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Effect of Feeding Natural Zeolite on Performance of Laying Hens Drinking Saline Water

تأثير تناول الزيولايت الطبيعي على أداء دجاج بيض يشرب ماء ذا ملوحة زائدة

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Abstract

This experiment was conducted to determine the effects of dietary natural zeolite on performance of laying hens receiving saline drinking water (2g NaCl/L). One hundred and twenty 49 weeks old laying hens were randomly assigned (two birds per cage) to 60 cages in a naturally ventilated laying house. Six treatments were examined over a 28-day period. Control hens received town water and a commercial layer diet (TW-LD). Hens of treatment 2 were given town water and were fed a commercial diet supplemented with 10 g/Kg natural zeolite (TW-Z10). The remaining four treatments received the water containing 2g NaCl/L (SalW-) and a commercial diet supplemented with 0, 10, 20, and 30g/Kg natural zeolite for treatments 3 (SalW-LD), 4 (SalW-Z10), 5 (SalW-Z20), and 6 (SalW-Z30), respectively. To account for differences in the amounts of added zeolite, sand was added to the diet in order to keep the resulted diets isoenergetic. Egg production, egg weight, egg mass output, daily water intake feed consumption, feed conversion, and eggshell quality parameters were measured. No significant treatment effects were observed with percentage egg production, egg weight, egg output, feed conversion and feed consumption among the different treatments. However, water intake for hens in treatment 5 was significantly higher than that of hens in the remaining treatments. Significant differences between treatments were observed with regard to all shell quality measurements other than egg specific gravity. Saline water caused a significant reduction in shell thickness, shell weight: egg weight, and shell weight per unit surface area. Addition of natural zeolite (10 to 20g) improved eggshell quality parameters especially for hens receiving saline water.

(KEY WORDS: Saline water, natural zeolite, laying hens, and shell quality)

ملخص

اجريت هذه التجربة لتحديد أثر إضافة الزيولايت الطبيعي الى علائق دجاج بيض يتناول ماء شرب ذي ملوحة عالية نسبيا (٢غم كلوريد الصوديوم/لتر). استخدم لهذا الغرض ١٢٠ دجاجة بعمر ٤٩ اسبوع حيث

وزعت عشوائيا (دجاجتين لكل قفص) على ٦٠ قفص في بيت انتاج من النوع المفتوح. تكونت التجربة من ست معاملات واستمرت لمدة اربعة اسابيع. الدجاجات في معاملة الشاهد اعطيت ماء شرب اعتيادي وتناولت عليقة تجارية معدة لدجاج بيض (TW-LD). دجاجات المعاملة الثانية اعطيت ماء شرب اعتيادي وعليقة دجاج بيض اضيف اليها (١٠غم/كغم) زيولايت طبيعي (TW-Z10) اما في المعاملات الأربع الاخرى فقد اعطيت الدجاجات ماء شرب اضيف اليه ٢غم/لتر كلوريد الصوديوم كما تناولت عليقة دجاج بيض اضيف اليها صفر، ١٠، ٢٠ او ٣٠غم/كغم زيولايت طبيعي لكل من المعاملات الثالثة (Salw-LD)، والرابعة (Salw-Z10) والخامسة (Salw-Z20) والسادسة (Salw-Z30) على التوالي. يستدل من نتائج التجربة بأن نسبة انتاج البيض، ووزن البيضة المنتجة، وكمية استهلاك العلف، والكفاءة التحويلية لم تكن مختلفة معنويا فيما بين المعاملات الستة. أما معدل استهلاك الماء لدجاج المعاملة الخامسة فقد كان اعلى بشكل ملحوظ مقارنة بدجاج بقية المعاملات. وباستثناء الجاذبية النوعية فانه كانت هناك فروق معنوية ما بين المعاملات لمقاييس جودة قشرة البيض حيث كان لاضافة الزيولايت (١٠ او ٢٠غم/كغم) اثر واضح في تحسين جودة قشرة البيض المنتج خاصة للدجاج المعاملات التي تناولت ماء شرب الذي اضيف اليه الملح.

Introduction

The addition of NaCl (2g/L) to drinking water of laying hens has been shown to reduce egg shell quality and increase incidence of egg shell defects[1-4]. Moreng et al.[10] reported that supplementing the drinking water of laying hens with 2g NaCl/L did not significantly affect feed intake, egg production, or egg weight and that eggshell defects were increased. Attempts were made to overcome the detrimental effects of saline water on eggshell quality. Balnave *et al.*[4] concluded that hens producing eggs with defect shell as a result of receiving saline drinking water failed to show any improvement in eggshell quality or any reduction in incidence of eggshell defects when saline water was supplemented with ascorbic acid. On the other hand, Moreng *et al.*[10] reported that supplementing layer diet with zinc-methionine, but not zinc-sulfate, was effective in overcoming the negative influence of the added 2g NaCl to town water. In contrast, Balnave and Zhang[3] concluded that supplementing the saline drinking water with zinc-methionine, zinc sulfate, or chellated zinc-EDTA significantly reduced the incidence of eggshell defects and in some cases improved eggshell breaking strength. These inconsistent responses were explained by the differences in zinc availability when these compounds are fed to chickens.

Under normal conditions when hens were not exposed to stressors (i.e. environmental temperature or saline water), dietary supplementation with

sodium zeolite has been shown to improve eggshell quality[12-13]. Similarly, Olver[11] using clinoptilolite as a dietary supplement (50g/Kg) observed significant differences in response of different strains of laying hens with regard to egg production parameters but not feed intake. Because of it's high ion-exchange capability, it is postulated that supplementation of natural zeolite may have beneficial effects on eggshell quality of hens drinking saline water. Therefore, the purpose of this study was to investigate the effects of commercially available natural zeolite when added to diets of hens drinking saline drinking water.

Materials and Method

A total of 120 commercial laying hens (49 wk of age) were randomly assigned to (two hens per cage) 60 cages (40x38x33 cm) in a naturally ventilated laying house. Each cage was considered as an experimental unit. Experimental diets and drinking water was provided for *ad libitum* intake, and photoperiod was maintained at 16 hrs. The daily temperature range in this study was 16 to 29 degrees centigrade over the 4-wk experiment. The basal diet used in the experiment was a commercial layer mash with a calculated composition of (180 g/Kg crude protein, 3.8% Ca, 0.6% P, and 0.35% NaCl). The basal diet was supplement with natural zeolite (table 1) and/or sand (as a diluent) that were washed and sun dried. Sand was added to the experimental diets in order to keep the diets, resulted from natural zeolite supplementation, iso-energetic. The treatments used were:1) Town water and basal diet supplemented with 30 g sand (TW-LD); 2) Town water and diets supplemented with 10 g zeolite and 20 g sand (TW-Z10); 3) Town water supplemented with 2 g NaCl/L and diet supplemented with 30 g sand SalW-LD); 4) Town water supplemented with 2g NaCl/L and diet supplemented with 10 g zeolite plus 20 g sand (SalW-Z10); 5) Town water supplemented with 2g NaCl/L and diet supplemented with 20 g zeolite plus 10 g sand (SalW-Z20); 6) Town water supplemented with 2 g NaCl/L and diet supplemented with 30 g zeolite. Following a 2-wk acclimation period, performance parameters were recorded for 28 days experimental period. Egg production was recorded daily for each cage, but average values for each experimental unit was used for data analysis. Egg weights were recorded weekly from all eggs produced on the last 2 consecutive days. These eggs were also used for specific gravity measurements[7]. Eggs produced during the final 2 days of the experiment were used for eggshell quality measurements[4-5]. Water consumption for each treatment was monitored daily, but the average water intake was used for data analysis. The data were analyzed using the General

Linear Model (GLM) procedures of SAS[14]. Significant differences ($P<0.05$) among treatments were determined by the multiple range test[6].

Results

Table 2 shows treatment effects on percent egg production, egg weight, egg mass output, daily feed intake, water intake, feed conversion and eggshell quality measurements. Providing hens with natural zeolite did not affect ($P>0.05$) percentage egg production, egg weight, egg output, feed intake or feed conversion. However, eggshell quality measurements other than specific gravity, were significantly lower for hens provided with saline drinking water and normal feed (SalW-LD). As can be seen from the data, saline water did reduce shell thickness, shell weight:egg weight ratio, and shell weight per unit surface area. Meanwhile the measurements for these parameters were greater for hens drinking saline water when provided with diets supplemented with natural zeolite at 10 and 20 g levels.

Water consumption was significantly higher for hens given saline water and 20 g zeolite as compared with the hens given saline water and dietary zeolite.

Discussion

The results of the present study indicate that saline water (2 g NaCl/L) did not significantly affect percentage egg production, egg weight, egg mass output, feed conversion, feed intake and water intake. Similar results were reported in earlier studies[3-4,10].

Supplementing the drinking water of laying hens with NaCl (2 g/L) significantly increased the incidence of egg defects and significantly decreased eggshell quality[2,4]. In contrast to these findings, Balnave and Zhang[3] reported that none of the eggshell quality measurements, other than shell strength, were affected by saline drinking water. These authors suggested that salt might have influenced the structural organization of the shell but not other quality measurements. The results reported here indicated that shell thickness, shell weight:egg weight percent and shell weight per unit surface area were significantly decreased when hens are provided with the saline water. However, egg specific gravity was not affected by saline treatment. Hen strains may account for these contrasting responses[4]. It appears that environmental temperature plays a role in aggravating the detrimental effects of saline water on eggshell quality since in the current and in the previous studies hens were

exposed to relatively mild environmental temperatures. In support of the finding of Rabon *et al*.[12] who used sodium zeolite, the results of this study indicated that egg specific gravity for hens provided with town water and 10 g natural zeolite had higher values compared with hens provided with town water and supplemental zeolite. Olver[11] found that supplementation of a diet (135 g protein/Kg) with 50 g clinoptilolite/Kg caused significant difference between strains with regard to egg production, shell thickness, feed conversion but not with regard to feed intake per hen. This experiment clearly demonstrates that eggshell thickness was significantly decreased for hens provided with saline drinking water without dietary zeolite supplementation (SalW-LD). Similar trends were noticed with regard to egg specific gravity, shell weight:egg weight percentage, and shell weight per unit surface area.

The results of the present study indicate that providing natural zeolite to laying hens drinking saline water did not adversely affect production parameters. In addition, eggshell quality characteristics were improved by providing laying hens with a dietary zeolite supplement. The availability of the natural zeolite makes it a possible alternative to other chemical supplements for laying hens when water salinity is a problem.

Table (1): Composition of the natural zeolite

Compound	**g/100g**
Sio2	43.3
Al2O3	13.3
Fe_2O_3	9.8
FeO_2	2.2
CaO	10.9
MgO	4.3
Na_2O	4.2
K_2O	1.7
TiO_2	2.5
P	0.87
F	0.06
SO_3	0.07
Si/(Al+Fe)	1.74
LOI	4.1

Table (2): Effect of different dietary treatments on commercial laying hens receiving saline drinking water and zeolite supplements for 4 weeks.

Variable	Treatment[1]					
	TW-LD	TW-Z10	Salw-LD	Salw-Z10	Salw-Z20	Salw-Z30
Percent egg production,(%)	0.77[a]	0.78[a]	0.85[a]	0.82[a]	0.79[a]	0.73[a]
Egg weight , g	62.4[a]	61.8[a]	61.3[a]	61.7[a]	62.9[a]	60.5[a]
Egg output[2] , g	1355.2[a]	1347.8[a]	1459.7[a]	1419.0[a]	1372.8[a]	1223.1[a]
Feed intake per hen per day (g)	120.9[a]	118.8[a]	118.7[a]	115.2[a]	121.1[a]	121.0[a]
Water intake per hen per day,(ml)	272.9[a]	258.1[ab]	236.2[bc]	261.0[bc]	289.4[a]	257.5[bc]
Feed conversion, kg feed: kg egg output	2.6[a]	2.5[a]	2.3[a]	2.3[a]	3.1[a]	2.9[a]
Specific gravity , g/cm^3	1.076[a]	1.079[a]	1.075[a]	1.077[a]	1.076[a]	1.077[a]
Shell thickness , um	348.9[a]	351.8[a]	331.4[b]	351.8[a]	350.7[a]	348.3[a]
Shell weight : egg weight, %	8.55[ab]	8.56[ab]	8.07[c]	8.70[a]	8.24[bc]	8.24[bc]
Shell weight per unit surface area , mg/cm^2	70.9[abc]	70.2[bc]	69.1[c]	72.2[ab]	72.5[a]	70.9[abc]

[abc]means: within a raw with no common superscripts are different ($P<0.05$)

[1] In the treatments symbols indicate the following: TW stands for town water; LD stands for normal layer diet; Salw stands for drinking water supplemented with 2g Nacl/L; Z10, Z20; and Z30 stand for level(g) of natural zeolite added to the normal diet at 10g, 20g and 30g/kg, respectively.

[2] Egg mass output was calculated as number of eggs multiplied by average egg weight

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