Effect of Feeding Different Sources of Energy on Performance of Goats Fed Saltbush in Sinai

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Abstract: Feeding halophytes is a feasible solution to minimize the problem of feed shortage in arid and semiarid areas of Egypt. This work aimed to investigate the effect of feeding goats on fresh *Atriplex nummularia* which is grown naturally and cultivated in Sinai on performance of growing goats when added with different sources of energy supplementation (concentrate feed mixture CFM, ground barley grains or ground date stones and mixture of these materials) on nutrients digestibility, nitrogen balance, water utilization and some rumen and blood metabolites. The experiment was performed on twenty eight of growing goats (six months old) with mean body weight 16 ± 0.38 Kg were divided into four equal groups for 105 days. The diets were given at the basis of 60% concentrat for growth requirements , roughages were offered as ad-lib. The roughages were berseem hay in T1 (control group) or fresh *Atriplex nummularia* in T2, T3 and T4 whereas the energy supplements were concentrate feed mixture (CFM) in T1, ground date stones in T2, ground barley grains in T3 and a mixture of 50% ground barley grains with 50% ground date stones in T4. Results obtained revealed that inclusion of barley grains in T3 group improved DMI of Atriplex than that in T1, T2 and T4 groups. The highest body weight gain was recorded by animals in T1 and T3 compared to those of the other treatments. In addition Intakes of TDN and DCP were maximum in T1 and T3. The maximum apparent digestion coefficients of OM, CP, EE and NFE were recorded by animals in T3 while those of DM and CF were digested much better by animals in T1. TDN% and DCP% were increased in T1 followed by T4. All animals were in positive nitrogen balance. The maximum values of total water intakes were recorded for animals in T2 whereas the lowest values for animals in T3 with significant differences. Serum creatinine, total protein, globulin and AST levels were not affected by diet type and they were within the normal ranges. Also a sampling time factor was detected. Ruminal ammonia- nitrogen and total volatile fatty acids revealed significant variations before feeding and 6 hrs post feeding. The feed cost of daily gain (L.E)/ kg was achieved for animals fed ground date stone in T2 (L.E 0.860) which was lower than T4, T3 and T1 (L.E. 1.255, 1.273 and 1.290) respectively. In conclusion, barley grains or ground date stones or their mixture improved the nutrients utilization and intake of *Atriplex.* Utilization of such halophytic plants supplemented with non–conventional energy supplements could be recommended to enhance feed materials availability all-round year and to improve animal performance as well under arid and saline conditions of Sinai.

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1. Introduction:

Agro-industrial by-products are available in Egypt in large quantities averaged (26 million ton) (El Shaer, 2004), some of such materials are characterized by high nutritive value (Youssef et al., 2006). So it can be used as supplementary feed ingredients in animal rations (Mohamed and El-Saidy, 2003). Date stone is one of this agro-industrial by- products used as feed ingredients under desert conditions which are available in abundancy all over the year as a main source of energy. It should be offered to ruminants in crushed or ground forms. Date stone have been demonstrated by many investigator as an acceptable, cheap and rich feed ingredients feedstuffs for sheep and goats (Shawket et al., (2001); Nasar, (2002) and Abdou, (2003).

Atriplex nummularia an ever green shrub, widely distributed and cultivated in Egypt along the Mediterranean Coastal Zone and the Suez Gulf (Shawket et al., 1998 and El-Shaer, 2006). *Atriplex* so called is known to be tolerant to drought and salinity (Ben Salem et al., 2002). It is high in crude protein, crude fiber and ash (sodium) but relatively low in carbohydrates (El-Shaer, 2004a and Ben salem et al., 2005). The previous authors reported that sheep fed on *Atriplex* alone decreased or at least maintained their live body weights. In the presence of energy sources like barley grains, *Atriplex* could proved to be a good, cheap source of nitrogen.

The aim of this study is to evaluate the effect of replacing barely grains by ground date stone as energy supplement sources for growing goats fed *Atriplex nummularia* as a basal diet in terms of growth performance, economic, feed efficiency and some rumen and blood parameters.

Materials and Methods

The current work was carried out at Ras Suder Research Station, belongs to Desert Research Center, Southern Sinai Governorate. The experiment lasted for 105 days.

Experimental animals and rations:

Twenty eight growing black Desert goat kids Six months old with an initial live body weight of 16$\pm$0.38 kg were divided randomly into four equal groups (7 animals each) as follow:

T_1: Berseem hay (4th cut *Trifolium alexandrinum*) + concentrate feed mixture (CFM) as a control Treatment

T_2: *Atriplex nummularia* + Ground Date Stone (GDS).

T_3: *Atriplex nummularia* + Barley grains (BG).

T_4: *Atriplex nummularia* + (50% barley grains + 50% ground date stone).

Rations were formulated according to the recommended nutritional requirements for growing goats (Kearl, 1982). Diets were balanced on basis of 60% concentrates and fresh *Atriplex nummularia* was collected daily and left free choice for animals except T1 group which fed berseem hay.

A feeding trial followed by a digestibility trial was conducted and lasted for 105 days. Each 7-animal group was offered one of the above mentioned four treatments in a group feeding system. *Atriplex nummularia* was harvested daily and left free choice for animals. During the feeding trial, animals were weighted every two weeks and nutrients requirements were adjusted according to the change in their live body weight. Feed offered and refused were daily weighed to calculate dry matter intake (DMI). Drinking water was available for all animals during the whole feeding trial.

Digestibility trial:

Four animals from each treatment were randomly selected for the digestibility trail, at the end of the feeding trial, as a 15-days adaptation period followed by 5 days collection period. All the animals were kept in separate individual metabolic cages and 90% of their feeding requirements were offered to each animal where accurate records were kept for feed and water intakes and animal excreta during the collection period. Measured amounts of drinking water was available for each animal daily , then daily water intake was calculated and recorded , the composite samples of feed offered and feces were dried, ground and kept for further chemical analysis by the end of collection period. A common method of assessing metabolizable energy intake (MEI) is use of body weight change or gain as an indirect measure (Luo et al., 2004).

Rumen liquor and blood sample:

During the last three days of collection period, rumen liquor was sampled before feeding, and 6 hours post feeding by stomach tube. Simultaneously, blood samples were taken from the jugular vein before feeding and 6 hours post feeding in dry clean centrifuge tube, left to clot for 30 minutes at 37^{o}C and then centrifuged at 3000 r.p.m. for 10 minutes. Serum was separated, divided into five aliquots and stored at -40^{o}C to be thawed only once on demand.

Chemical analysis:

Proximate analysis for feed, feces and urinary nitrogen were analyzed according to A.O.A.C. (1997). Natural Detergent Fiber (NDF), Acid Detergent Fiber (ADF) and Acid Detergent lignin (ADL) were determined according to Goering and Van Soest (1972).

Rumen total volatile fatty acids (TVFA's) were tested (warner, 1964) and ammonia nitrogen values were also evaluated (A.O.A.C. 1997). Blood serum samples were assayed for total protein (Armstrong and Carr1964), albumin (Doumas and Biggs 1971). Globulin was obtained by substracting the total proteins values from the albumin values. Serum creatinine (Henry1965) and urea (Patton and Crouch1977). Aspartate amino Transferase (AST) and Alanine amino Transferase (ALT) (Schmidt and Schmidt 1963) were tested. All blood serum analysis were measured using Jenway spectrophotometer (UK) and using kits purchased from Human Company (Germany).

Statistical analysis:

General linear model procedure was used for statistical analysis using **S**AS (1998). The used design was one way analysis. Duncan's multiple tests (1955) were applied for means comparison.

3. Results and Discussion

Chemical composition:

Chemical composition for barley, ground date stone, Concentrate Feed Mixture as energy feed supplements and *Atriplex nummularia* and berseem hay as basal diets are displayed in Table (1). The results showed that DM, OM, EE, CF and cellulose contents are higher in berseem hay than that of *Atriplex nummularia*. Fresh *Atriplex nummularia* and berseem hay had comparable values of CP. Similar results were obtained by Abdul-Aziz et al, (1999). On the other hand, fresh *Atriplex nummularia* contained higher ash, NFE, NDF, ADL and Hemicellulose than that of berseem hay. Such findings are acceptable since *Atriplex nummularia* is halophytic saltbush which is rich in ash fiber constituents. The results are in good agreement with many investigators tested the saltbush as animal feed materials (Le Houerou, 1994,Shawket et al, 2001and El -Shaer, 2006).

Data of Table (1) showed that DM and OM were higher in barley and date stone than that of concentrate feed mixture (CFM). However, CP content of CFM was higher than that of barley or date stone respectively. Barley grains contained lower ash and higher NFE than that of date stone and CFM which were comparable. However, date stone contained higher CF, EE, NDF, ADF, ADL, cellulose and Hemicellulose than that of barely grains.

Metabolisable energy concentrations (ME kcal/kg DM) of individual feedstuffs in this study differed markedly from each other. Barley grains was the richest supplement (2.88 kcal/ kg DM) followed by Date stones, CFM, Atriplex then BH, respectively (2.74, 2.16, 1.74 then 1.73 Mkcal/kg DM), respectively. Metabolisable energy pattern could be attributed to TDN % of each feedstuff.

Table (1): Chemical composition and feed ingredients of diets fed to goats (as DM basis %)

Items	Hay	Atriplex	barley	Date stone	concentrate feed mixture CFM
DM	85.321	36.68	95.60	94.32	89.66
OM	85.86	76.30	96.60	96.50	95.44
Ash	14.14	23.70	3.40	4.50	4.56
CP	12.75	12.25	9.03	8.15	14.2
CF	28.65	17.08	6.38	13.67	8.14
EE	1.69	1.59	2.1	4.88	3.36
NFE	42.77	45.38	79.09	68.80	69.74
Fiber constituents %					
NDF	58	60.30	18.00	71.90	52.75
ADF	43.15	42.81	7.00	56.08	9.78
ADL	13.45	17.89	2.00	12.99	4.65
Cellulose	29.70	24.92	5.00	43.09	5.13
Hemicellulose	14.85	17.49	11.00	15.82	42.97
ME, Mcal/kg DM	1.73	1.74	2.88	2.74	2.16

T_1: Berseem hay + concentrate feed mixture (CFM) as a control treatment
T_2: *Atriplex nummularia* + Ground Date Stone (GDS). T_3: *Atriplex nummularia* + Barley grains (BG).
T_4: *Atriplex nummularia* + (50% barley grains + 50% ground date stone).
ME,M cal/ kg DM = (TDN × 3.6) /100 (Church and Pond, 1982).
a, b, c and d : values with different letters in the same row means statistically significant at $P<0.05$

Body weight changes and intakes**:**

Average values of body weight changes and feed intakes are illustrated in Table (2). Response of animals fed different rations was varied and hence, the resulted final live body weights among treatments were varied. Body weight changes for all experimental animals were generally positive and all kids increase in weight. Animals of the control group (T1) revealed the highest percent body weight change all over the experimental period.

Average daily gain of T1 did not differ significantly from that of T4 & T3. Animals fed on *Atriplex* plus 100% ground date stones (T2) had the lowest ($P \leq 0.05$) gain averaged 34.7 g/ day.

Body weight changes, kg % of initial weights were 33.64, 32.61, 29.33 and 21.89 for T1, T4, T3 and T2 in descending order. Such findings were recorded earlier using Black Bedouin kids by El-Shaer et al. (1996) and El-Hassanein et al., (2002).

Similar results were obtained by Shawket et al. (2001 & 2002) who found that replacing 50% of barley grains by 50% date seed led to appreciation increase of ADG.

Total dry matter intake (TDMI) approximately did not differ significantly among treatments. They recorded comparable values of TDMI. Similar trends were observed by Shawket et al. (2001). The differences in dry matter intake of basal diet (gm/kg B.W) were not differ significantly among the experimental treatments. It was high in T3 which may be attributed to mutual associative effect between *Atriplex* and barely grains. The results are in harmony with the findings of (Kandil and El-Shaer (1990) and El-Shaer et al., 2001 & 2002) who found that the utilization of barley grains as energy supplement in sheep diet resulted in an increase in feed intake of roughage.

There are non significant differences in intake of energy supplement among treatments. Total intakes of basal diets and feed supplements revealed insignificant differences. It was noticed that maximum intake was record in (T3) and the minimum was in (T4). Such reduction in dry matter intake in (T4) might be due to date stones content of ADL compared with barley grains and CFM. This result was similar to that of El-Shaer et al, (2002) and El-Hassanein et al., (2002). In general, the present results indicated that intakes were considerably affected by the type of diet. Moreover, higher fiber constituents mainly ADL and NDF were known to reduce DM intake (El-Shaer, 1995). Changing the type of energy supplement by replacing barley grains instead of date stone not significantly increased nutrient digestibilities.

It is noted that the types of energy supplements did not affect the digested nutrients intakes (TDN) but significantly ($P \leq 0.05$) influenced the digested crude protein (DCP,g/Kg BW). Growing kids fed the control consumed the highest amounts of DCP (3.25g/Kg BW), while the lowest one (1.79g/Kg BW) was recorded for animals in T2. The goat fed the rations containing Atriplex plus barley grains (T3) consumed amounts of digested nutrient (TDN) nearly equal those of the control ration (T1). These findings revealed that *Atriplex* and berseem hay showed similar digestibilities. The results revealed, also, that the average daily gain for successive diets appeared to be affected by TDN and DCP intakes where feeding the rations of T1 and T3 to the experimental animals resulted in higher daily gain compared to the other groups. These results proved that addition of barley grains improve the total digestible nutrients (TDN) intake which resulted in increment in daily gain. These findings could be related to higher CF content of date stones which decreased significantly the digestibilities of other nutrients (Shawket et al., 2002). This may reduce dietary readily available carbohydrates resulted in reduction of the nutrients digestibilities of diet.

It is concluded that growing goats fed on unconventional feeds (Atrilpex, barely grains or ground date stones) appeared to consume and utilize the TDN and DCP similarly to those fed conventional feed (CFM + berseem hay). Such results are in agreement with those reported by Abdou (1998), Abdul Aziz et al. (1999), El-Shaer et al., (2001 & 2002) and Shawket et al. (2001).

Table (2): Body weight changes, average daily gain and intake of goats fed the experimental diets.

Items	T_1	T_2	T_3	T_4	± SE
No. of animals	7	7	7	7	
Initial L.B.W, Kg	16.14	16.64	16.57	16.16	
Final L.B.W, Kg	21.57	20.28	21.43	21.43	1.27
Body weight changes	5.43	3.64	4.86	5.27	1.49
% of initial weights	33.64	21.89	29.33	32.61	
Average daily gain, gm /day	51.71^a	34.70^b	50.90^a	50.19^a	0.56
DM intake gm/kg B.w.					
Supplement	24.89	22.41	22.50	21.35	0.82
Roughage (basal diet)	14.85	15.96	18.24	16.54	1.06
Total DM intake	38.94	38.37	40.74	37.89	1.16
Digested nutrient intake g/kg B.W.					
TDN	22.67	21.37	22.05	21.42	0.82
DCP	3.25^a	1.79^c	2.20^b	2.12^b	0.10
MEI (kcal / kg $BW^{0.75}$	140.4	131.1	140	139.6	2.32

T_1 : Berseem hay + concentrate feed mixture (CFM) as a control treatment

T_2 : *Atriplex nummularia* + Ground Date Stone (GDS). T_3 : *Atriplex nummularia* + Barley grains (BG).

T_4 : *Atriplex nummularia* + (50% barley grains + 50% ground date stone).

a,b,c Means with different superscripts in the same raw are significantly different at ($P \leq 0.05$)

MEI = 457+(25.23XADG) ($g/kg^{0.75}$**)** (Luo et al., 2004)

.Digestion coefficients and nutritive value:

Data of Digestion coefficients and nutritive values (Table 3) showed that DM, OM, CP, EE digestibility did not differ significantly by changing the types of energy supplements as animals tended to digest such nutrients at comparable trends. However, animals fed *Atrilpex* plus barley grains (T3) exhibited greater values of OM, CP and EE digestibilities than those recorded for goats in the other groups; the lowest values was recorded for animals of T2. It may be due to the low contents of ADL, ADF and NDF contents of barley grains compared to other feed supplements. Furthermore, replacing barley grains with ground date stones in T2 resulted in decreasing digestibilities of DM, OM and CP. Similar trends were reported earlier on small ruminants fed saltbush supplemented with non-conventional energy supplements (Hassan and Abd El-Aziz, 1979, Abou El- Nor et al.., 1995 and El- Shaer et al. 1996). The apparent digestion of crude fiber as well as all fiber fractions were varied significantly (P≤0.05) among treatments. It was noticed that inclusion of ground date stone alone (T2) and barley grains (T4) with *Atriplex* improved digestion coefficient of NDF, ADF, and cellulose (T4) and ADL and hemicellulose (as in T2). Indeed, it might be due to higher cellulolytic bacteria in the rumen of animals fed on date stones (Kandil and El-Shaer, 1988).

Nutritive values expressed as TDN% and DCP% revealed significant (P≤0.05) differences among groups. The addition of barely grains as a sole energy supplement (T3) or mixed with ground date stone (T4) to *Atriplex nummularia,* as a basal diet, improved the nutritive values of the rations. Such results are in close to those reported by El-Shaer et al. (1996), El-Shaer et al. (2001) and Shawket et al. (2002). Significant increment of TDN and DCP in T1 might be attributed to concentrate mixture and higher digestiblities of nutrients in this treatment. It is clear that TDN % was affected by energy source in diet. These results are in agreement with those reported by Etman and Soliman (1999).

Metabolizable energy intake (MEI) data for growing goats were comparable with slight differences among them. These differences were a reflection to average daily gain (ADG) values. Animals of control group (T1) showed the greatest MEI (140.4 kcal/kg BW $^{0.75}$) followed by animals fed T3 (140.0 kcal/kg BW $^{0.75}$) followed by animals fed T4 and at last animals fed T2 (139.6 and 131.1 kcal/kg BW $^{0.75}$), respectively. These differences might be partially attributable to two reasons: 1) differences in metabolic activity of tissues because of different energy supplements and 2) experimental conditions where the studied animals were kept under normal farm conditions hence, greater energy use for activity would be expected (McDonald et al., 1977). MEI estimates for growing goats were greater than that (103.01 kcal/kg BW $^{0.75}$) determined by Luo et al.(2004). This difference might be attributable to experimental conditions. In publications used by Luo et al. (2004) most goats were housed in relatively small areas, such as metabolism chambers or crates, whereas goats in the publications assed in the present study were kept under normal farm conditions hence greater energy use for activity would be expected. Similar findings and explanations were recorded by Luo et al. (2004a).

Table (3): Digestion coefficients, nutritive value of goats fed the exprimental diets.

Items	T_1	T_2	T_3	T_4	± SE
Digestion coefficients %					
DM	75.51	70.18	71.68	72.93	2.47
OM	77.76	69.47	79.04	76.73	2.91
CP	75.29	70.51	76.00	74.96	2.11
CF	63.57^{a}	62.83^{a}	45.77^{b}	60.58^{a}	3.14
EE	79.72	73.96	80.83	77.90	2.56
NFE	74.15^{ab}	70.63^{b}	82.61^{a}	82.18^{a}	2.51
NDF	63.75^{a}	65.77^{a}	51.35^{b}	67.31^{a}	3.97
ADF	47.91^{c}	63.68^{ab}	51.90^{bc}	66.68^{a}	3.85
ADL	39.80^{ab}	52.27^{a}	32.51^{b}	46.33^{ab}	4.85
Cellulose	52.90^{c}	68.32^{ab}	63.68^{bc}	76.2^{a}	3.61
Hemicellulose	74.89^{a}	78.08^{a}	62.48^{b}	68.96^{ab}	3.8
Nutritive value					
TDN %	78.40^{a}	69.80^{b}	75.50^{ab}	76.76^{a}	2.50
DCP %	9.80^{a}	6.89^{b}	7.52^{b}	7.66^{b}	0.25

T_1: Berseem hay + concentrate feed mixture (CFM) as a control treatment
T_2: *Atriplex nummularia* + Ground Date Stone (GDS). T_3: *Atriplex nummularia* + Barley grains (BG).
T_4: *Atriplex nummularia* + (50% barley grains + 50% ground date stone).
a,b,c Means with different superscripts in the same raw are significantly different at ($P \leq 0.05$).

Nitrogen utilization and water intake:

Data in Table (4) revealed that nitrogen utilization (mg/kg BW) in terms of nitrogen intake (NI), nitrogen excretion and retention were affected significantly (P≤0.05) by the types of energy supplements among the four treatments. However, Nitrogen intake of kids fed saltbush supplemented with ground date stone or / and barley grains did not vary significantly between T2, T3 and T4 since the animals consumed relatively similar amounts of nitrogen (10.49,10.29 and 10.54 mg/kg BW, respectively). NI of animals in T1(control) was significantly ($P \leq 0.05$) higher than that fed the experimental treatments (T2, T3, T4); it might be attributed to high CP content of CFM than barley and date stone(Table 1). Total nitrogen excretion followed the same patterns of NI and fecal nitrogen excretion Where animals fed saltbush supplemented with different energy sources excreted slightly similar($P \geq 0.05$) amounts of N through feces and urine. The total N excretion was highest (11.48 mg N/Kg BW) for animals fed the control ration in T1.

Concerning nitrogen retention, there were significant ($p \leq 0.05$) variations among treatments where all sheep were in positive nitrogen balance and retained significant various amounts of nitrogen. The highest NB was recorded in T1. Utilization of ground date stone in T2 instead of barley grains (T3) led to a decrease in nitrogen balance by about 46.15. It seems that the pattern of daily body weight gain of the treated animal groups was matching with the pattern of nitrogen retention where animals retained more nitrogen tended to gain higher body weight and the opposite was true (($P \leq 0.05$) Table 2). The results are in harmony with those obtained by Allam et al., (1997) and El- Shaer et al., (2001).

Data of Table (4) showed that drinking water and feed water intake varied ($P \leq 0.05$) significantly among treatments. Goats in T2 consumed higher amount of drinking water while those fed T4 showed the lowest amount of drinking water. The highest value of feed water intake was recorded for animal in T4 while the lowest value was recorded in T1 due to low moisture content of berseem hay fed to animals of T1. This reduction in free water intakes for experimental diet groups, compared with control group was attributed mainly to the high moisture content of *Atriplex* compared with berseem hay. It is, also, appeared that animals in T4 were able to digest NDF, ADF and cellulose (Table3) better than their mates in other treatments due to the lowest drinking water consumption (Table 4). These results are in agreement with several investigators (Abou El-Nasr, 1985; El -Shaer et al. 2002 and Shawket et al .2002).

Table (4): Nitrogen utilization and water intake of goat fed the experimental diets.

Items	T_1	T_2	T_3	T_4	± SE
Nitrogen utilization:					
Nitrogen intake (NI) (mg/kg Bw)	15.80^{a}	10.49^{b}	10.29^{b}	10.54^{b}	0.86
Fecal nitrogen (FN) (mg N/kg Bw)	4.64^{a}	3.15^{b}	3.05^{b}	4.01^{b}	0.36
urinary nitrogen (Un) (mg N/kg Bw)	6.84^{a}	5.38^{ab}	3.60^{b}	3.45^{b}	0.76
Total nitrogen excretion (TNE) (mg N/kg Bw)	11.48^{a}	8.53^{b}	6.65^{b}	7.46^{b}	0.79
Nitrogen balance (NB) (mg N/kg Bw)	4.32^{a}	1.96^{b}	3.64^{ab}	3.08^{ab}	0.38
NB % of intake	27.34	18.68	35.37	29.22	3.49
Water intake ml/kg BW					
Drinking water. (Free water)	157.26^{a}	136.44^{ab}	116.07^{c}	99.46^{bc}	8.30
Feed water	8.69^{b}	39.67^{a}	18.60^{a}	40.86^{a}	3.002
Total water intake	165.95^{ab}	176.11^{a}	134.67^{b}	140.32^{ab}	10.28

T_1: Berseem hay + concentrate feed mixture (CFM) as a control treatment
T_2: *Atriplex nummularia* + Ground Date Stone (GDS). T_3: *Atriplex nummularia* + Barley grains (BG).
T_4: *Atriplex nummularia* + (50% barley grains + 50% ground date stone).
a,b,c Means with different superscripts in the same raw are significantly different at ($P \leq 0.05$).

Rumen liquor characteristics:

There were significant ($p \leq 0.05$) differences in ammonia-N concentrations and total VFA's (as illustrated in Table 5) among experimental animals before and 6 h post feeding which could be related to the significant changes of TDN and DCP of the tested diets. Punia and Sharma (1990) reported that total VFA's concentration and its production were higher for barley and molasses as a source of energy. Similar results were reported by Hatfield et al.(1998) and Abou'l Ella et al. (2005) who found that total VFA's and ammonia –N concentrations were significantly ($P \leq 0.05$) increased with further increases in the nutritive values of the diet.

The NH3- N concentration was affected by time where it was the minimum before feeding and increased significantly (P≤0.05) 6hrs post feeding in all treatments. Similar trends were observed by Ibrahim et al. (2001).

Table (5): Rumen characteristics of goats fed the experimental diets.

Criteria	Sample time	T_1	T_2	T_3	T_4	Mean
Ammonia- nitrogen	0	31.618 ^{cb}±0.94	12.76^{d}±1.32	26.28^{c}±3.30	26.69^{c}±0.85	24.34^{b}±1.99
NH3-N	6	33.89 ^{b}±0.83	14.77^{d}±1.93	41.04^{a}±4.03	41.38^{a}±1.31	32.77^{a}±2.99
Mean		32.75 ^{a}±0.72	13.76^{b}±1.15	33.66±3.69	34.03^{a}±2.87	
Total volatile fatty acids	0	3.91 ^{b}±0.163	2.87^{c}±0.177	5.44^{a}±0.35	5.50^{a}±0.293	4.43±0.31
TVFA's	6	5.17 ^{a}±0.123	4.0^{b}±0.591	3.98^{b}±0.355	3.95^{b}±0.13	4.27±0.21
Mean		4.54^{a}±0.26	3.44^{b}±0.36	4.71^{a}±0.38	4.73^{a}±0.33	

T_1: Berseem hay + concentrate feed mixture (CFM) as a control treatment
T_2: *Atriplex nummularia* + Ground Date Stone (GDS). T_3: *Atriplex nummularia* + Barley grains (BG).
T_4: *Atriplex nummularia* + (50% barley grains + 50% ground date stone).
a,b,c Means with different superscripts in the same raw are significantly different at ($P \leq 0.05$)

Blood parameters:

Table (6) summarizes the data of blood biochemical parameters of the studied experimental animals. Blood urea levels revealed significant variations (P≤0.05) among tested diets at both 0 and 6 h post feeding. The highest level of urea was found in animals fed the Berseem hay (T1) where BH was the richest N diet in the present study followed by animals fed on T3 as a reflection of DCP pattern among the treatments could be attributed to the presence of tannins in *Atriplex nummularia* which form a complex compound with protein and adversely affect N digestion in rumen (Reed et al. 1990, Romero et al., 2000 and El-Shaer et al. 2005). There was no significant difference in urea levels in fasting and 6 hrs post feeding when neglecting diet type.

Creatinine level was neither affected by sample time nor by type of diet indicating normal renal function. Similar results were obtained by Shawket et al. (2001).

Blood proteins profiles showed that the total protein (TP) concentration was not significantly different among the tested groups, but it revealed significant differences (P≤0.05) when time factor was included. The mean value of TP in the fasting state was higher than that recorded in 6 hrs post feeding.

Serum albumin and globulin concentrations showed the same trend when the types of the tested diet were ignored (P≤0.05). Hoffman et al. (2001) reported that animals fed on high protein diets had significantly higher total protein, albumin and total globulins than those on low protein, Total protein concentration of serum increased in response to the rising level of rumen concentration of ammonia (Abou'l Ella et al., 2005). Although nitrogen intake was differed significantly among groups but blood proteins not follow the same trends.

Albumin levels were affected significantly with the type of diet (P ≤0.05) whereas levels of globulin were not. Animals fed T2 had the least concentrations of albumin. It is known that change in albumin level reflect the change in liver function because the liver is the sit of albumin synthesis.

Serum Aspartate amino transferase (SAST) enzyme level was not differ with the time of sample but it was slightly affected by the diet. Serum Alanine amino transferase (SALT) values mentioned non significant variations among groups. It is clear that AST and ALT concentrations were in normal ranges although animals fed on tanniferous rations as previously reported indicating that the experimental animals were in good health and showed no hepatotoxicity and these results coincided with those of Romero et al. (2000).

Data of Table (7) found that the animal fed the control diets was more feed efficiency. expressed as kg DM/ kg gain (12.16) while the lowest was T2 (18.4). TDN kg/kg gain was higher in T2 (9.82) while T1, T3 and T4 had comparable value. These finding may be attained by increasing the level content of CF, NDF, ADF and ADL in date stone than that of CFM and barley. Similar results were obtained by Allam et al., (1997) and Abdul- Aziz et al. (1999), The best utilization efficiency of DCP was found with animals fed *Atriplex* + unconventional energy source (barely or date stone) . Data of table (7) showed that the economical efficiency was affected by type of roughages and concentrate. Data indicated that kids fed T2 and T4 were more economic efficiency for production one kilogram gain of body weight followed by T3 (12.67LE/ kg gain). These results indicated that concentrate which contain date stone had minimum price for production one kilogram by about 54, 48.89% than that of control (T1) which fed on CFM and berseem hay and by about 41.99, 34.41% than that (T3) which fed on barley grains plus *Atriplex*

Table (6): Blood metabolites changes of goats fed the experimental diets.

Criteria	Sample time	T_1	T_2	T_3	T_4	Mean
urea	0	$38.31^{ab}\pm0.867$	$25.31^{c}\pm1.064$	41.42 ± 5.36^{a}	$33.94^{a}\pm1.75$	34.75 ± 2.032
mg/dL	6	$40.79^{a}\pm1.064$	$28.72^{c}\pm1.74$	$34.05^{ab}\pm8.07$	$26.79^{b}\pm3.05$	32.59 ± 2.429
Mean		$39.55^{a}\pm0.789$	$27.02^{c}\pm1.14$	$37.73^{ab}\pm4.69$	$30.37^{b}\pm2.11$	
creatinine	0	$0.616^{b}\pm0.050$	$0.902^{a}\pm0.152$	$0.948^{a}\pm0.064$	$0.716^{a}\pm0.0363$	0.795 ± 0.054
mg/dL	6	$0.863^{ab}\pm0.085$	$0.639^{b}\pm0.081$	$0.809^{a}\pm0.029$	$0.773^{ab}\pm0.046$	0.759 ± 0.034
Mean		0.739 ± 0.059	0.77 ± 0.094	0.878 ± 0.042	0.744 ± 0.034	
Protein profile						
Total protein	0	8.13 ± 0.188	8.36 ± 0.585	8.19 ± 0.184	7.89 ± 0.255	$8.14^{a}\pm0.160$
mg/dL	6	$7.72^{a}\pm0.125$	$6.13^{a}\pm0.613$	$7.57^{a}\pm0.494$	$7.31^{a}\pm0.402$	$7.18^{b}\pm0.257$
Mean		$7.925^{a}\pm0.129$	$7.24^{a}\pm0.576$	7.88 ± 0.271	$7.61^{a}\pm0.257$	
Albumin	0	$3.92^{ab}\pm0.176$	$3.55^{b}\pm0.164$	$4.05^{ab}\pm0.177$	$4.15^{a}\pm0.096$	$3.92^{a}\pm0.091$
gm/dL	6	$3.57^{ab}\pm0.182$	$2.97^{c}\pm0.253$	$3.84^{ab}\pm0.089$	$3.74^{ab}\pm0.228$	$3.53^{b}\pm0.124$
Mean		$3.74^{a}\pm0.134$	$3.26^{b}\pm0.177$	$3.49^{a}\pm0.99$	$3.94^{a}\pm0.124$	
Globulin	0	$4.21^{ab}\pm0.228$	$4.82^{a}\pm0.596$	$4.22^{ab}\pm0.121$	$3.75^{ab}\pm0.280$	$4.26^{a}\pm0.186$
gm/dL	6	$4.16^{ab}\pm0.162$	$3.16^{b}\pm0.402$	$3.71^{ab}\pm0.417$	$3.59^{b}\pm0.398$	$3.65^{b}\pm0.185$
Mean		4.18 ± 0.130	3.99 ± 0.456	3.97 ± 0.221	3.67 ± 0.185	
Liver Enzymes						
AST	0	$27.83^{b}\pm2.58$	$22.0^{c}\pm3.37$	$18.55^{c}\pm1.614$	$18.875^{c}\pm2.21$	$21.81^{a}\pm2.26$
U/L	6	35.33 ± 3.46	$17.38^{c}\pm1.375$	$17.0^{c}\pm1.23$	$17.38^{c}\pm2.03$	$21.77^{a}\pm3.19$
Mean		$31.58^{a}\pm2.17$	$19.69^{b}\pm1.56$	$17.78^{b}\pm1.33$	$18.13^{b}\pm2.27$	
ALT	0	$4.00^{c}\pm0.03$	$4.00^{c}\pm0.01$	$4.10^{c}\pm0.10$	$4.40^{c}\pm0.40$	$4.13^{b}\pm0.135$
U/L	6	$5.33^{ab}\pm0.18$	$4.60^{bc}\pm0.38$	$5.60^{a}\pm0.33$	$4.50^{c}\pm0.25$	$5.01^{a}\pm0.179$
Mean		4.66 ± 0.266	4.30 ± 0.210	4.85 ± 0.32	4.45 ± 0.179	

T_1 : Berseem hay + concentrate feed mixture (CFM) as a control treatment
T_2 : *Atriplex nummularia* + Ground Date Stone (GDS).
T_3 : *Atriplex nummularia* + Barley grains (BG).
T_4 : *Atriplex nummularia* + (50% barley grains + 50% ground date stone).
a,b,c Means with different superscripts in the same raw are significantly different at ($P \leq 0.05$)

Table (7): Feed and economical evaluation of goats fed the experimental diets.

Items	T_1	T_2	T_3	T_4
Price of feed intake head/ day LE*				
concentrate	0.591	0.237	0.624	0.399
Roughages	0.250	0.018	0.021	0.018
Total	0.841	0.255	0.645	0.417
Feed cost of daily gain L.E	1.290	0.860	1.273	1.255
Feed cost/ kg gain	16.26	7.35	12.67	8.31
Economical efficiency**	1.534	3.373	1.974	3.010
Feed efficiency (kg feed/ kg gain)				
DM	12.16	18.40	13.26	14.19
TDN	7.08	9.82	7.18	7.06
DCP	1.01	0.86	0.77	0.71

* Based on market price of (2008) (LE /ton). The price of ton on DM basis was as follows:
CFM 1450, barley 1600 and berseem hay, 850 L.E.
The price of 1 kg live body weight of goat: 25 L.E/ kg
** Economic feed efficiency is expressed as the ratio between the price of total live body weight gain and the price of feed consumed to that gain.
T_1: Berseem hay + concentrate feed mixture (CFM) as a control treatment
T_2: *Atriplex nummularia* + Ground Date Stone (GDS). T_3: *Atriplex nummularia* + Barley grains (BG).
T_4: *Atriplex nummularia* + (50% barley grains + 50% ground date stone).

4. Conclusion.

It could be concluded that T2 and T4 which contained 100%, 50% date stone respectively were highly recommended to be used as concentrate diet for goats. This may be due to the higher price of CFM and barley than the price of date stone. Also, berseem hay was expensive than the collected *Atriplex.*

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