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Animal Production

Effect of Salicornia Bigelovii Torr Meal and Age on Egg Components of Baladi and Leghorn Laying Hens

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Abstract. The study was undertaken to assess the effect of incorborating Salicornia bigelovii Torr meal (SM) in laying ration on egg components of Baladi and Leghorn hens. Hens were fed ration containing 0, 40 or 80 g Kg^{-1} SM. Four eggs per day of each replicate of both breeds were collected for three consecutive days during the last week of each 28- day age period. Albumen, yolk and shell weights of each individual egg, their percentages and yolk:albumen ratio were determined. The results showed that the inclusion of SM in the layer ration had a significant ($P< .05$) adverse effect upon egg, shell and yolk weights, yolk:albumen ratio, shell and yolk percentages and the degree of the adverse effect was proportional to SM inclusion level with respect to egg weight, yolk weight and yolk:albumen ratio whereas albumen weight was not affected and consequently albumen weight percentage was increased ($P<.05$) proportional to the SM inclusion level. Significant ($P< .05$) differences in breeds' response to SM inclusion in the ration was also observed with regard to shell weight and shell weight percentage. The results also showed significant ($P< .05$) breed and age differences with regard to all studied egg component traits except albumen weight which was not affected by age .

Introduction

Limited resources of standard feed ingredients for poultry in certain countries has necessitated a continual search for altternative feed ingrredients. Salicornia bigelovii Torr is a halophytic oil seed crop tolerant of brackish and seawater irrigation. Yield of seed and biomass equalled or exceeded conventional oil-seed crops such as soybean and sunflower [1]. Salicornia bigelovii Torr meal is a by-product of the oil extraction containing 34% protein and 5.5% residual oil [2]. Inclusion of Salicornia bigelovii Torr meal in the diet has been found to exert a depressing effect upon broiler performance as reported by several investigators [2-5]. With respect to layers performance. Similar results were observed by Al-Batshan et al. [5]. Salicornia bigelovii Torr meal contained an antinutritional factor (saponin) which has an adverse effect upon broilers and layers performance [2-5]. Egg components have been shown to be infleunced by age [6-8], strain [9-11] and breed [6,7,9,12]. However, the information about its effect upon egg components is lacking. The objective of this study is to assess the effect of Salicornia bigelovii Torr meal and age upon egg components of Baladi and Leghorn laying hens.

Materials and Methods

Two hundred seventy 40-weeks-old Saudi Arabian Baladi and Leghorn hens (135 hens of each breed) were obtained from the Baladi and Leghorn populations which have been randomely bred for severel years in the Experimental Poultry and Livestock Farm of the Animal Production Department, College of Agriculture, King Saud University. The hens of each breed were divided into 9 groups, 15 hens in each, and randomely alloted to 9 floor pen (1.5x2m) in an environmentally controlled house. Three groups (replicates) of each breed were randomely assigned to one of the following dietary treatment; (a) laying hen basal diet (Table 1); (b) basal diet supplemented with 40 g Kg^{-1} Salicornia Bigelovii Torr meal (SM); (c) basal diet supplemented with 80 g Kg^{-1} SM. The chemical composition of SM has been previously reported by Attia *et al.* [2].

Table 1. Composition of the basal diet used in the experiment

Ingredients and calculated analysis	g Kg^{-1}
Ingredient	
Ground yellow corn	100.0
Soybean meal (48% CP)	141.1
Ground wheat	515.7
Fish meal	21.0
Bran meal	80.0
Alfalfa meal	11.0
Limestone	99.0
Dicalcium phosphate	9.5
Concentrate [a]	4.0
Palm oil	11.0
Pigments [b]	3.7
Salt (NaCl)	2.4
Enzyme preparation[c]	1.0
DL-Methionine	0.6
Calculated analysis	
Crude Protein	170.0
ME_n (Kcal g^{-1})	2.7
Ether extract	30.0
Calcium	35.0
Total Phosphorus	6.0
Sodium	3.5

[a]Provided the following per Kilogram of diet: vitaminA,12000IU; vitamin D_3, 6000 ICU; vitamin E, 8mg; choline chloride, 20 mg; vitamin K, 1.6 mg; vitamin B_1, 1.6 mg; vitamin B_2, 4mg; vitamin B_6, 0.8 mg; niacin, 20 mg, pantothenic acid, 8mg; folic acid, 0.8 mg; biotin, 0.08 mg; vitamin C,80 mg; ethoxyquin, 56 mg; Cu 12 mg; I,0.8 mg; Fe, 40 mg; Mn, 80 mg; Zn, 48 mg; Co,.04 mg; Se, 0.16 mg.

[b]Provided the following per Kilogram of diet: xanthophyls 1.15^{-4} mg; ethoxyquin 2.3^{-4} mg; emulsified fat, 9.55^{-3} mg; silica, 6.21^{-3} mg; carrier, 6.9^{-3} mg.

[c]Xylanase (EC 3.2.1.8) 12000 fxu/g; β- glucanase (EC 3.2.1.6) 5000 bgu/g.

The trial lasted for five 28 day age periods and the birds were subjected to standard management practices. For egg components study, four eggs per day of each replicate of both breeds were collected for three consecutive days during the last week of each 28-day age period (P). Eggs were stored overnight at 10-11 ^{0}C. The next day, the eggs were individually weighed to the nearest 0.1 g, broken, the yolk separated from the albumen, and the albumen discarded. The yolk was then rolled on a damp paper towel to remove any adhering albumen and yolk was weighed. The shell was washed carefully to remove albumen, and dried at 21-24 C^0 for 24h prior to weighing. The albumen weight (AW) was then calculated by substracting yolk weight (YW) and dry shell weight (SW) from the initial whole egg weight (EW). Shell (SHP), albumen (AWP) and yolk (YWP) weights percentages and YW:AW ratio were also calculated.

Data obtained were subjected to statistical analysis using the General Linear Models procedures of SAS Institute [14] using the following statistical model:

$$Y_{ijkl} = \mu + B_i + P_j + T_k + BP_{ij} + BT_{ik} + PT_{jk} + BPT_{ijk} + e_{ijkl}$$

where Y_{ijkl} is the lth observation of the ith breed (B), jth age period (P) and kth treatment (T). BP_{ij} is the interaction between breed and age period, BT_{ik} is the interaction between breed and treatment, PT_{jk} is the interaction between age period and treatment and BPT_{ijk} is the interaction between breed, age period and treatment. μ is the general mean and e_{ijkl} is the random error associated with Y_{ijkl} observation. Shell, albumen and yolk weight percentages were transformed to arc sin $\sqrt{\ }$ proportion prior to statistical analysis and all three way interaction effects were neglected.

Results and Discussion

Breed, age period and treatment had a significant (P< .05) effect upon all studied traits except albumen weight (AW) which was only significantly affected by breed (Tables 2and 3). All interaction effects shown in Table 2 and 3 were not significant except those of B×T with respect to shell weight (SW) and shell weight percentage (SWP). Baladi eggs were significantly (P< .05) smaller in size and had consequently smaller SW, AW and yolk weight (YW) compared with those of Leghorns. However, Baladi eggs had significantly (P< .05) higher SWP and Yolk weight percentage (YWP) and YW:AW ratio than those of Leghorns (Table 3). Similar breed and strain differences were observed by several investigators [6, 7, 9-13]. Marion et al.[11] found that smaller eggs had higher yolk and lower albumen percentages which supports our findings. EW, YW and YW:AW ratio had significantly (P< .05) the lowest value at the first age period then tended to increase with advancing age (Table 2). SW started to decrease significantly (P< .05) following the third age period whereas AW was not affected by age period (Table 2). SWP and YWP showed similar trend as SW and YW, respectively whereas AWP decreased significantly (P< .05) following the first age period (Table 3).

Table 2. Effect of age and treatment on egg (EW), shell (SW), albumen (AW) and yolk (YW) eights of Baladi and Leghorn laying hens.

	EW	SW	AW	YW
Breed (B)	**	**	**	**
Baladi	45.47^{B}	4.49^{B}	26.57^{B}	14.41^{B}
Leghorn	53.13^{A}	4.94^{A}	33.11^{A}	15.08^{A}
Age Period (P)	**	**	NS	**
1	48.49^{B}	4.84^{A}	29.77	13.88^{E}
2	49.19^{A}	4.79^{A}	29.69	14.71^{D}
3	49.47^{A}	4.79^{A}	29.77	14.91^{AD}
4	49.67^{A}	4.65^{B}	29.93	15.09^{A}
5	49.69^{A}	4.52^{C}	30.03	15.15^{A}
SM level g kg^{-1} (T)	**	**	NS	**
0	49.85^{A}	4.84^{A}	29.96	15.05^{A}
40	49.18^{B}	4.60^{B}	29.66	14.82^{B}
80	48.87^{B}	4.71^{C}	29.79	14.37^{C}
B × P	NS	NS	NS	NS
B × T	NS	**	NS	NS
T x P	NS	NS	NS	NS
SEM	± 0.105	± 0.015	±0.082	± 0.035

* significant (P< .05).
** highly significant (P< .01).
NS nonsignificant.
Means in the same column with different superscripts differ significantly (P< .01).

Table 3. Effect of age and treatment on shell (SWP), albumen (AWP) and yolk (YWP) weight percentages and on YW:AW ratio of Baladi and Leghorn laying hens

	SWP	AWP	YWP	YW/AW
Breed (B)	**	**	**	**
Baladi	9.89^{B}	58.37^{B}	31.74^{B}	54.64^{B}
Leghorn	9.31^{A}	62.27^{A}	28.42^{A}	45.77^{A}
Age period (P)	**	**	**	**
1	10.01^{A}	61.21^{A}	28.79^{C}	47.35^{D}
2	9.77^{B}	60.16^{B}	30.07^{B}	50.28^{B}
3	9.71^{B}	59.98^{B}	30.31^{AB}	50.88^{AB}
4	9.39^{C}	60.04^{B}	30.57^{A}	51.32^{A}
5	9.12^{D}	60.24^{B}	30.64^{A}	51.18^{AB}
SM level g kg^{-1} (T)	**	**	**	**
0	9.74^{A}	59.90^{A}	30.36A	51.02^{A}
40	9.39^{B}	60.33^{B}	30.28^{A}	50.54^{A}
80	9.67^{A}	60.74^{C}	29.59^{B}	49.04^{B}
B × P	NS	NS	NS	NS
B × T	*	NS	NS	NS
T x P	NS	NS	NS	NS
SEM	± 0.025	±0.067	± 0.063	± 0.161

* significant (P< .05).
** highly significant (P< .01).
NS nonsignificant.
Means in the same column with different superscripts differ significantly (P< .01).

Similar trends were observed by Marion et al. [11] with respect to EW, AW and YW and by Hussein et al. [6] with regard to YW:AW ratio. Fletcher et al. [8] also concluded that increased yolk yield was equally dependent upon increased flock age. Feeding 40 or 80 g Kg^{-1} SM led to significantly ($P< .05$) decreased EW, SW, YW, and YW:AW ratio, whereas SWP and YWP showed similar trend but AW was not significantly affected and consequently AWP significantly ($P< .05$) increased compared with the control (Table 2 and 3). On the other hand the effect of the higher SM level was more pronounced with respect to EW, YW, YW:AW ratio and YWP (Table 2 and 3). Fig.1 shows that the inclusion of SM at the level of 40 g Kg^{-1} had a higher ($P< .05$) adverse effect upon SWP of both breeds compared with that of the higher level (80 g Kg^{-1}). However, with respect to SW of Leghorn eggs, the same trend was observed as for SWP, whereas SWP and SW of those of Baladi were not significantly affected by the high SM level compared to the control (Fig. 1 and 2).

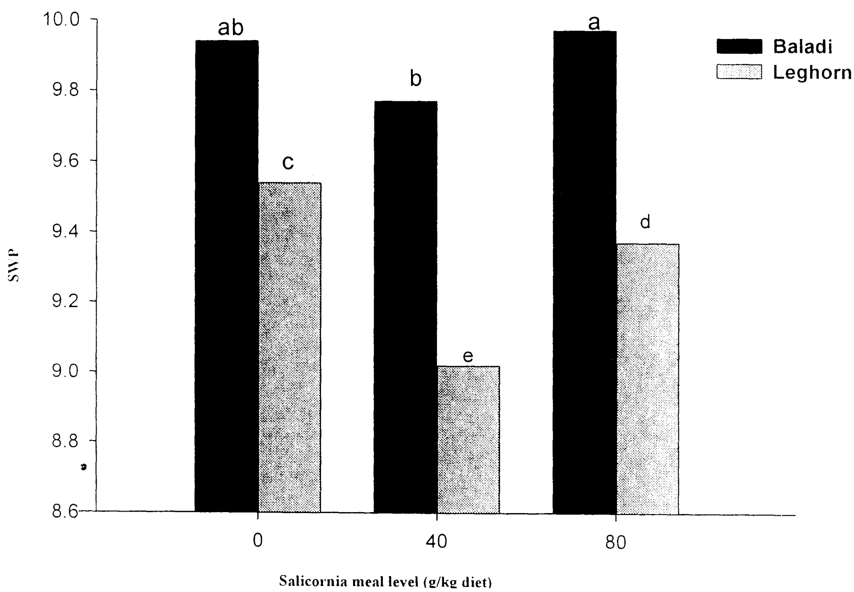

Fig.1. Effect of B*T on Shell Weight Percent (SWP).
[a-e] columns with different superscripts differ significantly ($P< .05$).

The less pronounced adverse effect of the high SM level upon SW and SWP might be attributed, among other reasons, to the fact that hens received the high SM level produced less number of eggs compared to those received the low SM level as reported by Al-Batshan et al. [5] and partially to the high mineral content of SM, particularly calcium, compared to soybean meal as reported by Attia *et al.* [2].

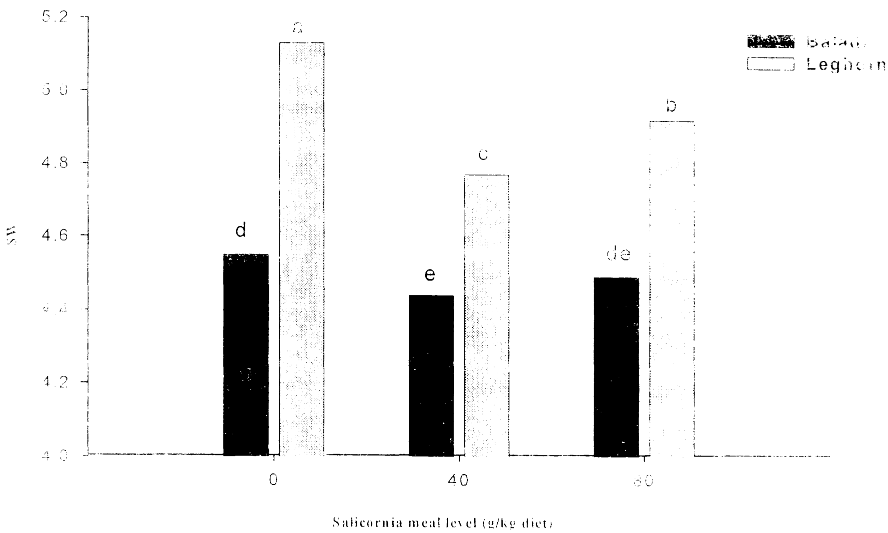

Fig.2. Effect of B*T on Shell Weight in gram (SW).
a-e columns with different superscripts differ significantly (P< .05).

The high mineral content of SM might also have forced the hens to increase their water intake at the expense of their feed intake. However, Al-Batshan *et al.* [5] also reported a signficant decrease in plasma cholesterol of Baladi hens when SM was included in the layer ration at 40 or 80 g Kg^{-1} and only the higher level had an adverse effect upon body weight and feed intake but livablity was not affected.

From the results reported herein, we conclude that inclusion of SM in the layer ration had an adverse effect upon all studied traits except AW and AWP and the adverse effect was mostly proportional to SM inclusion level. However, according to the chemical analysis reported by Attia et al. [2], SM could be a valuable protein source if there is a feasable way to deactivate the antinutritonal factors. The results also showed breed and age differences with regard to all studied egg component traits except AW with respect to age.

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تأثير كسب السليكورنيا، والعمر في مكونات بيض الدجاج البلدي والليجهورن

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ملخص البحث: أجريت هذه الدراسة لتقويم تأثير إضافة كسب السليكورنيا على مكونات بيض الدجاج البلدي والليجهورن. غذيت الطيور على عليقه تحتوي علي ٠، ٤٠ أو٨٠ جم كجم$^{-1}$ كسب ساليكورنيا. تم جمع عدد أربع بيضات من كل مكررة ثلاثة أيام متتابعة خلال الأسبوع الأخير من كل فترة عمريه، وتم تقدير وزن البياض، والصفار،وقشرة البيضة وكذلك نسبهم لوزن البيضة الكلي، وكذلك نسبة الصفار إلى البياض لكل بيضة. تشير الدراسة إلى أن إضافة كسب السليكورنيا لعليقه الدجاج البياض كان له تأثير سلبي(P<.05) على وزن كل من البيضة، القشرة، الصفار، وكذلك نسبة الصفار:البياض، ونسب وزن القشرة ووزن الصفار وكانت شدة التأثير السلبي لكسب السليكورنيا تتناسب طرديا مع مستواه المضاف إلى العليقه بالنسبة لوزن البيضة والصفار ونسبة الصفار إلى البياض. لكن وزن البياض لم يتأثر بإضافة الكسب وعليه زادت نسبته طرديا مع زيادة مستوى كسب السليكورنيا المضاف إلى العليقة، كذلك تشير الدراسة إلى وجود اختلافات معنوية (P<.05) تعود إلى السلالة في التجاوب مع المعاملة فيما يخص وزن ونسبة وزن القشرة، بالإضافة إلى ذلك وجدت اختلافات معنوية (P< .05) تعود إلى السلالة والعمر بالنسبة لجميع الصفات المدروسة ما عدا وزن البياض بالنسبة لتأثير العمر.