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EFFECTS OF FABA BEANS INCLUSION INTO HENS' DIET AND AGE INFLUENCE ON EGG-SHELL QUALITY

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ABSTRACT

The aim of this experiment was to study the influence of Faba Beans (FB) (*Vicia faba L.*) and further the influence of birds' age on some egg-shell parameters of commercial layers. Seven different experimental diets (Raw Faba Beans "RFB" 10% - T_1, 20% - T_2 and 30% - T_3 were compared with Roasted Faba Beans "RoFB" 10% - T_4, 20% - T_5 and 30% - T_6 and both groups were compared with commercial layers', labeled control group C). The experiment was performed with seven group laying tests with 3 replications, thus with a total number of 630 birds aged 43 weeks. The control group and six trial groups were housed in 3 floor caged batteries. To test the effect of the birds' age on the egg-shell quality, 28 days during the experiment period (p) were observed. For the feeding we used a feed mixture of wheat, barley, soybean meal, RFB or RoFB, vegetable fats with added minerals, vitamins and enzymes. The influence of the diets and ages on egg-shell percentage (ESHP), egg-shell thickness (ESHT) and total broken egg percentage (TBEP) were studied. An insignificantly augmented value of ESHP was observed under T1, a significantly lower value of this parameter was observed under T2, as compared with control. During the age period ESHP was observed to decrease significantly ($P \leq 0.05$). In the T1 and T4 groups, ESHT values were higher than the other treatments, and tended to decrease with increasing FB levels in the diet. The age of the birds did not affect ESHT in our experiment. Including FB into the diet increased TBEP. However, the differences between trials and control remained insignificant, with the exception of the T2 group. A significant and gradually increased value of TBEP was observed with advancing age of the birds.

Key words: broken egg percentage, egg-shell percentage, egg-shell thickness, layers, *Vicia faba*

INTRODUCTION

The use of legumes as sources of protein for the animal feed industry is expected to increase further in the near future. Rising incomes in the Asian regions increase the demand for meat products; hence there is a proportional requirement for animal feeds. There have been changes in public perception and some unfortunate developments, such as the consequences of the 'mad cow' disease (i.e. bovine spongiform encephalopathy or BSE) in the UK, have taken place. This has resulted in many feed compounders either choosing to, or being banned from, using animal by-products as a source of protein (Farrell, 1997). A single source of plant proteins, however, is unable to provide the exact amount of amino acids required for all animals. It is therefore preferable to include a mixture of protein sources in diet formulations, each complementing the other (Hanburya, 2000).

There are many factors affecting the egg-shell quality such as genetic variation, environmental temperature, age of the bird and feeding etc. (Potts et al., 1985 and Faiath and Naji, 1989, Horniaková et al., 1995). It is possible to represent the strength and the quality of the egg-shell by egg-shell percentage and thickness (Nanakali, 1998).

A depression in ESHP is observed with the increasing age of birds (Izat et al., 1985; Al-Batshan et al., 1994; Silversides and Scott, 2001; Nanakali, 1998; Al-Haweizy, 2002). These authors confirmed the previous results, but their values were significant ($p \leq 0.05$). Marion et al. (1964) observed that the ESHP increases through the beginning to the middle of the production period, and then decreases towards the end of the production period.

Izat et al. (1985), Al-Batshan et al. (1994) and Nanakali (1998) found that ESHT decreased with the increase of birds' age. But Al-Haweizy (2002) observed an increase in ESHT through the period of 36-55 weeks

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of the birds' age. Mateos and Puchal (1982) observed a decrease in ESHT by using 10%, 20% and 30% of RFB in layers' diets, compared to the control. But this parameter was significantly improved by adding methionine to the diet. In another trial the authors observed that an inclusion of 4%, 8% and 12% of RFB in the diet had no effect on ESHT. The usage of different form of calcite (powdered and grained) confirmed better results in ESHT when the powdered form of calcite was used (Fľak at al., 2002).

The age of the birds affected the TBEP significantly (Nanakali, 1998; Al-Haweizy, 2002). There is a strong correlation between ESHP, ESHT and TBEP. Increasing ESHT and ESHP decreases TBEP (North, 1984). The positive correlation between the live weight of laying hens at the age of 5 weeks of their production and ESHP was confirmed Baumgartner at al. (2003).

Roland et al. (1975) pointed out that the TBEP increment at advanced ages of the birds could be attributed to increases in egg weight, thus increasing the egg-shell surface. However, as the shell substance deposition is constant, this leads to a depression in ESHT. Silversides (1994) attributed the depression in Ca and anorganic P in the blood to the depression in the utilization of these two elements by rising birds' age, thus deteriorating the egg-shell quality.

MATERIAL AND METHODS

The experiment was carried out in frame of the Erbil poultry project, and the laboratory analysis in the nutrition laboratory of the Agriculture College of the University of Salahaddin. The study focused on the determination of the effects using 10%, 20% and 30% of RFB and the same levels of RoFB compared with the control group, and the effect of the birds' age with commercial Hy-Lime®W98 layers. Egg-shell percentage (ESPH), egg-shell thickness (ESHT) and total broken eggs percentage (TBEP) were recorded.

A total of 630 hens aged 43 weeks were used in the experiment. The birds were housed in automatically controlled housings in 3 floor caged batteries (45x40x45cm) for each stage. They were distributed randomly into 7 groups, each group comprising 90 birds was placed into 18 cages (3 replications x 6 cages x 5 birds), which were fed with different mixtures. The experimental period lasted 140 days.

Table 1: Percentage composition and calculated chemical analyses of the rations

Feed staffs %	Treatments						
	T1	T2	T3	T4	T5	T6	control
Broad bean	10	20	30	10	20	30	0.0
SBM 44%*	10.985	6.618	2.252	10.985	6.618	2.252	15.347
Wheat	11.833	20.636	29.444	11.833	20.636	29.444	3.260
Barley	55.240	40.714	26.188	55.240	40.714	26.188	69.518
Vegetable Fat	0.800	0.800	0.800	0.800	0.800	0.800	0.800
Methionine	0.138	0.171	0.203	0.138	0.171	0.203	0.106
Lysine	0.122	0.127	0.132	0.122	0.127	0.132	0.117
Limestone	9.291	9.278	9.265	9.291	9.278	9.265	9.303
Di Cali Pho**	1.017	1.055	1.094	1.017	1.055	1.094	0.979
Salt	0.375	0.375	0.374	0.375	0.375	0.374	0.376
[Cx-Layer]***	0.025	0.025	0.025	0.025	0.025	0.025	0.025
Avienzyme****	0.080	0.080	0.080	0.080	0.080	0.080	0.080
Choline Chloride	0.044	0.069	0.093	0.044	0.069	0.093	0.039
Minerals*****	0.050	0.050	0.050	0.050	0.050	0.050	0.050
Calculated Chemical analyses for diets							
Kcal ME/Kg Diet	2570	2570	2570	2570	2570	2570	2570
Crude Protein %	15.19	15.19	15.19	15.19	15.19	15.19	15.19
Crude Fibre %	5.503	5.308	5.144	5.503	5.308	5.144	5.608
Calcium %	3.700	3.700	3.700	3.700	3.700	3.700	3.700
Phosphorus%	0.350	0.350	0.350	0.350	0.350	0.350	0.350
Lysine5	0.800	0.800	0.800	0.800	0.800	0.800	0.800
Methionine+Cystin %	0.58	0.58	0.58	0.58	0.58	0.58	0.58
Sodium	0.170	0.170	0.170	0.170	0.170	0.170	0.170
ME / CP	169.19	169.19	169.19	169.19	169.19	169.19	169.19

*Soybean meal **Di-calcium Phosphate ***Vitamin Complex - K3, E, Biotin, Pantothenic acid, Niacin, Folic acid, B12, B6, B2, B1, D3, A **** Xylanase, β-Glucanase ***** Mineral Complex - Cu, Fe, I, Mn, Si

Diet was provided to the birds *ad libitum,* at the end of the week leftover diet was collected and weighed to determine the daily feed consumption for each replication. The average daily feed consumption was 110.06 g for the control group and 109.86, 107.77, 109.65, 110.74 and 110.33 g for T2, T3, T4, T5 and T6 respectively. Dietary compositions are illustrated in table 1. The daily light period was 17 hours with a light density of 10 lux. The experimental scheme is presented in table 1:

Table 1: Scheme of experiment

Treatment	Description
Control	Commercial feed mixture
T1	10% Raw Faba Bean (10%RFB)
T2	20% Raw Faba Bean (20%RFB)
T3	30% Raw Faba Bean (30%RFB)
T4	10% Roasted Faba Bean (10%RoFB)
T5	20% Roasted Faba Bean (20%RoFB)
T6	30% Roasted Faba Bean (30%RoFB)

Heat treatment of FB seeds was carried out by roasting (baking) in a locally set up bakery. The following method was used:

1. Seeds were soaked in water for 5 minutes 24 hours before roasting in order to stimulate the seed endosperm growth, primarily to improve the dietary values of the protein (Mohsin, 2000).
2. Seeds were soaked in water a few minutes before placing them inside the bakery, to prevent seeds from direct high temperature exposure of the bakery (180^{o} C). They were roasted for two minutes. Temperature of seeds was measured for two minutes after heat processing and the temperature was 126°C – 130^{o}C.
3. Chemical analyses of the seeds were carried out according to A.O.A.C. 1975. Moisture was 7.08%, crude protein 23.5%, crude fat 1.0%, crude fiber 7.72%, and ash 3.7%.
4. Measurement of the egg-shell weight was carried out by drying it at room temperature, and then the ESHP was calculated. A micrometer apparatus type (Mitutouo/IP-54) was used to determine the ESHT including egg-shell with the two shell thin layers. TBEP was calculated by registering the total number of broken eggs - without shell, damaged and pecked eggs.
5. Statistical analysis was carried out by a factorial experiment conducted in C.R.D, with the model equation $Yijk = \mu + Ti + Pj + eijk$ and the means compared by the Duncan Multiple Range Test (Duncan, 1955) at a probability level of 5%.

RESULTS AND DISCUSSION

A significant lower value of ESHP was observed in T2 (table 2). This is attributed to the lowest feed consumption in the T2 group, thus leading to a deficiency in calcium (Ca) and phosphorus (P). This feature could also be attributed to the influence of a high concentration of phytic acid, which, when bound to Ca and P, inhibits the absorption of these materials through the small intestine (Al-Nouri, 1979 and Flaeh et al., 1998). Also, the effect of haemagglutinin should be considered, which inhibits the absorption by the mucosal layer along the intestine inner surface (Marquardt et al., 1974). T4, T5 and T6 results were similar to control. This could be attributed to the effect of the heat treatment, which may reduce ANTs effects, thus leading to the best utilization of Ca and P along the intestine mucosa.

Table 2: Effects of treatments on egg-shell percentage, thickness and total broken eggs

Treatments	Egg-shell characters		
	Percentage	Thickness	Total broken eggs
Control	9.866±0.184ac	0.341±0.002ab	2.2±0.3a
T1	10.014±0.179a	0.347±0.003a	2.4±0.4a
T2	8.909±0.119d	0.310±0.004c	5.0±0.4b
T3	9.681±0.119bc	0.335±0.004b	2.7±0.3a
T4	9.803±0.160ac	0.348±0.003a	2.9±0.3a
T5	9.696±0.148bc	0.336±0.003b	2.6±0.2a
T6	9.866±0.184ac	0.336±0.003b	3.0±0.5a

means within a colum without a common superscript letter were significantly different at P <0.05

ESHP was found to decrease with the advancing age of the birds (table 3). This is attributed to the depression of the Ca and P metabolism with the rising age of the bird, and to the decrease of D_3 activity in the blood serum, thus leading to a disorder in the calcium-balance mechanism in the body. These results are in accordance with those of Silversides and Scott (2001) and Al-Haweizy (2002).

Table 3: Effects of birds' age on egg-shell percentage, thickness and total broken eggs

Periods in days (28 days)	Egg-shell characters		
	Percentage	Thickness	Total broken eggs
P1	10.926±0.101b	0.337±0.004	2.2±0.35b
P2	10.523±0.152c	0.329±0.003	2.5±0.37b
P3	9.489±0.072d	0.337±0.002	3.0±0.35ab
P4	8.669±0.056a	0.338±0.002	3.4±0.31a
P5	8.680±0.059a	0.338±0.002	3.7±0.30a

a,b,c,d - see table 2

The lowest significant value was observed for ESHT in the T2 group when compared to other groups. This is attributed to the low value of egg-shell percentage in the T2 group, considering the depression of feed consumption. The differences in egg-shell thickness values between T4, T5 and T6 groups and the control were insignificant. This property can be attributed to the improvement in feed consumption in these groups by considering the heat treating to the FB seeds, which improves the palatability of the diet, and depresses ANFs effects. These results are in agreement with the results obtained by Mateos and Puchal (1982). The effect of bird's age on egg-shell thickness was insignificant.

An adverse relationship was observed between TBEP with both the egg-shell percentage and thickness. The highest value of TBEP was observed in the T2 group but lowest values were registered in both the T1 and the control group. This property could be explained by the dependence of egg-shell quality to both the parameters of egg-shell percentage and thickness.

Rising age of birds affected the TBEP adversely, and it increased gradually with the advancing age of birds. This can be attributed to the significant decrease of egg-shell percentage with older birds. It could also be explained by the increase of egg weight, because the shell substance deposition is constant and at the same time the surface of the egg increases by increasing egg weight with advancing age. Thus the shell substance is deposited on a wider surface, which leads to a decrease in the thickness, thus increasing the probability of the occurrence of broken eggs. These results are in accordance with Scott et al. (1982), Thompson et al. (1985), Abdullah et al. (1993), Nanakali (1998), Chowdhury and Smith (2001) and Al-Haweizy (2002).

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