Physiological and Productive Performance of Sina Laying Hens Fed *Atripex Nummularia* Leaves Meal under Arid Conditions of South Sinai

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Abstract: The present study aimed to investigate the effect of using different levels of *Atripex nummularia* leaves meal (ALM) on hemato-biochemical, serum mineral parameters, hormonal profiles and productive performance of Sina hens under arid conditions of South Sinai. A total number of 180 Sina laying hens (22 - week of age and body weight of 1196.30 ± 21.09 g) were used until 34 week of age. Experimental hens were randomly divided into four equal treatments (45 hens of each). The 1st treatment was fed a basal diet as a control (0 % of *Atriplex nummularia* leaves meal), while, the 2nd, 3rd and 4th treatments were fed diets containing 4, 8 and 12 % *Atriplex nummularia* leaves meal, respectively. The results showed that the hens fed 12 % ALM recorded the lowest values ($P<0.05$) of red blood cells (RBC's), hemoglobin (Hb) and mean corpuscular hemoglobin concentration (MCHC) as compared to other treatments. However, hens fed 8 % ALM showed insignificantly effect on RBC's and Hb concentrations. On the other hand, hematocrite (Ht), mean corpuscular volume (MCV) and mean corpuscular hemoglobin (MCH) increased ($P<0.05$) in the diet containing 12 % ALM than those of other treatments. However, Ht increased ($P<0.05$) in the hens of 8 and 4 % ALM as compared to control diet. While, there were no significant differences between the hens fed 8 % ALM and control group on MCV and MCH. Hens fed diet containing 12 % ALM showed a reduction ($P<0.05$) of total protein and globulin levels compared with other treatments. No significant differences were observed among other treatments in total protein, globulin and A/G ratio. Cholesterol and triglycerides concentrations were significantly decreased in the diet containing 8 and 12 % ALM compared with other two treatments. Alanin transaminase (ALT) and aspartic transaminase (AST) were increased ($P<0.05$) in the hens fed 12 % ALM as compared to other treatments. Hens fed 12 % ALM showed decreased ($P<0.05$) total antioxidant capacity (TAC) by 17.2 and 14.2 % as compared to control and 4 % ALM, respectively. However, no significant differences among 0, 4 and 8 % ALM treatments in TAC. Aldosterone hormone decreased ($P<0.05$) in the hens fed 12 % ALM by 39.5 % than that of control treatment. Triiodothyronine (T_3), estradiol and progesterone hormones recorded insignificant decrease with increasing ALM levels. No significant differences among treatments in sodium (Na) and magnesium (Mg) concentrations. Potassium (K) concentration was significantly lower in the diets containing 4 and 8 % ALM by 13.5 and 20.3 %, respectively, compared with control treatment. Serum calcium (Ca) concentration was higher ($P<0.05$) in the diets containing 8 % ALM compared with other treatments. However, hens fed 8 % ALM showed lower ($P<0.05$) concentrations of phosphorus) P (and chloride) Cl (by 21.8 and 14.1 %, respectively, as compared to control treatment. Final body weight and boy weight change showed insignificant increase in the hens fed 0 (control) or 4 or 8 % ALM than that of the diet containing 12 % ALM. Hens fed 8 and 12 % ALM recorded an increase ($P<0.05$) in egg weight by 1.36 and 1.54 %, respectively than that of control treatment. Egg number and egg mass recorded a significant ($P<0.05$) increase in the hens fed 4 and 8 % ALM as compared to the hens fed 12 % ALM. Substitution of diet by 8 % of ALM level improved feed conversion by 11.9 % as compared to the diet containing 12 % ALM level.

***In conclusion*,** under arid conditions, *Atriplex nummularia* leaves meal might be used up to 8 % as a source of alternative feed resources of Sina laying hens without any adverse effects on physiological reactions and productive performance.

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1. Introduction

South Sinai is hyper arid region with salt affected natural resources (water, soil, plants, etc). Therefore, feed resources in the region are that represent one of the main obstacles for animal production development in the region. Salt tolerant forage species could play an important role in the region. *Atriplex nummularia* has great potentialities since it is known to be tolerant to salinity and drought (El Shaer, 2010). However, it is deficient in energy and around 65% of nitrogen is non- protein nitrogen. The high salt level in Atriplex limits its intake and digestion (Hassan, 2009). Also Atriplex species contain some secondary metabolites as condensed tannins which may restrict feed intake and lead to a negative impact on animal performance (Mansoori and Acamovic, 1997 and Ben Salem *et al*., 2005).

There are specific problems for poultry performance associated with consumption of salt in feed and water, particularly sodium, potassium and chloride. The body has little or no capacity to store excess electrolytes. Digestive function is also changed with an increase in the rate of passage of feed through the digestive tract. High levels of sodium in the diet also depress appetite (Wilson, 1966) and the efficiency of energy use for production (Arieli *et al*., 1989). A major gap exists between the requirements and supplies of feeds for feeding poultry in Egypt. To alleviate this shortage, it is essential to increase these feed supply by using untraditional feeds can substantially participates in solving this problem and decreases the cost of feeding which in turn decreases the marketing price of poultry production.

However, *Atriplex nummularia* leaves meal (ALM), can be used in feeding laying hens as a particle substitute for the conventional feed stuffs, as a cheap untraditional feedstuffs, and it used already in sheep and goats feeding (Kandil and El-Shaer, 1988). The chemical composition of *Atriplex nummularia* edible dry matter consists of 10.3 - 25.9 % crude protein, 17.9 - 35.4 % ash, 0.89 - 0.94 % Mg, 1.10 -1.99 % Ca, 0.24 - 0.40 % P, 2.96 - 8.96 % Na, 20 -21 ppm Fe, 26 -78 ppm Cu, 46 -53 ppm Zn and 3.20 - 4.82 % K (Amin, 1999, Abdel Galil and khider, 2001 and Ben Salem *et al*., 2010). This resource combined with other ingredients may be used a good feeding alternative during heat stress conditions by achieving the acid-base balanced and may improving animal consumption. Minerals play an important role in the regulation of body fluids, acid base balance and metabolic processes (Milne, 1996).

Scared studies were concerned with the effect of *Atriplex nummularia* leaves meal on the physiological and productive performance of hens. Therefore, this study was conducted to investigate the effect of using different levels of *Atripex nummularia* leaves meal (ALM) on hemato-biochemical parameters, hormonal profiles, serum mineral parameters and productive performance of Sina hens under arid conditions of South Sinai.

2. Materials and Methods

The present experiment was carried out at South Sinai Experimental Research Station (Ras-Suder City) which belongs to the Desert Research Center. The experiment started in June to September 2012. The experiment aimed to study the physiological performance of Sina laying hens fed *Atriplex nummularia* leaves meal under heat stress conditions.

A total number of 180 Sina laying hens (22 weeks old and body weight of 1196.30 ± 21.09 g) were used until 34 week of age. Experimental hens were randomly divided into four equal treatments (45 hens of each) and randomly divided into three equal replicates (15 hens each). The first treatment was fed a basal diet as a control (0 % of *Atriplex nummularia* leaves meal), while, the 2nd, 3rd and 4th treatments were fed diets containing 4, 8 and 12 % *Atriplex nummularia* leaves meal, respectively. Experimental hens were housed in wire cages of triple deck batteries.

The experimental diets (Table 1) were formulated in granular form according to NRC (1994) and were iso-nitrogenous (16 % CP) and iso-caloric (2700 kcal ME/kg). Feed was offered *ad libitum* and fresh water was available all time.

The proximate chemical analysis of *Atriplex nummularia* leaves and mineral content were 20.13 % crude protein, 4.01 crude fiber, 18.39 % ash, 0.89 % magnesium (Mg), 1.50 % calcium (Ca), 0.35 % phosphorus (P), 2.96 % sodium (Na), 3.51 % potassium (K), 20.40 ppm iron (Fe), 26.57 ppm copper (Cu), 51.89 ppm zinc (Zn) and 75.00 ppm manganese (Mn).

All treatments during production period were reared under hot month's condition (Table 3). Indoor ambient temperature (AT, ^{o}C) and relative humidity (RH, %) were recorded using electronic digital thermo-hygrometer. Temperature-humidity index (THI) was calculated according to Marai *et al.* (2001).

THI = db ^{o}C (dry bulb temperature in centigrade) – [(0.31 – 0.31 × RH (relative humidity %) × (db ^{o}C – 14.4)]. The THI values were classified as absence of heat stress (<27.8), moderate heat stress (27.8-28.8), severe heat stress (28.9-29.9) and very severe heat stress (>30.0).

Birds were exposed to natural day- light and provided with artificial light to increase the day light length until reaching 14 h at 18 weeks of age. Then, the day light length period was increased 30 minutes every other week until fixed at 16 h daily from 30 weeks of age to the end of experiment (34 weeks). Birds were kept under the same managerial and hygienic conditions. Birds were examined against diseases and treated with antibiotics and vaccines to keep them healthy.

Individual body weight was recorded at the beginning of experiment (22 weeks) and at end of experiment (34 weeks). Body weight changes were calculated as the differences between the initial and final body weights. Egg number and weight were recorded daily for 90 days during egg production period. Egg mass was calculated by multiplying average egg weight by egg number. Daily feed intake was recorded and feed conversion was calculated as follows: feed conversion= feed intake (g)/egg mass (g).

Blood samples (5 ml) of 10 birds/treatment were randomly withdrawn (two times during the experimental periods at 28 and 34 weeks of age) from the wing vein into tube containing EDTA to examine immediately red blood cells counted in blood under the microscope by means of hemocytometer and hemoglobin concentration according to Jaime (2000). Hematocrite (%) estimated using microhematocrit tubes by wintrobe methods. Mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH), and mean corpuscular hemoglobin concentration (MCHC) were calculated by the following equations: MCH (in pico gram, pg) = (Hb content g/dl × 10) / RBCs in million, MCHC (%) = (Hb content × 100) / Ht %, MCV (in femto liter, fl) = (Ht % × 10)/ RBCs in million.

Serum was collected by using centrifugation for 15 minutes at 3000 rpm and it stored at –20 $^{\circ}$C until analysis. Blood metabolites (total protein, albumin, cholesterol, triglycerides, alanine transaminase, aspartic transaminase and total antioxidant capacity) and minerals (sodium, potassium, calcium, phosphorus, chloride and magnesium) were determined calorimetrically by using commercial kits. Globulin was calculated by the difference between total protein and albumin.

Concentrations of triiodothronine, aldosterone, progesterone and estradiol-17β hormones were determined by ELISA method using commercial kits of company of Monobind Inc. Lake Forest, CA 92630 USA and IBL international GMBH, Flughafenstrasse 52a, D-22335 Hamburg, Germany, respectively.

Statistical analysis was carried out using General Linear Model (GLM) procedures by SAS (2004) using simple one-way analysis of variance according to this model: $Y_{ij} = \mu + T_i + e_{ij}$

Where: Y_{ij} = Any observation of ith bird within jth treatment, μ = Overall mean, T_i = Effect of ith treatment (i: 1-4), e_{ij} = Experimental error.

Significant differences among treatment means were tested using Duncan multiple range test (Duncan, 1955).

Table (1). Composition and calculated analysis of the experimental diets

Ingredients (%)	Levels of *Atriplex nummularia* leaves meal			
	Control	4 %	8 %	12 %
Atriplex nummularia leaves meal	0.00	4.00	8.00	12.00
Yellow corn	62.00	60.63	60.00	58.25
Soybean meal (44 % CP)	16.10	11.75	10.50	7.35
Corn gluten meal (60 % CP)	4.75	6.40	6.40	8.10
Wheat bran	6.74	7.25	5.31	4.61
Limestone ground	7.80	7.60	7.50	7.40
Dicalcium phosphate	1.70	1.70	1.70	1.70
Vit. and min. premix*	0.30	0.30	0.30	0.30
Salt	0.23	0.10	0.00	0.00
Dl- methionine	0.28	0.27	0.29	0.29
Total	**100**	**100**	**100**	**100**
Proximate chemical analysis %				
Crude protein	16.11	16.10	16.04	16.13
Crude fiber	3.29	3.21	3.06	2.95
Ether extract	2.81	2.85	2.91	2.99
Ash	2.37	2.80	3.39	3.89
Calculated values				
Metabolizable energy (kcal/kg)	2700	2700	2700	2700
Calcium (%)	3.48	3.46	3.47	3.48
Available phosphorus (%)	0.45	0.44	0.43	0.43
Methionine (%)	0.60	0.60	0.60	0.60
Lysine (%)	0.72	0.71	0.78	0.81
Methionine+ Cyc (%)	0.87	0.88	0.88	0.82
Cystine	0.27	0.28	0.28	0.29

* Each 2.5 kg Vitamins and minerals premix contains (per ton of feed), Vit. A 10000000 IU, Vit. D_3 2000000 IU, Vit.E I0g, Vit.K_3 1000 mg, Vit. B_1 1000 mg, Vit. B_2 5000mg, Vit. B_6 1.5g, Vit. B_{12} 10 mg, Pantothenic acid 10g, Niacin 30g, Folic acid 1g, Biotin 50 mg, Iron 30g, Manganese 70g, Choline chlorite 10g, Iodine 300 mg, Copper 4g, Zinc 50g and Selenium 100 mg.

Table (2): Indoor ambient temperature (AT), relative humidity (RH) and temperature-humidity index (THI) during experimental period

Items	AT (^{0} C)		RH (%)		THI	
Months	**Min**	**Max**	**Min**	**Max**	**Min**	**Max**
June	24.6±0.52	34.7±0.84	22.5±1.11	28.1±0.86	22.1±0.30	29.8±0.48
July	23.9±0.71	36.9±0.99	23.3±1.18	25.2±1.11	21.6±0.86	31.6±0.82
Aug.	25.8±0.81	38.6±1.56	22.9±2.01	23.2±2.07	23.1±0.66	32.8±0.52
Overall	24.8±0.51	36.7±0.98	22.9±1.32	25.5±1.32	22.2±0.41	31.4±0.81

2. Results and Discussions

1. Hematological parameters

The results demonstrate that the hens fed 12 % ALM recorded the lowest (P<0.05) value the values of RBC's (by 34.3, 27.7 and 35.6 %), Hb (by 16.9, 18.4 and 13.2 %) and MCHC (by 26.5, 25.0 and 15.3 %) as compared to control, 4 and 8 % ALM, respectively (Table 3). However, hens fed 8 % ALM showed insignificantly effect on RBC's and Hb concentrations compared with control treatment, while it decreased (P<0.05) MCHC by 11.5 and 13.2 % as compared to 4 % ALM and control treatments, respectively. Blood is a major body fluid through which most of body biological functions have taken place.

Therefore, it is important to study the effect of feeding salt plants such as ALM on certain adaptive picture in blood of hens. This decrease may be attributed to the decrease of erythropoitine hormone by damage kidney tissue. This hormone stimulates narrow bone to produce RBC's (Guyton and Hall, 2006). In contrary, Ht, MCV and MCH were increased (P<0.05) in the diet containing 12 % ALM than that of other treatments. However, Ht was increased (P<0.05) in the hens of 8 and 4 % ALM as compared to control diet. While, there were no significant differences among the hens fed 8 % ALM and control diet on MCV and MCH (Table 3). The increase in Ht, MCV and MCH might be resulted from increased total body water with increase in water intake (Morsy *et al*., 2012 and Amal, 2013). This higher water intake would lead to hemodilution, which resulted in the relative lower RBC's and Hb (Assad *et al*., 1997).

Table (3). Effect of feeding different levels of *Atriplex nummularia* leaves meal on the hematological parameters of Sina laying hens

Traits	Levels of *Atriplex nummularia* leaves meal			
	Control	**4 %**	**8 %**	**12 %**
RBC (×10^6)	4.95^a±0.18	4.50^b±0.08	5.05^a±0.08	3.25^c±0.18
Hb (g/dl)	13.98^a±0.27	14.23^a±0.74	13.38^a±0.04	11.61^b±0.04
Ht (%)	30.66^b±1.94	31.83^a±1.62	33.83^a±1.32	34.66^a±0.80
MCV (fl)	61.93^b±4.29	70.73^b±3.83	66.99^b±3.06	106.64^a±7.33
MCH (pg)	28.24^{bc}±0.79	31.62^b±1.16	26.49^c±0.48	35.72^a±1.96
MCHC (%)	45.59^a±1.00	44.70^a±3.34	39.55^b±1.49	33.49^c±2.77

RBC's, red blood cells; Hb, hemoglobin; Ht, hematocrite %; MCV, mean corpuscular volume; MCH, mean corpuscular hemoglobin; MCHC, mean corpuscular hemoglobin concentration.
a, b, c. Means with different superscript among columns are significant differences (P<0.05).

Others researchers found a decrease in Hb of different species of farm animals feeding salt plants (El-Hawy, 2013; Kawashti *et al.,* 1983 Hussein *et al.*, 1990 and Ibrahim, 1995). Also, feeding salt plants and drinking saline water caused varying degrees of anhydremia resulting in an elevation of specific gravity and hematocrit value in the blood (Amal, 2013).

On the other hand, this decrease in MCV of hens fed 4 and 8 % ALM occurred in spite of increase in RBC's and decrease in Ht %. This might indicate a responses efficiency of hens fed 4 and 8 % ALM by increasing surface ratio compared with volume unit so that rapid diffusion of oxygen (Alessandro *et al*., 2011).

2. Biochemical parameters

Results of biochemical parameters were shown in Table (4). Hens fed diet containing 12 % ALM showed decreased (P<0.05) serum total protein (by 30.5, 30.8 and 28.4 %) and globulin (by 45.7, 53.9 and 51.9 %) as compared to control, 4 and 8 % ALM, respectively. However, A/G ratio was increased (P<0.05) in diet of 12 % ALM than that of other treatment. El-Hawy (2013) suggested that feeding salt plants such as *Atriplex nummularia* and/or saline water might reduce hepatic synthesis of RNA, which in turn depressed the incorporation of amino acids for protein synthesis. While, Ahmed (1996) and Morsy *et al*. (2012) postulated that this decrease in TP was due to the insignificant decrease in feed intake or the increase in water intake and consequently dilution of the blood components.

Table (4). Effect of feeding different levels of *Atriplex nummularia* leaves meal on the biochemical parameters of Sina laying hens

Traits	Levels of *Atriplex nummularia* leaves meal			
	Control	4 %	8 %	12 %
Total Protein (g/dl)	7.00^{a}±0.48	7.03^{a}±0.22	6.79^{a}±0.13	4.86^{b}±0.63
Albumin (g/dl)	3.57±0.34	2.99±0.28	2.92±0.16	3.00±0.10
Globulin (g/dl)	3.43^{a}±0.23	4.04^{a}±0.48	3.87^{a}±0.19	1.86^{b}±0.61
A/G Ratio	1.06^{b}±0.10	0.96^{b}±0.23	0.78^{b}±0.08	3.33^{a}±0.97
Cholesterol (mg/dl)	171.31^{a}±10.63	159.54^{a}±9.79	140.60^{b}±5.38	138.18^{b}±7.74
Triglycerides (mg/dl)	623.56^{a}±35.13	572.79^{ab}±28.45	553.58^{b}±35.47	552.05^{b}±37.45
ALT (I.U./L)	23.28^{ab}±1.45	23.47^{ab}±3.30	20.95^{b}±2.51	37.32^{a}±8.76
AST (I.U./L)	49.86^{b}±1.42	46.56^{b}±6.22	51.50^{b}±5.66	76.60^{a}±5.52
TAC (mM/L)	0.58^{a}±0.01	0.56^{a}±0.01	0.52^{ab}±0.04	0.48^{b}±0.02

A/G ratio = Albumin / globulin ratio; ALT = Alanine transaminase; AST = Aspartic transaminase; TAC= Total antioxidant capacity;
a, b Means with different superscript among columns are significant differences (P<0.05).

The highest mean value of total protein concentration was in 4 and 8 % ALM may be indicated that total protein did not affected by these levels of *Atriplex nummularia* leaves meal. However, no significant differences between 0, 4 and 8 % ALM treatments in total protein, globulin and A/G ratio.

Cholesterol concentration was significantly decreased in the diet containing 8 and 12 % ALM by 17.9 and 19.3 %, respectively as compared to control and it decreased by 11.8 and 13.3 %, respectively as compared to 4 % ALM. Also, triglycerides was decreased (P<0.05) in the hens fed 8 and 12 % ALM by 11.2 and 11.4 %, respectively as compared to control one. Ayyat *et al*. (1991) noted a decrease in cholesterol level as a result of high salt intake. They suggested that protein and fat metabolism were negatively affected as a result of drinking saline water.

Alanin transaminase (ALT) was increased (P<0.05) in the hens fed 12 % ALM by 78.1 % than that of the diet containing 8 % ALM. And it insignificantly increased in the diet containing 12 % ALM by 60.3 and 59.0 % as compared to control and 4 % ALM, respectively. Meanwhile, aspartic transaminase (AST) was increased (P<0.05) in the hens fed 12 % ALM by 53.6, 64.5 and 48.7 % than that of control, 4 and 8 % ALM, respectively. This increased being significantly only with feeding 12 % ALM, which may be due to the direct effect of tannins on the liver function. The liver and kidney suffer serious damage from feeding tannins. Tannins cause liver polyribosome disaggregation, inhibition of microsomal enzymes, inhibition of protein and nucleic acid synthesis, fibrosis, coagulation and necrosis in the liver cells (Singleton, 1981). Also, the increase of ALT or AST concentration might be caused by high tannins, oxalates, alkaloids in salty plants (Craig *et al.,* 1991).

Hens fed 12 % ALM showed decreased (P<0.05) total antioxidant capacity (TAC) by 17.2 and 14.2 % as compared to control and 4 % ALM, respectively. However, no significant differences between 0, 4 and 8 % ALM groups in TAC. The lowest TAC indicates of decreased antioxidant status in the Sina hens fed 12 % ALM. So, a low antioxidant status has been regarded as one of the major factors negatively affecting bird's performance (Zhao *et al*., 2011). Albumin concentration showed a non-significant difference between treatments. However, hens fed salt plant 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 site of albumin synthesis (Ahlam *et al*., 2011).

***3.* Hormonal profiles**

Aldosterone hormone was decreased (P<0.05) in the hens fed 12 % ALM by 39.5 % than that of control group. And it insignificantly decreased in the hens fed 8 and 4 % ALM by 22.3 and 17.2 %, respectively, as compared to control one. The hens fed a high-salt diet (12 % ALM) managed the physiological of salt retention and salt excretion for an overload of salt by reducing their plasma aldosterone concentration by approximately 50% of control values. Aldosterone is responsible for 50-70 % of total minerals corticoids activity as well as regulation and adjustment of water and electrolytes balance among the body compartments (Amal, 2003 and El-Hawy, 2013).

Triiodothyronine (T_3), estradiol and progesterone hormones recorded insignificant decrease with increasing ALM levels. T_3 level was decreased in the hens fed 12 % ALM by 15.3, 2.7 and 24.8 % as compared with control, 4 and 8 % ALM treatments, respectively. These results agree with the results of Ahmed (1996). They attributed this decrease in T_3 hormone to increase water intake and decrease feed intake which lead to hemodilution or increase in the osmotic pressure of body fluids which resulted in decrease thyroid hormones (Amal, 2003 and 2013). Additionally, there is fewness of information on the effect of salt plants feeding on the estradiol and progesterone hormones in poultry (Table 5). The insignificant decrease might be attributed to the high content of salt in atriplex plant.

Table (5). Effect of feeding different levels of *Atriplex nummularia* leaves meal on the hormonal changes of Sina laying hens

Traits	Levels of *Atriplex nummularia* leaves meal			
	Control	4 %	8 %	12 %
Aldosterone (pg/ml)	$15.03^{a}\pm1.98$	$12.44^{ab}\pm2.54$	$11.67^{ab}\pm1.32$	$9.09^{b}\pm1.67$
T_3 (ng/ml)	2.93±0.19	2.55±0.19	3.30±0.35	2.48±0.35
Estradiol (pg/ml)	77.32±7.17	77.26±8.21	81.77±5.97	66.33±10.91
Progesterone (ng/ml)	1.30±0.37	0.91±0.31	1.24±0.68	1.01±0.25

T_3 = Triiodothyronine hormone

a, b. Means with different superscript in the different columns are significant differences (P<0.05).

***4.* Electrolyte balance**

Results of Figure (1 and 2) showed that no significant differences between treatments in sodium (Na) and magnesium (Mg) concentrations. Potassium (K) concentration was significantly lower in the diets containing 4 and 8 % ALM by 13.5 and 20.3 %, respectively, compared with control one.

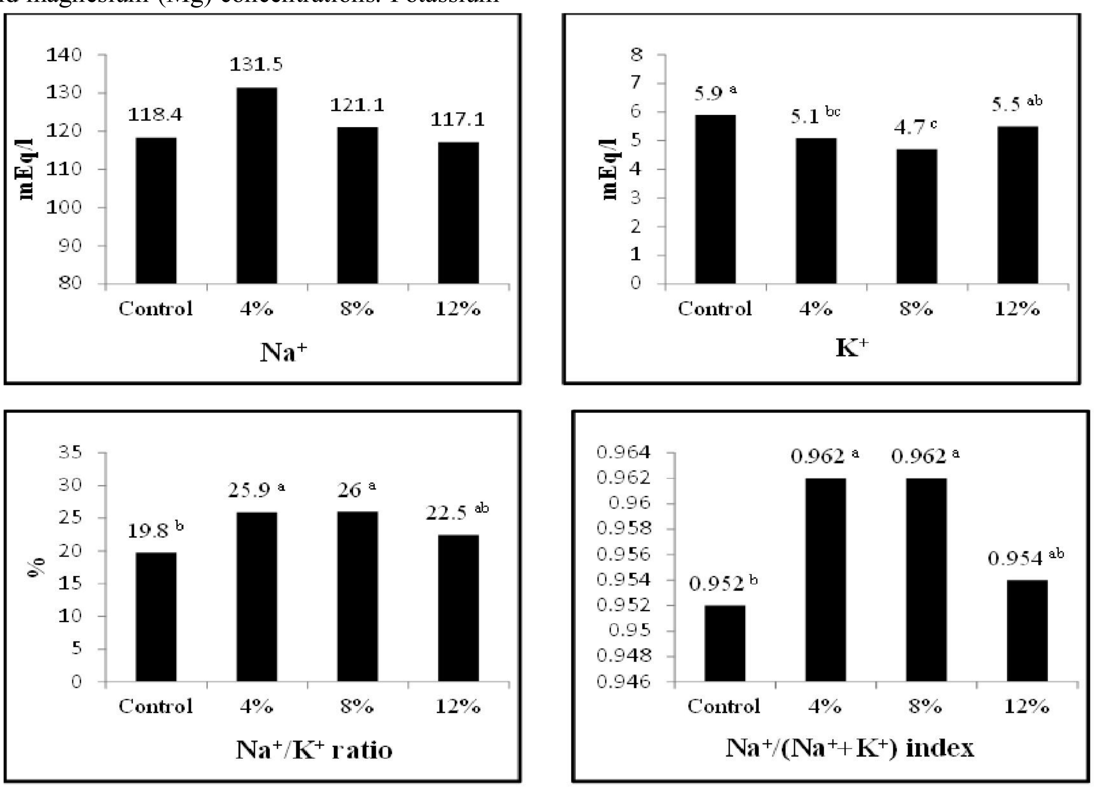

Figure (1). Effect of feeding different levels of *Atriplex nummularia* leaves meal on the sodium (Na), potassium (K), Na/K ratio and Na/(Na+K) index of Sina laying hens

However, K concentration was decreased ($P<0.05$) in the hens fed 8 % ALM by 14.5 % as compared to the hens fed 12 % ALM. Minerals occur in body fluids and tissues as electrolytes, concerned with the maintenance of osmotic pressure, acid–base balance, membrane permeability and tissue irritability (Underwood and Suttle, 1999). This decrease in K concentration may be attributed to protect the body against hyperkalemia and so protect the body against muscle irritability. So, increased levels of Na/K ratio and Na/(Na+K) index may due to increase the rate of glomerular filtration in the kidney for such electrolytes or increasing of absorption of such minerals in the gastrointestinal tract and hence a direct increase in their concentration in the blood (Hamdi *et al*., 1982; Balnave *et al*., 1989; Ahmed and Abdel-Rahman, 2004; Morsy *et al*., 2012 and El-Hawy, 2013).

Serum calcium (Ca) concentration was higher ($P<0.05$) in the diets containing 8 % *Atriplex nummularia* leaves meal by 23.2, 31.1 and 26.5 % compared with control, 4 and 12 % treatments, respectively (Figure 2).

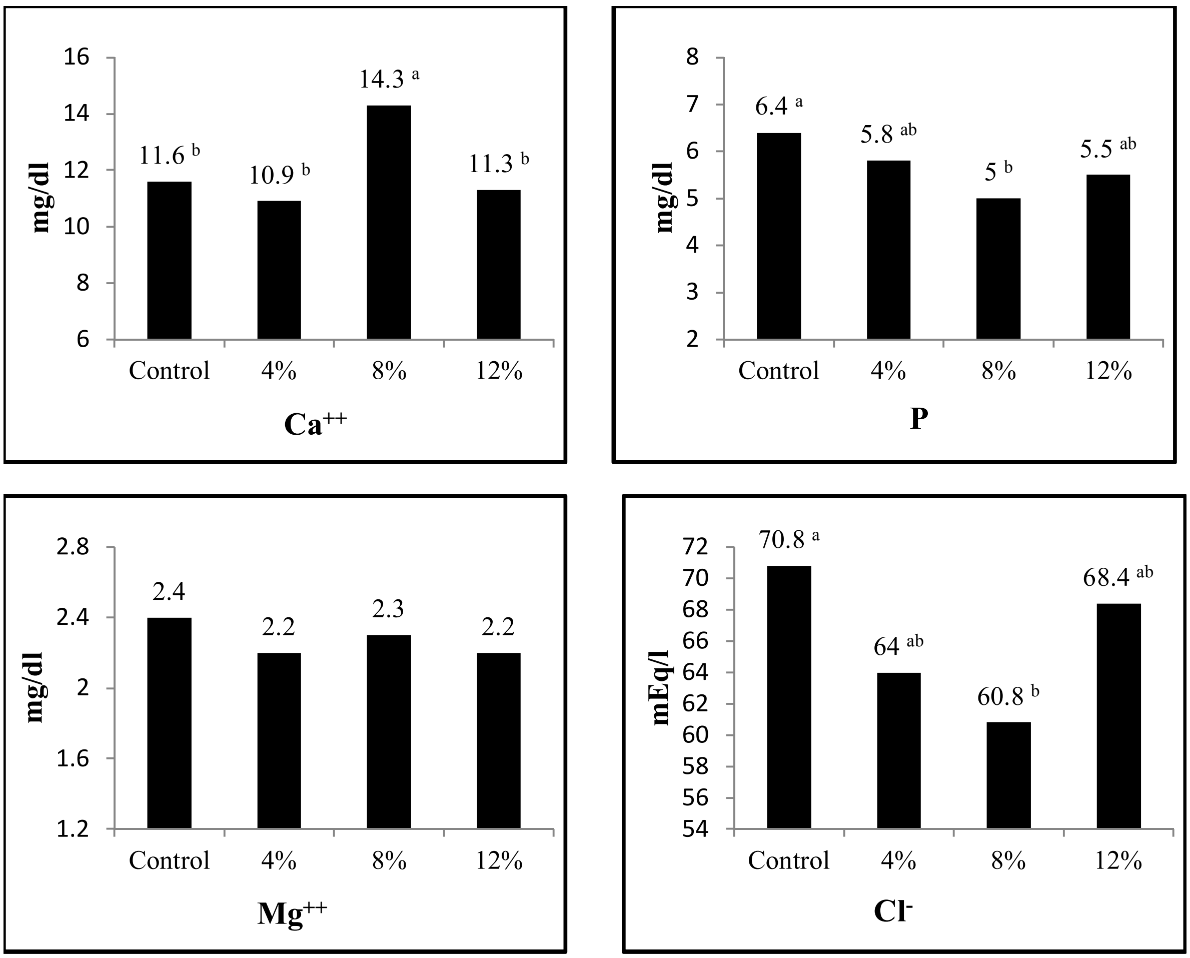

Figure (2). Effect of feeding different levels of *Atriplex nummularia* leaves meal on the calcium (Ca), phosphorus (P), magnesium (Mg) and chloride (Cl) of Sina laying hens

On the other hand, phosphorus (P) concentration showed reverse trend, whereas hens feeding 8 % ALM showed lower ($P<0.05$) concentration of P by 21.8 % as compared to control diet (Figure 2). The decreased phosphorus level may be attributed to their reciprocal reverse relationship as the increased blood calcium level resulted in increased parathyroid hormone secretion which inhibits the renal tubules reabsorption of phosphorus (Morsy *et al*., 2012 and Tyler, 1979). Chloride (Cl) concentration was lower (P<0.05) in the hens fed 8 % ALM by 14.1 % as compared to control diet, while there were no significant differences between the diets containing 12, 4 and 0 % ALM (Figure 2). This decrease may be attributed to Cl is the primary anion, balancing sodium, potassium and other cations (NRC, 2005).

5. Productive performance

Final body weight and body weight change showed insignificant increase in the hens fed 0 (control) or 4 or 8 % *Atriplex nummularia* leaves meal (ALM) than that of the diet containing 12 % ALM (Table 6).

These results agreed with those of Amin (1999) and Abd El-Galil and Khidr (2001). This result may be related to a non- significant effect of ALM in daily feed intake. More presence of tannins in the diet containing 12 % ALM may decrease palatability and depressing body weight gain (Abeer, 2003). The less palatability was found to be due to the presence of secondary plant metabolites such as acid detergent fibers, acid detergent lignin, and hemicellulose (Kandil and El-Shaer, 1988). It may also be concluded that the 4% level had a better palatability than other treatments of ALM. Makkar *et al*. (1996) indicated that increased tannin could decrease palatability through precipitation of salivary glycoproteins. Moreover, Distle and Provenza (1991) reported that phenols in blood may stimulate emetic receptors in mid brain and brain stem, causing a conditioned food dislike and reduced feed intake.

Table (6). Effect of feeding different levels of *Atriplex nummularia* leaves meal on the productive performance and egg shell thickness of Sina laying hens

Traits	Levels of *Atriplex nummularia* leaves meal			
	Control	4 %	8 %	12 %
Initial body weight (g)	1195.51±19.05	1199.21±20.72	1197.15±24.13	1193.33±20.48
Final body weight (g)	1422.69±22.94	1428.20±26.60	1430.70±27.46	1415.13±29.24
Body wt. changes (g)	227.18±25.71	228.99±28.89	233.55±29.16	221.80±32.01
Egg weight (g)	44.88 ^{b}±0.20	45.51^{ab} ±0.28	45.49^{a} ±0.26	45.59^{a} ±0.35
Egg no. (egg/hen/day)	0.635^{ab}±0.01	0.658^{a} ±0.01	0.662^{a} ±0.01	0.567^{b} ±0.01
Daily feed intake (g)	98.68±2.15	101.43±2.47	97.88±2.53	95.40±2.74
EM (g egg/hen/day)	28.50^{ab}±0.35	29.96^{a}±0.95	30.11^{a}±1.05	25.87^{b}±1.13
Feed conversion	3.46^{ab}±0.11	3.39^{ab}±0.15	3.25^{b}±0.13	3.69^{a}±0.17
Shell thickness (mm)	0.401^{b} ±0.04	0.421^{b}±0.05	0.453^{ab}±0.03	0.482^{a}±0.08

EM = egg mass.
a, b Means with different superscript among columns are significant differences (P<0.05).

On the other hand, tannin have antioxidant properties and can improve immunity system through protecting cells from oxidative stress, lipid oxidation, improving cell mediated immunity and humeral immunity (Yokozawa *et al*., 2000).

Hens fed 8 and 12 % ALM recorded an increase (P<0.05) in egg weight by 1.36 and 1.54 %, respectively than that of control diet (Table 6). Results of Table (6) indicate that egg number and egg mass during the whole experimental period recorded significantly (P<0.05) increase in the hens fed 4 % ALM (16.0 and 15.8 %, respectively) and 8 % ALM (16.7 and 16.3 %, respectively) as compared to the hens fed 12 % ALM. Data indicated that no significant differences among 0, 4 and 8 % treatments in the egg number and egg mass. It is clear that substitution of diet by 12 % ALM level tend to get smallest of egg number and egg mass. This may be attributed to the decrease in feed intake and hormones are creating ways of negative, decrease was observed of hormones (estradiol and progesterone hormone) with increased percentage of ALM in the diets (Table 5). High level of salt in diet of 12 % ALM may explain some delayed in poultry's performance.

The increase in egg mass with the 8 % ALM level was expected in view of the increase in egg number and egg weight compared with the 12 % ALM level. This result agreed with the finding of Amin (1999) who found that the egg production and egg mass of laying turkey fed diets with 10 or 15 % ALM were lower than the control diet. It is clear that substitution of diet by 8 % ALM level tend to improve feed conversion by 11.9 % as compared to the diet containing 12 % ALM level. This improvement may be attributed to its highest egg mass as compared to that of experimental diets. Improvement of productive performance in the hens fed 4 or 8 % ALM under heat stress conditions may attributed to the electrolytes system of hens was capable of maintaining normal homeostasis. And / or may be attributed to maintaining blood acid-base balance which disturbance during heat stress conditions (Tanveer, 2004).

It is worth noting that shell thickness was increased ($P<0.05$) by increasing ALM level in the diet at 12 %, while, it insignificantly increased in the diet containing 8 % as compared to control and 4 % ALM treatments (Table 6).

In conclusion**,** under arid conditions, *Atriplex nummularia* leaves meal (ALM) might be used up to 8 % as a source of alternative feed resources of Sina laying hens without adverse effects on physiological reactions and productive performance.

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References

1. Abdel Galil, K. and khider, R.E. (2001). Utilization of *Atriplex nummularia* in feeding growing rabbits under the desert and newly reclaimed areas. Egypt. Poultry Sci., 21:53-71.
2. Abeer, E. (2003). Studies of some anti-notional factors affecting forage utilization by ruminates. Ph.D. Thesis, Fac. of Sci., Cairo Univ., Cairo, Egypt.
3. Ahlam, R.A., Eid, E.Y.; Abeer M. El-Essawy, Afaf M. Fayed, Helal, H.G. and El-Shaer, H.M. (2011). Effect of feeding different sources of energy on performance of goats fed saltbush in Sinai. Journal of American Science, 7(1). 1040-1050.
4. Ahmed, M.H. (1996). Effect of saline drinking water on productive performance of rabbits. M.Sc. Thesis, Fac. of Agric., Zagazig Univ., Egypt.
5. Ahmed, M.M. and Abdel-Rahman, M.A. (2004). Effect of drinking natural saline groundwater on growth performance, behavior and some blood parameters in rabbits reared in new reclaimed lands of arid areas in Assiut Governorate. Assiut Univ. Bull. Environ. Res. Vol. 7 No. 2, 125-135.
6. Alessandro, Z., Salvatore, S., Vanessa, M., Stefania, C., Ambra, R. and Giuseppe, P. (2011). Hematological profile of Messinese goat kids and their dams during the first month post-partum. Animal Sci. Papers and Reports Vol. 29, 223-230.
7. Amal, M. Hassan (2013). Semen quality and hematology parameters of White leghorn cocks drinking saline water under hot desert conditions. Egypt. Poult. Sci. Vol (33) (I): 163-179.
8. Amal, M. Hassan (2003). Some physiological and productive effects of promoting growth in rabbits drinking natural saline water. Ph.D. Thesis, Fac. Agric. Cairo, Univ.
9. Amin, E. (1999). Effects of crossbreeding and feeding different levels of atriplex meal on production characters of local and commercial varieties of turkey. M.Sc. Thesis, Fac. of Agric., Alex. Univ., Alex., Egypt.
10. Arieli, A., Naim, E., Benjamin, R.W. and Pasternak, D. (1989). The effect of feeding saltbush and sodium chloride on energy metabolism in sheep. Anim. Prod. 49, 451–457.
11. Assad, F.M., Nassar, A.M., Hussein, N. and Abdelmageed, S.M. (1997). Effect of saline water on some biochemical parameters in sheep. Egypt. J. Applied Sci. 12: 1-13.
12. Ayyat, M.S., Habeeb, A.A. and Bassuny, S.M. (1991). Effect of water salinity on growth performance, carcass traits and some physiological aspects of growing rabbits in summer season. Egypt J. Rabbit Sci., 1: 21-34.
13. Balnave, D., Yoselewitz, I. and Dixon, R.J. (1989). Physiological changes associated with the production of defective egg-shells by hens receiving sodium chloride in the drinking water. British J. Nutr., 61(1): 35 - 43.
14. Ben Salem, H., Norman, H.C., Nefzaoui, A., Mayberry, D.E., Pearce, K.L. and Revell, D.K. (2010). Potential use of oldman saltbush (*Atriplex nummularia Lindl.*) in sheep and goat feeding. Small Ruminant Research 91: 13–28.
15. Ben Salem, H., Sourour Abidi, H.P.S. Makkar and A. Nefzaoui (2005). Wood ash treatment, a cost- effective way to deactivate tannins in *Acacai cyanophylla Lindl* foliage and to improve digestion by Barbariae sheep. Animal Feed Science and Technology, 122: 93- 108.
16. Craig, A.M., Pearson, E.G., Meyer, C. and Schmitz, J.A. (1991). Serum liver enzyme and histopathologic changes in calves with chronic and chronic-delayed Senecio jacobaea toxicosis. Am. J. Vet. Res., 52 (12): 1969-1978.
17. Distle, R.A. and Provenza, F.D. (1991). Experience early in life affects voluntary intake of Block brush by goats. J. Chemical Ecology, 17:431-450.
18. Duncan, D.B. (1955). Multiple range and multiple F- test, Biometrics, 11:42.
19. El-Hawy, A.S. (2013). Reproductive efficiency of Shami goats in salt affected lands in South Sinai. Ph.D. Thesis, Fac. Agric., Ain Shams Univ.
20. El-Shaer, H.M. (2010). Halophytes and salt-tolerant plants as potential forage for ruminants

in the Near East region. Small Ruminant Research, 91(1): 3-12.
21. Guyton, A.C. and Hall, G.E. (2006). Text Book of Medical Physiology. 6th Edn., London.
22. Hamdi, H., Abdel-Rahman, Y., Malek, A., El-Bagoumy, I., Ibrahimw, Z. and Makasem, F. (1982). Fundamadels of humen physiology. Kidney and body fluids. Vol. 7. Atlas Press, Cairo.
23. Hassan, A.A. (2009). Effect of some Enrichment and Nawaz biological treatments on a melioration utilization of *Atriplex nummularia* fed by sheep. Egyptian J. Nut. And Feed. (12): 3 Special Issue: 553-566.
24. Hussein, N.M., Assad, F., Abdel-Megeed, S.M. and Nassar, A.M. (1990). Variation in blood cellulose to drinking salty water in sheep. Egypt. J. Comp. Pathol. Clin. Pathol., 3(1): 55 - 63.
25. Ibrahim, S.M.N. (1995). Clinicopathological studies in goats drinking salty water under desert conditions. M. Sc. (clinical pathology), V. Sc. Cairo Univ.
26. Jaime, S. (2000). Text book of Avian Medicine. Chapter 3, Edited by Judith C. H. Harcourt publishers limited, London.
27. Kandil, H.M. and El-Shaer, H.M. (1988). The utilization of *Atriplex nummularia* by goats and sheep in Sinai. Proc. of the Inter. Symp. on the constraints and possibilities of ruminant production in the dry subtropics, Nov. 5-7, Cairo, Egypt, P. 71-73.
28. Kawashti, I.S.; Badawn, M.E.; Mageed, S.M. and Omer, M.M. (1983). Salt tolerance of desert sheep. 6-Effect of saline water administration on intake-urinary and fecal water losses and body water distribution. Desert Inst. Bull., Egypt. 14: 392- 408.
29. Makkar, H.P.S., Good child, A.V., Abd El-Manein, A.M. and Becker, K. (1996). All constituents, tannins levels by chemical and biological assays and nutritional value of some legume foliage and straw. J. Sci. Food Agric., 71: 129-136.
30. Mansoori, B. and Acamovic, T. (1997). The excretion of minerals from broilers fed tannic acid with and without gelatin. In: Proc. of Spring Meeting of the World Poultry Sci., 25-26.
31. Marai, I.F.M., Ayyat, M.S. and Abdel-Monem, U.M. (2001). Growth performance and reproductive traits at first parity of New Zealand White female rabbits as affected by heat stress and its alleviation under Egyptian conditions. J. Trop. Animal Health Prod., 33, 1-12.
32. Milne, D.B. (1996). Trace elements. In: Tietz Fundamentals of clinical chemistry. Burtis, C.A. and Ashood, E. R. (4th Ed.), 485-496.
33. Morsy, A.S., Mona, M. Hassan and Amal, M. Hassan. (2012). Effect of natural saline drinking water on productive and physiological performance of laying hens under heat stress conditions. Egypt Poult. Sci. Vol. (32) (III): 561-578.
34. National Research Council (2005). Mineral tolerance of animals. National Academies Press, Washington.
35. National Research Council (1994). Nutrient Requirements of Poultry. 9th edition. National Academic Press. Washington, D.C.
36. SAS Institute (2004). SAS User's Guide: Statistics. Release 9.1. SAS Institute Inc., Cary, NC.
37. Singleton, V.I. (1981). Naturally occurring food toxicants phenolics substances of plant origin common in foods. Advances in Food Research, 27: 149-242.
38. Tanveer, Ahmed (2004). Effect of different dietary electrolyte balance on performance and blood parameters of broilers reared in heat stress environments. Ph. D. Thesis, Fac. of Institute of Animal Nutrition and Feed Technology, University of Agriculture, Faisalabad.
39. Tyler, D.D. (1979). Water and mineral metabolism. In: Physiological Chemistry. 17th Ed., Lang Medical Publication, California, USA.
40. Underwood, E.J. and Suttle, N.F. (1999). The mineral nutrition of livestock. 3rd Edition. Chapter 1. New York, USA.
41. Wilson, A.D. (1966). The value of Ariplex (Saltbush) and Kochia (Bluebush) species as food for sheep. Aust. J. Agric. Res. 17, 147–153.
42. Yokozawa, T., Cho, E.J., Hara, Y. and Kitani, K. (2000). Anti-oxidative activity of green tea treated with radical initiator 2, 2-azobis (2-amidinopropane) dihydrochloride. J. Agric. Food Chem. 48:5068–5073.
43. Zhao, X., Yang, Z.B., Yang, W.R., Wang, Y., Jiang, S.Z. and Zhang, G.G. (2011). Effects of ginger root (*Zingiber officinale*) on laying performance and antioxidant status of laying hens and on dietary oxidation stability. Poultry Science 90 :1720–1727.

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