FEEDSTOCK VALUES OF SOME COMMON FODDER HALOPHYTES IN THE EGYPTIAN DESERT

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ABSTRACT

This article focuses on presenting the state-of-the-art of topics related to feedstock values of some common fodder halophytes in Egypt in order to highlight the importance of halophytes in the arid regions of Egypt. The covered topics in this article include the following:

- Common halophyte fodders in different regions of Egypt.
- Advantages and disadvantages of halophytes as fodders for livestock.
- Demonstration in a brief the processing methods for alleviating effects of tannins and other secondary metabolites on Livestock performance.
- Supplementation either as feed or minerals and its effects on rangeland feed intake.
- Aspects of halophytes effects on animal production and reproduction

The article ends with some conclusions and recommendations

Keywords: Livestock, Halophytes, Nutritive value, Reproduction, Milk, Carcass.

1 INTRODUCTION

The rapidly growing demand for animal products in Egypt and a parallel increase in livestock and imports of feed grains have drawn the attention towards the need for intensification of efforts to develop the indigenous livestock and feed resources, particularly in the newly reclaimed and desert areas. FAO projections (2004) suggest that global meat production and consumption will rise from 233 million tons in the year 2000 to 300 million tons in 2020, and milk from 568 to 700 million tons over the same period. This forecast shows a massive increase in animal protein demand, needed to satisfy the growth in the human population.

The main challenge for improving animal production in Egypt is the animal feed gab where there has beenno strategy to overcome this problem since last decade. There are deficits of dry matter; DM, (-14.42 million tons) and total digestible nutrients; TDN (–2.21 million tons), while there is a surplus of digestible crude protein; DCP (+1.11 million tons) in the animal feeding balance, Kewan and Khattab, (2016).These criteria indicted that self-efficiency was 67, 86 and 177% for DM, TDN and DCP, respectively. So, there is an urgent need to maximize the available feeding sources particularly the natural vegetation to cover the livestock requirements to realize the higher production.

The purpose of the present study is to briefly discuss the role of halophytes in feeding ruminant livestock in the Egyptian deserts. Special emphasis is given to understanding the role of halophytes as a potential source of animal feed including consideration of problems and precautions necessary in their utilization by livestock.

2 METHODOLOGY

This review focused on the feedstock values of some common fodder halophytes used in the Oases, new reclaimed areas, Halaib-Shalatin- Abou Ramad Triangle, Sinai and North Western Cost.

Chemical analysis of plants was carried out according to the A.O.A.C. (1990).The nutritive values in terms of total digestable nutrients (TDN) and digestable crude protein (DCP) were determined using the ordinary methods of A.O.A.C. (1990).Dry matter digestibility (DMD) technique using in vitro fermentation followed by enzymatic hydrolysis seems to be most effective in predicting the nutritive value Tilley and Terry (1963).Milk was analysed for fat and protein content as described by (Ling, 1963). Dressing percentage was calculated as described by Koch et al. (1963) as follows:

Dressing percentage = hot carcass weight (kg) ×100/ live or empty body weight (kg)
Where: Hot carcass weight (kg) = live body weight (kg) – organs and offals (kg)
Empty body weight (kg) = live body weight (kg) – digestive tract contents (kg)

3 RESULTS

3.1 Potentialities of Fodder Halophytes in Egypt

3.1.1 Oases and New Reclaimed Areas of Egypt

Tables (1 and 2) shows some of the halophytes that havebeen common as animal fodders since they are well adapted to the salt environmental conditions in Egypt in particular in the Oases and newly reclaimed areas.They illustrate the edible parts, overall average values of proximate chemical composition and nutritive values in terms of total digestible nutrients (TDN) and Digestible crude protein (DCP) of these plants. It appears that they contain sufficient nutrients to cover the nutritional requirements of ruminants. Aqool attained the highest nutritive values in terms of TDN. However,the highest DCP value was observed for succulent Kochia. Considering the acute shortage of fodder in the country, it is encouraging that we have found a suitable grass in the local flora, which can completely replace Maize or Berseem (conventional green fodders) and thus result in considerable savings on corn purchase or reduce cultivated area with Berseem to be utilized for cash crops.

Table 1. Some halophytes nominated to apply in the oases and newly reclaimed land*

Common name	Scientific name	Season of cultivation	Cut No.	Edible parts	Crop Production
Kochia, Burning bush,	*Kochiaindica* Wight.	Summer	2-3	Succulent & Hay	5-10 T/fed./ cut
Big Saltbush, saltbrush	*Atreplixlentiformis* (torr.) Wats.	Perennial	2-3/ year or Grazed	Succulent	15-20 T/ fed.
Leucaena	*Leucaenaleucocephala* (Lam.) De wet.	Perennial	Grazed	Succulent	4-5 T/ year
Acacia	*Acacia saligna*	Perennial	Grazed	Leaves & Succulent	2-4 kg/tree
Fodder beet	*Beta vulgaris* L.	Winter	Cut and carry	Leaves	5-10 T/fed.
				Tubers	30-50 T/ fed.
Aqoul	*Alhagigraecorum*	Perennial	Grazed	Leaves & fruits	4941 kg dry wt./ha
Halfa	*Imperatacylindrica*	Perennial	Grazed	Wet season	1810kg dry wt./ha
				Dry season	4548kg dry wt./ha

*After: Kewan and Khattab (2016) and Elkhouly andAbu- El Nasr (2006).*Feddan = 0.42 hectare

Elkhouly andAbu- El Nasr (2006) studied four forage halophytes in Siwa Oasis. These species: are *Alhagigraecorum(Boiss), Imperatacylindrica (L.), Juncusrigidus (Desf),* and *Phragmitiesaustralis(Cav.).* The results indicate that the burning of *P. australis*causeda reduction in its productivity and decreased its palatability, but improved the palatability of *J. rigidus*(Table, 3). The biomasses of *I.cylindrica* , *J. rigidus,* and *P.australis* were higher in the dry season than in the wet season whereas in *A. graecorum*itit was higher in the wet season than in the dry season. Most of the nutritive values were higher in the dry season than in the wet seasonexcluding NFE. *Alhagigraecorum* had the highest value of TDN and DCP followed by the old sprouts of *P.australis*(Table, 2). In the dry season the carrying capacity of these halophytes was approximately twice that in the wet season. *Alhagigraecorum* and the new sprouts of *J. rigidus* had very high palatability.

Table 2. Chemical composition and nutritive values of some halophytes

Common name	**Edible parts**	**DM (%)**	**% On DM basis**				**Nutritive value (%)**	
			CP	CF	NFE	Ash	TDN	DCP
Kochia	Succulent	16	23.4	4.1	15.2	2.7	21.9	16.7
	Hay	92	17.6	22.9	35.9	14.2	-	-
Saltbush, Atreplix	Succulent	33	18.4	15.4	44.8	19	35.6	9.6
Leucaena	Succulent	32	20	30	35	4	29.0	13.0
Acacia	Leaves	40	13	6.22	50	8.9	21.1	3.1
Fodder beet	Leaves	-	17	7.6	40	19.2	-	-
	Tubers	7.9	13	6.1	60.6	9.6	18.5	10.5
Aqool	Wet season		9.8	14.4	57.7	12.6	60.77	5.6
	Dry season		18.6	14.4	48.0	12.0	68.04	13.87
Halfa	Wet season		3.9	23.1	61.5	10.6	58.12	0.01
	Dry season		3.7	32.9	51.8	9.6	54.3	0.0
SammarMurr (new sprouts)	Wet season		5.4	24.9	59.0	9.9	58.11	1.50
	Dry season		5.2	29.1	55.0	9.2	56.44	1.32
SammarMurr (old sprouts)	Wet season		6.0	29.5	56.4	7.2	57.98	4.85
	Dry season		4.0	27.1	56.4	11.0	56.64	0.2
Hagna (new sprouts)	Wet season		4.3	26.4	58.7	6.2	56.98	0.48
	Dry season		4.7	35.3	48.3	10.4	53.84	0.85
Hagna (old sprouts)	Wet season		16.5	28.5	43.7	10.0	61.74	11.83
	Dry season		10.8	22.9	27.2	28.9	61.30	6.52

After:Kewan and Khattab, (2016) andElkhouly and Abu- El Nasr, (2006).

Table 3. Comparison between mean (± SE) of standing biomass (Kg dry wt./ha) of the halophytic species in the burned/grazed and unburned/ ungrazed stands during wet and dry seasons*

Species	**Wet**			**Dry**		
	UB	**B**	**%∆**	**UB**	**B**	**%∆**
J. rigidus	7388±3145	1320±307	82.1	7883±30.15^{ns}	2067±666	73.8
P. austrlais	4605±2607	473±132	89.7	7534±3265*	1188±373	84.2

UB= unburned stands, B= Burned stands, ∆%=difference %. (*=p<0.05, ns= not significant).*After: Elkhouly and Abu- El Nasr (2006).

2.1.2 Halaib, Shalatin, Abou-Ramad Triangle

It is observed that, herbaceous plant communities in wadis of Shalatin basin are dominated by the unpalatable species of *Sasolabaryosma* and*Francoeriacrispa*, while in wadis of Halaib basin, there are more palatable species dominated by *Panicum*turgidumwhich is a good forage grass,El Shaer et al., (1997). Similarly, wadiHedrerba in Halaib basin has the richest grazing resources and the highest potential for conservation and improvement than other wadis. The most important forage species in wadiHederba are *Panicumturgidum, Aristidamutabilis, Artemisajudaica and Lyciumshawii* which could provide good grazing resources for small ruminants and camels during winter and summer. Some of these shrubs are highly palatable for all animal species and often overgrazed. However, *P.*turgidumisthe main dominant forage crop in WadiHederba where most of Bedouins animals rely on such plant throughout the year,El Shaer(2002).

The chemical composition of *P.turgidum* compared with Berseem hay is presented in Table (4). The chemical composition indicatesthat CF% and the fiber fractions (NDF and ADF %) in *P. turgidum* are remarkably higher than Bersee hay. On the contrary, the CP, ADL and ash contents of *P.turgidum*are lower than that in Berseem hay, and this might be due to the fact that the former one belongs to grasses, and the latter is a legume.Otherwise, more fibrous tissues lead to a high ADF content in grasses than legumes(Arzani et al. 2003). Nitrogen free extract (NFE) is almost similar and around 47% as an average.

Table 4. Chemical composition (%) of *P. turgidum* compared with Berseem hay

Item	M	Ash	CP	EE	CF	NFE	NDF	ADF	ADL	HC	C
P. turgidum	45.38	7.08	4.01	3.9	36.8	48.2	79.9	52.0	32.5	27.9	19.5
B. hay	12.80	14.3	11.8	1.9	26.5	45.5	38.8	21.5	54.2	17.3	16.1

M: Moisture%; HC: Hemicellulose; C: Cellulose; B. hay: berseem hay

2.1.3 Sina and North Western Coast

In Sinai, it has been found that grazing ruminants contribute 90% to rangeland production and use 40–50% of the total feed available. Table (5) illustrates the different species of halophytes that are widespread in Sinai and their chemical composition.

Table 5. Chemical composition and nutritive value (DM basis) of dominant perennial forages in Sinai and the North-Western Coast of Egypt

Species	DM %	% on DM basis					In vitro-DMD	TDN%
		CP	CF	EE	Ash	NFE		
Sinai								
Atriplexhalimus	34.22	12.63	25.44	2.28	22.68	36.96	66.7	60.0
Salsolatetrandera	53.56	10.20	21.33	2.50	21.82	44.15	55.48	53.92
Swaedafructicosa	25.0	10.0	33.2	5.00	16.1	35.7	70.4	58.2
Nitrariaretusa	37.6	10.2	32.6	2.46	33.0	21.74	21.8	60.2
Acacia saligna	44.4	8.80	22.3	2.40	10.6	55.9	-	-
Z. album	34.7	7.76	11.2	2.46	34.2	44.38	76.3	59.0
Tamarixmennifera	40.0	8.19	11.6	3.57	24.9	51.74	59.6	-
Tamarixaphylla	34.9	12.9	13.6	3.99	20.1	49.41	48.7	-
HS	29.7	6.69	14.3	2.22	40.3	43.75	63.0	50.7
TheNorthWestern Coast of Egypt								
Nitrariaretusa	20.60	13.07	10.49	3.96	31.38	41.10	76.70	-
LS	48.62	11.49	14.56	3.49	23.65	46.81	68.20	-

DMD: dry matter disappearance, ZA *Zygophylum album*, HS *Halocnemumstrobilaceum*, LS *Limoniastrummonopeta L.*

It can be seen that crude protein content is ranged between 7.69 and 12.9%, and it has different percentages of crude fiber. It has moderate values of TDN% ranged between 50.7 and 60.2.

Differences in the chemical composition and nutritive value between plant species *Nitrariaretusa* and *Limoniastrummonopeta L.*,asdominant perennial forages in the North Western Coast of Egypt, are shown in Table (6). It can be seen that the former has a higher nutritive value than the latter, and thiscouldbe due to its lower CF content.Tree foliage is being increasingly recognized as a potentially high-quality feed resource for ruminants, particularly to supply crude protein.Where trees often provide more edible biomass than pasture and this biomass remains green and high in protein, even when pastures dry off. Because of their deep rooted nature, trees can tap water and nutrient resources deep in the soil profile.

3.2 Challenges of Utilizing Halophytes in Ruminant Feeding

Table (6) shows a screening of anti-nutritional factors present in some halophytes. The degree of lignification, is also a matter that affects the nutritive value of not only the halophytes but also all other fodders, Attia-Ismail et al. (1994). The salt concentrations in halophytic plant also affect its acceptability and intake by animals (Fahmy; et al. 2001).

Table 6. Secondary metabolites screening of most common halophytes in Egypt

Secondary metabolites	AH	HS	NR	ST	SF	TA	TM	ZA
Oxalate		+		+	+			
Triterpenoids		+		+				+
Glycosides								+
Saponins	+	+	+	+		+	+	+
Flavinoids	+	+		+			+	+
Alkaloids	+	+		+	+			+
Tannins	+	+	+	+	+	+	+	+
Nitrates	+	+	+	+	+	+	+	+

AH *Atriplexhalimus*, HS *Halocnemumstrobiclaceum*, NR *Nitrariaretusa*, ST *Salsolatetrandra*, SF*Suaedafruticosa*, TA *Tamarixaphylla*, TM *Tamarexmannifera*, ZA *Zygophyllum album*

Some halophytes are toxic. This toxicity results from several secondary metabolites in the plants. However, rate of toxicity is affected by several factors such as rate of ingestion, type and rate of microbial transformation of such metabolites in the rumen, rate of gastro-intestinal absorption, liver and kidney enzymatic activity. Alkaloids, saponins, tannins, and nitrates are present in most halophytes. High concentrations of alkaloids decrease animal performance and increase diarrhea. Tannins reduce feed intake through reducing palatability resulting from the precipitation that occurs upon binding of tannins with salivary proteins. Tannins also inhibit digestive enzymes,Streeter, et al. (1993).

The major nutritional problems are protein, energy and mineral deficiencies, while correction of protein and energy deficiencies may be complicated, expensive and long-term; the correction of mineral deficiencies by the provision of mineral supplements is inexpensive and usually cost-effective. Even under conditions where protein and energy sources arelimited, the provision of mineral supplements can result in significant increases in productivity (Masters et al. 2004). Most tropical forages were found to be borderline to deficient in many essential elements, McDowell, et al., (1983).

3.3 Processing Methods for Alleviating Secondary Metabolites Effects on Livestock

Several methods of reducing toxic effect of anti-nutritional factors were applied, such as:

1) Physical treatment as chopping, grinding and air dried reduced some secondary metabolites in halophytic plants.
2) Chemical treatments likethe addition of polyethelene glycol, which considered to break formed tannin-protein complex as their affinity for tannin is higher than protein.
3) Biological treatments (ensiling).
4) Incorporation of halophytes into blended diets would be advantageous because a level of inclusion could be selected to minimize adverse effects of the factors listed above on animal growth performance. Also, mixtures of halophytes and higher energy ingredients, such as legumes, cereals, molasses or fat, would be more likely to support levels of animal productivity required to justify the expense of growing halophytes under irrigated conditions.

All previous methods improves halophytes acceptability and consequently increase both of intake and digestibility by ruminants. These results are of great importance towards making best use of available unpalatable desert shrubs as animal feeds specially for desert sheep and goats.

3.4 Impact of Feed Supplementation on Halophytes Intake

Fedele et al. (1993)reported that herbage intake level was influenced by animal breed and the amount of concentrate, and its CP content. They found that with a high level of concentrate supplementation, the grazing goats reduced herbage intake. Also, dry matter intake was positively correlated with total legumes in the pasture, with legumes in the diet and DM production of the pasture, while the relation was negative with a fiber content of the diet. Otherwise, forage intake is affected by grazing time (as month of the year) as found by Roque et al. (1991).

Forbs were eaten in larger “amounts by does (38 ± 14% of the diet) during the rainy season compared to bucks (20 ± 10%). Bucks avoided grasses in the rainy season, but they formed 15% of the buck diet in the dry season. Bucks also avoided succulent plants during drought conditions, but they made up 14% of the does diet. Diets of does never contained more than 5% of grasses”(Melladoa et al. 2005).

Shawket(1999b)reported that daily intakes from DM, TDN, and DCP of yearling male camel calves (*Camelus dromedaries*) were not affected when they were fed on ad lib. Saltbush (*Atriplexhalimus*) with different energy sources: (a) barley grains (b) barley grains plusolive cake.

Faye et al. (1992) indicated that feed intake of Mangrove was slightly more important with mineral supplementation only and with minerals andconcentrate supplementation. In addition, a high interaction between mineral absorption and quality of the diet was observed. A well-balanced diet seems essential to avoid deficient mineral status. Even so, minerals supplementation is an important management aspect for the production and productivity of camels(Simpkin 1998).

Soder et al. (1995)indicated that un-supplemented ewes lost more body weight and body condition score than supplemented ewes. Less body weight and body condition loss in the supplemented ewes may have been due to factors other than the influence of supplementation on forage intake, such as increased energy or protein intake. Hossain et al. (2003)stated that feeding of grazing goats with increased levels (10.02, 11.06 and 11.98 MJ ME/kg DM) of dietary energy supplementation significantly decreased intake of green grass dry matter (222.9, 191.7 and 179.7 g/d) and daily average dry matter (406.1, 374.3 and 362.4 g/d). Dry matter intake expressed as a percent of live weight, significantly decreased in goats (3.44, 3.13, 2.84 kg/d) with increased levels of dietary energy supplementation (low, medium and high energy, respectively). The same trend of results wasreported by Adogla-Bessa, and Aganga(2000b)as dry matter intake decreased as energy intake increased.

Where dry matter intake of does offered the high-energy supplemented diet were equivalent to 5% of body weight.

Nassar(2008)found that dry matter intake (DMI) of range *(Panicumturgidum*) was affected significantly by different levels of supplementation (T1; 25%; T2; 50% of the total requirements and ad lib. level; T3). The greatest intake of range was recorded for goats in T1 (5.56% of BW) followed by T2 (2.32% of BW) whereas the lowest value was recorded by T3 (1.12 % of BW). As a restricted amount of supplementary concentrate feed mixture was offered to animals, the highest dry matter intake of concentrate was (54.01g/kg $w^{0.75}$) in T3 followed by T2 (23.86 g/kg $w^{0.75}$), whereas the lowest value was recorded by T1 (12.25 g/kg $w^{0.75}$). Total dry matter intake (range plus supplementation) was significantly increased as the level of supplement increased. Mean values were 121.05, 77.33 and 71.14 g/kg $w^{0.75}$ for T1 and T3 and T2 respectively. It is clear that in T3, although animals were fed ad lib concentrate feed mixture, they maintained 29: 71 roughage concentrate ratio.

3.5 Water Intake as Affected by Feeding Halophytes

Dromedary can drink once a week in summer; every 10 days in autumn and spring and every 6 weeks in winter. On the pasture containing 30% moisture, camels donot require drinking water unless they are lactating Yagil(1982).

Growing male camels consumed 92.60, 75.05, 93.90 and 88.50 and 66.36ml water/$kg^{0.82}$ when they were fed *Atriplexnummularia*(AN), *Acacia saligna* (AS), AN-AS mixture (1: 1), 2.5% urea treated rice straw or berseem hay and all was supplemented with concentrate mixture (70% total digestible nutrients) at a level of 125% of maintenance requirements(Kewan 2003). It can be seen that camels that were fed atriplex consumed more free water due to its higher content of ash, especially sodium chloride.

3.6 Effect of Feeding Halophyte Forages on Reproductive Performance

"Certain reproductive parameters such as age at puberty, gestation weight, and kid birth weight may be improved by supplementary feeding of concentrate. Therefore, feeding of grazing goats and sheep with concentrate supplement may be suggested to optimize growth performance" (Salim et al. 2002). Hossain et al. (2003)reported that, reproductive traits of female goats raised under three feeding regimes *i.e.*, low, medium and high energy supplementation (10.02, 11.06, 11.98MJ ME/kg DM) in addition to grazing.Table (7) illustrates the reproductive performance of Barki ewes fed on concentrate mixture and roughages as berseem hay (group C), halophytic plants mixture (*A. nummularia*and *Pennisetumglaucum*) either without additive (G1) or enriched with one gram propionic-bacteria (P169) (Helal, et al. 2018).The obtained results revealed that reproductive performance for groups 1 and 2 were relatively in accordance with that in a control group, these may reflect an economic return for breeders.

Table 7. Effect of feeding halophytes with propionibacteria on reproductive performance of Barki ewes

Item	Experimental groups		
	Control	G1	G2
No. mated ewes	11	11	11
Concept rate, %	100	90	90
Lambing rate, %	90	100	100
offspring mortality, %	0.0	0.0	0.0
Weaned offspring, %	100	100	100
No. weaned offspring/100 mated ewes	90	90	90
No. weaned offspring/100 pregnancy ewes	90	100	100

Control, animals fed on berseemhay+CFM. G1, animals fed on a mixture of A. nummularia (50%)+P. glaucum (50%)+ CFM. G2, animals fed on a mixture of A. nummularia (50%)+P. glaucum (50%)+ CFM+1 gm. Propionic bacteria /h/d.

3.7 Effect of Feeding Halophytes on Milk Production

Data in Table (8) illustrate feed intake by Barki ewes and their milk production. Barki ewes were fed concentrate mixture and roughages as berseem hay (group C), halophytic plants mixture (*Atriplexnummularia* and *Pennisetumglaucum*) either without additive (G1) or enriched with one gram propionic-bacteria (P169)(Helal et al. 2018). The results were insignificant among groups. Late stage of lactation showed the highest values of fat, compared with other stages, but there were no significant differences among all groups in milk protein. These results were in agreement with Ibrahim (2014) who found that percentages of milk fat content was higher for ewes fedon halophytic silage than those that were fed on berseem hay. These findingscouldbe due to high fermentation products in particular acetic acid in case of feeding fresh forage compared with dry forage as berseem hay.

Camels are persistentanimal as they maintain milk production throughout the long period usually 12 months. Shawketand Ibrahim (2013) concluded that feeding Atriplex(saltbush) to lactating camels for a long-term did not negatively affect milk production or change its chemical composition and physical properties. They calculated the digestible protein and metabolizable energy utilization of the Atriplexdietas5.04 g DCP and 0.16 Mcal ME/kg$^{0.75,}$ which were enough to cover the maintenance and milk production requirements.

Table 8. Effect of feeding halophytes with supplementation on milk production of ewes

	Item	**Control**	**G1**	**G2**
Dry matter intake (g/h/d):				
	Concentrate	680	700	700
	Alfalfa hay	900	-	-
	Halophytic plants mixture	-	850	870
	Milk yield (ml/h/d)	720	660	668
Milk Fat %	Early lactation	3.23c	3.43c	3.67c
	Mid lactation	4.46b	3.80c	3.83c
	Late lactation	4.67ab	4.03bc	5.10a
	Overall mean	4.12	3.75	4.20
Milk Protein %	Early lactation	4.29bc	5.05ab	4.57ab
	Mid lactation	5.21ab	4.90ab	4.92ab
	Late lactation	5.38a	3.60c	4.60ab
	Overall mean	4.96a	4.52a	4.70a

Control, animals fed on berseemhay+CFM. G1, animals fed on a mixture of A. nummularia (50%)+P. glaucum (50%)+ CFM. G2, animals fed on a mixture of A. nummularia (50%) +P. glaucum (50%) + CFM+1 gm. Propionic bacteria /h/d.

3.8 Growth Performance of Livestock Fed on Halophytes

Shawket (1999a) found that the average daily gain of camel calves was 750 g for animals fed control diet (concentrate mixture plus berseem hay), and 692 g for animals fed on olive cake (25%) plus barley grains (Kuria et al. 2004) and *Atriplexhalimus*. However, no significant differences were found in daily gains of camels fed on control diet and a diet of barley grains plus *A. halimus* (732 g).

Inanother experiment conducted indoor for camels fed *ad libitum;* fresh *A. nummularia* (AN), fresh *A.saligna* (AS), AN+AS mixture (1: 1), 2.5% urea treated rice straw (RS) compared with a group fed on berseem hay (BH). All camel groups were supplemented with concentrate mixture (70% total digestible nutrients) at a level of 125% of maintenance requirements (Kewan 2003). The corresponding daily gain values were 0.525, 0.719, 0.689, 0.589 and 0.828 kg/d.

3.9 Carcasses Value Resulting from Animals Fed on Halophytes

Camels fed fresh mixture (1:1) of *A. nummularia* plus *A. saligna* resulted in dressing percentage calculated based on eitherslaughter weight or empty body weightas 64.8% and 70.6%, respectivey. However, the same criteria were 59.7 – 68.1% *vs* 61.1- 69.4% for camels fed either *A. nummularia* or *A. saligna*, respectively(Kewan 2003).

3.10 Focusing on Salicornia and Kochia Species as Non – Conventional Forages

Salicorniabigelovii:Mota(1987) reported that *S. bigelovii*yielded up to 18 tons per ha of dry matter biomass under seawater irrigation in United Arab Emirates. The seeds representing approximately 10 – 15 % of the harvest weight, contained 30 – 33 % crude protein, 26 – 33 % oil, 5 – 7 % crude fiber and 5- 7 % ash. Oil fatty acids contained 6.9 – 8.7 % palmitic, 1.6- 2.8 % stearic, 12.0 – 14.1 % oleic, 73.0 – 75.2 % linoleic and 2.1 – 2.7 % lenolenic. *Salicornia*straw hadlower lignin content per unit of crude fiber than *Atriplex*or conventional forages. It contained 4 – 6 % crude protein and 30 – 45 % ash consisting mainly of NaCl. Despite a higher ash content and lower protein level than *Atriplex*, *Salicornia*straw has proven to be a valuable forage material in formulated ruminant diets(Glenn, et al.1991).

*Salicornia*straw was incorporated at 15 % instead of alfalfa hay in diets fed to goats for a 93 day feeding trial. All diets were adjusted by adding cottonseed meal. Average daily gain (ADG) and feed conversion ratio (FCR) were 83.9, 69.9 g/day and 10.5, 13.5 Kg DMI / Kg gain for goat fed on alfalfa hay or *Salicornia*straw, respectively. In another experiment, sheep were fed on diets containing15 or 30 % *S*. straw comparedwith 15 % alfalfa diet for 92-day feeding trial.*Salicornia*diets contained 10 % extra cottonseed meal and 10 % rolled wheat straw to balance protein levels (ca. 10 %) across treatment.ADG and FCR were 87.0, 105.4, 157.6 g/day and 11.4, 12.6, 11.2 kg DMI/kg gain for diets containing15 % alfalfa, 15 % *S.* straw and 30 % *S.* straw, respectively. These results showthat *Salicornia*plus cottonseed meal substituted favorably for alfalfa; comparing the two *S.* treatments favorably for wheat straw as well. De La Liata(1991)measured acceptability and digestibility by lambs of *Salicornia*forage harvested at three different cutting dates during the growth cycle. Ash content was high at all cutting dates (35-46%) but protein levels were higher than in straw (7.5 – 8.5%). *Salicornia*was incorporated at 30% of the diet; the control diet contained 30 % wheat straw, and all diets contained 35 % alfalfa hay, 33 % sorghum grain and 2% molasses. All three cuttings of *Salicornia*compared favorably to the control diet in acceptability and digestibility.

Riley, et al. (1994)reported that the vegetative portion of the seawater-irrigated halophyte, *Salicorniabigelovii*, was fed, washed or unwashed, to sheep and goats in four trials in the United Arab Emirates and Kuwait during 1987 – 1990. They concluded that diets of 50 and 100 % *Salicornia*could be fed to sheep and goats, respectively, as long dietary crude protein content was adequate.

Kraidees, et al. (1998)studied the effect of dietary inclusion of *Salicornia*by-products on the performance, carcass characteristics, and mineral and water intakes of Najdi sheep lambs. Either the dry stems or spikes of this seawater-irrigated halophyte were incorporated into complete diets at four rates of 0, 10, 20 or 3o %, replacing equal amounts of Rhodes grass hay. Feeding *Salicornia*stems up to 30 % or spikes at 10 % did not affect dry matter intake (DMI) compared to control diet. However, the inclusion of spikes at levels above 10 % decreased DMI. Feeding stems at 10 and 20 % improved ADG by 10.6 and 4.8%, respectively, whereas feeding 20 and 30 % decreased ADG by 20.2 and 23.9 % respectively, compared to the control diet.

Abouheif, et al. (1998)estimated the digestibility coefficients, nutritive values, nitrogen balance and the rumen functions of the *Salicornia*by-products diets. They found that the digestibility of DM, OM, EE and fecal and urinary nitrogen, expressed as a percentage of nitrogen intake, were not affected by increasing the level of *Salicornia*stems in the diet. As level of *S*. stems increased from 0 to 20 % in the diet, CP digestibility reached its minimum.However, increasing its level to 30 % no further effects were observed. On the other hand, except for EE, digestion of all nutrients and nitrogen retention was linearly depressed as *S*. spikes increased from 0 to 30 % level. Concentrations of ammonia-nitrogen and total VFA in the rumen were lower with *S.* by-products than the control.

Tagel-Din (1991)used SM at 0, 10 and 20 % instead of the equivalent amount of soybean meal nitrogen in four complete diets, containing40 % roughage and 60 % concentrate, for growing Najdi male lambs. They observed that, increasing the level of SM slightly decreased digestibility coefficients of DM, OM, EE, and NFE, whereas CP and CF significantly decreased. The TDN and DCP were, also decreased. Nitrogen balance was decreased when SM was increased to 20 %. Mineral balance of Na, K, Mg, and Ca was not affected. However, P balance was decreased by increasing the level of SM. The average daily gain was not affected, however, feed conversion ratio was decreased by increasing SM levels and the differences were not significant. Water drunk as L/kg DMI was increased significantly by increased SM level to 20 %. Hot carcass and dressing percentage were not different among the three treatments. They concluded that SM could be incorporated into diets for growing lambs up to 20%. *Salicornia*seed meal represents a potential primary protein source (42 % CP) in formulating diets. Experiments with sheep showed that ruminants readily accepted the milled whole seeds. However, the seeds contained 0.05 % of oleanolic acid, a saponin which acts as an antifeed compound in poultry (Glenn, 1994).

Ba-Smaiel, et al. (1998)reported that S. forage hay couldbe fed to Majaheem camel lambs at the level of 25 % in the complete diet, instead of Rhodes grass hay, containing13.5 % CP. Swingle (1994) reported that, *Salicornia*meal (SM), 10 % of dry matter, was compared with cottonseed meal in diets containing Bermudagrass hay as the source of forage.The results indicated that: feed intake, ADG, feed efficiencies, diet digestibility, and carcass characteristics did not differ between the control and SM diets, indicating that SM is at least equivalent to cottonseed meal as a source of supplemental protein for growing lambs.

Kochia species**:** *Kochiaindica*and *Kochiascoparis*are annual bushy herbs, which belong to the family Chenopodiaceae.They may be considered as non - conventional forage - producing plants.Their nutritive valuesare comparable to those of clover (*Trifoliumalexandrinum*) and higher than those of many palatable xerophytes and halophytes, e.g.,*Diplachinefusca*(L.), *P. Beauv*, *Chlorisgayana*Kunth, *Panicumrepens*L., *Traganumnudatum*Del., …etc. However, their nutritive values are less than those of alfalfa, *Medicago sativa* L. (Whyte and Cooper 1966). Two *Kochia*species can be cultivated in arid lands using artesian saline water for irrigation. *K. indica*seeds showed that germination was highest when the seeds were watered with distilled water or with dilute solutions of NaCl. *Kochia*plants contain alkaloids yet the amounts present are not harmful to animals.

The chemical composition of *K. indica*differs between green branches and hay, which contains, 84.2 - 7.7 % moisture, 3.4 -17.0 % CP, 0.4 - 1.6 % EE, 4.1 - 22.0 % CF and 2.7 - 14.3 % ash (Draze, 1954).However, the chemical analysis of whole plant (stems plus branches) showed15 - 15.8 % CP, 24 - 26 % CF, 2 - 3%EE and 14 - 16% ash (Nour, 1995).Tagel-Din (1991)reported that *K. indica*contained CP (15.8%) similar to berseem hay (15.2%), however, digestibility coefficients of *K. indica*(72.5 % DM, 70.8 % OM, 71.0 % CP, 54.8 % EE, 58.6 % CF and 78.3 % NFE), and the TDN (60.4 %) and DCP (11.2 %) were higher than those of berseem hay. Also, Tagel Din (1991)studied the effect of inclusion of *K. indica* hay in complete diets, containing 45 % roughage and 55 % concentrates, at the levels of 0, 15, 30, and 45 % instead of berseem hay on dry matter intake digestibility coefficients, nutritive value and nitrogen balance by sheep. They reported that there were no significant differences in all parameters amongst the four diets. Nour(1995) fed fresh or dried *Kochiaindica*alone and dried *Kochiaindica*plus restricted amounts of rice bran or wheat bran or corn ear to sheep and goats. He found that feed intakes of sun-dried *Kochia*and rice bran or wheat bran, were higher than fresh *Kochia*alone, without significant differences. Digestibility coefficients in sheep fed on fresh *Kochia*were higher than sun-dried Kochia without or with concentrates. The nutritive values (TDN and DCP) of fresh *Kochia*were higher than those of sun-dried *Kochia*either alone or supplemented with concentrates. Nitrogen utilization was similar in fresh and dried *Kochia*. Nour(1995)concluded that *Kochiaindica* could be used as a good green fodder or hay for ruminants, especially in newly reclaimed land of relatively high salinity, for its higher content of crude protein and higher palatability compared with berseem hay which is becoming scarce and expensive.

4 DISCUSSION

Chemical Composition, Nutritive Value and Anti-Nutritional Factors

Halophytes are generally considered to be extremely valuable as a fodder reserve during drought. These plants are variable in both biomass production and nutritive value. They are characterized by slow growth, low digestibility (therefore low metabolizable energy) and high content of anti-nutritional factors. According to the chemical composition (Tables 2, 4, 5) several species plants have a relatively high nutritive value for ruminants and may be useful as a feed supplement (Ueckert et al. 1990). The highest forage values are found during the wet season of the year when plants are green andactively growing (Kandil ad El Shaer 1990). In comparison with other shrub species all chenopod shrubs contain high concentrations of digestible crude protein (DCP) and Na, K, and chloride ions relative to other pasture grasses and clover hay or straw as reported by Gihad and El Shaer (1994).

For many of the halophytic grasses, the fiber content is high and digestibility of that fiber is low. Halophytic shrubs present a different concern, the plant may be highly digestible, but much of the digested content is of little nutritional value (e.g., excess minerals). The organic matter component is also not highly digestible. The ME value of the plants is low with measured or predicted ME often 7 MJ ME/ kg. Adult sheep require 7- 9% protein in the diet to maintain weight and up to 18% for lactation and growth. Most of the halophytic grasses contain less than 8% CP and therefore will only support low levels of production if fed without a supplement. Much of the CP in halophytic shrubs is non-protein nitrogen. This can be converted to protein by the ruminant, but only if the supply of ME is high. The halophytic shrubs accumulate high concentrations of many minerals, particularly sodium (often 0.7% of DM), and also sulfur, magnesium, calcium, and potassium. When halophytes used a major part of the diet of desert animals, the daily intake of sodium chloride can be as high as 254g (Wilson 1966), that could has an adverse effect on the nutritional parameters of the consumer animal.

The feeding value of any rangeland is generally expressed in terms of voluntary intake and digestible nutrients per unit of feed. There are several factors which could considerably limit the feeding values of halophytic plants such as physical and chemical defenses, lignification and salinity.The high concentration suppresses appetite and creates a mineral imbalance within the animal. Concentrations of crude protein, minerals, and secondary compounds also contribute to nutritive value and are important considerations for halophytic forages.Such a list of limitations may discourage many livestock scientists away from grazing options for saline and semi-arid land. Some of secondary metabolitesthat naturaly found in halophytic plantsare poisonous. The nature of the toxic principle has not always been identified (Bayoumi and El Shaer 1994). Tannins (condensed or hydrosoluble tannins, nitrates and alkaloids are common in numerous halophytic plants. Tannins are widely perceived as important because they may reduce the digestion of protein and fiber (Lindroth 1989). Tannins are bound with protein or cell wall. In addition, herbivores may reject tannin-rich plants because they cause internal malaise (Provenza et al. (1991). A decline in cellulose digestion as wellas other changes in digestion and metabolism of lambs fed diets containing perloline were reported by Boling et al. (1975). Proper identification of the secondary metabolites that actually defend halophytes against browsing and foraging is required.

Voluntary Feed Intake (VFI)

Variation in VFI accounts for at least 50% of the variation that is observed in the feeding value of forages. Ruminants select a diet that is higher in digestible nutrients and lower in toxins than the average of available plant material on offer, indicating that feed selection is not random. Intake is influenced primarily by hunger, which is distressing, and by satiety, which is pleasurable. Nutrients and toxins both cause animals to satiate and excesses of nutrients, nutrient imbalance, and toxins all limit food intake.The reduced intake of some halophytic plants is probably caused by relatively high concentrations of secondary metabolites in such plants in comparison to graminoids (Bryant et a1.1991).Saltbush intake by sheep or goats was affected ($P< 0.05$) by the level of energy supplement Gihad, and El Shaer 1994).Saltbushesdefinitely possess a rather low energy value of around 5-7 MJ ME kg^{-1} DM (= 2.5-3.5 MJ NE) just enough to cover the maintenance needs of sheep if they consume 1.2-1.5 kg DM/day (Le Houerou 1991) but it is not enough to cover production requirement for growth, pregnancy or lactation. When small ruminants are grazing on Saltbushesas a sole feed, they do not satisfy their production requirements of energy. Sheep and goats may not obtain even their maintenance energy requirements as animals lend to lose weight (EI Shaer and Kandil 1990).

Salt and Water or Feed Intake Relationships

Salt accumulation reduces the nutritional value and feeding quality of most plants. Salt in the diet is associated with positive and negative effects on VFI, depending on concentration. From a low salt diet, an increase in salt intake increases water intake, which flushes partially digested biomass through the gut more rapidly and therefore has the potential to increase feed intake as clearance from the rumen is faster. On the other hand, ruminants have a limited capacity to ingest, absorb, and excrete salt. High concentrations of sodium chloride or potassium chloride in feed or water have shown to depress food intake and alter the size and frequency of meals.

The quantity and quality of the diet consumed by animals are largely dependent upon the available feed resources and the environmental stresses. When animals are maintained under normal conditions, dry matter intake is influenced mainly by body size, energy density of the diet and rate of digestion or fermentation. This may partly be the reason showing that legume hays are more readily consumed than grass hays of similar quality. In extreme cases of limited natural vegetation, the camel not only decreases its feed intake but also reduces its metabolic rate. Even so, in times of severe drought, camels can withstand better and benefit the best on the desert agricultural by-products supplement as compared to the other species. The preferability of using the by-products mixture in the supplementary feeding for herds of camels is more evident than sheep and goats.Camels fed *Atriplex* consumed comparable amounts of water to those fed conventional rations, while sheep and goat consumption was extremely high, especiaIly sheep (Gihad et al. 1988).Camels can tolerate saltbush fodder better than sheep and goats. Camels showed the lowest increase of water consumption and decrease of feed intake. Moreover, camel utilized the low crude protein intake better than other animals, which reflected in a positive N balance. These advantages give camels a special ecological niche, since they can be fed salinity-tolerant plants or tolerate high salt loads in drinking water. (Gihad 1993)

Several factors affect and limit the intake of halophytes. The lower consumption of the many halophytic ranges is one of the main limitations to their utilization as forage, which consequently impairs the performance and productivity of grazing or browsing livestock. This can be overcome when the salty rangelands have a good green cover of herbaceous plants (Wilson and Graetz 1980) or when supplemented with a source of readily available carbohydrate such as barley or molasses(Gihad, and El Shaer 1994).

The high and constant water content of halophytic plants make them preferred species for animals to assure a good portion of their water requirements in arid and semi-arid areas. Water in these areas is the most limiting factor for animal production, because it is either inadequate or unsuitable for drinking. Water content of lush leaves and twigs of trees and shrubs is as high as 80% (Gauthier-Pilters and Dagg 1981). The highwater content might furnish 40-50% of water requirements of animals which will be able to survive several days without drinking water (Macfarlane, 1964). In other words, therelatively high moisture content of grazable ranges (mostly halophytes) in the wet season, decrease water intake by 60% in sheep and by 25% in goats (Gihad and El Shaer 1994).

The high salt content of halophytes increase the animals water requirement because additionalwater is required to excrete their high salt content (about 70 ml g-1 of NaCI). Salt intake approaching 200 g NaCl/sheep day have been measured for sheepgrazing *Atriplex vesicaria* in summer. Sheep grazing on *A. vesicaria* rangelands drank approximately 7-12L/day, whereas, similar sheep grazing on an adjacent grassland consumed less than 3-5 L/day (Wilson 1974). The higher waterintake is needed for the urinary excretion of the high salt intake. He found that free water intake and sodium intake from *A. vesicaria* is high. Each gram of Na ingested required 74 ml free water to make full use of it. A similar figure (70.8 ml g^{-1}) was obtained by Hassan et al. (1979). Gihad et al. (1988) reported thatdrinking water intake increased by 61.4% when sheep were fed *A. halimus* instead of clover hay but the increase was lower in camels and higher in goats in comparison with sheep. It is hypothesized that minerals provided by moderate levels of halophytes in blended diets could be considered 'physiologically inert' if sufficient fresh drinking water can be provided to allow excretion of excess salts(Swingle, et al 1994).Mineral requirements of camels are not well established, so it is difficult to formulate aproper mineral supplement to satisfy requirements and avoid possible deficiencies. Moreover,content and availability of trace elements in the pasture can vary in consequence of salt mineralcontent, season and vegetation state. This means that it is very difficult to know the real amountof minerals that are available for the grazing animals daily.

Supplementation and Animal Productivity

The lack of sufficient energy in halophytes is the most serious deficiency for grazing animals kept for production of milk, fiber or work (Gihad and El Shaer 1994)and the most expensive to counteract. In most of the rangelands of the world, there is a wide seasonal variation in both the quantity and quality of the forage available, but livestock numbers remain more or less stable. In other words, there is always a gap between the feeds required for livestock production and the available resources. Supplemental feeding is a widely accepted defense against scarcity of forage under arid and semi-arid conditions. Proper feeding practices are closely related to rangeland management. It includes establishing policies for proper and wise use of supplementary feeding during dry seasons or other times when the animal's feed requirements is higher than availability. Animals which were given barley grain tended to consume more saltbush than those fed on forage alone. Sheep and goats raised on the salty rangelands (mainly *Atriplexhalimus, Anummularia, Nitrariaretusa, Salsolatetrandra, Tamarixaphylla,*and *Suaedafruticosa)* lost weight all the year round. Weight loss was least in spring and the highest in summer. Barley (energy) supplements improved the growth of sheep and goats.

Moreover, the amount of feedstuffs fed as a supplement to grazing/browsing ruminants has an effect on their productive and reproductive performance and the amount of range plants consumed. High levels of supplements given to ewes and does in late pregnancy or early lactation led to a significant improvement in milk production, birth weights of lambs and kids as compared to either the medium or low level of supplements. Reproductive efficiency, as judged by lambing percentage of ewes and does grazing natural halophyte-dominated rangelands without supplements, was enhanced by the supplements. When a supplement of a high energy feed was given, in addition to grazing, lambing percentage was increased by 15% units.Lambs per lambing were1.33 and 1.53 for ewes grazing *Atriplex*spp. only and those grazing *Atriplex*plus a barley supplement, respectively(Benjamin et al. 1986).*Atriplexnummularia*intakes over 9 months were able to maintain body weight of mature sheep indefinitely without supplements. When these shrubs were supplemented, sheep had body weight gains of 80 g day^{-l}Le Houerou (1991). Similar findings have been reported in Egypt with wild and cultivated *A. halimus*and *A. nummularia*. The type of supplementary feeding of lactating ewes and does is one of the principal factors affecting body weight changes of dams and their milk yield and composition in addition to daily gain of the offspring. Encouraging results, mainly economic benefits, have been obtained in Egypt from using agro-industrial by-products such as grape pulp and date seeds as energy supplements for sheep, goats, and camels on halophytic rangelands(El Shaer 1986).Ground date seeds and olive pulp could be used economically in supplementing sheep and goats grazing a mixture of halophytic rangelands. This would reduce dependence on the highly expensive conventional feedstuffs (Khamis et al. 1989).

The effect of halophyte intake on weight gain would depend on the ability of animals to adjust feed intake to compensate for the lower dietary energy density(Swingle, et al 1994). In high-roughage diets, where intake is limited by gastrointestinal fill, energy intake and weight gains would likely be lower on halophyte diets than could be achieved using conventional feedstuffs. However, in higher-concentrate diets, where intake is not regulated by gastrointestinal fill, halophyte diets might be consumed at a level that would allow energy intakes and gains equivalent to those possible on diets containing only conventional ingredients.

Animals which were given barley grain tended to consume more saltbush than those fed on forage alone (EI Shaer et al. 1991). Sheep and goats raised on the salty rangelands lost weight all the year round. Weight loss was least in spring and the highest in summer. Barley (energy) supplements improved the growth of both sheep and goats, decreased water intake and rumen ammonia-N and increased the rumen volatile fatty acids (Kandil and EI Shaer 1990). Moreover, the amount of feedstuffs fed as a supplement to grazing/browsing ruminants, has an effect on their productive and reproductive performance and on the amount of range plants consumed. Barley supplements were fed to grazing sheep and goats on a mixture of halophytic plants in Sinai, Egypt.

Diets rich in green forages can augment milksecretion *(*Knoess, 1977), while water restriction can only marginally decrease milk yield *(*Yagil and Etzion (1980).The major factors that affect camel milk yields include the forage (quality and quantity), watering frequency, climate, breed, age and parity, milking frequency, calf survival and the presence of calf, milking method, speed of milking, health status, reproductive status and individual potential (Bengoumi et al. 2002).

In a world where grains arescarce and best used for feeding people or at least for livestock with a high feed conversion ratio, the sustainable use of feed supplements for grazing ruminants is questionable. We suggest that the use of high-quality supplements is shortsighted. However, supplementation with either agricultural or industrial by-products could be applied as long as they are available. A more sustainable long-term approach is to improve the feeding value of halophytes. With such an approach, the current limitations represent opportunities. From an agricultural systems' perspective, improved livestock production is essential; however, this should also be seen as part of a package that can provide broader environmental benefits. Halophyte supplementation would find application only if their cost per unit energy or cost per unit product is competitive with that of conventional feeds.

Using of Halophytes in Mixed Feeds

Information on effects of including halophyte ingredients in mixed diets on the economically important characteristics of weight gain and efficiency of feed conversion by livestock is lacking.In general, results show organic constituents of halophyte forages are highly digestible by goats (Wiley 1982) and sheep (De la Llata 1991), and that mixed diets containing halophyte forages are acceptable to sheep and goats (Wiley 1982; Glenn et al.1992). Halophyte forages have usually been included as 15 to 35% of diet dry matter, but De la Llata (1991) reported that a diet with 70% *Atriplex* forage was readily consumed by lambs.

Although nutrient composition varies by species, plant part, stage of maturity and is affected by many variables, halophytes usually contain sufficient crude protein and/or carbohydrate components to have significant nutritional potential. However, the typically high content of minerals (much of which is sodium chloride), low content of available energy and possible presence of antinutritional factors including tannins, alkaloids, oxalates and saponins are factors which compromise the usefulness of halophytes in animal production(Bayoumi and EI Shaer 1994).Incorporation of halophytes into blended diets would be advantageous because a level of inclusion could be selected to minimize adverse effects of the factors listed above on animal growth performance. Also, mixtures of halophytes and higher energy ingredients, such as legumes, cereals, molasses or fat, would be more likely (than halophytes grazed or fed alone) to support levels of animal productivity required to justify the expense of growing halophytes under irrigated conditions.

As a result of the lower energy density in halophyte ingredients, weight gains will necessarily be reduced if dry matter intake is the same or lower than can be achieved on conventional diets; alternatively, intake will have to be higher in order to achieve weight gains possible on conventional diets. The reduced feed conversion efficiency will likely be a constant 'penalty' for using halophyte ingredients in livestock feeding systems as attempts to improve nutritional value of halophyte forages by water leaching to reduce the mineral content have not been encouraging. However, the significance of the feed conversion penalty will vary.

The problems of feeding chenopods seem to be largely overcome by feeding them as a supplement or as part of forage mixtures. Thus a supplement of 284 g/day of *A. nummularia*increased the total intake of hay and saltbush by 200 g/day. A mixture of *A. undulate*and hay had an intake of 1449 g/day, compared with intakes of only 850 g/day for hay and 615 g/day for *A. undulate*when fed alone. This suggests that the effect of the secondary compounds is diluted and livestock performance reflects the true nutritional value of the combined ratio.

The importance of feeding mixtures of plants, such as *A. nummularia*, with herbaceous species and annual grasses, which together fulfill the requirements of an effective fodder crop and can be grown at moderate salt levels, is recommended to be followed.

5 CONCLUSION

About one-third of the earth’s land surface is affected with desertification due to the spread of salinity, especially in arid and semi-arid regions, resulting in reduced crop yields. As halophytes and salt-tolerant species yield high edible biomass in saline lands where non-halophytic species cannot grow, it could be used for grazing, conservation as forage or incorporated into mixed rations to replace roughage. Feeding halophytes to ruminant animals could be a feasible solution to minimize the problem of feed shortage in Egypt. Its nutritive values vary according to many factors, some of which are related to plant and the others to the soil. The principal disadvantage to use of halophyte ingredients will be reduced feed conversion efficiency, due to the dilution effect of minerals on energy density**.**Halophytes offer a range of nutrients for ruminants, but these may not be balanced as a diet, and plants may also contain toxins called anti-nutritional factors. Nutritionists do their best to create any processing method for alleviating the bad effects of those factors. Unleached*Salicornia*hay (immature plants) could replace wheat straw in lamb diets. Besides high ash content, the other apparent limitation to incorporating *Salicornia*straw into goat or sheep diets is low protein content, which can be adjusted by adding more protein concentration.

In Egypt, one of the proper utilization methods for halophytes otherwise, rangeland management is a mixing halophytic feeds with other types more palatable and nutritious to get beneficial complementary effects. Furthermore, supporting herds of livestock with different types of feeds or additives helps to maintain their productivity, otherwise keeping the pasture for sustainability.

RECOMMENDATIONS

It can be recommended that some halophytes feedstock could be used as a sole diet depending on its nutritive value and used just in case of animals that are in a physiological dry phase.However, it is better, for maximizing benefits resulted from utilizing halophytes as feedstock and for economic value, to mix it with each other or with high feed values especially in the scarcity of forage in the area. Halophytes can be used at moderate levels if sufficient fresh drinking water is provided to animals to allow efficient excretion of the excessive minerals. Halophyte plants contain higher levels of crude protein and ash, and lower readily available carbohydrates than most of conventional feeds. They must be supplemented or mixed with another ingredient feed that is a good source of readily available energy, e.g., barley, corn, molasses and concentrate mixture to dilute the high minerals content, especially sodium chloride and adjust the N: C ratio. Where conventional feedstuffs are available, halophyte plant ingredients will apply only if cost per unit energy or per unit of production is comparable with those of competing feeds.

*Kochiaindica*is considered as an alternative for berseem in relatively high salinity land. It could be successfully used as a good green fodder or hay for ruminants. *Salicorniabigelovii*could be planted inthe Mediterranean Sea and Red Sea coastal areas, which are silty lands, and irrigated with seawater. There are promising results of using S. *bigelovii*as feed for ruminants or their extracted oil as food for humans.Therefore, more attention should be given to this plant.

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