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Impact of aqueous extracts of Borage and Melilotus plants on some egg quality traits for laying hen

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Abstract

This study was carried out to evaluate the effect of aqueous extracts of Borage flowers and (*Borago officinalis*) and the air parts of Melilotus (*Melilotus officinalis*) on some egg quality traits. A total number of 180 Lohmann Brown laying hens at 56 weeks of age were randomly distributed into four groups; each group was sub-divided into nine replicates (5 hens/ replicates). The first group (C) received drinking water without additives and consider as control, the second group (T1) received drinking water supplemented with the aqueous extract of flowers of Borage plant (BF) at level 4 ml / liter of water, the third group (T2) received drinking water supplemented with the aqueous extract for air parts of Melilotus plants (MAP) at level 4 ml / liter of water, and the forth group (T3) received drinking water included the mixture of extracts of Borage and Melilotus at level 4 ml for each/liter of water. The experiment included the following traits: weights and heights of yolk and albumen, shell weight and thickness and Haugh unit. The results of this study showed that there was a tendency to improvement in some egg quality traits by using aqueous extracts of Borage and Melilotus plants at level 4 ml for each /liter of drinking water for Lohmann Brown laying hens. However, the differences were not significant among all groups. It is recommended to conduct other studies on these two plants and use it in different forms and levels.

Keywords: Borage, Melilotus, aqueous extracts, egg quality, laying hen.

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1. Introduction

In recent years, one of the top priorities in poultry production is to identify new nutritional supplement alternatives that will enhance animal health, quantitative and qualitative production standards (Gerzilov *et al.*, 2015). Many medicinal plants have different biological properties due to the abundance of active compounds that improve animal growth and immunity (Soltan *et al.*, 2018). This is due to the active substances they contain, which are known as metabolites. These substances are byproducts of the secondary metabolism of plants, and they include phenolic acids, flavonoids, terpenes, amino acids, alkaloids and other substances (Al-Snafi, 2018; 2019). These compounds have a variety of biological functions, such as antioxidants (Momen Heravi *et al.*, 2014; Mladenovi *et al.*, 2016), antimicrobials (Al-Snafi, 2020), and anti-inflammatory properties. Borage is an herbaceous plant belonging to the intimate family *Boroginaceae* (Leos-Rivas *et al.*, 2011). Physiotherapy practitioners use borage to regulate metabolism and the hormonal system (Miraj and Kiani, 2016). According to Karimi *et al.* (2018), the borage plant has several medicinal properties as it acts as an antioxidant, anti-bacterial, anti-inflammatory and anti-cancer agent when used as an extract, whether methanol, ethanol or aqueous. Its importance is in suppressing free radicals and thus preventing deadly diseases; that since it contains flavonoids and phenols, and these compounds have antioxidant, allergic and inflammatory biological activity (Hale *et al.*, 2008). Oskoueian *et al.* (2011) stated that the borage plant contains alkaloids, tannins, saponins and coumarins. For the Melilotus plant, it is an herbaceous plant that belongs to the family *Fabeaceae* (Anwer *et al.*, 2008). Melilotus plant also has the advantage of having antioxidant activity and this biological activity is due to its high content of phenols and flavonoids (Sheikh, 2017). The aqueous extracts of medicinal plants and herbs are important not only in botany and modern natural therapy, but also for the food and fodder industries because they contain antioxidants and are appetizing and digestive (Abdollahi *et al.*, 2003). Egg quality is important from an economic perspective. Egg producers are particularly interested in shell quality, while chefs are interested in the functional and physico-chemical characteristics of eggs, which signify freshness and quality. The production and quality of eggs are greatly affected by the physiological condition of the laying hens (Singh *et al.*, 2009). In general, the egg quality, whether hatching or table eggs, plays a fundamental role in the economic return. It is known that the egg quality begins to decline soon after the first egg is laid. So, this experiment was designed to study the effects of aqueous extracts of Borage and Melilotus plants on some egg quality traits for Lohmann Brown laying hens at 56 weeks of age as an attempt to improve egg quality.

2. Materials and methods

2.1 Experimental design and diet

This study was carried out at the Poultry Research Station, Department of Animal Resource, Directorate of Agricultural Research, Ministry of Agriculture, Iraq. The experiment lasted 10 weeks from July to September of 2017. A total number of 180 Lohmann Brown laying hens aged 56 weeks were randomly distributed into four groups. Each group included nine replicates of 5 birds each. The first group (C) received drinking water without additives and served as control, the second group (T1) received drinking water supplemented with the aqueous extract of Borage flowers (*Borago officinalis*) at level 4 ml / liter, the third group (T2) received drinking water supplemented with the aqueous extract of Melilotus air parts at level 4 ml / liter, and the forth group (T3) received drinking water included the mixture of extracts of Borage and Melilotus at level 4 ml for each/ liter. All hens were raised in cages (5hens/cage) at the same space, in closed house under similar hygienic and environmental conditions with automatic ventilation. The birds during the whole experimental period (from 56 to 65 weeks of age) are exposed to the same lighting program of (16 hour light: 8 hour dark per day); which depend on artificial lighting. Birds in all experimental groups fed a commercial diet which recommended for strain, during all experimental periods. Feed amount was restricted by about 120g/ bird/ day. The composition and proximate chemical analysis of commercial diets were presented in Table (1).

Table (1): Composition and calculated analysis of laying hens diet.

Ingredients	%
Corn	45.00
Wheat	27.00
Soybean Meal (48%)	14.00
Protein concentration (layer)*	5.00
Soybean oil	0.20
Dicalcium Phosphate	1.40
Sodium Chloride	0.05
Limestone	7.35
Total	100
Calculated analysis**	
Metabolizable energy (kcal/kg diet)	2784
Crude protein, (%)	15.90
Methionine, (%)	0.35
Methionine + Cysteine, (%)	0.60
Lysine, (%)	0.76
Calcium, (%)	3.40
Available phosphorus, (%)	0.50

* Product From Netherlands Origin (Brocon). It contains 40% Crude Protein, 2107 Kcal / Kg, Crude Fat 2.20%, Crude Fiber 5%, Calcium 4.68%, Phosphorus 3.85%, Lysine 4.12%, Methionine 4.12%, Methionine plus Cysteine 0.42%, Tryptophan 0.38%, Threonine 1.70%. ** According to NRC (1994).

The eggs were daily collected three times per day at 8AM, 11AM and 1PM. Specific egg quality traits were measured at the middle of 5^{th} and 10^{th} weeks of study. Eggs were weighed individually and recorded to calculate average egg weight (g) using a sensitive balance. Shell with membranes were dried for 72 hours and weighed to the nearest 0.01 g. Shell (%) measured as percentage of egg weight. Shell thickness of the dried shell (without membranes) was measured using shell thickness apparatus at four different regions of the shell (blunt, pointed and both sides) and the average was recorded (mm). The yolk was separated gently from the albumen and weighted. Yolk % was calculated as percentage of egg weight. The albumen weight was calculated by subtracting both of shell and yolk weight from egg weight. Yolk height was measured using a Micrometer, as described by Brant and Shrader (1952). Albumen height was measured in mm using a tripod micrometer at the highest region of the thick albumen connected with yolk (Wilgus and Van Wagenen, 1936). Haugh units were recorded and calculated from the egg weight and albumen height, as described by (El-Tarabany *et al.*, 2015), it calculated for each egg using the following equation: Haugh unit = 100 log (H + 7.57 - 1.7 × $W^{0.37}$), Where: H = the height of albumen (mm); W = weight of egg (g).

2.2 Aqueous extract

Aqueous extracts for Borage and Melilotus plants were prepared according to the method described by Duh and Yen (1997). The plants were obtained from reliable sources. 10 g of each plant was placed with 300 ml of boiled distilled water and left for 30 minutes on the magnetic stirrer at room temperature and mixture was filtered by layers of gauze. Then, the filtrate was concentrated by a rotary evaporator at a temperature of 70 C°.

2.3 Statistical analysis

The observed data was subjected to one way analysis of variance (ANOVA) using General Linear Model (GLM) procedures by SAS software program (SAS, 2012) for the significance of treatments effect. The statistical model was as follows:

$Y_{ij} = \mu + T_i + e_{ij}$

Where: Yij = Dependent variable, μ = Overall mean, T_i= Effect of treatment, e_{ij} = random error.

Differences among means of the experimental groups were testified for significance by Duncan's multiple range test (Duncan, 1955). Significant differences were considered to exist when $P \leq 0.05$.

3. Results

From data are shown in Table (2) the results revealed that there was a tendency to improvement in yolk, albumen and shell percentages by using aqueous extracts of Borage and Melilotus plants at level 4 ml for each /liter of drinking water for Lohmann Brown laying hens as compared to control group. However, the differences were not significant among all groups.

Table (2): Effect of aqueous extracts of Borage and Melilotus plants on yolk, albumin and shell percentages (%) for laying hens (mean ± standard error).

Parameters	Age	Treatments				Sig.
		C	T1	T2	T3	
Albumin (%)	60th week	65.61±1.31	65.58±1.58	65.61±1.51	65.62±1.66	NS
	65th week	64.15±1.56	64.21±1.93	64.18±1.51	64.20±1.51	NS
	Mean	64.87±1.24	64.89±1.82	64.90±1.04	64.91±1.29	NS
Yolk (%)	60th week	24.55±1.14	24.64±1.03	24.69±0.86	24.79±1.24	NS
	65th week	26.13±1.00	26.28±0.99	26.19±1.15	26.36±1.05	NS
	Mean	25.35±0.89	25.46±1.34	25.44±1.21	25.57±1.07	NS
Shell (%)	60th week	9.82±0.32	9.81±0.38	9.72±0.47	9.68±0.25	NS
	65th week	9.72±0.27	9.50±0.40	9.64±0.32	9.48±0.30	NS
	Mean	9.76±0.32	9.65±0.43	9.68±0.36	9.61±0.37	NS

C= Control (without additives), T1= 4 ml of aqueous extract of flowers of Borage plant / liter of drinking water, T2= 4 ml of aqueous extract for air parts of Melilotus plants / liter of drinking water. T3= Mixture of extracts of Borage and Melilotus at level 4 ml for each / liter of drinking water. NS= No significant.

Our observations are shown in Table (3) explained that adding aqueous extracts of Borage and Melilotus plants at level 4 ml / liter insignificantly enhanced albumen and yolk height as compared to control group.

Table (3): Effect of aqueous extracts of Borage and Melilotus plants on albumin and yolk heights (mm) for laying hens (mean ± standard error).

Parameters	Age	Treatments				Sig.
		C	T1	T2	T3	
Albumin height (mm)	60th week	9.77±0.42	9.85±0.53	9.81±0.41	10.00±0.42	NS
	65th week	9.55±0.64	9.64±0.55	9.48±0.45	9.71±0.61	NS
	Mean	9.67±0.51	9.74±0.41	9.66±0.36	9.84±0.47	NS
Yolk height (mm)	60th week	17.95±0.73	18.03±0.82	18.19±1.03	18.22±0.91	NS
	65th week	18.21±0.75	18.40±0.69	18.61±0.73	18.67±0.89	NS
	Mean	18.09±0.81	18.21±0.87	18.39±0.92	18.43±0.88	NS

C= Control (without additives), T1 = 4 ml of aqueous extract of flowers of Borage plant / liter of drinking water, T2 = 4 ml of aqueous extract for air parts of Melilotus plants / liter of drinking water, T3 = Mixture of extracts of Borage and Melilotus at level 4 ml for each liter of drinking water, NS= No significant.

The effects of aqueous extracts of Borage and Melilotus plants on shell thickness and Haugh unit are shown in Table (4). Results showed that T3 group had the highest ($P > 0.05$) Haugh unit value, followed by T1 group, then T2 group, while the lowest ($P > 0.05$) Haugh unit value was observed for control group. However, our findings stated that the differences in shell thickness and Haugh unit were not significant among all groups.

Table (4): Impact of different soil organic amendments on hydraulic properties of soil after the growing seasons of 2017-2018 and 2018-2019.

Parameters	Age	Treatments				Sig.
		C	T1	T2	T3	
Shell thickness (Mm)	60th week	1.70 ± 0.09	1.71 ± 0.06	1.68 ± 0.11	1.73 ± 0.07	NS
	65th week	1.60 ± 0.08	1.62 ± 0.08	1.66 ± 0.05	1.65 ± 0.06	NS
	Mean	1.65 ± 0.05	1.66 ± 0.06	1.67± 0.07	1.69 ± 0.09	NS
Haugh unit	60th week	83.81±2.33	84.33±2.69	84.09±2.35	84.79±2.58	NS
	65th week	86.43±2.31	86.76±2.16	86.69±1.92	87.07±2.07	NS
	Mean	85.13±1.96	85.50±1.77	85.26±2.02	85.70±1.95	NS

C= Control (without additives), T1 = 4 ml of aqueous extract of flowers of Borage plant / liter of drinking water, T2 = 4 ml of aqueous extract for air parts of Melilotus plants / liter of drinking water. T3 = Mixture of extracts of Borage and Melilotus at level 4 ml for each liter of drinking water, NS= No significant.

4. Discussion

The improvement in some egg quality traits when aqueous extracts of Borage and Melilotus plants were added may be attributed to that the Melilotus plant contains phenylacetic acid and flavonoids, and this plant also has the advantage of having antioxidant activity and this biological activity is due to its high content of phenols and flavonoids (Sheikh, 2017). Also, the borage plant acts as an antioxidant when used as an extract (Karimi *et al.*, 2018); its importance is in suppressing free radicals (Karimi *et al.*, 2013). Phytochemicals have been shown to exert their positive antioxidant benefits to animals in terms of preferred performance and quality of production (Tyagi and Vasishtha, 1996). From a biological point of view, this is crucial because compounds with antioxidant activity can protect cellular systems from the damaging effects of metabolic processes that cause excessive oxidation. In addition, the antioxidant can interrupt free-radical chain reactions and the equivalent free radicals (Moline *et al.*, 2000). From a biological point of view, this is important because compounds with antioxidant activity can protect cellular systems from the harmful effects of metabolic processes that cause excessive oxidation. In addition, antioxidants can interrupt the reactions of chain free radicals and equivalent free radicals (Moline *et al.*, 2000). Hence, protecting the cells of the body and thus improving metabolism and utilization of nutrients through their positive and direct effect on the physiological state of the bird's body. This also leads to improving the performance of the reproductive system, which leads to improving the egg quality.

5. Conclusion

The presents study revealed that using aqueous extracts of Borage and Melilotus plants at level 4ml for each in drinking water for Lohmann Brown laying hens at 56 weeks of age had not significant effects on some egg quality traits. Hence, we recommend further studies on these plants at different forms and levels to determine the best level needed to obtain the highest egg quality for laying hens.

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