The efficacy of different Dietary levels of *Alhagi graecorum* herb on Eggs Characteristics of Japanese quail *(Coturnix japonica)*

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Abstract

The experiments of the current study were carried out in poultry houses to the College of Agriculture, the University of Al-Qadisiyah, in AL-Diwaniyah City, Republic of Iraq. The current study aimed to compare the effectiveness of dietary supplementation of (*Alhagi graecorum*) on some qualitative characteristics of Japanese quail (*Coturnix japonica*) eggs. A total of 80 Japanese quail birds weighted an average of 125 g at 12 weeks of age were randomly distributed to groups based on *Alhagi graecorum* herb additive level in the diet : A without addition (control group), B (2%), C (4%) and D (6%). Each treatment was replicated in 2 cages (10 birds per each) in a 6-week experimental period. The results showed that the levels of addition did not lead to clear differences in the average of eggshell thickness, except for the birds of treatment B, C and D in the third week 0.250 mm for each, respectively; $p<0.05$. In the sixth week of the experiment, High significance difference ($p<0.01$) was observed in the relative eggshell weight, as the birds of C treatment achieved the highest values (15.22%). A significance difference was observed in the relative albumen weight at the first and third weeks ($p<0.01$), where the birds of the C and D treatments show significance $p<0.01$ (54.56% and 54.55%, respectively). On the same track, the birds of the two previous treatments alternated superiority in the relative yolk weight trait at the first and fifth weeks, respectively (34.57% and 38.41% respectively). In conclusion, dietary supplementation of *A. graecorum* herb at levels starting from 6% led to significant increase in the qualitative characteristics of the eggs of Japanese quail.

Key words: *Alhagi graecorum*, Japanese quail, egg, qualitative characteristics.

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Introduction

Major or secondary links between the sciences related to the poultry industry led to remarkable progress in this field. A close correlation was observed between the reproductive and genetic aspects related to the genetic improvement, but the association among the nutritional, reproductive and productive aspects is no less important than the previous one (1,2,13,23and30). Many medicinal plants or chemical compounds derived from these plants have been introduced In the field of poultry nutrition, such as chrysin (3and4) ginger (4), Mannatree (5and37). *A. graecorum* herb is also known as camel thorn, and it is a medicinal herb that is widely spread in many countries around the world in Asia, Australia and Europe. *A. graecorum* is an herbaceous perennial plant with a height of 60-100 cm, its roots are deep in the soil. Sometimes, the depth of the roots reaches 10-15 m so that it can absorb moisture from the soil, especially since this plant lives in semi-arid areas that receive a small amount of rain. It is one of the herbs commonly used in fodder and medicinal uses as a result of containing adose of phytochemical compounds and nutrients that are useful in treating and preventing many diseases (22). According to the references, the herb has many advantages that qualify it to conduct many extensive types of research on all destinations related to living cell and animal production including farm animals and poultry. Numerous studies have proven that the *Alhagi* species contain many elements, chemical and biological compounds, for example, but not limited to flavonoids (6 and33) fatty acids (11and16) Coumarins (7) alkaloids and sterols (11and16).

The Japanese quail (*Coturnix japonica*) has gained afamous economic importance as a dual-purpose bird (eggs and meat). Japan is one of the leading countries that sought to raise the level of egg production, while the focus on meat production was in Europe. The bird is characterized by its small size and weight, which ranges between 80 and 300 g. The period of the bird generation is 3 to 4 times annually. The bird is characterized by its resistance to diseases and high egg production. (38) Recently, the demand for this bird has increased and it is receiving great research interest in various countries of the world. In Iraq, there was a tendency to pay attention to this bird being an important source of eggs and meat. Here, in our current study, we sought to study the effect of adding *Alhagi graecorum* herb in different proportions to the quail feed mixture on some qualitative characteristics of eggs within the local conditions of Iraq.

Materials and methods

Rearing and feed:

The study was conducted in poultry houses belonging to the College of Agriculture, the University of Al-Qadisiyah in Al-Diwaniyah city, Republic of Iraq. The birds were housed in cages covered with metal nets. The dimensions of one cage were 3 × 4 × 5 M. Diet mixtures were provided in the morning and evening times by specific feeders throughout the experiment period, which extended for forty days , while drinking water was provided by fountains that match the height of the bird. Birds of the study were fed on a standard diet based on yellow corn and soybean (Table1).

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The overall housing conditions were controlled including temperature (25 ^{0}C), ventilation and humidity (60%-70%).The birds were subjected to light for18 h/day.

Table 1. Ingredient of production diet-fed birds of the study (according to NRC 1994)

Component	Treatment			
	T1 (Control) A	T2 B	T3 C	T4 D
Alhagi (powder)	0	2	4	6
Limestone (powder)	0.6	0.6	0.6	0.6
Soybean gain(48%)	30	30	30	30
Wheat	8	8	8	8
Salt	0.4	0.4	0.4	0.4
Yellow corn	50	50	50	50
Protein concentrate	10	10	10	10
Dicalcium phosphate (DCP)	1.00	1.00	1.00	1.00
Chemical analysis				
Metabolizable energy	3000			
Crude protein	21.85			
Phosphorus	0.38			
Calcium	1.14			
Methionine	0.41			
Lysine	1.08			

Qualitative characteristics measurements:

The qualitative characteristics (internal and external) of the egg were measured at an average of once a week. Three eggs were taken from each replicate. Egg weight was recorded from each replicate. To achieve measurements, the eggs were broken on a glass surface. The procedures and measurements of the studied parameters were made with the help either rephrase of some of the previous researches (18,25and 34).

Relative yolk weight (RYW):

The yolks were separated from the albumen using strainer with large holes. After removing the surrounding- albumin, the yolk (g) was weighed using a digital scale. The RYW was calculated by the following equation:

$$RYW = \frac{egg\ yolk\ weight(g)}{egg\ weight\ (g)} \times 100$$

Relative albumen weight (RAW):

The weight of the albumen was measured using a digital scale. RAW was calculated according to the formula:

$$RAW = \frac{egg\ albumen\ weight(g)}{egg\ weight\ (g)} \times 100$$

Average eggshell thickness (AST):

After the yolks and albumen were weighed, the shells were left to dry. Next, the shell was removed and weighed using a sensitive scale. AST was calculated according to the following formula:

$$AST = \frac{egg\ shell\ weight(g)}{egg\ weight\ (g)} \times 100$$

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Shell thickness:

Thickness of the eggshell with its membranes was measured after they were left for two days to dry. The thickness of the shell was measured from the wide and pointed end using a micrometer device.

Experimental design and sampling:

84 days-old female Japanese quail birds (125 ± 5g) were used in a 42-day feeding trial with two replicates (10 birds per each). According to the one-factor random design, birds were randomly distributed to four groups (treatments) based on *Alhagi graecorum* level in the feed mixture: A: control; without addition, B:2%, C:4% and D:6%. Records of the studied traits were taken for 6 consecutive weeks (experimental period).

Statistical analysis:

Values of the studied traits across the various groups of birds among treatments were expressed as mean ± standard error of the mean (SE). One-way analysis of variance (ANOVA) was applied to analyze the data according to the maximum likelihood (ML) mathematical way. For this purpose, the statistical analysis software (SAS) with the version of SAS/STAT17(31) has been resorted to. Differences among means of various parameters that were tested by least significant difference(Duncan) were considered statistically different at the level of $p<0.05$ and $p< 0.01$.

Results

Average eggshell thickness (AST).

By looking at the outputs of Table 2, the AST values fluctuated between 0.240 mm and 0.260 mm overall. According to the stage of age, it is noted that the eggshell thickness of the birds across the various treatments did not show any significant differences that drew attention except the third week. In the third week, in particular, a clear superiority ($p<0.05$) was observed in the trait values, as the birds of B,C, and D treatments achieved a standardized value (0.250 mm) compared to the birds of the control treatment A (0.240 mm).

Relative eggshell weight (REW).

Relative eggshell weight to egg weight values is presented in Table 3. On the same path for the previous trait, no significant differences were observed across most groups of birds in treatments according to stage of age, except for the sixth week. Birds fed a ration containing 4% of *Alhagi graecorum* (B treatment) achieved the highest values (15,22%; the sixth week), while the lowest values reached 13.15% for birds of the control treatment A. Otherwise, it was noted that the lowest values reached 10.27% (birds of C treatment; the fourth week).

Relative albumen weight (RAW).

Across the care stage and within the treatments, significant differences were observed in the first and third weeks (Table 4). In the first week, the birds of C treatment showed a relative superiority compared to the rest of the birds in the different treatments (54.56%; $p<0.01$). In the third week, the birds of D treatment achieved the highest value (54.55%; $p<0.01$). On the other hand, the lowest value was 49.25 (birds of C treatment; the sixth week).

Relative yolk weight (RYW).

The results of Table 5 show that there are no significant differences across groups of birds

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in different treatments in most weeks of care except for the first and fifth weeks. In the first week, the birds of D treatment relatively outperformed the rest of the other treatment birds (34.56%; p<0.01). In the fifth week, a noticeable superiority was observed for the birds of the same group (38.41%; p<0.01), where the difference between the birds of this treatment and the birds of treatment C was 3.03%.

Table. 2. Mean± standard error (SEM) of average eggshell thickness (AST) of the birds fed on rations of different levels of mannatree (*Alhagi graecorum)*

Date of experiment (week)	Treatment[1]				Probability[2]
	A	B	C	D	
1	0.245 ± 0.005	0.245 ± 0.005	0.240± 0.000	0.240± 0.010	NS
2	0.250±0.000	0.245± 0.005	0.255± 0.015	0.240± 0.000	NS
3	0.240± 0.00^{b}	0.250± 0.000^{a}	0.250± 0.000^{a}	0.250± 0.000^{a}	<0.05
4	0.245± 0.005	0.245± 0.005	0.240± 0.000	0.245± 0.0050	NS
5	0.250± 0.010	0.260± 0.000	0.260± 0.010	0.265± 0.0050	NS
6	0.255± 0.005	0.250± 0.000	0.260± 0.000	0.260± 0.010	NS

[1]: A: control treatment (Without addition), B: 2% *Alhagi graecorum*, C:4% *Alhagi graecorum*, D:6% *Alhagi graecorum*.[2]: NS: not significant. Across the treatments, each subscript letter denotes a subset of treatment categories whose proportions do not differ significantly from each other at the p<0.05 level.

Table. 3. Mean± standard error (SEM) of relative eggshell weight (REW)of the birds fed on rations of different levels of mannatree (*Alhagi graecorum)*

Date of experiment (week)	Treatment[1]				Probability[2]
	A	B	C	D	
1	11.36 ± 0.25	11.49 ± 0.11	10.86± 0.17	10.98± 0.09	NS
2	11.59±0.47	10.99± 0.69	12.02± 0.49	10.78± 0.53	NS
3	11.82± 0.82	10.72± 0.41	12.12± 0.45	10.75± 0.07	NS
4	11.37± 0.86	10.56± 0.26	10.27± 0.02	10.80± 0.52	NS
5	14.20± 0.20	14.36± 0.02	12.99± 1.10	13.62± 0.53	NS
6	13.15± 0.62^{b}	13.94± 0.70^{ab}	15.22± 0.14^{a}	13.79± 0.09^{ab}	< 0.01

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[1]: A: control treatment (without addition), B: 2% *Alhagi graecorum*, C:4% *Alhagi graecorum*, D:6% *Alhagi graecorum*.[2]: NS: not significant. Across the treatments, each subscript letter denotes a subset of treatment categories whose proportions do not differ significantly from each other at the p<0.01 level.

Table. 4. Mean± standard error (SEM) of relative albumen weight (RAW) of the birds fed on rations of different levels of mannatree (*Alhagi graecorum)*

Date of experiment (week)	Treatment[1]				Probability[2]
	A	B	C	D	
1	54.17 ± 0.1^{6b}	54.32± 0.09^{ab}	54.56± 0.04^{a}	54.46± 0.01^{b}	< 0.01
2	53.93±0.04	54.05± 0.16	53.83± 0.29	54.31± 0.29	NS
3	53.87± 0.16^{ab}	53.91± 0.02^{ab}	53.64± 0.25^{b}	54.55± 0.17^{a}	< 0.01
4	54.34± 0.38	54.29± 0.09	54.37± 0.24	54.25± 0.23	NS
5	49.77± 0.64	49.81± 0.16	49.69± 0.13	47.97± 0.67	NS
6	49.42± 0.50	49.29± 0.50	49.25± 0.15	49.39± 0.02	NS

[1]: A: control treatment (without addition), B: 2% *Alhagi graecorum*, C:4% *Alhagi graecorum*, D:6% *Alhagi graecorum*.[2]: NS: not significant. Across the treatments, each subscript letter denotes a subset of treatment categories whose proportions do not differ significantly from each other at the p<0.01 level.

Table. 5. Mean± standard error (SEM) of relative yolk weight (RYW) of the birds fed on rations of different levels of mannatree (*Alhagi graecorum)*

Date of experiment (week)	Treatment[1]				Probability[2]
	A	B	C	D	
1	34.47 ± 0.09^{b}	34.20± 0.02^{b}	34.57± 0.13^{a}	34.56± 0.08^{a}	< 0.01
2	34.33±0.33	34.97± 0.53	34.16± 0.20	34.91± 0.25	NS
3	34.30± 0.98	35.15± 0.39	38.38± 0.20	34.95± 0.10	NS
4	34.30± 0.30	35.15± 0.36	38.38± 0.20	34.95± 0.29	NS
5	36.03± 0.45^{b}	35.84± 0.18^{b}	35.38± 0.23^{ab}	38.41± 0.15^{a}	< 0.01
6	35.37± 0.63	36.77± 0.65	37.60± 0.77	36.83± 0.10	NS

[1]: A: control treatment (without addition), B: 2% *Alhagi graecorum*, C:4% *Alhagi graecorum*, D:6% *Alhagi graecorum*.[2]: NS: not significant. Across the treatments, each subscript letter denotes a subset of treatment categories whose proportions do not differ significantly from each othe at the p<0.01 level.

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Discussion

Medical plants used in the nutritional and productivity destinations of poultry several modern approaches and applied theories that are in line with the traditional way, have appeared to improve the nutritional and productive situations. Most of these plants including *A. graecorum* are closely related to each other and share some features and principles in the mechanism of effectiveness, In our current study, the clear effect of *A. graecorum* on the qualitative characteristics of quail eggs (Tables 2,3,4 and 5) can be attributed to a group of multiple explanation and mechanisms. In the available references related to the studied plant, but three main pathways can be worthy explanations. Perhaps flavonoids that are present in high levels in the different sections of the studied plant *(A. graecorum)* will contribute to increasing the efficiency of the digestive activities in the digestive tract. In more detail, flavonoids modulate the different bioactivities of the gastrointestinal like metabolism, distribution, absorption and excretion by targeting the luminal molecules, microbiota and gastrointestinal tract cell types. Furthermore, flavonoids equilibrate the concentrations of glucose and lipids. Besides, flavonoids play a fundamental role in regulating the activity of enzymes responsible for lipid and carbohydrate absorption (12,26and39).

In one of the studies related to the effects of flavonoids on laying hen performance and egg quality (14), the flavonoids hesperidin, naringin and quercetin were added separately at a rate of 0.5 g/kg. It was found that the previous levels had a significant effect on the albumen index; (p=0.02) and yolk index (p=002). The same study showed significant differences in the total cholesterol (p=0.0001), cholesterol esters (p= 0.0001) and free fatty acid (p= 0.004) (egg yolk lipid). Concerning eggshell strength, eggshell thickness and Haugh unit, the study of Liu (20) reported that the addition of flavonoids (quercetin) affected the previous parameters.

The effect of *A. graecorum* on the traits studied in the current research is the effect on supporting the health status and immune system of the bird. In addition to flavonoids, many studies indicated that the plant contains several compounds and chemical elements (fatty acids, methanolic and alkaloid extracts) that raise intestinal resistance and improve absorption through antioxidant, anti-proliferative and antimicrobial activities (17,19,28 and35).

Some mechanisms have been clarified in the oxidative-reducing activity, especially concerning the prominent role in this activity of the zinc element present in the studied plant. A direct correlation was observed between zinc and malondialdehyde (MDA). Zinc acts as an antioxidant in several ways like the conservation of protein sulfhydryl and reducing the conversion of hydrogen peroxide (H_2O_2) to OH (27and29).

To reducing cytotoxicity levels in the cell membrane. This activity is indeed subjected to several considerations (inhibition the of synthesis of fatty acid, topoisomerase, proteasome,topoisomerase), but phenol compounds, within certain levels, will contribute to a clear reduction in the effect of cytotoxicity levels (8,9,10 ,32,36 and 40).

Some studies indicated the great role of the *A. graecorum* herb in increasing the effectiveness of blood in the various physiological activities of the body. Some studies indicated the great role of the plant in increasing the effectiveness

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of blood in the various physiological activities of the body. The reason for this is that the *A. graecorum* is rich in vitamins C and B12. Particularly, vitamin C stimulates the secretion of the erythropoietin hormone, which is involved in the formation of red blood cells (15and21).

For Japanese quail, the results of the current study were logical in comparison with many studies that used feeding mixtures that do not contain plant additives. In a study using standard mixtures, the values of RYW, RAW and eggshell thickness (%)the treatments (A and B); farm A and; farm B (34). In general, for the previous traits in our study, a slight relative fluctuation was observed compared to the results of a group of studies (24and25).

In fact, adding the *A. graecorum* herb to the feed mixture in our study is considered a supportive addition due to what this plant contains of reasonable amounts of protein and fat, which will positively affect the causal relationship between metabolism, the various activities of digestion and the productivity side, whether for meat or eggs with its various parameters.

Conclusion

From what was presented in our current study, it is concluded that the addition of the *A. graecorum* herb to the quail feed mixtures at levels ranging between4% to 6% led to an slight amelioration in some qualitative characteristics of eggs.

Conflict of interest

The authors declare no conflict of interest.

References

1.Al-Bandr,L.K.and Qasim,A.A.2017. Effect ofsupplementing different levels of conjugated linoleic acid(CLA) to the diet on productive performance of broiler chicken. *Iraqi Journal ofAgriculturalSciences*.48(4):1081-1088. https://doi.org/10.36103/ijas.v48i4.365.

2.Al-Rubaee, M.A.M .; S.J.Hamodi and Hussein,F.M.2017. Effect of enzyme supplementing and soaking to the diets of the laying hens containing corn and wheat on productive performance. *Iraqi Journal of Agricultural Sciences.* 48 (2) : 485 - 495. https://doi.org/10.36103/ijas.v48i2.411.

3.Al-Tawash,A.S.;A.Z.Shahneh;H.Moravej and Ansari, M.2017. Chrysin-induced sperm parameters and fatty acid profile changes improve reproductive performance of roosters. *Theriogenology*.104:72–79. https://doi:10.1016/j.theriogenolog.

4.Al-Tawash,A.S.;T.A.Suwaihi;M.S.Mohammad and Mohsen A.2020. Beneficial effects of chrysin and ginger on blood biochemical parameters, hematology and immune response of broilers. *Plant Archives*. 20: 215-219.

5.Al-Tawash, A.S.; M.S. Mohammad and Mahdy, M.R.2020. Impact of Addition of *Alhagi graecorum* to Quail Diet on Physiological and Biochemical Blood Parameters. *Indian Journal of Ecology* .12:306-309.

6.Al-Yahya,M.A.;J.S.Mossa;A.A.AlBadr;M.S.Tariq and Al-Meshal , I.A .1987. Phyto chemical and biological studies on Saudi medicinal plants Part 12. A Study on Saudi Plants of Family “Leguminosae.” International Journal of Crude Drug Research, 25(2), 65–71. https://doi.org/10.3109/13880208709088128.

7.Behari,MandGupt,S.C.1980. The isolation and biogenesis of 24-alkylsterols in *Alhagi*

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pseudoalhagi.ActaCiencIndicaChem.6:207–208.

8.Brusselmans,K.;R.Vrolix;G.Verhoeven and Swinnen,J.V.2005. Induction of cancer cell apoptosis by flavonoids is associated with their ability to inhibit fatty acid synthase activity.J.Biol.Chem. Feb 18;280(7):5636-45. https://doi: 10.1074/jbc.M408177200.

9.Chen,D.;K.G.Daniel;M.S.Chen;D.J.Kuhn; K.R.Landis-Piwowar and Dou, Q.2005. Dietary flavonoids as proteasome inhibitors and apoptosis inducers in human leukemia cells. *Biochem. Pharmacol*. 69: 1421- 1432.

10.Ganguly,C.;PSaha;C.K. Panda and Das, S.2005. Inhibition of growth, induction of apoptosis and alteration of gene expression by tea polyphenols in the highly metastatic human lung cancer cell line NCIH460.*Asian.Pac.J. Cancer Prev*.6: 326-331.

11.Ghosal,S.;R.S.Srivastara;S.K.Battachary `andDebanath,P.K.1974. The active principles of *Alhagi pseuddalhagi* phenethylamine and tetrahydroisoquinoline bases. *Planta Med*.26: 318–326.

12.Gonzales,G.B.;G.Smagghe;C.Grootaert,; M.Zotti;K.Raes and Van Camp,J. 2015. Flavonoid interactions during digestion, absorption, distribution and metabolism: a sequential structure- activity /property relationship-based approach in the study of bioavailability and bioactivity. *Drug Metab Rev*. 47(2):175-190. http://doi:10.3109/03602532.2014.1003649.

13.Hassan,W.H and Tayeb, I.T. 2021. Effect of different administration methods of vitamin AD_3E to hatching eggs and supplement it with drinking water on hatchability traits and post hatch performance and biochemical parameter of broiler. Iraqi *journal of Agricultural Sciences*.52(2):322–335. https://doi.org/10.36103/ijas.v52i2.1294.

14.Iskender,H.;G.Yenice;E.Dokumacioglu; O. Kaynar; A. Hayirli and Kaya,A.2017. Comparison of the effects of dietary supplementation of flavonoids on laying hen performance, egg quality and egg nutrient profile.British.Poultry.Science.1-7 http://dx.doi.org/10.1080/00071668.2017.1349297.

15. Jasim,M.R.M and Ibrahim, D.K.2021. Effect of Supplementing Alcoholic and Aqueous Extract of Khalal and Seedless Date and Date Seed Khalal AL-Zahdi Date(*Phoenix dactylifera L.)* to Drinking Water on Some Productive Traits of Quail Females reared Under High Temperature. Indian Journal of Ecology (2021) 48 Special Issue (15): 355-360

16.Junqueira,L.C.;J.CarneiroandKelley,R. O.2003. Basic histology:text and atlas (Vol. 11). New York: Mc-Graw-Hill.234-254.

17.Kalhoro,M.A.;Z.Kapadia and Badar, Y. 1997. Physicochemical studies of indigenous medicinalplants.Bangladesh.J.Sci.Ind.Res.32:418–421.

18.Kumar, M.;M. Chandel; S.Kumar and Kaur,S.2011. Protectiveeffects of *Koelreuteria paniculataLaxm*.on oxidative stress and hydrogen peroxide-induced DNA damage. Phytopharmacology.1: 177-189.

19.Kumaril,P.B.;R.B.Gupta;G.M.Prakash and Reddy,R.A.2008. A study of egg quality traits in Japanese quails *(Coturnix coturnix japonica)*.J.Veterinary&Animal Sciences.4 (6) 227-231.

20.Laghari,A.H.;A.Ali Memon ; S. Memon ; A. Nelofar;K.M.Khan and Yasmin, A.2012. Determination of free phenolic acids and antioxidant capacity of methanolic extracts obtained from leaves and flowers of camel

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thorn *(Alhagi maurorum*). *Natural Product Research, 26*(2),173–176. http://doi:10.1080/14786419.2010.538846.

21.Liu,Y;L.LI.;H.N.Liu;Y.Suo;L.L.HuL;X. A. Feng;L.Zhang and Jin,F.2013. Effect of Quercetin on Performance and Egg Quality during the Late Laying Period of Hens. *British Poultry.Science*.54:510–514. http://doi:10.1080/00071668.2013.799758.

22.McDowell,L.2000. Vitamins in Animal and Human Nutrition .2nded. Iowa State Univ. Press. Iowa, USA., pp.155 -225.

23.Muhammad,G.;M.A.Hussain;F.Anwar; M.Ashraf and Gilani, A.H .2014. Alhagi: A Plant Genus Richin Bioactives for Pharma ceuticals.*PhytotherapyResearch*.29(1):1–13. https://doi:10.1002/ptr.5222.

24.Mustafa,M.Aand Wasman,P.H.2020. The impact of powders and oil additives of cinnamon and clove in quail's diet as antistressor and antioxidant during hot months. *Iraqi journal of Agricultural Sciences*.51(3): 760–766. https://doi.org/10.36103/ijas.v51i3.1031.

25.Nowaczewski,S.;H.Kontecka;A.Rosiñski; S.Koberlingand Koronowski, P.2010. Egg Quality of Japanese Quail Depends on Layer Age and Storage Time. *Folia Biological*.(58) 3-4.

26.Oteiza,P.I.;C.G.Fraga;D.A.Mills and Taft,D.H.2018. Flavonoids and the gastroint estinal tract: Local and systemic effects . *Molecular Aspects of Medicine*. 61:41–49. https://doi:10.1016/j.mam.2018.01.001.

27.Pan,H.Z.;L.Zhang;M.Y.Guo;H.Sui;H.Li; W.H.Wu and Chang,D.2010. The oxidative stress status in diabetes mellitus and diabetic nephropathy.*Actadiabetol*. 47(1):71-76. https://doi: 10.1007/s00592-009-0128-1.

28.Parthasarathy,S.;B.J.Azizi;S.Ramanatha n;S.Ismail; S.Sasidharan; M.M. Said and Mamor ,S.M..2009. Evaluation of antioxidant and antibacterial activities of aqueous, methanolic and alkaloid extracts from Mitragyna speciosa (Rubiaceae-family) *leaves.Molecules*.14:3964-3974.

29.Prasad,A.S.2014. Zinc:an antioxidant and anti-inflammatory agent:role of zinc in degenerative disorders of aging. *Journal of Trace Elements in Medicine and Biology* .28(4):364-371.

30.Saieed,A.Y.;Z.A.Mahdi and Ibrahim, A. A.2018. Effect of addition from egg yolk of different avian to tris extender on freezing semen traits of Awassi rams. *Iraqi journal of Agricultural Sciences*. 49(4):663-669. https://doi.org/10.36103/ijas.v49i4.76.

31.SAS Institute .2017. SAS /STAT®14.3 User's Guide. Cary,NC 27513 (USA): SA.

32.Singh,R.P and Agarwal, R. 2006. Natural flavonoids targeting deregulated cell cycle progression in cancer cells. *Curr Drug Targets* . 7: 345-354. https://doi. 10.2174/138945006776055004.

33.Singh,V.P.;Y.Bineeta and Pandey, V.B. 1999. Flavanone glycosides from *Alhag ipseudalhagi. Phytochemistry*. 51: (587–590).

34.Stojčić,M.D.;N.Milošević and Perić, L . 2012. Determining Some Exterior and Interior Quality Traits of Japanese Quail Eggs (*Coturnix japonica*). *Agroznanje*.13: 667-672. https://doi:10.7251/agren1204667s.

35.Sulaiman,G.M.2013. Antimicrobial and cytotoxic activities of methanol extract of *Alhagimaurorum. African Journal of Microbiology Research*. 7(16) : 1548 –1557. https://doi.org/10.5897/AJMR12.1795

36.Szliszka,E.; Z.P. Czuba; M. Domino ;B. Mazur ;G.Zydowicz and Krol, W. 2009.

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Ethanolic extract of propolis (EEP) enhances the apoptosis- inducing potential of TRAIL in cancer cells. Molecules.14(2):738-54. https://doi: 10.3390/molecules. .

37.Taher,W.M.;H.R.Maleh and Enayah, S. H.2019. Effect of Heavy Metals in *Alhagi graecorum* on Some Physiological Parameters of Laboratory Rats. *Journal of Education for Pure Science*.9(2):140-150.

38.Vali,N.2008. The Japanese Quail: A Review . *International Journal of Poultry Science*, 7: 925-931. https://doi:10.3923/ijps.2008.925.931.

39.Williamson, G and Clifford, M.N. 2017. Role of the small intestine, colon and microbiota in determining the metabolic fate ofpolyphenols.*Biochem.Pharmacol*.139:2439. https://doi: : 10.1016/j.bcp.2017.03.012. .

40.Yoon,G.;B.Y.Kang and Cheon, S. H.2007. Topoisomerase Iinhibition and cytot oxicity of licochalcones A and E from Glycyrrhizainflata. *Archives of Pharmacal Research*.30:313-316. https://doi: .org/10.1007/BF02977611 .

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