Liver and Kidney Functions and Blood Minerals of Shami Goats Fed Salt Tolerant Plants under the Arid Conditions of Southern Sinai, Egypt

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Abstract: This study was conducted to investigate the effects of feeding salt tolerant fodder crops to Shami goats during pregnancy and lactation on some blood minerals as well as kidney and liver functions under the arid conditions of Southern Sinai, Egypt. Twenty- four of Shami goats were divided into two groups. The first group was fed wheat straw whereas the second one was fed salt tolerant plants (*Sorghum vulgare* and *Pearl millet*). Both groups were offered concentrate feed mixture. The levels of some macro and trace elements; sodium (Na), potassium (K), calcium (Ca) and magnesium (Mg), cadmium (Cd), chromium (Cr), molybdenum (Mo), lead (Pb) and zinc (Zn) were measured in blood serum throughout the different physiological status. Moreover, urea and creatinine (Crea) concentrations in addition to the activity of liver enzymes: alanine (ALT) and aspartate (AST) aminotransferase were determined.
The results demonstrated that feeding salt tolerant plants resulted in increasing levels of serum K ($P<0.01$) and decreasing Ca ($P<0.05$) compared to the control group while Na and Mg concentrations increased insignificantly. Moreover, animals of G2 achieved higher values of Mo, Pb and Zn while they had lower values of Cd and Cr than their counterparts of the control group. There was obvious effect of physiological status on blood electrolytes assessment. The concentrations of Ca, K, Mg, Cd, Cr, Mo, Pb and Zn tended to decrease in advanced of pregnancy and lactation which might be attributed to the accumulative need of these elements to foetus growth and milk production. Na levels showed an adverse trend. Feeding salt tolerant plants elevated ($P<0.01$) the activity liver enzymes but decreased both creatinine ($P<0.05$) and urea levels. Pregnancy and lactation stages increased the ALT, AST, urea and creatinine concentrations.
It could be concluded that introducing salt tolerant plants to Shami goats could be an avenue to minimize the feedstuff shortage under arid conditions of Southern Sinai. However, feeding such salt tolerant plants during pregnancy and lactation periods may have adverse effects on blood minerals in addition to liver enzymes activities but not kidney function. These effects might be amplified due to the stress of pregnancy and lactation.
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Key Words: Shami goats; salt tolerant plants; physiological status; minerals; liver function, kidney function

1. Introduction

The comprehensive sustainable development in Sinai Peninsula is facing a dilemma of lack of arable lands and available fresh water. Globally, the world is losing at least 3 ha of arable land every minute because of soil salinity (El-Shaer, 2010). Salt stress is one of the most serious limiting factors for crop growth and production in the arid regions (Jouyban, 2012). About 23% of the world's cultivated lands are saline and 37% is sodic (Khan and Duke, 2001). Southern Sinai is hyper arid region with salt affected natural resources (water, soil, plants, etc..). Therefore, feed resources in the region represent one of the main obstacles for animal production development. Salt tolerant forage species could play an important role in the region (Fayed *et al.*, 2010). Salt tolerant forage species have great potentialities to induce agricultural revolution in such areas since it is known to be tolerant to salinity and drought so it could play an important role in such arid regions (Jouyban, 2012). Sorghums have high water efficiency and require less total water to reach their production potential. The combination of drought-tolerance and salt-tolerance makes sorghum a very interesting feed resource under arid and semi-arid conditions in saline lands (Al-Khalasi *et al.*, 2010 b, Fahmy *et al.*, 2010 and Khanum *et al.*, 2010).

On the other hand, such plants might have adverse effects on animal health via chemical or physical factors that either limit or inhibit optimum animal performance (Craig *et al.*, 1991). Dykes and Rooney (2006) reported that sorghum is a good source of phenolic compounds with a variety of genetically dependent types and levels including phenolic acids, flavonoids, and condensed tannins. While, millet has tannins in some varieties that contain a red testa. There are limited data on the phenolic compounds in millets; only phenolic acids and flavones have been identified. Moreover, high salt content of saltbushes is perhaps the major factor which limits intake and also reduce digestibility by shortening rumen turnover rates (Warren and Casson, 1992 and Bayoumi *et al.*, 1990).

There has been much interest regarding pregnancy nutrition and its impact on animal's health and reproductive, and lactation performances (Robinson, 1995). Pregnancy and lactation are physiological statuses considered to modify metabolism in animals (Krajnicakova *et al.* 2003 and Iriadam 2007). Minerals have a significant role to play in many aspects of production including successful establishment of pregnancy. Minerals activate enzymes; which are essential co-factors of metabolic reactions function as carriers of proteins, regulate digestion, respiration, water balance, muscle reaction, nerve transmission and skeletal strength (Haenlein, 1991). Concentrations of minerals in blood are generally not only related to intake, but also, are influenced by sex, breed, age, and reproductive status e.g. pregnancy or lactation (ARC, 1980).

Improving the sustainability of animal production systems in Sinai by increasing the availability of forage resources through introduction of salt-tolerant forage crops is considered one of the means to insure sustainable development of Bedouin communities in Southern Sinai. Therefore, the objective of this investigation was to evaluate the effect feeding tolerant plants (*Sorghum vulgare and Pearl millet*) as untraditional forage on some macro and trace elements, kidney function and liver enzymes activity in blood serum during different physiological status of Shami goats raised under arid conditions of the southern region of Sinai, Egypt.

2. Materials and Methods

The study was carried out at South Sinai Desert Research Station; is located in Ras Sudr City, South Sinai Governorate, belongs to Desert Research Center, Agriculture and Land Reclamation Ministry, Egypt.

Experimental design:

Twenty four Shami goat does were randomly divided into two groups. Animals of the first group (T1) were fed wheat straw. While, animals of second group fed *Sorghum vulgare* and *Pearl millet* (as salt tolerant plants) which are planted in salt affected lands and irrigated with saline water. Fresh tap water was available for drinking of all animals. Animals were maintained on these treatments for 20 days before recording data and considered as a preliminary period before the beginning of mating season. Animals of all groups were naturally mated.

Forage sampling:

It is worthy to mention that the wheat straw was imported from the Nile Valley while the salt tolerant plants were planted in the studied area. The salt tolerant plants samples were collected from the same place from where soil samples were collected. All the samples were weighed and air-dried for a day, to reduce water content, and then they were oven-dried at 70–80 °C for 24 hours to remove all moisture. Dried samples were powdered for further use. Analysis was carried out using microwave digestion technique (in a closed Teflon vessel under high temperature and pressure control) as reported by Littlejohn *et al.* (1991). The metals were determined by spectroscopic methods, Flame photometer and Inductively Coupled Plasma Mass Spectroscopy (ICP-MS).

The results of the both forages analysis were tabulated in Table (1).

Table (1): Some macro and trace elements concentrations in both experimental diets (ppm)

Exp. Diets	Elements								
	Ca	K	Mg	Na	Cd	Cr	Mo	Pb	Zn
1	20960	11000	7311	41000	0.25	16.57	7.64	7.55	720
2	27970	23000	6791	42000	0.26	19.74	2.13	8.68	276

T1: wheat straw T2: salt tolerant plants (*Sorghum vulgare and Pearl millet*)

Blood sampling:

About 8- 10 ml were allowed to flow gently from the Jugular vein into a clean dry labeled test tube that was left to coagulate at room temperature for 2 -3 hrs. The test tubes were then centrifuged for 15 minutes at 3000 rpm. Clear non hemolyzed serum was harvested and kept in a deep freezer at -20 °C before analysis.

Trace elements (Cu, Zn, Mn and Se) levels analysis in plasma were determined by flame atomic absorption spectrophotometer (Pye-Unicam SP9). Concentrations of both alanine amino transferase (ALT) and aspartate amino transferase (AST) were analyzed according to Reitman and Frankel (1957). While assay of 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.

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

3. Results and Discussion

Macro minerals:

The obtained results demonstrated that animals fed *Sorghum vulgare* and *Pearl* millet irrigated with saline water (as salt tolerant plants) had insignificant higher sodium (Na) values than their counterparts fed traditional diet (Table 2), although the higher content of Na found in the salt tolerant plants diet (Table 1) which might refer to the ability of desert animals to cope with such forages. In similar, Pierce (1968) reported that saline water (1.3% NaCl) had no effect on the concentrations of sodium in the blood plasma. From another point of view, the higher content of K in salt tolerant plants (Table 1) as compared to control diet might be contributed in loss of Na. Berger (2006) reported that an excess of potassium can aggravate a marginal sodium deficiency. This can even occur when high forage (pasture, hay or silage) diets are fed. Certain pastures may have up to 18 times more potassium than sodium.

On the other hand, the concentration of Na in serum was affected (P<0.01) by physiological status where it increased gradually from mating to late- gestation and dropped sharply during lactation period (Table 2). This pattern of changes might be due to the increasing in salt demand for pregnancy and lactation. For goats, the sodium requirements for pregnancy increased from 0.015 g/ day for dry animals to 0.034 g/ day on 105-133 days of pregnancy and 0.4 g/ day at lactation (NRC, 2007). When sodium losses and sodium requirements for growth, pregnancy, lactation and work exceed intake, sodium deficiency can occur (Michell, 1985). The same results were determined by Khan *et al.* (2009). Furthermore, in the present study, the lowest Na values were observed at lactation period. In consistence, Elnageeb and Abdelatif (2010) reported a decrease in serum levels of Na during the first of lactation. This pattern of reduction is most likely a consequence of loss of this element in colostrum and milk. In mammals, the aqueous phase of colostrum contains high concentrations of the main ions (Na and Cl) (Ruchebusch *et al.*, 1991). Also, milk is especially rich in salts to maintain osmotic equilibrium in milk (Swenson and Reece, 1993a). Accordingly, Underwood and Suttle (1999) indicated that the lactation animal has higher salt requirements.

Table (2): Means of some macro and trace elements concentrations (ppm) of serum goats fed wheat straw and salt tolerant plants during different physiological status under South Sinai conditions

Item	Tr.	Dry	Pregnancy periods			Lactation	Overall	±SE		
			Early	Mid	Late			T	S	TxS
Na	T1	4380	4450	4700	5480	3780	**4558**	923^{NS}	146**	209^{NS}
	T2	4560	4870	5140	5030	3980	**4716**			
Overall		**4470^{a}**	**4660^{a}**	**4920^{ab}**	**5255^{b}**	**3380^{c}**				
K	T1	208.8^{Aa}	192.4^{Aa}	179.4^{Aab}	158.0^{Ab}	157.8^{Ab}	**179.2^{A}**	4.6**	7.2**	10.2**
	T2	346.0^{Ba}	245.8^{Bb}	148.0^{AC}	168.0^{AC}	205.2^{Bd}	**222.6^{B}**			
Overall		**277.4^{a}**	**219.1^{b}**	**163.7^{c}**	**163.0^{c}**	**181.5^{c}**				
Ca	T1	196.5^{Aa}	173.5^{Ab}	154.3^{Ac}	155.6^{Ac}	142.2^{Ac}	**164.4^{A}**	2.4*	3.8**	5.4*
	T2	165.4^{Ba}	172.8^{Bb}	156.1^{Ac}	159.0^{Abc}	131.1^{Ad}	**156.8^{B}**			
Overall		**180.97^{a}**	**173.16^{a}**	**155.21^{b}**	**157.92^{b}**	**136.64^{c}**				
Mg	T1	56.05^{Aa}	46.07^{Ab}	38.84^{Ac}	40.43^{Ac}	39.50^{Ac}	**44.18**	0.85^{NS}	1.35**	1.91**
	T2	41.16^{Ba}	44.66^{Aa}	46.55^{Ba}	45.58^{Aa}	39.06^{Ab}	**43.80**			
Overall		**48.60^{a}**	**45.36^{b}**	**42.70^{b}**	**43.00^{b}**	**39.28^{c}**				

T1: animals fed wheat straw T2: animal fed salt tolerant plants (*Sorghum vulgare and Pearl millet*)
In the same column, means in a certain item having the same capital letter do not differ significantly.
In the same row, means in a certain item having the same small letter do not differ significantly.

Additionally, the salt tolerant animals had higher Na values at all physiological periods than control ones (Table 2). These results might reflect that the present higher level of Na in forage (Table 1) was considered to be effective during gestation and lactation.

Concerning the serum levels of potassium (K), the results revealed that animals fed *Sorghum vulgare* and *Pearl millet* irrigated with saline water (as salt tolerant plants) achieved higher (P< 0.01) values than those of control. Moreover, animals fed salt tolerant plants had higher (P< 0.01) K concentrations in advanced of gestation than control ones. The K concentrations in both groups were decreased from dry to lactation (Table 2). This might be attributed to the higher content of K in salt tolerant plants (209%) compared to wheat hay (Table 1). Forage plants had higher concentrations of K as potassium chloride (Masters *et al.*, 2007).

On the other hand, the concentrations of serum K decreased (P< 0.01) from dry period which recorded that the highest values (277.4 ppm) to the late gestation period which had the lowest value (163.0 ppm) then increased slightly up to the lactation period (Table 2). Elnageeb and Abdelatif (2010) reported that K level decreased significantly (P< 0.05) during late gestation. These changes in K level were observed during late gestation, while plasma progesterone level decreases and the plasma aldosterone level increases (Boulfekhar and Brudieux, 1980). Aldosterone increases renal k excretion in mammals (Swenson and Reece, 1993b). This pattern of endocrine response may explain the decrease in K level observed during the last weeks of pregnancy.

On the other hand, feeding salt tolerant plants resulted in lowering (P< 0.05) the serum calcium (Ca) concentrations compared to the control group (Table 2) although the higher content of Ca in salt tolerant plants (Table 1). Forage plants had higher values of Ca concentrations; however, animals fed salt-tolerant forages alone may be predisposed to mineral imbalance due to complex interactions between minerals (Masters *et al.*, 2007). Moreover, Mayberry *et al.* (2009) reported that sheep grazing saltbush for an extended period of time without supplementation could develop Ca deficiencies.

On the other hand, the present results demonstrated that Ca concentrations were decline (P<0.01) according to the physiological status where the dry period achieved the highest Ca level whereas the lactation period recorded the lowest Ca levels (Table 2). This might be attributed to the increased demand of Ca for fetus and synthesis of milk. Alazzeh and Abu-Zanat (2004) also found that feeding saltbush to lactating ewes led to a net loss of Ca. These results agreed with Szenci *et al.* (1994) who demonstrated that Ca concentrations reduced in early postpartum cows because of increasing demand of Ca for synthesis of milk coupled with the relatively slow response in up-regulating Ca absorption from the intestinal tract. Moreover, the observed decreasing trend of Ca concentration as the pregnancy advanced, agreed pervious results of Sykes and Dingwall (1975) and Kadzere *et al.* (1996). According to them, the requirements of Ca for pregnancy and lactation are higher than those for maintenance, which increases the quantity of Ca required at tissue level and thereby increase Ca absorption from the gastro-intestinal tract of sheep and goats. Georgivskii *et al.*, (1982) attributed the rising level of plasma Ca which required in gestation and lactation to high level of plasma parathyroid hormone in this period which activates osteoclasts and increase the level of calcium to mobilize skeletal Ca reserves. Mobilization is necessary to meet high Ca demand by the fetus for skeletal formation and for milk formation during lactation (Fredeen and Van, 1990 and Waziri *et al.,* 2010).

Concerning the magnesium (Mg) concentration, the present findings demonstrated that there were no significant differences between the both experimental groups in serum Mg levels (Table 2). Nevertheless, considerable variations in serum Mg were observed at sampling intervals accompanied with significantly affected (P< 0.01) by animal status (S), and the interaction between treatment and status (TxS) (Table 2). The higher serum Mg level was found during dry period and lowest Mg level at lactation period. Moreover, the animals fed *Sorghum vulgare* and *Pearl millet* irrigated with saline water (as salt tolerant plants) had lower Mg values than control ones at dry, early and lactation periods. Mayberry *et al.* (2009) reported that sheep grazing saltbush for an extended period of time without supplementation could develop Mg deficiency. Deficiencies in Mg can cause many problems for livestock, especially those with high nutritional demands such as rapidly growing weaners and pregnant or lactating ewes (Mayberry *et al.*, 2010). The lower concentrations of Mg recorded for animals of salt tolerant plants might be due to the higher potassium concentration in these plants (Table 1) which might affect the absorption of Mg. Magnesium is usually absorbed from the rumen and any excess is excreted via the kidneys (Underwood and Suttle, 1999). Absorption of Mg from the entire gastrointestinal tract is reduced when sheep are fed diets containing high levels of K (Newton *et al.*, 1972 and Dalley *et al.*, 1997). Mayberry *et al.* (2010) reported that there was a small reduction in the apparent digestion and absorption of Mg by sheep fed the formulated high-salt diet compared to the no-salt diet, but this was not significant. While the increased concentration of K may contribute to the loss of Mg from sheep fed saltbush, it is not likely to be the major cause.

Trace minerals:

Suttle (2010) reported that chromium (Cr), cadmium (Cd), molybdenum (Mo), lead (Pb) and zinc (Zn) are essential for life and have subsequently been shown to improve growth or health in goats.

Chromium (Cr) is an essential trace element and plays an important role in human and animals mainly in regulation of the glucose tolerance factor, in combination with nicotinic acid and some proteins which are required for every bodily function. In animals sufficient Cr been found to increase growth and longevity (Narwal *et al.*, 2013). In the present study, although, the higher chromium content in salt tolerant plants diet (Table 1), the obtained resulted revealed that chromium (Cr) levels were not significantly affected by feeding salt tolerant plants (Table 3). These results might be due to that chromium from blood is relatively quickly absorbed by bones, accumulating also in the spleen, liver and kidneys (Stoecker, 1999). Pechova and Pavlata (2007) reported that determination of the Cr concentration in blood does not seem to provide a good indicator of the Cr supplementation status and therefore, cannot be used for the diagnosis of Cr deficiency in the organism.

The mean values of chromium (Cr) decreased from dry to mid pregnancy while the lowest level was observed at lactation period (Table 3). This might be due to that Cr excretion, especially by the urinary system, may increase 10 to 300 times in stressful situations or due to diets rich in carbohydrates (Anderson, 1997). Moreover, Anderson *et al.* (1993) reported that secretion Cr reached its highest values during lactation. On the other hand, animals fed salt tolerant plants had lower chromium (Cr) values of control ones at dry and early pregnancy periods in contrary to mid, late pregnancy and lactation periods where control group achieved lower Cr values than salt tolerant plants (Table 3). This might be attributed to the higher content of potassium in salt tolerant plants (Table 1) and serum of animals fed such diet (Table 2) which increases the release of aldosterone hormone. Aldosterone increase renal k excretion in mammals (Swenson and Reece, 1993b).

Cadmium (Cd) is an essential nutrient for goats. Its deficiency had no significant effects on feed intake but impaired growth, caused myasthenia, reduced milk production and shortened life span (Anke *et al.*, 1986). The present results demonstrated that feeding *Sorghum vulgare* and *Pearl millet* irrigated with saline water (as salt tolerant plants) decreased ($P<0.01$) the mean values of cadmium (Cd) compared to control group. Moreover, animals of salt tolerant plants had lower ($P<0.01$) values of control group at all reproductive stages (Table 3). On the other hand, serum cadmium concentrations decreased ($P< 0.01$) from dry throughout the gestation stages and then increased again in lactation period. The mean values of cadmium of the two experimental groups decreased as in advanced in pregnancy and lactation (Table 3). Smith *et al.* (1991) reported that in pregnant animals, there is a concern that Cd may be detrimental to the developing fetus by direct accumulation of Cd in the fetus or by influencing Cu, Fe, and Zn. It is noteworthy that the values of Cd obtained in the present study are comparable with Radostits, *et al.*, (2000) who reported that whole blood Cd level in normal ruminants is usually below 0.05 – 0.25 ppm.

Molybdenum (Mo) is a trace element with known functions (i.e., activities of sulfite oxidase, xanthine dehydrogenase, and aldehyde oxidase) (Falke and Anke, 1987). The present results revealed that salt tolerant group had higher ($P<0.01$) molybdenum levels compared to control group (Table 3). In agreement, Alazzeh and Abu-Zanat (2004) found that feeding saltbush to lactating ewes led to an increase in the blood serum concentrations of molybdenum (Mo). On the other hand, physiological status affected ($P<0.01$) the molybdenum levels where dry period recorded the highest concentration then it decreased up to mid gestation and then increased again (Table 3).

Lead (Pb) is considered one of the major environmental pollutants and has been incriminated as a cause of accidental poisoning in domestic animals more than any other substance, particularly in cattle, sheep and horses (Ahmed *et al.*, 2012). The present results indicated that lead (Pb) concentrations were not affected by different agents (animal status (S), Treatment (T) and interaction between treatment and status (TxS). However, salt tolerant group had higher Pb values which might be owing to the higher Pb content in the diet compared to the control. On the other hand, lead values were decreased in advance of gestation and lactation (Table 3).

Zinc is an essential component of over 70 enzymes found in mammalian tissues. Enzymes that require zinc are involved in protein, nucleic acid, carbohydrate, and lipid metabolism. Zinc is also important for normal development and functioning of the immune system, in cell membrane stability, and gene expression (Spears, 2003). Feeding salt tolerant plants increased ($P<0.01$) the mean values of Zinc compared to the control (Table 3) in spite of the lower content of zinc in salt tolerant plants (Table 1). This might indicate that animals fed salt tolerant plants were more efficient to utilize the low Zn feed intake. In agreement, Elnageeb and Abdelatif (2010) suggested that a combination of low nutritional status and pregnancy in non- supplemented ewes may increase the efficiency of utilization of ingested Zn.

On the other hand, the resulted showed that Zn levels were affected ($P<0.01$) animal status where the Zn concentrations decreased along the gestation and lactation periods (Table 3). This could be attributed to the increasing demand of Zn to face the developing of feotus. Williams *et al.* (1972) showed that the developing foetus accumulates 1 to 2 mg of Zn/ day and the pregnant ewe increases the demands from Zn towards the end of pregnancy. Moreover, other reports (Egan, 1972 and Masters and Fels, 1980) have shown that pregnancy led to depletion of Zn in grazing ewes. The marked decrease in the serum Zn level during late gestation could be partly related to haemodilution. Similarly, Elnageeb and Abdelatif (2010) reported that in ewe, the serum Zn level decreased gradually with the advance of pregnancy. Our results have shown a marked decline in Zn serum concentrations from dry to lactate state. These results were in accordance with those of Kadzere *et al.* (1996), Ahmed *et al.* (2001) and Meglia *et al.* (2001) who showed that plasma Zn levels in goats vary according to the physiological status, highest concentrations are found before parturition and the lowest during lactation the rapid need for Zn in synthesis of colostrum may explain why Zn concentration is 22 % lower in blood of cows at calving. McDowell (1997) estimated the critical levels of Zinc in serum as 0.8 ppm. Zn trace element concentrations in blood 0.8 to 1.4 mg/l adequate and 2 to 5 mg/l are high (Kincaid, 2000). In contrast, Gurdogan *et al.* (2006) did not find serum Zn concentration differences, in sheep with single or twin pregnancies, nor during parturition or lactation. Likewise, sheep that aborted did not show Zn plasma differences, in relation to those that carried gestation to term (Naziroglu *et al.*, 1998).

Table (3): Means of some macro and trace elements concentrations (ppm) of serum goats fed wheat straw and salt tolerant plants during different physiological status under South Sinai conditions

Item	Tr.	Dry	Pregnancy periods			Lactation	Overall	±SE		
			Early	Mid	Late			T	S	TxS
Cd	T1	0.034^{Aa}	0.017^{Ab}	0.0002^{Ac}	0.0002^{Ac}	0.003^{Ad}	**0.011^{A}**	0.00**	0.005**	0.007**
	T2	0.027^{Ba}	0.013^{Bb}	0.0002^{Ac}	0.0002^{Ac}	0.0002^{Bc}	**0.008^{B}**			
	Overall	**0.031^{a}**	**0.015^{b}**	**0.0002^{c}**	**0.0002^{c}**	**0.0016^{c}**				
Cr	T1	0.749^{Aa}	0.536^{Ab}	0.323^{Ac}	0.527^{Ab}	0.254^{Ac}	**0.478**	0.02^{NS}	0.03**	0.05*
	T2	0.614^{Ba}	0.484^{Aa}	0.357^{Aab}	0.584^{Aa}	0.257^{Ab}	**0.459**			
	Overall	**0.682^{a}**	**0.511^{b}**	**0.341^{c}**	**0.556^{b}**	**0.255^{c}**				
Mo	T1	0.031^{Aa}	0.027^{Ab}	0.023^{Ac}	0.028^{Ad}	0.031^{Aa}	**0.028^{B}**	0.00**	0.00**	0.01**
	T2	0.039^{Aa}	0.034^{Ab}	0.028^{Ac}	0.025^{Ad}	0.029^{Ae}	**0.031^{A}**			
	Overall	**0.035^{a}**	**0.031^{b}**	**0.026^{c}**	**0.027^{d}**	**0.030^{e}**				
Pb	T1	0.397	0.466	0.629	0.296	0.275	**0.413**	0.16^{NS}	0.25^{NS}	0.35^{NS}
	T2	0.345	1.597	0.542	0.553	0.173	**0.642**			
	Overall	**0.372**	**1.031**	**0.586**	**0.425**	**0.224**				
Zn	T1	6.78^{Aa}	15.97^{Ab}	2.24^{Ac}	2.33^{Ac}	4.03^{Ac}	**6.26^{A}**	0.41**	0.64**	0.91**
	T2	14.65^{Ba}	2.62^{Bb}	12.12^{Bc}	9.56^{Bd}	5.17^{Ae}	**8.82^{B}**			
	Overall	**10.71^{a}**	**9.29^{a}**	**7.18^{b}**	**5.94^{bc}**	**4.60^{c}**				

T1: animals fed wheat straw T2: animal fed salt tolerant plants (*Sorghum vulgare and Pearl millet*)
In the same column, means in a certain item having the same capital letter do not differ significantly.
In the same row, means in a certain item having the same small letter do not differ significantly.

The liver function:

The liver is the first site after absorption, which is able to monitor the result of eating a meal. 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. Transaminases are widely distributed in plasma, bile, cerebrospinal fluid and saliva but none is found in urine unless a kidney lesion is present (Norbert, 1987). Alanine amino transferase (ALT) is particularly useful in measuring hepatic necrosis and increases in serum when cellular degeneration or destruction occurs (Lessard *et al.*, 1986).

The present results demonstrated that feeding salt tolerant plants resulted in increasing (P< 0.01) both liver enzymes (ALT and AST) compared to control (Table 4). Similarly, Assad and El-Sherif (2002) in their study on sheep, found that AST and ALT increased significantly as a result of drinking saline water. Badawy *et al.* (2002) found a significant increase in activity of AST by 13.2% in lambs fed on shrubs as compared to their counterparts of control group. El-Bassiony (2013) reported that feeding salt tolerant plants resulted in increasing the activity of aminotransferases (AST and ALT). The increase of ALT or AST activities might be caused by high tannins (Tripathy *et al.*, 1984), oxalates (Mclntosh, 1972), alkaloids (Craig *et al.*, 1991) and salt (Radostits *et al.*, 1994) in such salt tolerant plants. Dykes and Rooney (2006) reported that sorghum is a good source of phenolic compounds with a variety of genetically dependent types and levels including phenolic acids, flavonoids, and condensed tannins. While, millet has tannins in some varieties that contain a red testa. There are limited data on the phenolic compounds in millets; only phenolic acids and flavones have been identified. On the other hand, the activity of both liver enzymes (ALT and AST) were (P<0.01) affected by reproductive status where both of the two liver enzymes decreased from dry period to early gestation period and then increased again to reach its highest values at late gestation period. Then, it decreased again at lactation (Table 4). In agreement, El-Sherif and Assad (2001) reported that during pregnancy aspartate aminotransaminase (AST) and alanine aminotransaminase (ALT) in pregnant Barki ewes started to increase significantly reaching maximum values at parturition. Moreover, Sobiech *et al.* (2008) reported that the activity of ALT and AST increased during lactation in ewes. Batavani *et al.* (2008) reported that as the gestational stages increased, AST significantly (P<0.01) increased in blood serum but ALT had no changes in blood serum. The greatest activities for AST were found in stage III of pregnancy (P< 0.01).

The present results revealed that during lactation the activities of ALT and AST enzymes were comparable with those in dry period (Table 4). Similar results were reported by El-Sherif and Assad (2001). Adversely, Khatun *et al.* (2011) reported that serum AST and ALT levels decreased significantly in advanced of pregnancy.

Table (4): Means of liver and kidney functions of serum goats fed wheat straw and salt tolerant plants during different physiological status under South Sinai conditions

Items	Tr.	Dry	Pregnancy periods			Lactation	Overall	±SE		
			Early	Mid	Late			T	S	TxS
AST, (IU/L)	T1	41.47	30.90	32.55	34.95	33.75	**34.72[B]**	1.80**	2.87**	4.29NS
	T2	44.28	31.32	46.89	53.66	47.92	**44.81[A]**			
Overall		**42.87[a]**	**31.11[b]**	**39.72[a]**	**44.30[a]**	**40.83[a]**				
ALT, (IU/L)	T1	22.12	16.48	17.36	18.64	18.00	**18.52[B]**	0.95**	1.52**	2.27NS
	T2	23.32	16.49	24.69	28.26	25.24	**23.60[A]**			
Overall		**22.72[a]**	**16.48[b]**	**21.02[a]**	**23.45[a]**	**21.62[a]**				
Urea, (mg/dl)	T1	43.13	37.75	38.41	53.20	46.59	**43.82**	1.74NS	2.79**	4.15NS
	T2	41.31	30.61	33.42	49.50	57.43	**42.45**			
Overall		**42.22[a]**	**34.18[a]**	**35.92[a]**	**51.35[b]**	**52.01[b]**				
Crea. (mg/dl)	T1	1.26	1.38	1.49	1.56	1.39	**1.42[A]**	0.04*	0.07*	0.10NS
	T2	1.09	1.18	1.29	1.48	1.35	**1.27[B]**			
Overall		**1.18[a]**	**1.28[a]**	**1.39[ab]**	**1.52[b]**	**1.36[ab]**				

T1: animals fed wheat straw T2: animal fed salt tolerant plants (*Sorghum vulgare and Pearl millet*)
In the same column, means in a certain item having the same capital letter do not differ significantly.
In the same row, means in a certain item having the same small letter do not differ significantly.

The kidney function:

The kidneys play an important role in the regulation of water balance, electrolyte balance, acid/base balance and maintenance of osmotic pressure of body fluids and in the removal of metabolic waste products and other toxic substances (Sherwood, 1997). The level of serum blood urea and creatinine is known to reflect the state of glomerular filtration rate and kidney function (Kaneko, 1989).

Feeding mixture of *Sorghum vulgare* and *Pearl millet* irrigated with saline water as salt tolerant plants did not affect significantly urea concentration. Control animals had higher urea concentration compared to second group (Table 4). These findings were reported previously by Robert *et al.* (1992) who found that no significant differences were founded between Holstein steers that drank high salty water or fresh water in blood urea indicating no adverse short-term effects on kidney function. Moreover, Al-Khalasi *et al.* (2010 a) reported that there were no significant differences in blood urea of Omani sheep fed salt-tolerant sorghum forage or Rhodes grass. El-Bassiony (2013) reported that feeding salt tolerant plants did not have any adverse effects on BUN concentration. Azamel (1997) noticed that the blood urea was significantly lowered in two groups of growing lambs fed on Atriplex halimus in comparison with control groups.

Taking the effect of reproductive status into consideration, urea levels decreased from dry period to early gestation and then increased again throughout the gestation period to reach its highest level during lactation period (Table 4). Similarly, Khatun *et al.* (2011) reported that serum urea levels increased significantly in advanced of pregnancy. Sobiech *et al.* (2008) reported that urea levels increased significantly throughout lactation in ewes of both groups and urea content was higher in the mothers of twins. Similar results were obtained by Brzostowski *et al.* (1995). Saeed *et al.* (2009) reported that pregnant camels (*Camelus dromedarius*) had higher blood urea nitrogen compared with non- pregnant camels.

Feeding *Sorghum vulgare* and *Pearl millet* as salt tolerant plants resulted in decreasing (P<0.05) creatinine levels compared to control group (Table 4). In consistence, Melladoa *et al.* (2006) reported that increasing *Acacia farnesiana* proportion in goat diets resulted in decreasing levels of serum creatinine. On the other side, creatinine levels increased from dry period to reach its highest level at late gestation then declined during lactation period (Table 4). In consistence, Khatun *et al.* (2011) reported that serum creatinine levels increased significantly in advanced of gestation. Moreover, Abu El-Ella and Kommonna (2013) reported that serum creatinine concentration of Damascus goats increased gradually from mating until parturition. The increment in creatinine during this period might be owing to foetus development (Korshom *et al.*, 1993). Consistency, Abdel-Hafez (2002) reported that creatinine level in pregnant ewes was increased from 21 days after mating till last week of pregnancy. Doornenbal *et al.* (1988) found the serum creatinine concentration decreased during lactation and increased during post-weaning.

Conclusion

From the aforementioned results, it could be concluded that providing *Sorghum vulgare* and *Pearl millet* irrigated with saline water (as salt tolerant plants) for Shami goats raised under the arid conditions of Southern Sinai could be an avenue to the sustainable development of animal production especially in the nomadic communities in Sinai through minimizing the shortage of animal feedstuffs. However, feeding such salt tolerant plants during pregnancy and lactation periods could constitute a double stress on animals especially liver function and blood minerals.

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