Effect of Feeding Some Salt Tolerant Fodder Shrubs Mixture on Physiological Performance of Shami Goats in Southern Sinai, Egypt

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Abstract: This research was performed to study the effect of feeding a mixture of sun- dried- chopped salt tolerant fodder shrubs (*Prosopis juliflora, Acacia saligna* and *Leucaena Leucocephala*) on live body weight, some blood biochemical, electrolytes and hormonal profile of Shami doe goats. The study was carried out at South Sinai Research Station, South Sinai Governorate, Egypt. A total number of fourteen Shami doe goats were randomly allocated into two groups. The first group was fed berseem hay (control group, G1) while the second group (G2) was fed a mixture of sun- dried *Prosopis juliflora* (50%), *Acacia saligna* (25%) and *Leucaena Leucocephala* (25%). Both groups were supplemented with concentrate feed mixture (CDM). Live body weight changes and daily gain were recorded biweekly. The level of total proteins (TP), albumin (A), glucose (GLU), total lipids (TL), cholesterol (CHO), alanine amino transferase (ALT), aspartate amino transferase (AST), alkaline phosphatase (ALP), urea, creatinine were measured. Blood electrolytes of calcium (Ca), sodium (Na) and potassium (K) were analyzed. Values of globulin (G), and the ratios of albumin/ globulin (A/G), urea/ creatinine and sodium/ potassium (Na/ K) in addition to sodium potassium index (Na/ Na+ K) were calculated. Hormonal profiles of triiodothyronine (T_3), thyroxine (T_4) and aldosterone were also determined.
The results revealed that animals fed salt tolerant fodder shrubs mixture (G2) had insignificant higher final body weight and average daily gain. The levels of total proteins, albumin, globulin, A/G ratio, T_3, T_4, AST, ALP, urea/ creatinine ratio, calcium, sodium, potassium, Na/K ratio and Na/ Na index in both groups were comparable with non-significant differences. Furthermore, the shrubs mixture group (G2) showed significant lower values of glucose (P< 0.01) in addition to total lipids, cholesterol, urea, creatinine (P<0.01) than those recorded for the control group. On the other hand, it had higher ALT (P<0.01) and Aldosterone (P< 0.05) levels in comparison with the control group.
From abovementioned results, the obvious lack of adverse effects of feeding salt tolerant fodder shrubs mixture on physiological performance observed in Shami doe goats underlined the potential of *Prosopis juliflora, Acacia saligna* and *Leucaena Leucocephala* shrubs mixture as good quality feed materials to enhance livestock feed supply and ensure acceptable level of production under such desert conditions of Southern Sinai, Egypt.
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1. Introduction

Availability of conventional feed resources is declining as livestock populations increase especially in arid and semi-arid areas of Egypt. To overcome the problems of low availability of feed resources for animals, new fodder plant species have been tested. Feeding trees and shrub foliage and agriculture by-products are of importance in animal production because they do not compete with human food and can provide significant nutrients supplements, especially in the dry season (Makkar, 2003). The use of fodder trees and shrubs to solve the attendant problems of low productivity in small ruminant production has received research attention in recent times (El Shaer 2010). *Prosopis juliflora* grows in areas with little rainfall and on sandy, saline, stony or other lands unsuitable for cultivation (Silva, 1986). *Leucaena leucocephala* is a nutritious, drought resistant, leguminous tree found throughout the tropics, subtropics and arid region (Benge, 1980, Devendra, 1993 and Helal *et al.*, 2013) for ruminants. Leucaena forage can be an excellent source of calcium, phosphorus, and other dietary minerals (Akbar and Gupta, 1985, D'Mello and Fraser, 1981, Deshmukh *et al.*, 1987, James, 1978, D'Mello and Taplin, 1978 and Helal *et al.*, 2013) but is deficient in sodium (Akbar and Gupta, 1985, D'Mello and Fraser, 1981 and D'Mello and Taplin, 1978). Acacia is a perennial legume shrubs that yield green forages year round and grows in marshy areas near fresh and salt water on sandy soils. Acacia shrubs tolerate flooding and drought and is considered as a palatable pasture shrub rich in protein (Abd El-Galil and Khidr, 2000, El Shaer *et al.*, 2005 and El Shaer, 2010).

However, such trees and shrubs foliage are generally rich in ant-nutritional factors, particularly tannins (Makkar, 2003). Feeding a mixture of these fodder shrubs could minimize and overcome the problems of palatability and toxic effects (Lowry, 1990, Yusran and Teleni, 2000, Anbarasu *et al.*, 2001, Patra *et al.*, 2002 and El Shaer 2010).

The lack of information about the effect of feeding a mixture of *Prosopis juliflora, Acacia saligna* and *Leucaena Leucocephala* shrubs on animal performance in arid areas of Egypt was the motive of the investigation. Thus, this study aimed at evaluating the possible effects of such t shrubs on the physiological performance of Shami goats fed such shrubs mixture under arid and saline conditions of Southern Sinai, Egypt.

2. Materials and Methods

This study was carried out at South Sinai Station (Ras Sudr), belongs to Desert Research Center, South Sinai Governorate, Egypt. This experiment aimed at investigating the physiological and biochemical parameters of doe Shami goats fed on a sun- dried chopped mixture of *Prosopis juliflora, Acacia saligna* and *Leucaena Leucocephala* during a period of five months by monitoring the metabolic and electrolytes status, liver and kidney functions in addition to live body weight changes.

Fourteen Shami doe goats aged 2.5- 3.0 years old with averaged 25.04± 1.351 kg body weight, were divided into two equal groups (7 animals each). The first group (G1) was fed berseem hay (*Trifolium alexandrinum*, 4th cut) as control, while the second one (G2) was fed a mixture of *Prosopis juliflora*, *Acacia saligna* and *Leucaena Leucocephala* at rate of 50%, 25 and 25%, respectively. The fodder shrubs were sun dried and chopped before introducing to animals. All experimental animals were fed their nutrient requirements according to the recommended nutritional requirements of Kearl (1982). Representative samples were collected form the edible parts of plants and also from the tested mixture. The chemical composition of *Prosopis juliflora, Acacia saligna* and *Leucaena Leucocephala* and the tested mixture and berseem hay was determined according to A.O.A.C. (1985).

The experimental animals were housed indoors inside semi-closed pens, they were weighed biweekly up to end of the experiment. Drinking clean fresh water was made available twice a day over the experimental period.

Jugular blood samples were withdrawn into clean heparinized tubes in early morning just before offering ration and water. Blood samples were centrifuged for 30 minutes at a speed of 3000 r.p.m. for plasma separation.

Assay of total proteins (TP) was carried out by a test kit supplied by Egyptian- American Company for Laboratory Services according to Biuret method after Gornal *et al.* (1949). On the other hand, albumin (A) was determined according to Doumas *et al.* (1971). Values of globulin (G) were calculated by subtracting the value of albumin from the total protein whereas A/G ratio was calculated according to results of albumin and globulin.

Plasma total lipids concentration was determined according to Schmit (1964). The assay of total cholesterol was carried out according to Roeschlau *et al.* (1974), while the glucose concentration was analyzed according to Tietz (1986).

Concentrations of both alanine (ALT) and aspartate (AST) amino transferases were analyzed according to Reitman and Frankel (1957). Whilealkaline phosphatase concentration (ALP) was determined according to Belfield and Goldberg (1971). Plasma urea and creatinine concentrations as indicators for kidney function were determined using biodiagnostic kits according to Fawcett and Soctt (1960) and Schirmeister *et al.* (1964), respectively.

The blood electrolytes in terms of calcium (Ca), sodium (Na) and potassium (K) were determined according to Gindler and King (1972), Trinder (1951) and Sunderman and Sunderman (1958), respectively.

Direct radioimmunoassay technique (RIA) was performed for plasma triiodothyronine (T_3), thyroxine (T_4) and aldosterone hormones using ready antibody coated tubes kits manufactured by Immunotech, Beckman Counter Company, France.

Data were analyzed using General Linear Model Procedure (SAS, 2004).

3. Results and Discussion

Chemical composition:

Chemical composition for *Prosopis juliflora, Acacia saligna* and *Leucaena Leucocephala* and berseem hay is illustrated in Table (1). The results showed that dry matter (DM), ash and ether extract (EE) contents were higher in Berseem than in *Prosopis juliflora*, *Acacia saligna*, *Leucaena Leucocephala* as salt tolerant plants mixture. These salt tolerant plants had higher crude protein (CP), crude fiber (CF), nitrogen free extract (NFE) and organic matter (OM) which could safely cover the essential nutrients requirements for animals (El Shaer, 2010).

Live body weight changes:

The experimental Shami doe goats remained apparently in good health throughout the experimental period irrespective of dietary supplement.

The obtained results showed that animals fed salt fodder shrubs had insignificant higher final body weight and daily gain as compared to the

Table (1): Chemical composition of feed mixture of the two experimental diets fed to Shami doe goats (Dry matter basis)

	DM	OM	CP	CF	EE	NFE	Ash
Berseem hay	100	88.95	12.22	28.55	1.18	47.00	11.05
Prosopis juliflora	94.50	92.63	12.83	27.55	6.69	45.56	7.37
Acacia saligna	92.74	92.44	11.71	30.86	3.29	46.58	7.56
Leucaena Leucocephala	93.66	91.96	13.63	24.53	6.65	47.15	8.04
Salt tolerant plants mixture*	92.61	92.51	13.07	27.28	6.04	46.12	7.49
Concentrate feed mixture	93.76	89.20	16.73	12.77	4.11	55.59	10.80

DM, dry matter CP, crude protein CF, crude fiber
EE, ether extract NFE, nitrogen free extract OM, organic matter
*, *Prosopis juliflora* (50%)+ *Acacia saligna* (25%) + *Leucaena Leucocephala* (25%)

control (Table 2). These results demonstrated the potentiality of such salt tolerant plants mixture to fulfill the animal requirements to maintain their body weight. In similar, Shiroma and Akashi (1976) found that goats fed *Leucaena leucocephala* fodder for three months, maintained their body weights throughout the experimental period without any deleterious effect. Moreover, Zarkawi et al. (2005) demonstrated that Awassi ewes fed *Sesbania aculeate* which grown on salty soil and irrigated by saline water had comparable live body weight of ewes for control group. From another point of view, this slight increase in final body weight might be due to the increase in water intake in group (2). Similar trends were obtained by Shawkat et al. (1988) and Abou El-Nasr et al. (1998).

Table (2): Growth performance of Shami doe goats as affected by feeding salt tolerant shrubs mixture

Item		G1	G2	± SE	Overall mean
Initial body weight NS	**(kg)**	25.07	25.00	± 1.989	25.04±1.351
Final body weight NS	**(kg)**	30.43	30.71	± 2.045	30.57±1.390
Body weight changes NS	**(kg)**	5.36	5.71	± 0.497	5.54±0.342
% of initial body weight NS		21.66	24.44	± 2.930	23.05±2.027
Average daily gain NS	**(gm)**	35.71	38.10	± 4.264	36.90±2.856

Ns, non-significant
G1, animals fed berseem hay + CFM (Control group)
G2, animals fed a mixture of fresh *Prosopis juliflora* (50%)+ *Acacia saligna* (25%)+ *Leucaena Leucocephala* (25%)+ CFM

There was a steady increase in the mean LBW of the goats in both experimental groups throughout the study period (Figure 1). Neither the liver body weight (LBW) changes nor average daily gain (ADG) of goats on different diets differed insignificantly (P>.05) during the experiment (Table 2). Similar results were reported by Srivastavam and Sharma (1998) where feeding pelleted diets containing different proportions of sun-dried *Leucaena leucocephala* resulted in non-significant differences final body weight and average daily gain of Jamunapari male goats.

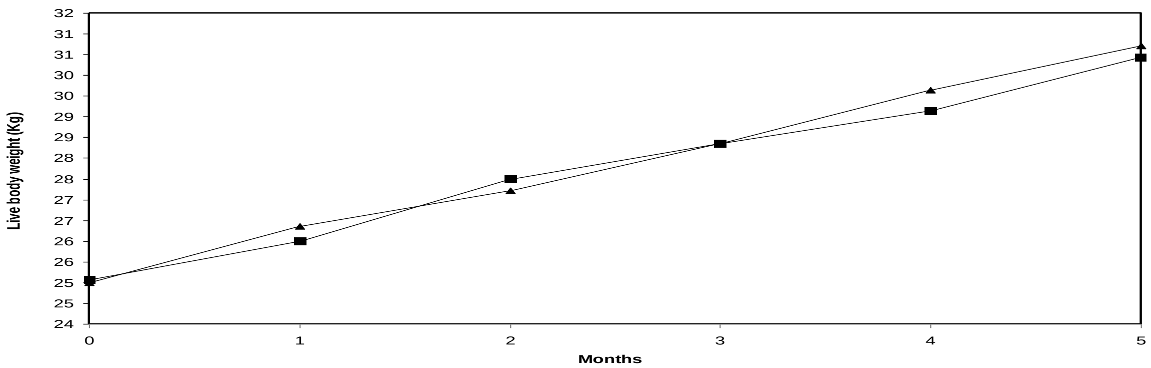

Figure (1): Live body weight changes of Shami doe goats as affected by feeding salt tolerant plants mixture

G1, animals fed on berseem hay + CFM (Control group)
G2, animals fed on a mixture of fresh Prosopis juliflora (50%)+ Acacia saligna (25%)+ Leucaena Leucocephala (25%)

Blood metabolites:

Total proteins profile:

The obtained results revealed that goats fed salt tolerant shrubs mixture had slightly insignificant lower concentrations of total proteins (TP), albumin (AL), globulin (GL) and albumin/ globulin ration (A/g ratio) than their counterparts of control group (Table 3). These findings were in accordance with those reported by Asker (1998) and Abdel- Halim (2003). Moreover, Shaker *et al.* (2008) working on growing Barki lambs and Badawy *et al.* (2002) on growing Barki lambs and Baladi kids reported that feeding fresh acacia lowered TP, A and G values. This reduction of TP in animals fed salt shrubs (G2) might be owing to the high content of tannins in these plants. In agreement, Muller *et al.* (1989) and Reed *et al.* (1990) reported that high content of tannins in acacia probably decreases the digestibility of crude protein. Coles (1986) found that poor absorption of dietary constituents from the intestinal tract leads to hypoproteinemia. Mahmoud (2001) reported that the decrease in concentration of globulin in sheep might be due to the presence of a high level of tannins, which form complexes with dietary proteins. However, the observed range of total protein in the present experiment was within normal range of 6 to 7.5 g/dl (Jain, 1993) irrespective of dietary treatment.

It seemed impossible to discuss the total protein without simultaneously bearing in mind the effect of high salt content in such salt shrubs. Results of earlier work obviously revealed that the decrease in protein fraction might be attributed to the high intake of salt. Badawy (1999) reported that drinking saline water decreased significantly total protein, albumin and globulin of sheep, suggesting that the decline in albumin might be due to the decrease in active transport of amino acids needed for building albumin rather than globulin in hepatic tissues. Since albumin is formed only in liver, so it is tended to be considered as criterion pointed to liver function. Thus, the decline in albumin concentration might reflect reasonable impairment of liver function (Miller *et al.*, 1954). Moreover, Tata and Widnell (1966) observed a decrease in total protein concentration due to drinking saline water which might possibly reduce hepatic synthesis of RNA which in turn depressed the incorporation of amino acids for protein synthesis.

Table (3): The mean values of total proteins, albumin and globulin concentrations and albumin/ globulin ratio of Shami doe goats as affected by feeding salt tolerant shrubs mixture

Item		G1	G2	± SE	Change	Overall mean
Total proteins ^{NS}	**(g/dl)**	7.10	6.62	± 0.464	-0.48 (7.25%)	6.860±0.359
Albumin ^{NS}	**(g/dl)**	3.06	2.77	± 0.153	-0.29 (10.46%)	2.91±0.142
Globulin ^{NS}	**(g/dl)**	4.04	3.86	± 0.345	-0.18 (4.66%)	3.95±0.330
A/G ratio ^{NS}		0.91	0.80	± 0.066	-0.11 (13.75%)	0.85±0.077

^{NS}, non-significant

In the same row, any two means in a certain item having different letters differ significantly.

G1, animals fed berseem hay + CFM (Control group)

G2, animals fed a mixture of fresh *Prosopis juliflora* (50%)+ *Acacia saligna* (25%)+ *Leucaena Leucocephala* (25%)+ CFM

Glucose concentration:

The results showed that the animals fed salt tolerant plants mixture (G2) had lower (P< 0.05) glucose mean values comparing to the control ones (Table 4). This reduction might be attributed to the high content of tannins in such desert plants. Tannins can reduce digestibility of protein and carbohydrate by inhibiting digestive enzymes and by altering permeability of the gut wall (Streeter *et al.*, 1993). Moreover, Ortiz *et al.* (1993) reported that tannins could adversely influence digestibility and absorption of nutrients such as proteins and amino acids, carbohydrates and lipids and also the activity of digestive enzymes. The results were in harmony with those reported by Ismail *et al.* (2003) and Shaker *et al.* (2008).

On the other hand, high salt in these desert forages might be another reason for such reduction in glucose concentration in salt shrubs fed group. This theory would be confirmed by Assad *et al.* (1997) when working on rams receiving saline water. In consistence, Kewan (2003) reported that the glucose level in camels fed halophytes was lower than that for control group.

Total lipids concentration:

Lipids have an essential role in all aspects of biological life, serving as hormones or hormones precursors, helping in digestion, providing energy storage and metabolic fuel and acting as functional and structural components in biomembranes (Tietz, 1990).

The mean values of plasma total lipids showed the same trend of glucose level where Shami does fed salt tolerant shrubs had lower (P<0.01) total lipids values than their counterparts of control group (Table 4). These results could be attributed to that such salt tolerant shrubs had low fat contents, therefore subsequently, feeding on these plants for long times led the animals to utilize the stored body fats for energy supply. In agreement, Abdelhameed *et al.* (2006)

demonstrated that ewes fed on salt tolerant shrubs had lower ($P<0.01$) levels of total lipids. Abdelhameed *et al.* (2004) reported a significant decrease in total lipids and lipid fraction in camels fed on fresh saltbush forage plants. Shaker *et al.* (2008) demonstrated that feeding halophytes led to a non-significant decrease in total lipids of Barki lambs.

Table (4): The mean values of total lipids, cholesterol and glucose concentrations of Shami doe goats as affected by feeding salt tolerant shrubs mixture

Item		G1	G2	± SE	Change	Overall mean
Glucose*	**(mg/l)**	51.14 a	41.25b	± 2.651	-9.89 (23.97%)	46.20±1.798
Total lipids**	**(g/l)**	3.05a	2.65b	± 0.076	-0.4 (15.09%)	2.85±0.077
Cholesterol**	**(mg/dl)**	99.01a	83.96b	± 2.177	-15.05 (17.93%)	91.49±2.890
Triiodothyronine^{NS}	**(pg/ml)**	2.27	3.11	± 0.009	+0.84 (37.00%)	2.69±0.267
Thyroxine ^{NS}	**(ng/ml)**	9.03	10.04	± 0.266	+1.01 (11.18%)	9.53±0.972

*, $P<0.05$ **, $p<0.01$ ^{NS}, non significant
In the same row, any two means in a certain item having different letters differ significantly.
G1, animals fed berseem hay + CFM (Control group)
G2, animals fed a mixture of fresh *Prosopis juliflora* (50%)+ *Acacia saligna* (25%)+ *Leucaena Leucocephala* (25%)+ CFM

Cholesterol concentration:

Data of cholesterol revealed that animals of salt tolerant plants group got lower ($P<0.01$) cholesterol concentration (Table 4). In similar, Shaker *et al.* (2008) found that animals fed halophytes had lower cholesterol level than control. Moreover, Fayed (2009) reported that blood cholesterol was reduced significantly in Barki rams fed *Acacia saligna* and *Tamarix mannifera*, as fed salt plants ($P< 0.05$) compared to that of control ones. This decrement in blood cholesterol level might be attributed to the anti- nutritional factors where they have been found to affect lipids profile indirectly where tannins play a considerable role in lipids digestibility by complexing with fatty acids (Romero *et al.*, 2000), decreasing cholesterol absorption and increasing fat excretion (Bravo *et al.*, 1993). On the other hand, this decrease in cholesterol levels might be owing to saponins contents of acacia (Salem *et al.* 2004; El- Shear *et al.*, 2005 and Fayed, 2009). A number of studies have shown that saponins from different sources lower serum cholesterol levels in animals (Matsuura, 2001). The hypocholesterolaemic action of saponins was previously reported (Francis *et al.*, 2002). This effect of saponins could be achieved through inhibiting the cholesterol absorption causing reduction in plasma non-high- density, lipoprotein cholesterol fraction (Morehouse *et al.*, 1999) and/ or delaying the intestinal absorption of dietary fat by inhibiting pancreatic lipase activity (Han *et al.*, 2000). Finally, it could affect the digestibility of fats in ruminants which is limited by the lack of emulsifying agents in the rumen (Cheeke, 1999).

Thyroid hormones:

Results of triiodothyronine (T_3) and thyroxine (T_4) hormones promulgated that the salt tolerant shrubs mixture group showed insignificant higher mean values comparing to control group (Table 4). In agreement, Falvey (1976) reported that non-significant elevation of thyroxine was observed along with hyper-activity as a result of feeding leucaena in cattle. Moreover, no significant change in thyroid hormones has also been reported in sheep (Pessoa *et al.*, 1988), goats (Rai *et al.*, 1991and Senani, 1992) and cattle (Wahyuni *et al.*, 1982 and Kailas, 1991) consuming Leucaena leaf meals.

Liver function:

Most plasma enzymes come from different tissues of animal. Its activity level had a relation with metabolism and functional status of certain organs. Body's ability to adjust and adapt depends on the function of tissues and organs largely (Shi-Gang *et al.*, 2010). Concentrations of its enzymes alanine amino transferase (ALT), aspartate amino transferase (AST), alkaline phosphatase (ALP) and gamma glutamyl transferase (GGT) are those conventionally used for diagnosing hepatic damage. The results of alanine amino transferase (ALT) demonstrated that salt tolerant shrubs mixture group had higher ($P< 0.01$) vales as compared to the control group, where it exceeded their counterparts of control ratio by 16.29% (Table 6). This increment ($P<0.01$) of ALT concentrations in animals fed on such salt tolerant forages mixture might be attributed to high tannins content in these shrubs (Tripathy *et al.*, 1984) or to high content of salt as reported by Ibrahim (1995) on goats, Hussein (1987) on sheep, Ibrahim (2001) on camels and Ibrahim *et al.* (1991) on male buffalo- calves. Consistently, Shaker *et al.* (2008) found that the activity of ALT was higher ($P<0.01$) in animals fed on fresh or silage form of atriplex and acacia mixture comparing to control group. Badawy *et al.* (2002) noticed that feeding lambs on fresh acacia increased significantly the level of ALT by 14.1 % in small ruminant.

Table (5): The mean values of alanine amino treanferase (ALT), aspertate amino tranferase (AST), alkaline phosphatase (ALP), urea, creatinine concentrations and urea/ creatinine ratio of Shami doe goats as affected by feeding salt tolerant shrubs mixture

Item		G1	G2	± SE	Change	Overall mean
ALT **	**(IU/l)**	28.79a	33.48b	± 1.040	+4.69 (16.29%)	31.13±0.920
AST ^{NS}	**(IU/l)**	22.44	26.10	± 1.640	+3.66 (16.31%)	24.27±1.255
ALP ^{NS}	**(IU/l)**	165.45	149.50	± 3.704	-15.95 (10.66%)	157.47±5.153
Urea**	**(mg/dl)**	44.78a	35.53b	± 1.805	-9.25 (26.03%)	40.16±1.426
Creatinine**	**(mg/dl)**	1.24a	1.01b	± 0.049	-0.23 (22.77%)	1.12±0.040
Urea: Creatinine ratio ^{NS}		36.58	35.76	± 1.868	-0.82 (2.29%)	36.17±1.237

**, p<0.01 NS, non-significant
In the same row, any two means in a certain item having different letters differ significantly.
G1, animals fed berseem hay + CFM (Control group)
G2, animals fed a mixture of fresh *Prosopis juliflora* (50%)+ *Acacia saligna* (25%)+ *Leucaena Leucocephala* (25%)+ CFM

Aspartate amino transferase (AST), which is present in extrahepatic tissues including myocardium and kidney, can be used as a good indicator of hepatic injury of sheep (Lessard *et al.*, 1986).

The activity of AST showed the same trend of ALT where higher insignificant activity (P>0.05) was observed in animals fed on a mixture of salt tolerant plants than those recorded for the control group (Table 5). The high contents of tannins in these shrubs might be the main reason of AST elevation (Badawy *et al.*, 2002 and Tripathy *et al.*, 1984). Such results supported the eariler findings obtained by Shaker *et al.* (2008) found an increase in activity of AST in lambs fed on fresh mixture of shrubs as compared to their counterparts control group.

In general, the increase of ALT or AST activity might be caused by high tannins (Tripathy *et al.*, 1984), oxalates (Mclntosh, 1972), alkaloids (Craig *et al.*, 1991) and salt (Rodostitis *et al.*, 1994) in tested forages plants.

Alkaline phosphatase is used to detect the bile obstruction (i.e. mild and progressive damage to the liver). Concerning the values of alkaline phosphatase (ALP) in animals fed salt tolerant shrubs mixture diet (G2) were lowered compared to control group. The utmost decline (P>0.05) of alkaline phosphatase might be owing to the presence of tannins, which react with this enzyme, rendering its activity as reported by many investigators (Horigome *et al.*, 1988 and Abde-Halim, 2003). Additionally, excess of oxalate in such salt forages is an inhibitor for that liver enzyme (McComb *et al.*, 1979). Similarly, Shaker *et al.* (2008) reported that ALP levels decreased (P<0.01) in animals fed either fresh or silage forms of acacia and atriplex mixture.

Kidney function:

Urea and creatinine are the two main nitrogenous compounds eventually excreted by kidney. Accordingly, any change of their concentration would reflect impaired glomerular filtration and/ or insufficiency of renal tubules (Coffin, 1955, Miller, 1966 and Kaneko, 1989). Furthermore, urea is the major nitrogen- containing metabolic product of protein catabolism accounting for more than 75% of the non- protein nitrogen excreted. Also, production is also too dependent on several non- real variables such as a diet and hepatic synthesis.

Animals fed salt tolerant plants mixture of sun- dried prosopis, acacia and leucaena had lower (P<0.01) mean concentration of urea in comparison with the control group (Table 5). In accordance, Cook *et al.* (2008) reported that adding *Prosopis glandulosa Torr*. in the goats' diet by 30, 60 and 90% resulted in decreasing blood urea nitrogen (BUN) concentrations as compared to control ones. Moreover, the decreasing was correlated positively with increasing of prosopis providing. Patra *et al.* (2002) reported that serum urea concentration in leucaena meal group was lower (P< 0.01) in comparison to the control group. This result could be attributed to the presence of condensed tannins, which reduced the ruminal proteins degradation (Mashudi *et al.*, 1997). Similar trends were reported by Shaker *et al.* (2008), Badawy *et al.* (2002) and Azamel (1997)

The present findings demonstrated that the mean values of creatinine behaved similarly to that of urea results where lower (P<0.01) mean value was observed for prosopis, acacia and leucaena fed group comparing to the control group (Table 5). On the other hand, the results of urea/ creatinine ratio followed the trends of urea and creatinine but with non-significant manner being lower in shrubs mixture group in comparison with the control (Table 5). This might be due to the high presence of condensed tannins, which reduced the ruminal proteins degradation which in turn caused a reduction of urea nitrogen levels in sheep and goats fed on legumes that high in tannins (Mashudi *et al.*, 1997; Waghorn *et al.*, 1994 and Azamel, 1997). These findings were in the same trend reported by Shaker *et al.* (2008).

Blood electrolytes:

Minerals play an important role in the regulation of body fluids, acid base balance and metabolic processes (Milne, 1996).

Concerning the calcium concentration in plasma, the obtained results declared that fresh shrubs fed group had non-significant lower mean value compare with control group (Table 6) which might owing to high content of tannins and oxalate in such salt tolerant shrubs. Tannins were found to disturb the absorption of minerals through the gastrointestinal tract and/ or increase the endogenous losses of minerals such as calcium, magnesium, and phosphorus (Mansoori and Acamovic, 1997). In accordance, with mesquite pods accounting for 30% of concentrate diet of cattle there was no effect on calcium levels in the blood (Talpada and Shukla, 1988). These results were confirmed for blood calcium and phosphorus levels for bullocks fed *Prosopis juliflora* pods up to 45% DM of their diet (Gujrathi *et al.*, 1982). Previous studies demonstrated that concentrations of Ca exhibited non- significant differences in animals fed halophytes in fresh or silage and their control ones (Abdel- Halim, 2003) and El-Hassanein *et al.*, 2002). These results were in agreement with those reported by Shaker *et al.* (2008).

Table (6): The mean values of calcium, sodium, potassium, aldosterone concentrations, Na/ K and of Na index doe Shami goats as affected by feeding salt tolerant shrubs mixture

Item		G1	G2	± SE	Overall mean
Calcium ^{NS}	**(ppm)**	187.48	186.52	± 5.391	186.99±8.262
Sodium ^{NS}	**(ppm)**	5800.00	6104.17	±12.843	5952.08±280.195
Potassium ^{NS}	**(ppm)**	159.92	165.42	± 1.840	162.66±3.284
Na^+/K^+ ratio ^{NS}		36.45	36.77	± 0.458	36.61±1.651
Sodium potassium index ^{NS}		0.97	0.97	± 0.003	0.97±0.001
Aldosterone*	**(pg/ ml)**	532.69a	781.98b	± 13.087	657.33±57.640

*, P<0.05 ^{NS}, non-significant

In the same row, any two means in a certain item having different letters differ significantly.

G1, animals fed berseem hay + CFM (Control group;)

G2, animals fed a mixture of fresh *Prosopis juliflora* (50%)+ *Acacia saligna* (25%)+ *Leucaena Leucocephala* (25%)+ CFM

On the other hand, regarding to the effect of high salt content, Amer (1990) found that in goats Ca and Mg were not affected by drinking saline water. Moreover, Jaster *et al.* (1978) reported that Ca in blood were unchanged and remained relatively constant in cows drinking saline water (2500 p.p.m. NaCl).

The present findings of sodium (Na) and potassium (K) concentrations demonstrated that animals fed fresh form of prosopis, leucaena and acacia mixture had non- significant higher values of Na and K comparing to control group (Table 6). In similarity, Shaker *et al.* (2008) demonstrated that ewes fed fresh form of atriplex and acacia had higher Na and K values than control ewes. Wenger and Schuh (1974) and Wichell (1976) noted a relationship between increasing Na^+ intake; which is already high in such forages, and high concentration of K^+ in plasma.

Na and K are known to be found in high concentrations in salt tolerant (NRC, 1975, Kearl, 1982 and El- Shaer, 1981), however, excess intake of these electrolytes is accompanied by their excess excretion through the kidneys (Neathery, 1980).

The values of Na/K ratio and Na, K index values showed that there were no significant differences among the two experimental groups. However, salt tolerant shrubs fed group (G2) achieved higher values of Na/K ratio in comparison with control group (Table 6). Consistently, Mohamed (1997) noted that the ratios of $Na^{+/}K^+$ as well as $Na^+ / Na^+ + K^+$ had no marked differences among groups but increased as the level of water salinity increase. Additionally, Shaker *et al.* (2008) declared that feeding acacia and atriplex resulted in insignificantly Na/ K ratio and Na, K index values.

On the other hand, the results revealed that feeding salt tolerant plants mixture to Shami goats increased (P< 0.05) the aldosterone levels in comparing to control ones (Table 6). This increment in aldosterone concentration might be attributed to the high content of salt in such salt tolerant shrubs. In addition, Aboulnaga (1987) reported that the aldosterone secretion and concentration of sodium and potassium in urine and blood plasma would be changed when the ratio of sodium and potassium intake was changed. In agreement, Shaker *et al.* (2008) demonstrated that aldosterone level increased as a result of feeding fresh acacia and atriplex.

Conclusion

It could be concluded that using such mixture of salt tolerant plants: *Prosopis juliflora*, *Acacia saligna* and *Leucaena Leucocephala* in small ruminants' diet can maintain better performance with no health challenges to the animals. The absence of hazard effects on physiological performance in Shami doe goats pointed to the potential of use *Prosopis juliflora*, *Acacia saligna* and *Leucaena Leucocephala* shrubs mixture to enhance livestock feed supply and ensure acceptable level of production under such desert conditions of Southern Sinai, Egypt.

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