NUTRITIONAL STUDIES ON SHEEP FED SALTBUSH SUPPLEMENTED WITH DIFFERENT DESERT ENERGY SOURCES UNDER SALINE CONDITIONS IN SOUTHERN SINAI.

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SUMMARY

The objective of the study was to determine the influence of source of energy supplementation grown in desert (e.g. barley grains, ground date seeds and fodder beet) on utilization of saltbush (*Atriplex nummularia)* on intakes, nutrients digestion coefficients, nitrogen utilization, and some blood and rumen metabolites in sheep. Twenty adult Barki rams, averaged 3 years old and 56.62±3.40 Kg body weight, were used in four equal groups for 6 weeks feeding trial then15 days as a digestibility trial. Each animal group was given daily fresh chopped saltbush supplemented with one of the following energy source: Concentrate Feed Mixture (CFM) for the Control group (G1), Barley grains for the second group (G2), Ground Date Stones (GDS) was for the third group (G3) and Fodder Beet (FB) was for the fourth group (G4). Chemical composition and plant secondary metabolites (PSM) screening of different supplements were recorded. Nutrients contents were varied among all feed materials. Atriplex plants were relatively high in ash, crude protein, and crude fiber while it was low in energy content. To compare energy feed resources, Fodder beet (FB) showed the highest energy content. CFM was the highest CP (13.28%) while the least one was in GDS (7.46%). It was noticed that CF, EE, OM, NDF, ADF and cellulose of GDS were higher than those of barley grains (BG), FB and CFM, while NFE of BG was higher than that of CFM, FB and GDS. Supplementation of Atriplex with FB is significantly ($P< 0.05$) increased total DMI and crude protein (CP) intake while reducing the free water intake. Dry matter and organic matter digestibility were significantly higher ($P< 0.05$) with G4 and G2 than G1 and G3, respectively. CP digestibility was improved ($P< 0.05$) by BG (G2) much better than that of FB (G4), CFM (G1) and GDS (G3). Digestibility of crude fiber (CF) and its fractions were improved ($P<0.05$) by using FB. Total digestible nutrients (TDN %) and digestible crude protein as percent of intake (DCP %) were increased in BG supplemented animals than other two studied supplements (FB and GDS). The highest nitrogen intake (NI) and nitrogen retention (% of intake) were the highest ($P<0.05$) in the control group while the lowest value was recorded in G3. The pre-feeding rumen characteristics ammonia– nitrogen (NH_3-N) and total volatile fatty acids (TVFA's) were increased significantly ($P< 0.05$) to reach the peak value at 6 hrs post feeding. Among the blood chemistry parameters, total protein (TP), albumin and globulin were reduced significantly in G3, while urea, creatinine, and cholesterol showed elevated values than control animals. In conclusion, fodder beet followed by barely grains, cultivated under saline conditions, are recommended to be the best energy supplements for sheep fed saltbush to solve the problems of feed shortage under arid and saline conditions of Sinai, Egypt.

Keywords: *Atriplex nummularia; fodder beet; date stones; energy supplements; digestibility; salt tolerant fodders; salinity and sheep.*

INTRODUCTION

Dry regions in Egypt suffer from a chronic shortage of fodder crops production due to several environmental factors, particularly salinity stress in soils and ground water. Bedouins spend a considerable amount of money to buy and transport other feed ingredients from the Nile valley region, which puts an additional burden on the economic situation of Bedouins and have an impact on the feed gab in the New Valley area. Introduction of high potential salt tolerant fodders such as salt bush and fodder beet to salt affected regions would have proved to be an effective way to overcome the shortage of animal feeds (El Shaer, 2010).

The increase in feed costs has encouraged nutritionists to search for cheaper non traditional feed materials, particularly high protein and energy feed ingredients. Saltbush (*Atriplex nummularia*) is one of the promising salt tolerant forages that exhibit a series of outstanding features such as hardiness and ability to grow under high drought and saline stress conditions. The shrub is characterized by high mass production and moderate digestible crude protein (DCP) but deficient in energy contents (Le Houerou, 1992, Ben Salem *et al*., 2005 and El Shaer, 2010). Deficiency of available carbohydrates and the rapid fermentation of crude protein (CP) in the rumen may be responsible for the poor utilization of the protein of saltbush (Weston *et al*., 1970 and Hassan *et al*., 1979). Supplementing Saltbush with carbohydrates sources such as barley grains and ground date seeds can improve its feeding value by providing energy to ruminal microbes to produce microbial protein, stimulate carbohydrate digestion and detoxify secondary compounds (Provenza *et al*., 2003; Van der Baan *et al*., 2004; Du Toit *et al*., 2006, El Shaer, 2010 and Al-Owaimer *et al*., 2011).

The study aimed to determine the influence of source of energy supplementation grown in desert (e.g. barley grains, ground date seeds and fodder beet) on utilization of *Atriplex nummularia* as a basal diet fed to rams in terms of nutrients digestion coefficients, nitrogen utilization, some blood metabolites and rumen fermentation parameters.

MATERIALS AND METHODS

The study was carried out at the Eexperimental Station of Desert Research Center, located at Ras Sudr region, Southern Sinai Governorate, Egypt which is characterized by high salt affected saline resources (soil and ground water). Most of the tested feed materials were provided from the Experimental Station: *Atriplex nummularia* (Old Man Saltbush), fodder beet (*Beta Vulgaris*) and barley grains. The study was performed during late spring (2010). It consisted of 2 trials: 1- feeding trial and 2- digestibility and metabolism trial.

Animals, feed and experimental design:

Feeding trial:

Twenty adult Barki rams, averaged 3 years old and 56.62±3.40 Kg body weight ,were used a simple factorial design for a 6 weeks feeding trial. The animals were equally a signed randomly in four groups where all animals in each group (group feeding system) were given daily fresh chopped *Atriplex nummularia* (Old Man Saltbush), as a basal roughage diet, and supplemented with one of the following energy sources: Concentrate Feed Mixture (CFM, which contains 25% cotton seeds cake, 35% yellow corn, 30% wheat bran, 3% rice bran, 3% molasses, 1% urea, 2% limestone and 1% common salt) for the Control group (G_1), Barley grains for the second group(G2), Ground Date Seeds (GDS) was given for the third group (G3) and Fodder Beet (FB) was offered to the fourth group (G4). The animals were offered their daily rations according to their live body weight calculated from the nutritional requirements according to Kearl (1982). All Animals were given the energy diets at 30% of their maintenance requirements while Saltbush was given *ad-libitum*. Feed allowances were offered twice daily at 8 a.m. and 2 p.m. and drinking water was available twice daily 9 a.m. and 3 p.m. Feed refusals were collected then weighed and recorded to calculate the daily voluntary feed intake(VFI) of Atriplex. Animals were individually weighed weekly and body weights were recorded.

Digestibility and metabolism trial:

After the end of the feeding trial, four animals from each group were selected and placed individually in metabolic cages for 10 days as a preliminary period followed by 5 days as a collection period. *Atriplex* was offered to the animals at 90% of the actual intake of the last day of the feeding trial while the energy diets were offered at 30% of their maintenance requirements (Kearl, 1982). Feed offered and refusals were recorded every day. Feces and urine samples were collected at 7 am for five successive days from each animal. Both separate fecal and urine samples from each animal were taken daily, mixed and composite samples were saved for chemical analysis. Rumen fluids samples, were taken before feeding and then at 6 hours post morning feeding for three successive days after the end of digestibility trial and then composite samples were stored for analysis while blood samples were collected just once before morning feeding and kept for analysis.

Chemical and Anti-nutritional factors (ANF s) analysis:

Proximate analysis for all feed ingredients, feed refusals, fecal samples and urine were analyzed according to A.O.A.C. (1990). The fiber fractions (neutral detergent fiber, NDF; acid detergent fiber, ADF and acid detergent lignin, ADL were applied by Goering and Van Soest (1970). Hemicellulose and cellulose values were calculated.

Qualitative estimation of total tannins and saponins as the main secondary metabolites (Anti-nutritional factors, ANF' s) in all energy feed resources were carried out according to Balbaa (1986) and Balbaa *et al.* (1981), respectively.

Rumen and blood analysis:

Rumen total volatile fatty acids (TVFA's) were determined according to Warner (1964) and ruminal ammonia nitrogen NH_3-N values were determined according to A.O.A.C. (1997). All blood serum samples were analyzed for urea–N (Berthelot, 1959), creatinine (Seelig and Wust, 1969), total protein (Reinhold, 1953), albumin (Rodkey, 1965), globulin was obtained by subtracting the albumin values from the total protein, cholesterol (Roeschlau *et al.*, 1974), triglycerides (Trended, 1969), alanine aminotransferase (ALT) and aspartate aminotransferase (AST) using the procedure of Schmidt and Schmidt (1963).

Statistical Analysis:

Statistical analysis for the obtained data was carried out using the general linear model of SAS software for PC (SAS, 2000). Differences among means were tested using Duncan's multiple range test (Duncan, 1955).

RESULTS AND DISCUSSION

Chemical composition and secondary metabolites of the feed ingredients:

Data of chemical composition of *Atriplex nummularia* and energy feed supplements are presented in Table (1). Nutrients contents were varied among all feed materials. Atriplex plants are relatively high in ash, crude protein, and crude fiber while it was low in energy content. Similar figures were recorded in several studies (Ben Salem *et al.* 2010 and Fayed *et al.* 2010). To compare energy feed resources, fodder beet (FB) showed the highest energy content (2.87Mcal/KgDM) which in agreement with the results of De Brabander *et al.* (1999) and El-Essawy *et al.* (2011).

Table (1): Chemical composition (DM, %), and fiber constituents of the experimental feed materials

Item	Atriplex	CFM	BG	GDS	FB
DM	94.72	92.98	91.39	94.0	89.22
OM	79.93	93.95	96.90	98.05	87.25
CP	12.25	13.28	9.38	7.46	8.5
CF	19.45	9.57	8.75	12.77	7.75
EE	1.57	1.91	2.46	6.59	2.43
Ash	20.06	6.05	3.10	1.95	12.75
NFE	46.65	69.19	76.31	71.23	68.56
NDF	63.73	36.0	19.0	71.9	42.39
ADF	36.36	29.0	8.0	56.08	22.47
ADL	24.65	11.0	2.0	14.77	15.25
Cellulose	11.71	18.0	6.0	41.31	7.22
Hemicellulose	27.37	7.0	11.0	15.82	19.92
ME (Mcal/Kg DM)	1.73	2.16	2.7	1.98	2.87

* *Concentrate feed mixture (CFM), Barley grains (BG), Ground date seeds (GDS) and Fodder beet (FB). ME, Mcal/kg DM= (TDN x 3.6) /100 (Church and Pond, 1982)*

CFM was the highest energy supplement in CP (13.28%) while the least one was in GDS (7.46%). It was noticed that CF, EE, OM, NDF, ADF and cellulose of GDS were higher than those of BG and CFM, while NFE of BG was higher than that of CFM and GDS. In general, the results were in harmony with those of Shawket *et al.* (2002).

Data on phytochemical screening of the energy supplements (Table 2) revealed that GDS contains high concentration of tannins (T) while it was free from saponins. FB contains moderate concentration of (T) and small amount of saponins. BG and CFM were free from both tannins and saponins. *Atriplex nummularia* grown in the same Experimental Research Station and tested by Fayed *et al.* (2010) who found that the content of tannins as condensed tannins (CT) was 2.29 g/ 100g DM and saponins was 4.42

g/100g DM. Such results were comparable to those reported earlier on the same feed materials (Du Toit *et al.*, 2006; Getachew et *al.*, 2008 and Fayed *et al.*, 2010).

Table (2): Phytochemical screening for the feed supplements

Supplement	Anti-nutritional factors	
	Tannins	Saponins
Barley grains (BG)	_	_
Ground date seeds(GDS)	+++	_
Fodder beet (FB)	++	+
Concentrate feed mixture(CFM)		

+: Small value ++: Moderate value +++: High value _: absent

Feeding trial:

Data on voluntary feed intake (VFI) of *Atriplex nummularia* during the feeding trial (6 weeks) are presented in Table (3) and illustrated in Figure (1).

Table (3): Voluntary feed intake (VFI) of *Atriplex nummularia* during the feeding trial.

Item	Rations				
	G1	G2	G3	G4	± SE
Initial Body Weight, Kg	58.83[a]	61.0[a]	58.83[a]	52[b]	±1.33
Final Body weight ,Kg	60.5[a]	63.2[a]	60.66[a]	54.5[b]	±1.43
Body weight changes, Kg	1.67	2.2	1.83	2.5	
VFI ,g DM/Kg $BW^{0.75}$					
Week1	9.09	7.97	7.42	9.67	
Week2	9.55	8.37	8.85	10.42	
Week3	9.10	8.77	9.51	10.18	
Week4	9.97	9.34	9.78	9.96	
Week 5	9.95	9.61	8.77	9.87	
Week 6	11.18	11.30	8.95	9.91	
Average	9.80	9.22	8.89	10.00	

G1: Atriplex nummularia + CFM, G2: Atriplex nummularia + Barley grain, G3: Atriplex nummularia + Ground Date seeds, G4: Atriplex nummularia + Fodder beet

a, b: values with different letters in the same row means statistically significant at ($P < 0.05$).

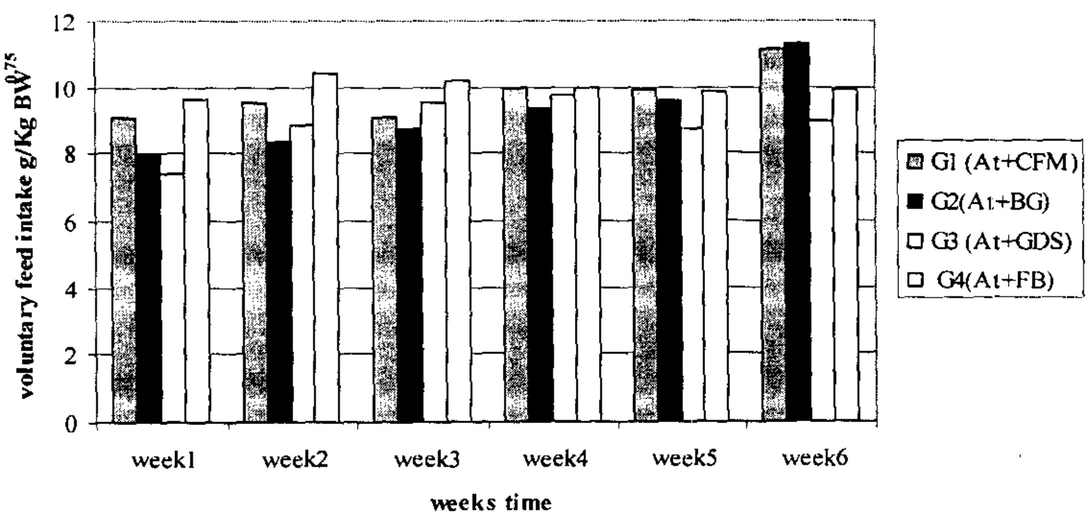

Figure (1): *Voluntary feed intake (g DM/Kg $BW^{0.75}$) of Atriplex nummularia during the 6-week feeding trial.*

VFI of saltbush was generally increased gradually from the 1[st] week up to the 6[th] week. It appeared that the VFI of saltbush was almost stable at the 6[th] week for animals in G3 and G4 (8.95 and 9.91 g DM/ Kg$BW^{0.75}$, respectively). It is indicated that all animals fed *Atriplex nummularia* and supplemented with such energy sources gained appreciable various amounts of weight although they were mature. These results are in agreement with those reported by Kandil and El Shaer (1988); Le Houerou (1992) and El

Shaer and Kandil (1998) who reported that sheep fed saltbush should be supplemented with barely grain (250 g barley/ Kg BW).

It seems that the type of energy supplements (brought mainly from the desert) showed varied associated effects on the VFI of Atriplex; Figure (1). Animals fed Atriplex supplemented with Fodder beet (G4) consumed the highest amounts of Atriplex which was reflected on the highest body weight gain in comparison with the other feeding groups. On averages basis, by the end of feeding trial, the relatively maximum VFI was recorded by animals in G4 (Atriplex with Fodder beet) while the minimum values were found for animals in G3 (Atriplex with ground date stones group).

Nutrients utilization and nutritive values:

The results of digestibility coefficients of saltbush supplemented with different energy sources (Table 4) showed that the digestion of dry matter (DM), organic matter (OM) and nitrogen free- extracts (NFE) were significantly (P< 0.01)higher for sheep fed Atriplex and supplemented with FB (G4) and BG (G2) ,respectively than the other groups. All fiber constituents were most efficiently digested for animals fed Atriplex with FB (G4) since the maximum digestion coefficients for NDF, ADF, ADL, cellulose and hemicellulose) were recorded in comparison with the other animal groups. The obtained results could be explained that FB is characterized by high sugar and starch contents resulting in high nutrients digestion and most likely supporting microbial growth (Hoover and Stokes, 1991 and De Brabander *et al.*, 1999).

The highest CP digestibility was recorded by animals fed G2 followed by those fed G1 and G4 and the least ones were for those fed G3 (Atriplex with GDS). However, the lowest digestibility coefficients of DM, OM, CP, CF, NDF, ADF and ADL were observed in sheep fed Atriplex with date seeds (GDS). These results are in comparable with those obtained by many investigators using sheep and goats fed Atriplex and supplemented with GDS (El Shaer *et al.* 2002; Shawket *et al.* 2002 and Al-Dabeeb 2005) Such results might be also attributed to the rich secondary metabolites in GDS particularly tannins as reported by Wina *et al.* (1999). Potter *et al.* (1993) showed that saponins reduce protein digestibility by the formation of less digestible saponin–protein complexes affecting the nutritive value of the diet. There was significant difference in digestibility coefficient of ether extract (EE) among all groups (P< 0.05). The highest values were recorded in G3 and G2, respectively. This result was in harmony with those of Al-Owaimer *et al.* (2011) with lambs fed Atriplex with date seeds.

Table (4): Digestion coefficient and nutritive value of the experimental rations fed to sheep.

Item	G1	G2	G3	G4	SE
Digestion coefficients %:					
DM	73.76^{b}	80.55^{a}	71.98^{b}	80.74^{a}	1.49
OM	74.39^{b}	81.21^{a}	71.29^{b}	83.24^{a}	1.53
CP	63.74^{ab}	66.39^{a}	58.47^{b}	63.03^{ab}	1.89
CF	58.23	56.74	55.59	65.29	2.27
EE	70.35^{b}	78.44^{a}	79.15^{a}	75.16^{ab}	1.58
NFE	72.66^{b}	84.97^{a}	73.15^{b}	86.99^{a}	1.54
NDF	60.33^{ab}	57.87^{ab}	55.15^{b}	64.46^{a}	2.15
ADF	56.20^{b}	51.22^{bc}	48.02^{c}	63.87^{a}	1.79
ADL	35.14^{b}	46.59^{a}	27.90^{c}	48.01^{a}	2.08
Hemicellulose	65.02^{b}	57.11^{c}	64.37^{b}	76.22^{a}	2.03
Cellulose	42.99^{b}	54.23^{ab}	61.87^{a}	60.20^{a}	3.72
Nutritive value:					
TDN (g/Kg BW)	17.61^{ab}	17.68^{ab}	16.46^{b}	19.28^{a}	0.110
TDN % of DMI	62.27^{b}	69.74^{a}	64.47^{ab}	67.96^{ab}	0.135
DCP (g/Kg BW)	2.28^{a}	1.866^{b}	1.50^{c}	1.92^{b}	0.090
DCP % of DMI	8.06^{a}	7.36^{b}	5.90^{c}	6.79^{b}	0.215
ME, Mcal/ kg DMI	2.322	2.655	2.420	2.575	0.095

G1: Atriplex nummularia + CFM, G2: Atriplex nummularia + Barley grain, G3: Atriplex nummularia + Ground Date seeds, G4: Atriplex nummularia + Fodder beet.

a, b, c : values with different letters in the same raw means statistically significant at (P< 0.05) .

The results of nutritional values of the experimental diets in terms of total digestible nutrients (TDN) and digestible crude protein (DCP) are presented in Table (4). TDN % values were relatively comparable among all groups and ranged between 62.27 and 69.74% without significant differences. DCP values were significantly varied among the groups. The highest value was recorded with the control diet (G1) followed by the diet containing Atriplex with BG (G2). Such trends could be attributed to high crude protein intake and high crude protein digestibility in G1 and G2. Sheep in G2 and G4 recorded the highest ME values without significant variations among the studied groups.

Intake and water consumption:

Dry matter intake (DMI), crude protein intake (CPI) and water intake (Table, 5) revealed that sheep in G1, G3 and G4 consumed comparable amounts of energy supplements without significant differences but higher ($P<0.05$) than those given barley (G2). Generally, irrespective of energy supplementation, it was noticed that saltbush intake was affected significantly ($P<0.05$) by the type of energy supplements. The highest Atriplex intake was recorded for sheep fed Fodder beet (G4) while animals in (G3) consumed the least amount of saltbush. Total dry matter intake (TDMI) were comparable without significant differences when sheep fed the control ration (G1) and those fed Atriplex plus FB (G4) which was higher than those in G2 and G3. It means that the ration of G4 was more palatable because of inclusion of FB. These results are in agreement with the findings of many investigators (Dulphy *et al.*, 1990; El Shaer, 1995; El Shaer *et al.* 2002 and Al-Owaimer *et al.* 2011). Improvement in DMI for animals of G4 matched with the results of greater digestibilites of nutrients in this group (Table, 4).

There are high significant ($P<0.01$) variations in total crude protein intake (CPI) (g/Kg $BW^{0.75}$) among the animals groups due mainly to the variations in CP contents and DMI of the feed materials. Animals in G1 and G4 showed the highest total CPI values (3.07 and 2.70 g/ kg $Bw^{0.75}$, respectively). These findings were matched with the highest values of total DMI in G4 and G1 (14.55 and 14.11 g/KgB$W^{0.75}$, respectively).

Table (5): Feed intake (g /Kg $BW^{0.75}$) and water utilization (ml / Kg $BW^{0.82}$) for the sheep fed the experimental rations.

	Rations				
Item	G1	G2	G3	G4	±SE
DM intake g/Kg $BW^{0.75}$:					
Energy supplement	6.11^{a}	5.62^{b}	6.21^{a}	6.13^{a}	0.096
Atriplex	7.99^{b}	7.75^{c}	7.39^{d}	8.42^{a}	0.063
Total	14.10^{a}	13.37^{b}	13.60^{b}	14.55^{a}	0.275
CP intake, g/Kg $BW^{0.75}$:					
Energy supplement	1.34^{a}	0.95^{b}	0.88^{c}	0.96^{b}	0.018
Atriplex	1.73^{a}	1.60^{ab}	1.50^{b}	1.74^{a}	0.044
Total	3.07^{a}	2.55^{bc}	2.38^{c}	2.70^{b}	0.055
Water intake, ml/Kg $BW^{0.82}$:					
Free drinking water	27.06^{b}	27.38^{b}	30.09^{a}	27.11^{b}	0.757
Combined water	6.41^{c}	10.66^{b}	10.94^{b}	36.15^{a}	0.216
Metabolic water	5.58^{ab}	5.88^{ab}	5.56^{b}	6.26^{a}	0.176
Total water intake	32.48^{d}	35.49^{c}	38.0^{b}	55.67^{a}	0.734

G1: Atriplex nummularia + CFM, G2: Atriplex nummularia + Barley grain, G3: Atriplex nummularia + Ground Date seeds, G4: Atriplex nummularia + Fodder beet

a, b, c, d: values with different letters in the same raw means statistically significant at ($P<0.05$).

Water consumption:

Water intake data (ml/kg $BW^{0.82}$) (table 5) showed significant differences for free drinking water, combined water, metabolic water and total water intake among the sheep groups.

It appears that Sheep in G3 consumed the highest amount of water (30.09 ml/Kg $BW^{0.82}$) while those in G1 and G4 consumed the lowest amounts of drinking water (27.06 ml/KgB$W^{0.82}$). It could be concluded from such findings that replacement of BG and GDS with FB would reduce water consumption which is considered as the limiting factor in desert region. These findings would be confirmed with the findings reported in Table (4) which indicated that animals fed Fodder beet in G4 were able to digest Atriplex more than their mates in other groups due to the lowest free water consumption. This could be, also, explained by the Swedish Dairy Association (2003) where they reported that fodder beets (*Beta Vulgaris*) as one of root crops that widely used in Swedish Dairy rations and they were regarded as "succulent" feeds, exchangeable for grass silage or green fodders. Moreover, high significant variations ($P\leq0.01$) were recorded in combined water data in comparison between G4 and other three groups and this reflected the high water content of FB as succulent feeds. The highest total water intake was recorded by animals supplemented with FB (55.67 ml/Kg $BW^{0.82}$) which related mainly to the effect of high combined water (36.15 ml/KgB$W^{0.82}$) showed by the same animals in G4.

Nitrogen Retention:

Nitrogen intake, excretion and retention data were reported in table (6). Nitrogen intake (NI) values were significantly (P<0.001) affected by the type of energy supplements. It might be due to the variations of DMI and N contents of rations among the groups. Animals fed in G1 showed the highest NI value (30.63 g/ head/day) compared to those in the other groups. These results agree with El Shaer *et al.* (2002).

Table (6): Nitrogen utilization (g/head/day) of sheep fed the experimental rations.

Item	G1	G2	G3	G4	SE
Nitrogen intake, g/head/day	30.63^{a}	27.61^{ab}	24.74^{b}	25.24^{b}	1.38
Excreted nitrogen:					
Fecal nitrogen	11.08^{a}	9.27^{b}	10.27^{ab}	9.19^{b}	0.350
Urinary nitrogen	13.73	14.09	11.57	12.63	1.148
Total nitrogen excretion:					
g/ head/day	24.81	23.36	21.84	21.82	1.24
% of intake	81.06	84.60	88.27	86.45	2.14
Nitrogen retention (NR):					
g/head/day	5.82^{a}	4.25^{ab}	2.90^{b}	3.42^{b}	0.656
NR % of intake	18.93	15.39	11.72	13.55	2.13

G1: Atriplex nummularia + CFM, G2: Atriplex nummularia + Barley grain, G3: Atriplex nummularia + Ground Date seeds, G4: Atriplex nummularia + Fodder beet

a, b: values with different letters in the same raw means statistically significant at ($P \leq 0.05$).

Animals fed on G3 that supplemented with GDS recorded the lowest NI. It could be explained from the previous data (table1) that detected that date stones had higher ADF content which could be bounded with nitrogen and led to poor digestion of N and consequently decreased NI (Ben Salem *et al.*, 1995). Total nitrogen excretion, in terms of g/ head/day or % of intake, varied but without significant differences among the groups. All sheep were in a positive nitrogen balance and retained significant amounts of nitrogen as g/ head/day (P≤ 0.05). Animals fed Atriplex supplemented with CFM (G1) retained the highest amount of N (5.82 g/ head/day) while animals in G3 had the lowest value (2.90 g/ head/day). Erikson (2003) reported that roots feeds such as FB and potatoes did not improve nitrogen retention compared to similar amounts of barley supplement.

Rumen parameters:

Results of rumen ammonia - Nitrogen (NH_3-N) and volatile fatty acids (TVFA's), are shown in table (7). Results indicated that both NH_3 – N and VFAs values were varied among sheep groups and affected significantly (P<0.01) by the types of energy supplements at 0 hr and 6 hr. after feeding. Both rumen NH_3-N and TVFA's concentrations tended to increase 6 hours post feeding with significant variations (P<0.01) among groups. The pre-feeding and 6 hr post feeding NH_3-N concentrations (mg/100ml) were the highest (31.57 and 36.47 mg/100ml, respectively for the control animals (G1) due to high CP content of the whole diet (12.25 and 13.28% for Atriplex and CFM, respectively as shown in Table 1).

Table (7): Some rumen parameters: Total volatile fatty acids (TVFA's, meq/ 100 ml) and Ammonia-Nitrogen (NH_3-N, mg/100 ml) of sheep fed the experimental rations.

Item		G1	G2	G3	G4	overall mean
	0 hr	$3.78^{d} \pm 0.90$	$3.36^{d} \pm 0.03$	$3.12^{d} \pm 0.277$	$5.83^{ab} \pm 0.316$	$4.02^{b} \pm 0.385$
	6 hr	$5.18^{bc} \pm 0.372$	$5.48^{ab} \pm 0.014$	$4.26^{cd} \pm 0.204$	$6.46^{a} \pm 0.155$	$5.34^{a} \pm 0.255$
overall mean		$4.48^{b} \pm 0.536$	$4.42^{b} \pm 0.475$	$3.69^{b} \pm 0.298$	$6.14^{a} \pm 0.24$	
NH_3-N	0 hr	$31.57^{abc} \pm 1.02$	$26.02^{cd} \pm 0.577$	$24.52^{d} \pm 0.866$	$30.03^{bcd} \pm 1.0$	$28.03^{b} \pm 0.943$
	6 hr	$36.47^{a} \pm 0.542$	$34.53^{ab} \pm 0.866$	$26.02^{cd} \pm 0.577$	$33.70^{ab} \pm 4.48$	$32.68^{a} \pm 1.55$
overall mean		$34.02^{a} \pm 1.21$	$30.27^{a} \pm 1.95$	$25.27^{b} \pm 0.574$	$31.86^{a} \pm 2.21$	

a, b, c, d: values with different letters in the same raw means statistically significant at ($P \leq 0.05$). G1: Atriplex nummularia + CFM, G2: Atriplex nummularia + Barley grain, G3: Atriplex nummularia + Ground Date seeds, G4: Atriplex nummularia + Fodder beet

The lowest corresponding values were recorded for animals fed Atriplex with GDS (G3) due to degradability of protein. Also, the drop of NH_3-N may be related to tannin contents of the GDS since Osakwe *et al.* (2000) showed that sheep fed low tannin fodder had a higher ruminal NH_3-N concentration than those given fodders with high condensed tannins. It is important to mention that sheep fed saltbush solely have less efficient rumen fermentation than sheep fed traditional forage (Mayberry *et al.*, 2007). Inefficient rumen fermentation could contribute to poor animal production by sheep offered saltbush.

However, based on the overall means of NH_3-N concentrations, it appeared that all studied rations are nutritious for sheep fed Atriplex with any of these energy supplements. These results are supported by earlier results by Satter and Slyter (1974) and Russel and Strobed (1987) pointed that the concentration of ammonia in the rumen should not be less than 5 mg/100ml as a minimal concentration for optimum microbial protein synthesis.

Higher NH_3-N concentrations in the present study were probably due to nitrogen content of *Atriplex nummularia* which is associated with non-protein nitrogen (NPN) to be around 470 g/kg as reported by Benjamin *et al.* (1995) in sort of nitrates, glycinebetaine and proline. These NPN are degraded by rumen microflora when adequate quantity of energy is available and can enhance the utilization and digestion of salty feed by microorganisms (Le Houerou, 1992). In addition, Ben Salem *et al.* (2002) found that about 65% of total nitrogen in old man saltbush is soluble non-protein compounds may be converted into microbial protein in the rumen but the extent to which this occurs depends on the availability of metabolisable energy (ME) which is low in old man saltbush.

Animals fed Atriplex with FB showed the maximum total VFA's values at pre-feeding and 6 hr post feeding (5.83 and 6.46 meq/100ml, respectively). The lowest values were recorded for those fed GDS in G3.

Blood metabolites:

Data in Table (8) illustrated some blood serum constituents as affected by the type of energy supplements. Urea-N was elevated significantly (P<0.01) in supplemented animals compared with control animals reflecting high protein intake by the supplemented sheep. The maximum urea-N level was attained in G3, while the control animals (G1) indicated the lowest ones. It might be a reflection of dietary CP intake, the levels of tannin or saponins contents. The results are in harmony with those reported by Silanikove *et al.* (1996); Samanta *et al.* (2003) and Getachew *et al.* (2008).

Table (8): Serum metabolites of sheep fed the experimental rations.

Blood metabolities	G1	G2	G3	G4	SE
Urea (mg/dl)	39.62^{c}	58.0^{ab}	66.23^{a}	49.4^{b}	2.695
Creatinine (mg/dl)	1.20^{c}	1.406^{b}	1.51^{a}	1.40^{b}	0.052
Total protein (g/dl)	8.26^{a}	7.8^{a}	4.06^{b}	5.45^{b}	0.717
Albumin (g/dl)	3.33^{a}	2.63^{b}	2.66^{b}	2.55^{b}	0.116
Globulin (g/dl)	4.93^{ab}	5.16^{a}	1.40^{c}	2.90^{bc}	0.650
Cholesterol (mg/dl)	63.5^{c}	72.5^{b}	107.0^{a}	76.96^{b}	1.564
Triglycerides (mg/dl)	48.19^{a}	26.0^{b}	57.66^{a}	59.25^{a}	4.09
ALT (U/L)	18.33^{a}	10.66^{b}	20.0^{a}	8.0^{b}	2.153
AST (U/L)	24.33	25.5	19.66	21.0	2.628

G1: Atriplex nummularia + CFM, G2: Atriplex nummularia + Barley grain, G3: Atriplex nummularia + Ground Date seeds, G4: Atriplex nummularia + Fodder beet

ALT: Alanine aminotransferase   AST: Aspartate aminotransferase

a, b, c: values with different letters in the same raw means statistically significant at (P< 0.05).

Creatinine levels followed the same pattern of urea indicating significant variations ($P \leq 0.01$) between the supplemented sheep and the control ones (G1). These results indicating impairment of renal function (Brenner *et al.*, 1987). It may be attributed to the dietary tannins because Romero *et al.* (2000) reported that serum creatinine increased in sheep fed on tanniferous diets.

Serum total protein (TP) value differs significantly among all groups ($P \leq 0.01$). The highest value of TP was recorded in G1 (control sheep, 8.26 g/dl) and the lowest was recorded in G3 (4.06 g/dl). These results could be explained by several reasons such as high protein content of CFM and low protein content of GDS. Also, barley grains and CFM improve CP digestibility while GDS reduce CP digestibility as was observed earlier in Table (4). Data of TP tended to be explained by the fact of presence of dietary tannins and saponin in FB and GDS. CP forms a complex with tannins under aerobic conditions causing a lowering in the available protein intake (Wina *et al.*, 1999). Also, saponins reduce protein digestibility by the formation of less digestible saponine - protein complexes affecting the nutritive value of the diet (Potter *et al.*, 1993).

Albumin showed the same pattern of the other metabolites among groups where the highest level was recorded in G1 and the lowest one in G4 with significant variations ($P<0.01$). Globulin showed significant ($P<0.05$) diet effect among the studied groups.

Considerable increase ($P<0.01$) in cholesterol levels was recorded in all supplemented sheep compared with control sheep (G1). The highest value of blood cholesterol was recorded in G3 animals while the lowest was shown in G2 supplemented with barley. Elevated levels of cholesterol in animals supplemented with GDS and FB were disagree with the fact of presence of tannins and saponine in DS (G3) and FB (G4) because Mastura (2001) and Francis *et al.* (2002) proved that several dietary saponine have a hypocholestrolaemic action. On the other hand, tannins complex with fatty acids (Romero *et al.*, 2000) is causing a decrease in cholesterol absorption and increase in fat excretion (Bravo *et al.*, 1993). One of the available reasons for elevated blood cholesterol in GDS fed animals is that, cholesterol one believed to be the typical animal sterols, has recently been found to be rather distributed among plants. So far, cholesterol has been identified in the pollen of many plants including the date palm (Bennett *et al.*, 1996).

The reduced levels of cholesterol in sheep supplemented with barley consistent with the fact of barley had the ability to reduce heart disease from reduced levels of blood cholesterol where (β-glucan) is believed to be the barley component most responsible for this hypocholesterolemic activity (Bhatty, 1993).

Triglycerides following the pattern of cholesterol where sheep in G4 and G3 showed highest levels than control sheep (G1) and the lowest one were (G2). Concerning serum enzymes Aspartate aminotransferase (AST) was not differ significantly among groups. Similar results were recorded by Romero *et al.* (2000). Alanine aminotransferase (ALT) indicated statistically significant variations ($P\leq 0.05$) but physiologically it accepted within normal values of the control animals. These results were in agreement with those reported by Abdou *et al.* (2011) who found normal levels of AST and ALT although animals fed on tanniferous diet indicating that experimental animals showed no hepatotoxicity. These results coincide with those of Romero *et al.* (2000).

CONCLUSION AND RECOMMENDATIONS

In conclusion, feeding saltbush to sheep supplemented with energy sources confirm the previous studies used this shrub as a basal diet for small ruminants. Fodder beet followed by barely grains, cultivated under saline conditions, are recommended to be the best energy supplements for sheep fed saltbush to solve the problems of feed shortage under arid and saline conditions of Sinai, Egypt. The supplementation with ground date seeds (GDS) adversely affect the consumption and utilization of nutrients of saltbush as the experimental sheep revealed some alternations in their blood chemistry because of the high content of tannins in GDS.

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دراسات غذائية على الاغنام المغذاة على نبات القطف الملحى مع مصادر طاقة من الصحراء تحت الظروف الملحية.

حسن جودة هلال و أحلام رمضان عبده و إيهاب يحى عيد و عبير محمد عبدالحليم العيسوى و عفاف محمود فايد و حسن محمد الشاعر.

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يهدف هذا البحث إلي دراسة تأثير إضافة مصادر الطاقة المتواجدة في الصحراء مثل (حبوب الشعير و نوي البلح المجروش و بنجر العلف) مع نبات القطف الملحي و معرفة مدى تأثيرها علي نمو الحملان التي تتغذى عليها خاصة فيما يتعلق بمعاملات الهضم و المأكول وميزان النيتروجين و بعض قياسات الدم و التمثيل في الكرش.

وقد أستخدم في هذه الدراسة عدد 20 من الكباش البرقي عند عمر 3 سنوات بمتوسط وزن 56.62 كيلو جرام و قسمت إلي أربع مجموعات، و أجريت تجربة التغذية لمدة 6 أسابيع تلتها تجربة هضم لمدة 15 يوما . حيث قدم نبات القطف الملحي الأخضر بعد تقطيعه لكل حيوانات التجربة كعلف خشن و قدم العلف المركز (مصدر الطاقة) للمجموعات كالتالي: قدم مخلوط العلف المركز للمجموعة الأولي (المجموعة الضابطة)، وحبوب الشعير للمجموعة الثانية، ونوى البلح المجروش للمجموعة الثالثة وبنجر العلف قطع وقدم للمجموعة الرابعة.

أظهرت النتائج إختلاف كبير في نسب المكونات الغذائية لمصادر الطاقة كما تبين أن نبات القطف مرتفع في نسبة الرماد و الألياف و البروتين الخام و منخفض في الطاقة ، وبمقارنة التركيب الكيماني لمصادر الطاقة إتضح الأتي: بنجر العلف سجل أعلى محتوى في الطاقة بينما سجل مخلوط العلف المركز أعلي نسبة بروتين و نوي البلح المجروش هو الأقل في البروتين و الأعلي في نسبة الألياف و المستخلص الإيثيري و المادة العضوية و مكونات الألياف NDF, ADF, و السليولوز عن باقي مصادر الطاقة المستخدمة في البحث. سجلت حبوب الشعير أعلي قيمة في المستخلص الخالي من النيتروجين عن باقي المصادر. وتبين أن التغذية علي نبات القطف مع بنجر العلف أدى إلي زيادة المأكول من المادة الجافة و كذلك المأكول من البروتين الخام بينما إنخفضت كمية مياه الشرب. تحسن معامل هضم البروتين مع حبوب الشعير وبنجر العلف علي التوالى. و إرتفع معامل هضم الألياف و مكوناتها في المجموعة المغذاه علي بنجر العلف بينما إرتفعت نسبة المركبات الغذائية الكلية المهضومة و كذلك البروتين المهضوم في حيوانات المجموعة الثانية. أما حيوانات المجموعة الضابطة فقد سجلت أعلي ميزان نيتروجيني (كنسبة من المأكول) و إرتفعت قياسات الكرش (الأمونيا و الأحماض الدهنية الكلية الطيارة) بعد 6 ساعات من الأكل وإختلفت نتائج قياسات الدم بين المجموعات علي نحو كبير مقارنة بنظيراتها في المجموعة الضابطة.

من النتائج السابقة أمكن إستنتاج أنه من الأفضل إستخدام بنجر العلف و حبوب الشعير كمصادر طاقة مع نبات القطف الملحي في تغذية الأغنام تحت ظروف الجفاف و الملوحة في سيناء بمصر.