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The Possibility of Using Watermelon Waste in Laying Hens Diets

Short Communicaion

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ABSTRACT

In this experiment 240 Hy-Line (W-36) laying hens from 65 to 75 weeks distributed in 5 treatments and 4 replicates (12 birds per replicate) in a completely randomized design were used. The amounts of watermelon skin meal (WSM) used to set the treatments were 0, 0.5, 1, 1.5 and 2% in 1 to 5 experimental groups. The results showed that using WSM up to 2% significantly improved the performance and egg traits of laying hens (P<0.05). The highest amounts of egg weight, egg mass and egg production percentage, the best feed conversion, the lowest feed price for production per kilogram of egg, the highest albumen quality percentage were observed by using 2% WSM. By using 2% WSM the eggshell and yolk weight significantly decreased (P<0.05). The overall results indicated that in laying hens, using watermelon skin meal up to 2% of diets, significantly improved their performance and reduced the production cost.

KEY WORDS egg traits, fruit waste, laying hens, performance.

INTRODUCTION

Nowadays, poultry industry is one of the most profitable agriculture businesses in the world that provides nutritious meats and eggs for human consumption within the shortest possible time. Recently, laying hens industry has become a rapidly developing enterprise among the other sectors of poultry production. Large numbers of farms are being established in different parts of the world, providing employment opportunities to people. But they are facing some problems, like the high prices and the unavailability of feed ingredients (Zarei *et al.* 2011). There are different ways for reducing production costs, one of them being the use of unconventional ingredients for the diets formulation. Some unconventional ingredients have high levels of fiber and low price. If properly used, they can have positive effects on performance and production costs of poultry (Farkhoy *et al.* 1994). As laying hens, compared with broilers, have developed digestive tract, they can tolerate a high amount of these kinds of ingredients (Zarei *et al.* 2011). Some of the experiments showed that using agriculture and food industry byproducts in moderate levels in laying hens diets is possible. About 2.5 million tons of watermelon is annually produced in Iran. More than 25% of watermelon is skin that is not used by humans. Watermelon skin contains antioxidants, beta-carotene, potassium, iron, sodium, B complex vitamins, amino acids such as arginine and pectin compared with edible parts, besides low levels of sugar and high levels of crude fiber (Zargari, 1990). Watermelon has diuretic effects and its use can reduce the heat stress (Zargari, 1990). Potassium is the main nutrient found in watermelon skin with positive effects on laying hens. In an experiment, it was shown that using high levels of potassium in laying hens diets (0.59-0.66%) in heat stress condition can improve their egg traits (Nobakht *et al.* 2008). In hot weather condition, using potassium chloride in drinking water of laying hens prevented a reduction in egg production (Dai and Bessei, 2007). The antioxidants substances present in some medicinal plants such as Thyme can improve the performance of laying hens by preventing the oxidation of susceptible nutrients (Nobakht and Mehmannavaz, 2010). The incorporation of vitamin E into laying hen's diet as an antioxidant agent during heat stress, improved egg production and egg yolk color (Puthpongsiriporn *et al.* 2001). Beta-carotene contained in watermelon skin be converted into vitamin A and improve the performance and egg yolk color (Sayiedpiran *et al.* 2011). High-fiber or reduced crude protein diets have been fed to laying hens without causing a depression in egg production (Summers, 1993). It was reported that diets containing up to 3.48% of crude fiber did not have any adverse effects on egg production performance of laying hens (Roberts *et al.* 2007). In the present study, the effects of different levels of watermelon skin dried powder on performance, production costs and egg traits of laying hens were investigated.

MATERIALS AND METHODS

Birds and experimental design

In this experiment 240 Hy-Line (W-36) laying hens from 65 to 75 weeks of age (1750±75g) in 5 treatments and 4 replicates (12 birds per replicate) in a completely randomized design were used. The amounts of WSM used to set the treatments were 0, 0.5, 1, 1.5 and 2% in 1 to 5 experimental groups.

Sufficient amount of watermelon skin was collected from a local fruit market, after cutting into small pieces, dried under the sun and ground to powder in a hammer mill. The compositions of the powdered watermelon skin were determined according to AOAC (2002) before mixing with the other diets ingredients (Table 1).

Diets preparation

The diets were formulated to meet the requirements of birds established by the NRC (1994) for laying hens (Table 2). The lighting program for laying hens during the experimental period was 16 hours light and 8 hours darkness. Environmental temperature was controlled and was about 18 ˚C. Feed intake, feed conversion, egg production percentage, egg mass and egg weight were determined weekly. Mortality was recorded if it occurred. The collected eggs were classified as normal or damaged; the latter including fully cracked eggs (an egg with broken shell and destroyed membrane), hair cracked eggs (an egg with broken shell but intact membrane) and eggs without shell (an egg without shell but with intact membrane). Determination of eggs specific gravity was done by floating eggs in salty water. Content of egg shells were cleaned and shells were maintained in environmental temperature for 48 h until dried, then weighed with a digital scale with an accuracy of 0.01 (g).

Color index of the yolk (Roche color index), yolk index, egg albumin index and Haugh units were determined (Card and Nesheim, 1972). The price of feed for production per kilogram to egg was obtained by multiplying the price of feed per kilogram to feed conversion ratio.

Statistical analysis

The data were subjected to one-way analysis of variance procedures appropriate for a completely randomized design using the General Linear Model procedures of SAS (2005). Means were compared using the Duncan multiple range test. Statements of statistical significance were based on $P < 0.05$.

RESULTS AND DISCUSSION

Performance

The effects of different levels of WSM on the performance of laying hens are summarized in Table 3. Using more than 0.5% of WSM in laying hens diets in contrast with control group significantly affected the performance of laying hens ($P<0.05$). The best performance was observed by using 2% WSM. So, the highest values of egg weight, egg mass, egg production percentages, the best feed conversion ratio and the lowest feed price / egg production were obtained by using 2% WSM. Feed intake was not affected by inclusion of different levels of WSM in laying hens diets ($P<0.05$). Using lower than 1% WSM in comparison with the other levels had the lowest effects on egg production performance and feed costs.

Egg traits

The effects of different levels of WSM on egg traits of laying hens are shown in Table 4. Inclusion of WSM in diets had significant effects on some of the egg traits in laying hens ($P<0.05$), When using 2% WSM, the shell weight and yolk weight decreased whereas the albumin weight increased.

Also, in comparison with the control group, WSM had positive effects on Haugh units. As it can be seen from Table 3, despite having a similar amount of feed intake, in experimental groups using WSM there was a significant improvement in significantly improved the egg production performance and a reduction in feed cost. Considerable increase in the egg weight, egg production percentage and egg mass by using 2% WSM caused the best feed conversion ratio and the lowest feed price for production per kilogram of egg were obtained in this group. Since, according to Table 2, except WSM, the percentages of other feeds ingredients are about the same and amount of feed intake is not significantly different, it can be said that using WSM caused these positive changes.

Table 1 The chemical composition of powder watermelon skin (100% dry matter base)

Nutrients	Metabolizable energy (kcal/kg)	Crude protein (%)	Crude fiber (%)	Calcium (%)	Phosphorus (%)	Potassium (%)
Amounts	1320	10.79	26.53	0.07	0.1	1.20

Table 2 The composition of basic diets

Feeds ingredients	Treatments				
	1	2	3	4	5
Corn	50.00	50.00	50.00	50.00	50.00
Wheat	23.93	23.40	22.94	22.29	21.73
Soybean meal (42% crude protein)	16.35	16.38	16.43	16.49	16.55
Watermelon skin meal	0.00	0.50	1.00	1.50	2.00
Oyster shell	7.83	7.83	7.84	7.84	7.84
Dicalcium phosphate	1.11	1.11	1.10	1.10	1.10
Salt	0.28	0.28	0.28	0.28	0.28
Vitamin premix[1]	0.25	0.25	0.25	0.25	0.25
Mineral premix[2]	0.25	0.25	0.25	0.25	0.25
Analysis results					
Feed price (toman/kg)	513	515	516	517	519
Metabolisable energy (kcal/kg)	2800	2800	2800	2800	2800
Crude protein (%)	14.00	14.00	14.00	14.00	14.00
Ca (%)	3.40	3.40	3.40	3.40	3.40
Available phosphorus (%)	0.31	0.31	0.31	0.31	0.31
Sodium (%)	0.15	0.15	0.15	0.15	
Potassium (%)	0.58	0.59	0.60	0.61	0.62
Crude fiber (%)	2.68	2.87	2.99	3.12	3.23
Lysine (%)	0.67	0.67	0.67	0.67	0.67
Methionine + cysteine (%)	0.55	0.55	0.55	0.55	0.55
Tryptophan (%)	0.18	0.18	0.18	0.18	0.18

[1] Vitamin premix per kg of diet: vitamin A (retinol): 8500000 IU; vitamin D_3 (cholecalciferol): 2500000 IU; vitamin E (tocopheryl acetate): 11000 IU; vitamin K_3: 2200 mg; Thiamine: 1477 mg; Riboflavin: 4000 mg; Panthothenic acid: 7840 mg; Pyridoxine: 7840 mg; Cyanocobalamin: 10 mg; Folic acid: 110 mg and Choline chloride: 400000 mg.

[2] Mineral premix per kg of diet: Fe ($FeSO_4.7H_2O$, 20.09% Fe): 75000 mg; Mn ($MnSO_4.H_2O$, 32.49% Mn): 74.4 mg; Zn (ZnO, 80.35% Zn): 64.675 mg; Cu ($CuSO_4.5H_2O$): 6000 mg; I (KI, 58% I): 867 mg and Se ($NaSeO_3$, 45.56% Se): 200 mg.

Table 3 The effects of feeding different levels of watermelon shell meal (WSM) on the performance of laying hens

Treatments	Egg weight (g)	Egg production (%)	Egg mass (g)	Feed intake (g)	Feed conversion ratio	Feed cost/kg egg (Toman)
Control group	65.50^{c}	63.71^{d}	41.71^{d}	113.56	2.74^{a}	1404^{a}
0.5% WSM	66.77^{bc}	63.91^{d}	42.71^{d}	112.39	2.64^{b}	1360^{a}
1% WSM	66.64^{bc}	67.34^{c}	44.86^{c}	112.60	2.52^{c}	1302^{b}
1.5% WSM	67.58^{ab}	70.81^{b}	47.86^{c}	112.74	2.37^{d}	1225^{c}
2% WSM	68.73^{a}	74.65^{a}	51.32^{a}	113.21	2.21^{e}	1147^{d}
SEM	0.44	0.71	0.50	0.46	0.03	14.11
P-value	0.005	0.0001	0.0001	0.0001	0.0001	0.0001

The means within the column row with at least one common letter, do not have significant difference (P>0.05).
SEM: standard error of the means.

The main reason related to WSM effective substances such as antioxidants and beta-carotene. It was mentioned previously that there are different compounds such as anti-oxidants, beta-carotene, potassium, iron, sodium, B complex vitamins, amino acids such as arginine, pectin and crude fiber in WSM (Najib and Basiouni, 2004). Each of these compounds by means of various mechanisms may have been able to have positive effects on laying hens health and improve their performance.

For instance, crude fibers acts via increasing the levels of digestive juices and amino acids synthesis by digestive tract microorganisms (Clarm, 1984; Carmen *et al.* 1985), anti-oxidants act by prev enting the oxidation of susceptible nutrients to oxidation (Puthpongsiriporn *et al.* 2001; Nobakht and Mehmannavaz, 2010) and potassium acts by supplying the requirements and ensuring proper electrolyte balance (Dai and Bessei, 2007; Nobakht *et al.* 2008), so, improving the health status, increasing the digestion and absorption of nutrients and finally, increasing the perform-ance.

Base on Table 4, using WSM significantly improved the albumin weight. As the major portion of egg albumin is the protein, it is thought that, by the inclusion of WSM the amounts of amino acid absorption increased and more amounts of them were transferred into eggs and increased the amount of egg albumin, as it was seen in group 5.

Table 4 The effect of feeding different levels of watermelon shell meal (WSM) on egg traits

Treatments	Specific gravity (mg/mL^3)	Yolk color	Shell weight (%)	Albumin weight (%)	Yolk weight (%)	Haugh unit
Control group	1.071	3.64	8.41^{ab}	62.26^{b}	29.61^{a}	81.27
0.5% WSM	1.068	4.00	8.39^{ab}	63.08^{b}	28.48^{a}	90.97
1% WSM	1.070	3.45	7.96^{b}	64.15^{ab}	27.89^{a}	85.89
1.5% WSM	1.074	4.00	8.81^{a}	63.47^{b}	27.72^{a}	89.05
2% WSM	1.069	3.24	7.94^{b}	65.77^{a}	24.02^{b}	92.92
SEM	0.002	0.41	0.18	0.69	1.03	3.22
P-value	0.24	0.63	0.04	0.04	0.03	0.17

The means within the column row with at least one common letter, do not have significant difference (P>0.05).
SEM: standard error of the means.

In this group, as the percentage of egg albumin considerably increased. The remaining percentage for shell and yolk reduced.

CONCLUSION

In the present study it was shown that in laying hens, using watermelon skin meal up to 2% of diets, significantly improved their shell performance and reduced the production cost.

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