | 59.3 | 60.8 | 57 | 1.24 |
| **Nutritive values,%:** | | | | | | | | | | | | |
| TDN | 57.2 | 57.9 | 59.9 | 54.4 | 56.6 | 55.4 | 55.9 | 57.3 | 57.7 | 58.4$^{a}$ | 55.4$^{b}$ | 1.00 |
| DCP | 8.99 | 9.83 | 9.29 | 10.6 | 10.6 | 10.2 | 9.78 | 10.2 | 9.76 | 9.37$^{b}$ | 10.5$^{a}$ | 0.19 |

***a, b, c; means with different letters in the same row differ significantly (P< 0.05), otherwise no significant differences were detected.*

**Levels of water salinity (L1, L2)*

Concerning nitrogen utilization data, it was pointed out (table 5) that both nitrogen intake and fecal nitrogen were not affected significantly ($P>0.05$) by the levels of salinity in irrigation water. However, total nitrogen excretion was significantly influenced by plant species while nitrogen retention was affected only by water irrigation salinity. It appears that all animals consumed similar amounts of nitrogen( approximately 645 mg/ kg BW) since the animals consumed comparable amounts of grasses dry matter (Table 3) in addition to similar CP content in the forages as well (Table 2) . It was surprising that, regardless plant species, animals fed the grasses irrigated with L2 retained around 38% more nitrogen (as percentage of N intake or mg/kg BW) than those fed the grasses with L1. Similar findings on nitrogen retention from feeding the same grasses species irrigated with fresh water (approximately 450 ppm total salts) were obtained by Madan Mohan *et al.* (1977); El Gendy (1990) and Abd El Hamid( 1998).

Data in (Table 6) indicated that t Data in (Table 6) indicated that the measured parameters for water utilization were influenced to some extents by the two factors: irrigation water salinity and grasses species. Animals fed Pearl millet grass (irrigated with L1 or L2) tended to consume 14 and 25% drinking water more than those fed Sudan grass and Sorghum grass, respectively. Similar trends were obtained for the total water intake value which recorded 12 and 25% higher for sheep fed the Pearl Millet compared to their mates fed Sudan and Sorghum grasses, respectively. However, total water intake indicated herein for the experimental sheep were slightly higher than those reported by Fahmy (2001) and Shehata *et al.*, 2001 since their sheep on similar grasses species contained less concentrations of ash contents. It was interesting to notice that all sheep fed the three grasses irrigated with the two levels of salinity retained relatively similar amounts of water (55.8, 53.8 and 54.7 % of intake, for Sudan grass, Pearl Millet and Sorghum grasses groups, respectively).

Sodium (Na) and Potassium (K) utilization (table 7) revealed that Na intake from the grasses, Na excretion and retention did not significantly affect by either the levels of salinity in irrigation water or by plant species while all parameters of K utilization were significantly influenced by the two factors. Sheep fed Sudan grass irrigated by L1 or L2 consumed slightly higher ($P>0.05$) amounts of Na but with significant amounts of K compared to those fed Pear millet and Sorghum grasses. Such higher intake could be attributed to high Na and K concentrations in Sudan grass (as shown in Table 2). The same trends were obtained with regards to Na and K retention.

Sheep fed the three grasses irrigated with L1 or L2 tended to consume relatively comparable amounts of Cobalt while Zink and Copper intakes were influenced significantly by grasses species or levels of salinity of irrigated water. High intake of Zink ($P<0.05$) recorded by sheep fed Sudan grass might be attributed to its higher content of Zink (79.5 ppm) compared to other grasses (Table 2 & 7). It seems that all sheep fed the three grasses irrigated with L1 water salinity showed variable trends in Cu, Zn and Co retention. The obtained negative retention might be attributed to lower concentrations of those minerals in forages irrigated with L1 compared with those irrigated with L2 (Table 2). It could be recommended that sheep fed on such grasses irrigated with L1 should be supplemented with Cobalt, Zinc and Copper to cover their requirements since they did not able to retain any amounts of these trace elements. On the other hands, feeding the L2 irrigated grasses improved the retention of such trace elements since the animals retained positively various appreciable amounts of these elements, in particular Zn element.

**Table (5): Nitrogen utilization (mg/kg BW) for sheep fed the experimental salt tolerant grasses.**

| Item | L1 | | | L2 | | | Plants | | | Salinity | | ±SE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Sudan grass | Pearl millet | Sorghum | Sudan grass | Pearl millet | Sorghum | Sudan grass | Pearl millet | Sorghum | L1 | L2 | |
| Nitrogen intake | 637 | 665 | 642 | 663 | 634 | 629 | 650 | 649 | 635 | 648 | 642 | 12.3 |
| Fecal nitrogen | 228 | 244 | 225.5 | 216 | 206.7 | 227 | 222 | 225 | 226 | 232 | 217 | 15.1 |
| % of intake | 35.8 | 36.5 | 35 | 32.7 | 32.6 | 35.9 | 34.3 | 34.6 | 35.5 | 35.8 | 33.7 | 1.98 |
| Urinary nitrogen | 366$^{a}$ | 256$^{b}$ | 196.4$^{b}$ | 202$^{b}$ | 284$^{ab}$ | 198$^{b}$ | 284$^{a}$ | 270$^{a}$ | 197$^{b}$ | 273 | 227 | 13.7 |
| % of intake | 57.1$^{a}$ | 38.5$^{bc}$ | 30.4$^{c}$ | 30.7$^{c}$ | 44.8$^{ab}$ | 31.4$^{bc}$ | 43.9$^{a}$ | 41.6$^{a}$ | 30.9$^{b}$ | 41.9 | 35.6 | 2.28 |
| Total nitrogen extraction | 594$^{a}$ | 500$^{ab}$ | 422$^{b}$ | 418$^{b}$ | 491$^{ab}$ | 425$^{b}$ | 506 | 495 | 423 | 505 | 444 | 20.6 |
| % of intake | 93$^{a}$ | 75$^{b}$ | 65.4$^{b}$ | 63.4$^{b}$ | 77.4$^{ab}$ | 67.4$^{b}$ | 78.2$^{a}$ | 76.2$^{ab}$ | 66.4$^{b}$ | 77.7 | 69.3 | 2.97 |
| Nitrogen retention | 43.4$^{b}$ | 165$^{a}$ | 220$^{a}$ | 245$^{a}$ | 143$^{ab}$ | 204$^{a}$ | 144 | 153 | 212 | 143$^{b}$ | 197$^{a}$ | 19.7 |
| % of intake | 6.99$^{b}$ | 24.9$^{a}$ | 34.6$^{a}$ | 36.6$^{a}$ | 22.6$^{ab}$ | 32.6$^{a}$ | 21.8$^{b}$ | 23.8$^{ab}$ | 33.6$^{a}$ | 22.3 | 30.7 | 2.97 |

*a, b, c; means with different letters in the same row differ significantly ($P< 0.05$), otherwise no significant differences were detected.

Table (6): Water intake (WI) , water excretion (WE) and water balance (WB) for sheep fed the experimental salt tolerant grasses.

| Item | L1 | | | L2 | | | Plants | | | Salinity | | ±SE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Sudan grass | Pearl millet | Sorghum | Sudan grass | Pearl Millet | Sorghum | Sudan grass | Pearl millet | Sorghum | L1 | L2 | |
| Drinking WI, ml/kg BW | 69.9 | 82.9 | 66.3 | 68.7 | 75.2 | 59.8 | $69.3^{ab}$ | $79.0^{a}$ | $63.1^{b}$ | 73.01 | 67.9 | 2.59 |
| Combined WI, ml/kg BW water intake | 2.63 | 2.48 | 2.92 | 3.24 | 2.87 | 3.05 | 2.94 | 2.67 | 2.99 | $2.68^{b}$ | $3.05^{a}$ | 0.087 |
| Metabolic WI, ml/kg BW | 8.79 | 9.34 | 10.1 | 8.60 | 8.56 | 8.44 | 8.69 | 8.95 | 9.27 | 9.41 | 8.53 | 0.26 |
| Total WI, ml/kg BW | 81.3 | 94.7 | 79.3 | 80.5 | 86.6 | 71.3 | 80.9 | 90.6 | 75.3 | 85.1 | 79.5 | 2.69 |
| Faecal water, ml/kg BW, | 9.44 | 9.43 | 7.83 | 10.3 | 9.58 | 6.33 | $9.89^{a}$ | $9.51^{a}$ | $7.08^{b}$ | 8.90 | 8.76 | 0.46 |
| % of intake | 11.5 | 9.95 | 9.80 | 12.8 | 11.06 | 8.84 | $12.2^{a}$ | $10.5^{b}$ | $9.32^{ce}$ | 10.4 | 10.9 | 0.36 |
| Urinary water, ml/kg BW | $25.9^{b}$ | $36.9^{a}$ | $25.3^{b}$ | $25.7^{b}$ | $27.7^{ab}$ | $28.9^{ab}$ | 25.8 | 32.3 | 27.1 | 29.3 | 27.4 | 1.45 |
| % of intake | 31.9 | 39.5 | 31.6 | 32.1 | 31.9 | 40.4 | 32.0 | 35.7 | 35.9 | 34.3 | 34.8 | 1.37 |
| Total WE, ml/kg BW | 35.4 | 46.3 | 33.1 | 36.1 | 37.3 | 35.2 | 35.7 | 41.8 | 34.2 | 38.3 | 36.2 | 1.62 |
| % of intake | 43.5 | 49.4 | 41.4 | 44.9 | 43 | 49.2 | 44.2 | 46.2 | 45.3 | 44.8 | 45.7 | 1.25 |
| Water balance, ml/kg BW | 45.9 | 48.3 | 46.2 | 44.5 | 49.3 | 36.1 | 45.2 | 48.8 | 41.1 | 46.8 | 43.3 | 1.79 |
| % of intake | 56.5 | 50.6 | 58.6 | 55.1 | 57 | 50.8 | 55.8 | 53.8 | 54.7 | 55.2 | 54.3 | 1.25 |

*a, b, c; means with different letters in the same row differ significantly ($P < 0.05$), otherwise no significant differences were detected.

Table (7): Mineral (mg/Kg BW) utilization for sheep fed the experimental salt tolerant grasses.

| Item | L1 | | | L2 | | | Salinity | | Plants | | | ±SE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Sudan grass | Pearl millet | Sorghum | Sudan grass | Pearl millet | Sorghum | L1 | L2 | Sudan grass | Pearl millet | Sorghum | |
| Sodium ( Na): intake | 523 | 460 | 463 | 507 | 482 | 453 | 482 | 481 | 515 | 471 | 458 | 12 |
| Total excretion | 296 | 289 | 261 | 286 | 282 | 299 | 282 | 289 | 291 | 286 | 280 | 8 |
| Sodium balance | 227 | 170 | 203 | 221 | 199 | 153 | 199 | 191 | 224 | 185 | 178 | 09 |
| Potassium ( K) intake | 862 | 722 | 659 | 854 | 688 | 590 | 747 | 711 | 858$^{a}$ | 705$^{b}$ | 624$^{b}$ | 29.6 |
| Total excretion | 296$^{a}$ | 223$^{b}$ | 155$^{c}$ | 277$^{ab}$ | 157$^{c}$ | 289$^{a}$ | 225 | 241 | 287$^{a}$ | 190$^{b}$ | 222$^{b}$ | 15.9 |
| Potassium balance | 565$^{a}$ | 498$^{a}$ | 504$^{a}$ | 577$^{a}$ | 530$^{a}$ | 301$^{b}$ | 522 | 469 | 570$^{a}$ | 514$^{a}$ | 402$^{b}$ | 26.2 |
| Cobalt intake | 221 | 227 | 244 | 233 | 247 | 245 | 230 | 241 | 227 | 237 | 245 | 5.58 |
| Total excrelion | 224 | 243 | 217 | 233 | 241 | 245 | 229 | 241 | 228 | 242 | 233 | 7.44 |
| Copper balance | -3.00 | -16 | 27 | 0.00 | 6.00 | 0.00 | 1.00 | 0.00 | -1.00 | -5.00 | 12 | 7.05 |
| Zinc intake | 192 | 143 | 140 | 192 | 181 | 184 | 159$^{b}$ | 186$^{b}$ | 193$^{a}$ | 162$^{b}$ | 162$^{b}$ | 6.42 |
| Total excretion | 143 | 157 | 150 | 161 | 151 | 178 | 150 | 163 | 152 | 154 | 162 | 5.72 |
| Zinc balance | 49$^{a}$ | -14.0$^{c}$ | -10.0$^{c}$ | 31$^{ab}$ | 30$^{ab}$ | 6.00$^{bc}$ | 9.00 | 23 | 41$^{a}$ | 8.00$^{b}$ | 0.00$^{b}$ | 6.86 |
| Copper intake | 29.4 | 27.2 | 34.9 | 34.1 | 37.6 | 34.6 | 30.5$^{b}$ | 35.5$^{a}$ | 31.7 | 32.5 | 34.7 | 1.15 |
| Total excretion | 33.4 | 39.3 | 34.6 | 32 | 36.3 | 36.1 | 35.8 | 34.8 | 32.7 | 37.7 | 35.4 | 1.42 |
| Cobalt balance | -4.00 | -12.1 | 0.300 | 2.10 | 1.30 | -1.50 | -5.3$^{b}$ | 0.70$^{a}$ | -1.00 | -5.20 | -0.70 | 1.57 |

*a, b, c; means with different letters in the same row differ significantly (P< 0.05), otherwise no significant differences were detected.

Table (8): Average crop yields of the cultivated salt tolerant grasses (Kg/acre).

| Item | L1 | | | L2 | | |
|---|---|---|---|---|---|---|
| | Sudan grass | Pearl millet | Sorghum | Sudan grass | Pearl millet | Sorghum |
| Fresh fodder yield | 7320 | 8051 | 9519 | 3899 | 6881 | 4368 |
| Dry matter yield | 2013 | 1522 | 3379 | 1357 | 1376 | 1057 |
| Crude protein yield | 247 | 204 | 399 | 185 | 187 | 139 |
| TDN yield | 1125 | 866 | 2031 | 725 | 759 | 561 |
| DCP yield | 156 | 137 | 282 | 136 | 137 | 100 |
| Number of ewes for maintenance/90day | 30 | 23 | 55 | 20 | 20 | 15 |
| Number of ewes for lactation / 90 day | 13 | 10 | 24 | 9 | 9 | 6 |

The forage crop yields , as fresh or in terms of DM, TDN or DCP yield per acre on average bases, of the three grasses irrigated with L1 were (approximately 50%) greater than the same grasses species irrigated with L2 (Table 8). Among the grasses, Sorghum grass irrigated with L1 water was superior and attained the highest yields of DM, CP, TDN and DCP due mainly to its higher fresh and dry yields. From the data presented in table 8 and based on the recommended nutritional requirements by Kearl (1982) it appeared that the yield of these nutrients per an acre from Sorghum grass (irrigated with L1) could cover the maintenance and lactation requirements of 55 and 24 sheep, respectively for 90 days.

## CONCLUSION

The experimental grasses cultivated in strongly saline soils (10 $dS/m^{-1}$) and irrigated with water contained level 1 of salinity (L1, 4000 ppm total salts) or level 2 of salinity (L2, 7000 ppm total salts) appeared to be nutritious for small ruminants as it contained enough contents of nutrients to cover their nutritional requirements in addition to promising forage crop yields in particular Sorghum grass irrigated with saline water (4000 ppm total salts). Such salt tolerant grasses could be used successively and safely as good quality summer fodders to solve the problems of feed shortage during summer and autumn seasons and, also, to increase the economical value of the marginal saline resources in Egypt.

## ACKNOWLEDGEMENT

This work was supported by the International Center for Biosaline Agriculture (ICBA), Dubai, UAE under the framework of the technical cooperation project entitled" Introduction of salt-tolerant forage production systems to salt-affected lands in Sinai Peninsula in Egypt: A pilot demonstration project".

## REFERENCES

**Abdel-Baky, S. M.; Ghanem, H. M.; El-Gendy, K. M.; El-Kholy, S. G. and Moawd, R. I. (1994).** Nutritional evaluation of three varieties of sorghum in Egypt. Zagazig J. Agric. Res. 21 (4), 1181- 1191.

**Abdel-Hamid, A. A. (1998).** Nutritional evaluation of some new green forages sown under Egyptian condition. M. Sc.Thesis. Fac. Agric. Zagazig Univ., Egypt.

**Anon, (2006).** Electronic Conference on salinization: Extent of salinization and strategies for salt – affected land prevention and rehabilitation, 6 Feb. – 6 March, 2006. Organized and coordinated by IPTRID (International Programme for Technology and Research in Irrigation and Drainage),FAO.

**A.O.A.C. (1990).** Association of official Analytical chemists: Official Methods of Analysis (15th Ed) Washington, D.C., U.S.A.

**Duncan, D.B. (1955).** Multiple range and multiple. F. tests Biometrics .

**El-Gendy, K. M. (1990).** Evaluation of some green forages with special reference to their nutritive values. Ph.D. Thesis. Fac. Agric.Zagazig Univ., Egypt

**El-Shaer, H. M. (2004).** Potentiality of halophytes as animal fodder under arid conditions of Egypt. Rangeland and Pasture Rehabilitation in Mediterranean Areas, Cahiers OPTIONS Mediterraneenes , Vol. 62 , PP. 369 -374.

**El-Shaer, H.M.; A. Rammah; A. Nasr and M. T. Bayoumi (1987).** Nutritional quality of some grasses in North Sinai. Proc. of the 2nd Inter. Conf. Desert Development, January 25-30. 1987. Cairo, Egypt.

**El-Shaer, H.M. (2006).** Halophytes as cash crops for animal feeds in arid and semi-arid regions. In: M Ozturk, Y Waisel, M A Khan, G Gork (eds): Biosaline Agriculture & High Salinity Tolerance in Plant. Birkhauser, Basel, 117 - 128.

**Fahmy, A.A. (2001).** The nutritive value of fresh, ensiled and sun dried pearl millet (*Pennisetum typhoides*) fed to goats. Desert Inst. Bull., Egypt, 51 No.2, 307-321.

**Gabra, M.A. (1984).** Studies on the productivity and feeding qualities of some annual and perennial forages as affected by some agronomic practice fed to sheep in metabolism trials including nutritional balance. Ph. D. Thesis. Fac. Agric. Cairo Univ., Giza, Egypt.

**Goering, H.K. and P. J. Van Soest (1970).** Forage fiber analysis. Agric. Handbook, No. 379, USDA , Washington D.C. , USA.

**Hanafy, M. A.; A. A. Fahmy; M. S. Farghaly and Afaf A. El-Sheref (2007).** Effect of using some fodder plants in diets on goats performance under desert conditions of Sinai. Egyptian J. Nutrition and feeds (2007) 10 (1): 151-163.

**Jackson, M.L. (1958).** Soil chemical analysis. Constable and company. Ltd. England.

**Kearl, L.C. (1982).** Nutrient requirements of ruminants in developing countries. Utah Agric. Exp. Sept. Utah State University, Logan, USA.

**Khafaga, H. S. (1999).** Improving nutritive value of some annual fodder plants interplanted among Atriplex nummularial as a biological reclamation of saline soil. Workshop on livestock and drought: policies for coping with changes. Cairo, May 24-27: 113 – 120.

**Madan Mohan, D. R.; D. R. Bhatia and B. C. Patnayak (1977).** A note on chemical composition and nutritive value of *Pennisetum typhoides* × *Pennisetum orientale* fodder fed as fresh green or hay. Indian J. Anim. Sci. 47 (8) : 504-506.

**Messman, M, A.; W. P. Weiss; P. R. Henderlong and W. L. Shockey (1992).** Evaluation of pearl millet and field peas plus triticale silage of mid lactation dairy cows. J. Dairy Sci., 75. pp 2769-2775

**Moawd, R. I. (1998).** Ntritional studies on using some green forage in ruminants ration. Ph. D. Thesis. Fac. Agric. Zagazig Univ.

**Nemati, N. (1976).** Range rehabilitation problems in the steppe zone of Iran. Journal of Range Management 30: 339-342.

**NRC (1981).** Nutrient requirements of domestic animals. No. 15. Nutrient requirements of goats. National Research Council. Washington D. C.

**SAS. (1993).** Institute, Inc., SAS/STAT, Guide for Personal Computers Versi. USA.

**Shehata, E. I.; M. E. Ahmed; A. M. Abd EL-Hamid; Faten F. Abou-Amou and M. H. El-Haggag (2001).** Comparative nutritive values of silage rations containing different levels of Teosinte and Kochia. J. Nutrition and Feeds (Special Issue), 4:129.

# المأكول والقيمة الغذائية لبعض الأعلاف النجيلية المغذاة للأغنام تحت ظروف الملوحة في جنوب سيناء

عبد الفتاح عفيفي فهمي – كمال محمود يوسف – حسن محمد الشاعر

قسم تغذية الحيوان – مركز بحوث الصحراء – المطرية – القاهرة.

إستخدام النباتات التي تتحمل الملوحة اصبح من الوسائل التطبيقية الملائمة لحل مشكلة نقص الأعلاف· تهدف هذة الدراسة الى التقييم الغذائي والاستساغة لثلاث محاصيل نجيلية (حشيشة السودان – الدخن اللؤلؤى – السورجم ) منزرعة تحت مستويين من ملوحة مياة الرى (مستوى١ – ٤٠٠٠ جزء فى المليون مستوى ٢ : ٧٠٠٠ جزء فى المليون أملاح كلية) ·عدد ١٨ من الكباش البرقى وزعت توزيعا عشوائى على عدد ٦ مجموعات (٣ كبش بكل مجموعة) حيث قدم للمجموعات الأولى والثانية والثالثة واحد من الأعلاف الثلاث المنزرعة تحت مستوى ملوحة١ بينما قدم للمجموعات الرابعة والخامسة والسادسة واحد من الأعلاف الثلاث المنزرعة تحت مستوى ملوحة٢ أجريت تجربة استساغة ثم اتبعت بتجربة هضم لتقدير بعض القيم الغذائية ·

أظهرت النتائج أن الأعلاف النجيلية الثلاث المنزرعة تحت مستويين ملوحة(١و٢) كانت مغذية للأغنام حيث كان محتواها من البروتين الخام كافى مع محتوى منخفض من ADF- ADL · تأثر المأكول الاختيارى تأثيرا طفيفا بمستوي الملوحة· تباينت وتأثرت الى حد ما معاملات هضم كل العناصر الغذائية بمستوى ملوحة ماء الري· كانت معاملات هضم المادة الجافة- الألياف الخام- المستخلص الذائب الخالى من النتروجين للأعلاف المنزرعة تحت مستوى ملوحة١ مقارنة بمثيلاتها المنزرعة تحت مستوى ملوحة٢ · تأثرت القيم الغذائية للأعلاف بمستوى الملوحة· أظهرت كل الأعلاف الثلاث المنزرعة تحت مستوى ملوحة٢ ارتفاع محتواها من البروتين الخام المهضوم مقارنة بمثيلاتها المنزرعة تحت مستوى ملوحة١ بغض النظر عن نوع النبات فقد احتجزت الحيوانات كمية نتروجين ٣٨٪ أكثر عندما تغذت على الأعلاف الثلاث المنزرعة تحت مستوى ملوحة٢ مقارنة بتلك التى تغذت على الأعلاف المنزرعة تحت مستوى ملوحة ١ · بصفة عامة احتجزت الأغنام كميات من عناصر النحاس – الزنك – الكوبلت عند تغذيتها على الأعلاف الثلاث المنزرعة تحت مستوى ملوحة٢ وعلى العكس من ذلك يجب امداد الحيوانات بهذة العناصر عند تغذيتها على نفس الأعلاف الثلاث المنزرعة تحت مستوى ملوحة١ · كانت كمية محصول العلف الناتجة من الأعلاف الثلاث تحت مستوي ملوحة ١ أكبر من الكمية الناتجة تحت مستوي ملوحة٢ ·

وتوصى الدراسة بإستخدام بعض النباتات التى تتحمل الملوحة (السورجم – الدخن- حشيشة السودان) المنزرعة فى بعض الاراضى الملحية والتى تروى بمياه تصل نسبة الملوحة بها الى ٧٠٠٠ جزء فى المليون فى تغذية الاغنام حيث أنها تحتوى على كميات كافية من البروتين الخام والمركبات الغذائية الكلية المهضومة اللازمة لتغطية احتياجات الحيوان بالاضافة الى إنتاج كميات من المحصول الوفير وبخاصة السورجم المنزرع تحت مستوى ملوحة ٤٠٠٠ جزء فى المليون. ولهذا يمكن استخدام مثل هذة النباتات بنجاح وبأمان كمواد علفية عالية القيمة الغذائية لسد الفجوة الغذائية فى فصلى الصيف والخريف ولزيادة العائد الاقتصادى للاراضى الملحية (الهامشية) فى مصر.