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RESEARCH OPINIONS IN ANIMAL & VETERINARY SCIENCES

Determination of the effects of *Cinnamomum zeylanicum* Blume and *Thymus vulgaris* on performance and egg quality of Japanese quail (*Coturnix japonica*)

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Abstract

This study was conducted on Japanese quails (*Coturnix japonica*) to evaluate the effects of dietary supplementation of two medicinal plants (*Cinnamomum zeylanicum* blume and *Thymus vulgaris*) on the performance and egg quality parameters. One hundred *C. japonica* quail, 42 days old, were randomly allocated to five treatments with five replicates of four birds each (three females and one male). The experiment lasted for 63 days until the quails reached to 105 days of age. Birds were assigned to the basal diet (control) which was supplemented with 1.0% thymus powder (T2), 2.0% thymus powder (T3), 1.0% cinnamon powder (T4) and 2.0% cinnamon powder (T5), respectively. In this experiment, performance parameters (live weight, feed intake, feed conversion ratio (FCR) egg production, and egg quality parameters (egg weight, eggshell weight, yolk weight, albumin weight, eggshell thickness and some of egg mineral content) were determined. The results showed that, egg production didn't differ among the treatments ($P>0.05$), while live weight and feed intake were affected significantly by experimental treatments ($P<0.05$). Moreover feed conversion ratio values were affected positively by thymus powder supplementation to the diets. Also, these results indicated that experimental treatments significantly improved egg quality parameters in Japanese quail ($P<0.05$) except for yolk weight. Thymus and cinnamon supplementation to the diet increased the egg mineral content (Fe, Zn, Cu) compared to the control ($P<0.05$). In conclusion, dietary inclusion of thymus and cinnamon powder may have beneficial effects on performance of Japanese quail and their egg quality parameters.

Keywords: Thymus; Cinnamon; Egg quality; Egg mineral content; Japanese quail

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Introduction

Due to the potentially undesirable effects of antibiotics as growth promoters in poultry production, researchers are looking for viable alternative to limit or replace their use. Natural feed additives of plant origin are generally believed to be safer, healthier and less subject to hazards for humans and animals (Stef and Gergen, 2012). There is evidence to suggest that herbs, spices and various plant extracts have appetizing and digestion-stimulating properties and antimicrobial effects (Langhout, 2000; Alçiçek et al., 2004; Zhang et al., 2005; Bolukbasi and Erhan, 2007), which stimulate the growth of beneficial bacteria and minimize pathogenic bacteria activity in the gastrointestinal tract of poultry (Wenk, 2000). Mixtures of complex compounds, vitamins and minerals found in plants tend to work together synergistically. These combinations were more effective than they were each used in isolated form. These beneficial effects make them useful as potential natural animal feed additives (Hernandez et al. 2004, Khaligh et al., 2011). Antioxidant properties of compounds from some medicinal herbs can result from their free radical scavenging activity but their ability to chelate transition metal ions, especially Fe (II) and Cu (II), also plays an

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important role (Karamać, 2009). Fe, Mn, Zn and Cu can be considered trace minerals with a central role in many metabolic processes throughout the body and are essential for correct growth and development of all animals, including humans. They predominantly act as catalysts in many enzyme and hormone systems which influence on growth, bone development, feathering, enzyme structure and function, and appetite (Stef and Gergen, 2012). There are many records working on including herbal plant powders or essential oils extracted from medicinal plants in animal diets (Chowdhury et al. 2002, Hernandez et al. 2004, Demir et al., 2008). Thyme and bentol in thyme and oregano lead to using these plants as disinfectants and improve digestion and absorption, labiotae family increases intestine length and depth and width of the villi of the intestines and opportunity for absorption of nutrients (Alcicek et al., 2003). Ali et al., 2007 reported that the addition of 0.25% thyme in the diet of laying hens improved feed conversion ratio (FCR) and egg production, fertility and hatchability, however, yolk (weight, height, diameter, index and colour), shell (weight and thickness), egg shape index and haugh units did not change. Slight improvements in mean egg production, weight, mass and FCR were found when Japanese quail hens were fed either 0.1 or 0.2% thyme (Zeweil, 2003). Thymus and Carvacrol can improve the digestion of nutrients. There are a lot of reports indicating the positive effects of herbs like anti-coccidal, anti-oxidant, anti-fungi and etc. Some of medical effects of herbs are related to their secondary metabolites such as phenols, necessary oils, saponins etc. (Mansoub, 2011).

The objective of this experiment was to evaluate the effects of two herbal plants cinnamon (*C. zeylanicum* blume) and thymus (*T. vulgaris*) on performance, egg quality and some of egg mineral (Fe, Cu and Zn) contents of Japanese quails.

Materials and methods

A total of 100 Japanese quails (*C.japonica*) of about 42 days of age were used in this experiment. Birds were divided into five treatments, each treatment with five replicates involving 3 females and 1 male. The experiment lasted for 63 days until the quails reached to 105 days of age. All the groups were subjected to similar management practices (brooding, lighting and watering) throughout the experiment. Birds were allocated to the basal diet (control) and basal diet was supplemented with 1.0% thymus powder (T2), 2.0% thymus powder (T3), 1.0% cinnamon powder (T4) and 2.0% cinnamon powder (T5), respectively. The diets were formulated using NRC (1994) guidelines and contained 20% protein and 2900 kcal/kg ME. The composition and nutrients content of the basal diet is shown in Table 1. Eggs were collected daily and egg production was recorded. Egg weights were determined daily.

Weekly feed consumption was recorded, and feed conversion ratio was calculated during the 9-wk experimental period. Body weights were measured weekly from 6 to 15 weeks of age with an electronic scale (sensitivity of ±0.01 gram). In order to measure the egg quality parameters, eight eggs were collected from each pen during $9^{th,}$ 12^{th} and 15^{th} weeks of experiment and put under the acid test. The shells and yolks were weighted by weighing machine which had 0.01g accuracy. The albumin weights were calculated using the following formula:

Albumin weight=egg weight–(yolk weight+shell weight)

Table 1: The ingredients and composition of basal diet

Ingredients	%
Corn	43.1
Soybean meal	38.9
Oyster shell	8.38
Dical. Phos.	2.28
Fatty acid	6.0
Common salt	0.047
$CaCO_3$	0.44
Vitamin-Mineral premix[A]	0.6
Vitamin E	0.3
Calculated values	
ME. Kcal/Kg	2900
Cp. %	20.0
Calcium. %	1.0
Available phosphorus. %	0.5
Lysin. %	1.0

[A]Provided per kilogram of diet: retinol (vitamin A), 7700 IU, cholecalciferol (vitamin D_3), 3300 IU, DL-alpha-tocopherol acetate (vitamin E), 6.6 IU, menadione (vitamin K_3), 0.55 mg, thiamine, 1.5 mg, riboflavin, 4.4 mg, pantothenic acid, 22 mg, niacin, 5.5 mg, pyridoxine, 3 mg, choline chloride, 275 mg, folic acid 1.1 mg , biotin 0.055 mg, vitamin B_{12} (cyanocobalamin), 0.088 mg, antioxidant,1 mg, Manganese, 66 mg, zinc, 66 mg, iron, 33 mg, copper, 8.8 mg, iodine, 0.9 mg, selenium, 0.3 mg.

The thickness of the shell was measured by micrometer with the accuracy of 0.001mm in the middle and 3 points of egg shell and the average was considered as the shell thickness. Sample of 10 eggs were randomly collected from each cage at each for egg mineral content (Fe, Zn, Cu). The eggs were mixed and two samples were obtained for the experiment. Minerals were determined by atomic absorption spectrophotometry using an AA 240 FS apparatus with SIPS 20 (Prky, America). The obtained data was analyzed by SAS software Ver.9.1 with general linear procedure, and multiple range Duncan test was applied for detection of possible significant differences between means ($P<0.05$).

Results and Discussion

Japanese quail's performance

The results of weekly live weight are presented in Table 2. There were no statistical differences among the groups at 42 and 91days of age, in terms of live weight but at the end of experiment observed a significant difference among the treatments (P<0.05). Treatment 2 (addition 1% of thymus powder) had significantly high live weight in comparison to other groups (P<0.05). The improvement in body weight of birds achieved thyme could be attributed to its positive effect on nutrient digestibility, as reported by Langhout (2000). Other factors which could have contributed to the beneficial effects of the herbal products on the growth performance of birds are their probable antioxidant and antibacterial effects in the intestine (Nascimento et al., 2000).

Table 3 shows the effects of treatment on egg production, feed intake and feed conversion ratio values. Egg production was not significantly affected by the dietary treatments (P>0.05). This result is in agreement with Cetingul et al. (2009) and Park et al. (2012). Park et al. (2012) found the utilized amounts of thymus powder did not significantly effects (P>0.05) egg production and egg weight but numerically increased in birds fed 2.0% thymus powder than other treatments, although there were statistical differences in terms of feed intake and feed conversion ratio. The supplemented diet with thymus powder decreased feed conversion compared to control groups (P<0.05). These results are in agreement with those of Bolukbasi and Erhan (2007), El-Ghousein and Al-Beitawi (2009) and Abdulkarimi et al. (2011). This activity may be due to thymus and carvacrol which are present in the essential oil of thyme (Basilico and Basilico, 1999). Zeweil et al. (2006) who supplemented diets with 1.0 and 2.0 g of thyme flowers reported no significant improvements in means egg production, egg weight, egg mass and FCR of Japanese quail hens. In opposite to our results, Okac et al. (2008) reported no differences in body weight gain, feed intake or feed to gain ratio were observed in broilers fed the different levels of thymus and peppermint diets. One reason for the lack of effects of supplements may be related to the environmental conditions (Okac et al., 2008). The fact that none of the supplements caused a growth promoter effect at slaughter age indicates that the trial was conducted in ideal conditions, which could affect the degree of growth promotion (Hernandez et al., 2004). Park et al. (2012) reported that feed intake was significantly lower in thymus powder addition treatments than the control (P<0.05), however, feed conversion was not significantly differed among control and treatments (P<0.05).

In general, the results indicated that the addition of 1.0% of thyme to laying Japanese quails diets may give the best performance in the term of egg production and FCR.

Egg quality parameters

Effects of dietary thyme and cinnamon supplementation to quail layer diets on egg quality parameters are summarized in Table 4. The experimental treatments significantly improved egg weight compare to control group (P<0.05). The maximum egg weight value observed in treatment with 1.0% thyme addition. The experimental treatments significantly improved albumin and eggshell weight and eggshell thickness (P<0.05). Bozkurt et al. (2012) found that supplementation of diet with essential oil mixture provided increments in eggshell weight, however relative albumen weight was significantly decreased in response to essential oil mixture. Since the thyme is known as antioxidant, the thyme may improved the small environment in uterus (site of calcium deposition) and consequently increase shell weight and shell thickness (Ali et al., 2007). Yolk weight had the highest value in control group and T3 group (addition of 2% of thyme). Shahryar et al. (2011) reported that there is an insignificant increased in egg yolk percentage in group with 3% thyme in result of increase in egg weight. Percentage of yolk formation depends on nutrients intake. Thymus increases digestion and abruption of nutrients because of having menthol (Alcicek et al., 2003). A significant

Table 2: Effect of treatments on weekly live weight (gm)

Age of birds (day)	Control	1.0% thymus	2.0% thymus	1.0% cinnamon	2.0% cinnamon	SEM
42	188.26	202.86	192.86	202.06	191.00	5.61
49	219.66^{b}	246.73^{a}	236.73^{ab}	238.60^{ab}	226.20^{b}	7.01
56	231.06^{c}	259.13^{a}	247.56^{ab}	249.00^{ab}	236.40^{bc}	5.78
63	243.46^{b}	262.60^{a}	253.26^{ab}	256.06^{ab}	248.60^{ab}	7.01
70	236.80^{b}	256.53^{a}	247.33^{ab}	250.86^{ab}	243.20^{ab}	5.15
77	239.86^{b}	262.60^{a}	246.86^{ab}	250.40^{ab}	239.73^{b}	5.86
84	245.33^{b}	266.60^{a}	249.46^{ab}	253.86^{ab}	240.13^{b}	6.54
91	256.00	267.80	254.00	257.60	251.33	6.82
98	255.40^{ab}	268.06^{a}	242.26^{b}	255.06^{ab}	243.60^{ab}	6.63
105	256.86^{ab}	271.53^{a}	244.26^{b}	255.86^{ab}	245.33^{b}	6.51

^{abc}Means in a row with different superscripts differ significantly (P<0.05).

Table 3: Effect of treatments on egg production, feed intake and FCR of Japanese quail performance

Treatments	Egg production (%)	Feed intake (g/ bird/d)	FCR (g Feed/g egg)
Control	84.09	27.55^{ab}	3.03^{ab}
1.0% thymus	87.01	27.63^{ab}	2.77^{b}
2.0% thymus	86.31	26.82^{b}	2.81^{b}
1.0% cinnamon	84.44	28.13^{a}	3.16^{a}
2.0% cinnamon	84.38	27.15^{b}	3.04^{ab}
SEM	1.20	0.29	0.10

^{abc}Means in a column with different superscripts differ significantly (P<0.05).

Table 4: Effect of treatments on egg quality parameters

Treatments	Egg weight (g)	Eggshell weight (g)	Yolk weight (g)	Albumin weight (g)	Eggshell thickness (mm)
Control	11.55^{ab}	1.16^{b}	3.80^{a}	6.59^{b}	0.24^{c}
1.0% thymus	11.83^{a}	1.20^{a}	3.78^{ab}	6.84^{a}	0.26^{a}
2.0% thymus	11.80^{a}	1.19^{ab}	3.81^{a}	6.80^{a}	0.25^{b}
1.0% cinnamon	11.51^{b}	1.20^{a}	3.66^{b}	6.64^{ab}	0.25^{b}
2.0% cinnamon	11.71^{ab}	1.21^{a}	3.73^{ab}	6.77^{ab}	0.26^{a}
SEM	0.10	0.01	0.04	0.07	0.001

^{abc}Means in a column with different superscripts differ significantly (P<0.05).

Table 5: Effect of treatments on egg mineral content

Treatments	Fe (mg)	Zn(mg)	Cu(mg)
Control	3.65^{d}	1.15^{b}	0.938^{d}
1.0% thymus	3.68^{c}	1.18^{cd}	0.969^{c}
2.0% thymus	3.71^{b}	1.24^{b}	0.985^{b}
1.0% cinnamon	3.72^{b}	1.22^{bc}	0.989^{b}
2.0% cinnamon	3.79^{a}	1.37^{a}	1.000^{a}
SEM	0.007	0.014	0.004

^{abc}Means in a column with different superscripts differ significantly (P<0.05).

improvement in yolk weight was observed as a result of plant essential oils supplementation in experiment of Canogullari et al. (2009), or Bozkurt et al. (2012). In opposite to our results, Ali et al. (2007) reported that the addition of 0.25% thyme in the diet of laying hens did not change yolk (weight, height, diameter, index and color), shell (weight and thickness), egg shape index and Hough units. However they observed that the addition of thyme increased insignificantly the percentage of egg shape index, shell weight and shell thickness.

Dietary supplementation with thymus and cinnamon significantly increased egg mineral content (P<0.05). These results are presented in Table 5. The maximum egg mineral content (Fe, Zn and Cu) observed in treatment with 2.0% cinnamon addition (P<0.05). Transference of nutrients from the hen to the egg follows two pathways: via the ovary to the yolk or via the oviduct to the albumen, egg shells, and membranes. Chemically, the transference of nutrients from the hen to the ovary and the oviduct involves the synthesis and the export of proteins able to bind specific molecules. Inside the egg, the embryo develops specific mechanisms to mobilize previously stored vitamins and minerals by means of transport proteins. Nutrient absorption, metabolism, and deposition vary with hens' genetics (Lillie et al., 1951). Alcicek et al. (2003) reported that using of labiatae family increases intestine length and depth and width of the villi of the intestines and opportunity for absorption of nutrients. There are no studies in the literature mentioning the effect of thyme, cinnamon or another herbal plant on the egg mineral content.

In conclusion, the results indicated that the diet containing thyme and cinnamon significantly improved egg quality and did not show negatively affects on Japanese quail's performance.

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