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Effect of thyme (Thymus vulgaris) as a feed additive on the growth performance, blood parameters and carcass characteristics of Japanese quails

ABSTRACT

This study was conducted to demonstrate the effect of supplemented thyme powder on growth performance, blood parameters and carcass traits in Japanese quail. One hundred and eighty (180) quail chicks after one week rearing were divide into four treatments which called: (T1) basal diet without thyme ; (T2) basal diet added 0.5% of thyme powder; (T3) basal diet added 0.75% of thyme powder; (T4) basal diet added 1% of thyme powder. Each treatment included 45 birds with three replicates, 15 birds in each replicate. all treatments were fed ad libitum of their own diet. The results showed that the addition of thyme powder significantly ($p\leq0.05$) increased the values of live body weight and body weight gain. The food consumed did not differ significantly in all treatments ($p\leq0.05$). Male eviscerated dressing percentage did not differ significantly ($p\leq0.05$), however, there is a significant increase ($p\leq0.05$) in females. The breast, wings, legs and backs percentage increased significantly ($p\leq0.05$) in both of males and females of the thyme supplemented treatments. Blood serum levels of cholesterol, triglycerides in males and females decreased significantly ($p\leq0.05$) of the thyme added treatments. HDL increased significantly ($p\leq0.05$) in both of males and females. LDL in males and females decreased significantly ($p\leq0.05$). In conclusion, 1% of thyme powder supplemented to dietary can be used as an effective diet supplement to enhance growth performance, carcass characteristics and blood lipids in Japanese quail.

INTRODUCTION

As a growth promoter the antibiotics use began in the 1940s. (Hashemi and Davoodi, 2010). Due to growing bacterial antibiotic resistance, residual effects on poultry products and adverse impacts on human safety, several governments have decided to outlaw these feed additives. In 1997, the World Health Organization (WHO) announced that antibiotic resistance was a global public health problem (Tajodini et al., 2015). Because of these negative consequences for human health, on January 1, 2006, the European Union completely banned growth promoting antibiotics (Kulshreshtha et al., 2014; Hafeez et al., 2016). It was led to an intensification in research for the development of antibiotic alternatives. This resulted in the appearance of plant additives that can be used to improve the growth, quality and health of poultry. Medicinal plants are considered to be a suitable antimicrobial alternative (Bozkurt et al., 2016).

Previous researches showed that the medicinal plants active components can improve poultry health and growth. It has also been discovered that using plant-based compounds in poultry diets increases productivity and immunity (Harrington et al., 2019). Some researchers have used plants which contain various essential oils as alternative medicines (Ceylan et al., 2003). Various plant extracts have been shown improvement in feed gain, carcass traits and mortality percentage in some studies (Parlat et al., 2005). Due to the presence of a variety of pharmacologically beneficial

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compounds, medicinal plants have been the subject of extensive scientific research (Aydin and Alçiçek, 2017). In poultry, thyme (*Thymus vulgaris*) has been identified as an effective candidate in this respect. It has been established that the primary constituents of thyme oil (thymol and carvacrol) are closely related to its antioxidation, antibacterial and antifungal properties (Toghyani et al., 2010). Al-Hlawee, (2020) concluded that thyme may help to improve the growth of birds and can be used as natural antioxidants. Thyme oil extract, that contains about 15% essential oil (soluble in alcohol), and thyme water extract are the end products of thyme extraction (soluble in water). The compounds of essential oil which defined as phenoylic compounds including thymol (44.4-58.1%), carvacrol (2.4-4.2%) and γ-terpipene (6.9-18.9%). Thymol (5-methyl-1-2-isopropyl phenol) and carvacrol (5-isopropyl-2-methyl phenol), acts as potent antioxidant scavengers (Hoffman-Pennesi and Wu, 2010). Carvacrol destroys pathogenic microorganisms by degenerate their cytoplasm and also prevents an inhance in plasma triglyceride and cholesterol (Lee et al., 2003).

The aim of the study is to evaluate the influence of thyme powder on growth performance, carcass characteristics and some blood parameters in Japanese quail.

MATERIALS & METHODS

Birds management, diet and data collection

This study conducted in Grdarasha poultry farm/ College of Agricultural engineering sciences - University of Salahaddin-Erbil/Iraq from 20/02/2021 to 2/4/2021.

Table (1): Ingredients and chemical composition of basal diet

Ingredients	Amount (kg)
Wheat	449.75
Soybean Meal 47%	336
Corn	150
Vegetable Oil	15
Limestone	15
MCP[1]	7
Enzyme[2]	0.25
Toxin binder	2
Premix 2.5%[3]	25
TOTAL	1000
Chemical Composition[4]	Calculated
Crude protein %	23
ME.Kcal/kg	3000
Available Ca %	1.05
Available P %	0.5
Na %	0.21
Lysine %	1.46
Methionine %	0.6
Fat %	4.03
Fiber %	2.82

Thyme powder was added to the experimental diets according to its percentage in each treatment.

1- MCP : contains 16% calcium and 22.7 % phosphorous
2- Enzyme: consists of a mixture of enzymes Xylanase, b-glucanase, Amylase, and Protease.
3- Premix 2.5% was used in the diets, which contain 16.7% protein, energy 3879 kcal/kg, %, lysine 8.1%, methionine 9.6 , Methionine + cysteine 9%, phosphorous available

7.2%, sodium 6.4%, salinomycin sodium 120 g/kg 2400 ppm, with a group of vitamins and minerals.

4- Chemical analysis of the feed and Ingredients of the diet was carried out in the laboratory of the Kosar Feedmill.

The Japanese quail (*Coturnix coturnix*) eggs took from quail's project of Grdarasha farm, and put in a private hatchery for about 18 days, after hatching the chicks returned to the same farm to perform this study which is lasted 42 days. All chicks were reared in battery cages (with dimensions: 70 cm width, 50 cm depth and 30 cm height) with the same environmental and management conditions. 180 quail chicks at 7 days of rearing were divided randomly into four treatments: treatment 1 was control (basal diet with no thyme powder) (T1), treatment 2 basal diet with 0.5% of thyme powder (T2), treatment 3 basal diet with 0.75% of thyme powder (T3) also treatment 4 basal diet with 1% of thyme powder (T4). Each treatment involved 45 birds with three replicates, 15 birds in each replicate. All treatments were fed *ad libitum* of their own diet. Commercial feed was used in the experiment and the diet chemical composition shown in Table 1, also thyme leaf powder was acquire from Erbil local market. It was purchased as dried grinded and fine powder. The feed system and water were *ad libitum*. Diet mixed with thyme powder according to the study plan every week. The temperature was kept at 37°C at first age and then steadily declined by 2°C per week until it reached 25°C at the end of the studyl. Every cage provided with long deep feeders (60×15) cm and two automated water droppers (nipples). 23 hours/day continuous light with 100watt lamps were provided during the experiment.

Growth performance

At day 7, 21 and 42 all birds per pen were weighed together and divided to their number to find out their body weight average. Their weights of day 21 and 42 after subtracting weights of day 7 to determine body weight gain. Before adding diet to the feeders, weighed in each cage, the residual feed also weighed by that feed intake was measured. To calculate feed conversion efficiency, at day 21 all feed intake per cage was divided by total body weight gain per cage and then corrected for mortality, the same procedure is performed to find out feed conversion efficiency at 42 days of age. Dehghani et al., (2018).

Carcass portion percentages

At day 42 of age twelve quails per treatment (six male and six female) were distributed, which were closest to the medium weight of replicate, diet was banned 3 hours before slaughtering, after slaughtering viscera was removed immediately, the weights of eviscerated dressing, breast, legs, wings and back were calculated by a digital scale. eviscerated carcass weight and relative weights of those portions were measured as a percentage of live body weight. Dehghani et al., (2018).

Blood sample preparation and analysis

diet was banned 3 hours before slaughtering. 12 quails/treatment (2 male/2 female for each replicate) were slaughtered and collected 4ml of each bird's blood in the gel tubes separately (serum separating tube, SST tube), then tubes put in centrifuge machine with 3000 rpm/ 10min (Dehghani et al., 2018) to obtain serum and evaluating biochemical traits, the amount of triglyceride, total cholesterol, high density lipoprotein (HDL) and very low density lipoprotein (LDL) measured by using Cobas-integra 400 plus auto-analyzer machine (Iraq, kurdistan region, Erbil, Pzishkan st. Bio lab.) according to the recommended procedures of producing company.

Statistical Analysis

All of the data was statistically analyzed using standard methods. SAS (2005) was used to evaluate the data and account for the impact of the treatments. The significance among means was determined by using Duncan's(1955) multiple range tests ($p \leq 0.05$). (SÖĞÜT & MOHAMMAD, 2018).

RESULTS

Growth performance

Effect of thyme powder added to diet on growth performance presented in table 2. The values of live body weight were no significantly differs (p≤0.05) at 21 days of age, but T4 was significantly (p≤0.05) increased at day 42 when comparing with the other treatments. There were no significant differences (p≤0.05) among treatments about body weight gain from 7-21 days of age but from 22-42 and 7-42 days of age T4 was significantly (p≤0.05) increased comparing with the other treatments. The feed intake did not differ significantly (p≤0.05) among treatments from all rearing periods. The feed conversion efficiency from 7-21 and 7-42 days of age improved significantly (p≤0.05) in T4 comparing with the other treatments but did not showed any significant differences among treatments during 22-42 days of age, but when the experimental period was considered as a whole, T4 showed improvement in feed conversion efficiency and tend to be better than the other treatments.

Table (2): Effect of added Thyme powder on growth performance of Japanese quail

Traits	Thyme treatments			
	T1	T2	T3	T4
Body weight 21 Day (g)	120.9±0.08 a	122.36±1.09 a	122.7±0.27 a	123.33±1.4 a
Body wt. gains 7 - 21 Day (g)	87.1±0.08 a	88.56±1.09 a	88.9±0.27 a	89.53±1.4 a
Feed intake 7 - 21 day (g)	301.72±8.7 a	283.13±8.17 a	294.84±8.51 a	280.22±8.08 a
Feed conversion efficiency 7-21 day	3.46±0.1 a	3.19±0.07 ab	3.31±0.09 ab	3.13±0.04 b
Body wt. gains 22 - 42 Day (g)	101.02±5.91 b	112.37±9.99 ab	114.99±5.55 ab	128.73±4.46 a
Feed intake 22 - 42 day (g)	481.67±13.9 a	457.6±13.21 a	466.67±13.47 a	467.37±13.49 a
Feed conversion efficiency 22 - 42 day	4.81±0.41 a	4.15±0.47 a	4.08±0.28 a	3.63±0.02 a
Body weight 42 Day (g)	221.93±5.98 b	234.73±10.39 ab	237.7±5.77 ab	252.06±5.86 a
Body wt. gains 7 - 42 Day (g)	188.13±5.98 b	200.93±10.39 ab	203.9±5.77 ab	218.26±5.86 a
Feed intake 7 - 42 day (g)	783.39±22.61 a	740.73±21.38 a	761.51±21.98 a	747.59±21.58 a
Feed conversion efficiency 7 - 42 day	4.18±0.25 a	3.71±0.27 ab	3.74±0.18 ab	3.42±0.01 b

-a and b mean within the same row followed by different superscripts are significantly different (p≤0.05).
-T1 = basal diet, T2 = basal diet with 0.5% of thyme powder, T3 = basal diet with 0.75% of thyme powder, T4 = basal diet with 1% of thyme powder
-Initial body weight at 7 days old= 33.8 g

Carcass and carcass portions

The effect of different amounts of thyme powder added to the diet on the percentage of eviscerated dressings for quail and the percentage of carcass portions at 42 days is shown in Table 3 than the other treatments. Although the percentage of breast, wings and legs increased significantly (p≤0.05) in both males and females at T4 than the other treatments. The proportion of male backs at T2 and females at T3 increased significantly (p≤0.05) compared to the other treatments.

Table (3): Effect of Thyme added on Japanese quail eviscerated dressing, and carcass portion percentages at 42 days of age

Traits \ Treatments		Thyme treatments			
		T1	T2	T3	T4
Eviscerated dressing percentage %	Male	70.59±2.03 a	69.26±2.0 a	73.00±2.1 a	75.55±2.17 a
	Female	69.46±2.0 ab	63.0±1.81 b	68.65±1.98 ab	72.61±2.09 a
Breast %	Male	27.27±0.78 b	25.82±0.74 b	28.27±0.81 b	31.55±0.9 a
	Female	25.12±0.72 b	25.55±0.73 b	25.74±0.74 b	28.63±0.82 a
Wings %	Male	5.4±0.15 ab	5.2±0.15 b	5.3±0.15 ab	5.78±0.16 a
	Female	6.2±0.17 b	4.8±0.13 c	5.3±0.15 c	6.9±0.19 a
Legs %	Male	17.64±0.51 b	16.39±0.47 b	16.87±0.48 b	20.44±0.59 a
	Female	15.1±0.43 b	14.09±0.4 b	14.18±0.41 b	16.8±0.48 a
Back %	Male	15.95±0.85 c	18.85±0.54 a	18.14±0.52 ab	16.44±0.47 bc
	Female	17.24±0.49 b	17.62±0.5 b	19.4±0.56 a	14.93±0.43 c

a and b mean within the same row followed by different superscripts are significantly different ($p \leq 0.05$).
T1 = basal diet,T2 = basal diet with 0.5% of thyme powder,T3 = basal diet with 0.75% of thyme powder,T4 = basal diet with 1% of thyme powder

Serum lipids

At 42 days of age blood lipids in male and female quails has been tested, details in Table 4. Cholesterol decreased significantly ($p \leq 0.05$) in T3 of males and T2 in females in comparing with the other treatments. Triglycerides decreased significantly ($p \leq 0.05$) in T2 and T3 in males and T2, T3 and T4 in females in compare with the other treatments. About HDL in males in T2, T3 and T4 and in females T4 increased significantly ($P \leq 0.05$) in comparing with the other treatments. LDL in males in T2 and females in T2 and T3 decreased significantly ($p \leq 0.05$) in contrast with the other treatments.

Table (4): Effect of dietary thyme powder at different levels with sex on triglyceride, cholesterol, HDL and LDL (mg/dl) in Japanese quail at 42 days of age

Treatments	Male			
	Cholesterol	Triglycerides	HDL	LDL
T1	217.00±6.26 ab	161.00±4.64 b	89.00±2.56 b	96.60±2.78 a
T2	212.00±6.12 bc	108.00±3.11 c	118.00±3.40 a	72.00±2.07 c
T3	195.00±5.62 c	97.00±2.80 c	114.00±3.29 a	61.40±1.77 d
T4	237.00±6.84 a	177.00±5.11 a	122.00±3.52 a	80.00±2.30 b
Treatments	Female			
	Cholesterol	Triglycerides	HDL	LDL
T1	265.00±7.65 a	1176.00±33.94 a	19.00±0.54 c	161.00±4.64 a
T2	125.00±3.60 d	731.00±21.10 b	37.00±1.06 b	105.03±3.03 c
T3	241.00±6.95 b	711.55±20.54 b	40.33±1.16 ab	101.00±2.91 c
T4	206.00±5.94 c	665.00±19.19 b	42.00±1.21 a	142.70±4.11 b

- a and b mean within the same columns followed by different superscripts are significantly different ($p \leq 0.05$).
- T1 = basal diet,
- T2 = basal diet with 0.5% of thyme powder
- T3 = basal diet with 0.75% of thyme powder
- T4 = basal diet with 1% of thyme powder

DISCUSSION

live body weight (LBW) and body weight gain (BWG) until 21 days of age did not observe any significant differences ($p \leq 0.05$) among treatments, but as a whole experiment at 42 days of age both of body weight (BW) and BWG increased significantly ($p \leq 0.05$). In an earlier study, an enhancement was observed in BWG when quails feed rich in thyme (Tiihonen et al., 2010). our result in agree with Raya et al., (2014) results, who noticed an improvement in BWG of growing Japanese quail because of feeding diet containing thyme powders. Toghyani et al., (2010) discovered that adding thyme powder to basal diet raised BWG in broiler chicks. In addition, Ocak et al., (2008) discovered that feeding thyme to broiler chicks from 7 to 35 days of age enhanced their BWG compared to their control group. Hashemipour et al., (2013) reported that the inclusion of thymol and carvacrol increased villi height, surface area and villi height to crypt dept ratio of jejunum and ileum in broilers. Development of villi provided greater absorption surface for availability of nutrients (Awad et al., 2008) this is will be stimulating effect on the nutrient digestibility of the thyme experimental diets (Khan et al., 2012) also positive effect of feeding the thyme-containing diets on growth performance of quail, may be related to thyme antibacterial action, as reported by El-Ghousein and Al-Beitawi (2009). Feed intake did not affected by dietary thyme powder among treatments, our result in agree with Raya et al., (2014) results which found that feed intake of quails fed dried thyme-containing diets was significantly not affected. Also in the research by Hong et al., (2012) declared that medicinal plant addition to chicken diets had no influence on feed intake. As whole of the experiment thyme improved feed conversion efficiency, according to Kalantar et al., (2017), Feed conversion efficiency generally improved significantly. Concerning the response of growing Japanese quail to dietary thyme, the current results harmonize with the results reported by Zeweil (2003), who observed an improvement in feed conversion efficiency of growing Japanese quail due to feeding thyme flowers-containing diet. The improvement in feed conversion efficiency of quail fed the diet containing thyme might be related to enhancement BWG and/or improved nutrient digestibility since their feed intakes were not affected (Raya et al., 2014).

Eviscerated dressing percentage of males did not differ significantly ($p \leq 0.05$), while females eviscerated dressing percentage increased significantly ($p \leq 0.05$). Breast, wings, legs and back percentage of males and females increased significantly ($p \leq 0.05$). Some researchers evaluated the impact of thyme powders, extracts, or essential oils on the weight of poultry organs, which is consistent with our findings. Kalantar et al., (2017), noticed improvements in dressing weight significantly of broiler chickens when fed thyme powder also Khaksar et al., (2012) discovered that Japanese quail feeds with essential oil of thyme had greater carcass and breast percentages, but Ocak et al., (2008) discovered no impact of feeding thyme leaves on carcass weight, carcass yield, or relative weights of the edible organs of broiler chicks also Dahal and Farran (2011) reported that carcass features did not affect by feeding diet containing thyme in broiler chicks, Other researchers found evidence that feeding thyme-rich diets to broiler chicks improved carcass features (Abd El-Latif et al., 2002; El-Ghousein and Al-Beitawi, 2009).

Table 4 declared that males and females cholesterol, Triglycerides and LDL decreased significantly ($p \leq 0.05$) in dietary thyme treatments while HDL in males and females increased significantly ($p \leq 0.05$). The current findings corroborate with Rostami et al., (2012), who discovered that additional thyme to feed significantly decreased triglyceride and total cholesterol concentrations in Japanese quail blood serum. (Ali, 2014) found that supplementing broiler diet with 0.5%, 1% or 1.5% thyme leaves powder decreased cholesterol level. Khaksar et al., (2012) found that Japanese quail fed a thyme essential oil-supplemented diet due to reduce serum triglycerides, and total cholesterol levels than control birds. In contrast to the control group, Sengul et al., (2008) reported that giving thyme extracts-containing diets had no effect on blood plasma cholesterol, triglycerides, HDL and LDL very levels. These findings are in line with Mansoub and Myandoab, (2011) who found that adding thyme products to laying hen diets significantly reduced blood triglyceride and total cholesterol, as well as LDL cholesterol levels. In the same line, Rahimi et al., (2011) found that adding thyme to chicken diets significantly decreased blood triglyceride,

total and LDL cholesterol levels while increased HDL cholesterol levels. The improvement in lipid profile may be due to thymol's ability to promote lipase and bile synthesis, resulting in better lipid digestion (Hernandez et al., 2004). Thymol, is thought to impact gastrointestinal tract function by boosting salivary amylase, bile salt, and pancreatic enzymes such as trypsin, chymotrypsin, and lipase production (Platel and Srinivasan, 2004). Thyme's hypocholesterolemic and antilipidemic impacts on blood characteristics are thought to be by preventing the activity of hydroxyl-methylglutaryl-CoA reductase (the rate-limiting enzyme in cholesterol synthesis), loweing fat absorption from gastrointestinal tract or gluconeogenesis via lipid catabolism (Abdulkarimi et al., 2016). The hypocholesterolemic and antilipidemic advantages of thyme in poultry have been proven in several scientific studies (e.g. Toghyani et al., 2010; Dahal and Farran, 2011).

CONCLUSIONS

In view of the above findings and discussion, we conclude that supplementation 1% of thyme powder added to diet had benefits on quails performance by increasing growth performance which is may be due to enhancing feed digestion. Positive effects were recorded on feed conversion efficiency. However, During the whole study period, there were no significant differences ($p \leq 0.05$) in feed intake among the supplemented thyme powder treatments and the control treatment. Moreover the results indicated that significantly increase ($p \leq 0.05$) in eviscerated dressing percentage and carcass portions percentages of dietary added 1% thyme powder treatment. Generally occurred reducing fat deposition of supplementation 0.75% of thyme powder diet treatment for example total cholesterol, triglyceride and LDL but significant increases ($p \leq 0.05$) occurred in HDL concentrations in the blood lipid profile for treatments which added 1% thyme powder. We recommend that further researches is necessary about thyme powder additive to poultry diet with different percentages or as mixture with other plants in the future.

Disclosure statement

The authors declare that they have no conflicts of interest.

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تأثير اضافة مسحوق الزعتر الى العليقة على الاداء الانتاجي وصفات الذبيحة وبعض معايير الدم في طائر السمان الياباني

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الخلاصة

أجريت هذه الدراسة لمعرفة تأثير مسحوق الزعتر على الاداء الانتاجي وصفات الذبيحة وبعض معايير الدم في طائر السمان .تم تقسيم مائة وثمانين فرخة طائر السمان في اليوم السابع من عمر الطير بشكل عشوائي إلى أربع معاملات على النحو التالي: المعاملة الاولى العليقة القياسية بدون اي اضافة. المعاملة الثانية العليقة القياسية مع أضافة 0.5٪ من مسحوق الزعتر. المعاملة الثالثة العليقة القياسية مع أضافة 0.75٪ من مسحوق الزعتر. المعاملة الرابعة العليقة القياسية مع أضافة 1٪ من مسحوق الزعتر. تضمنت كل معاملة 45 طائراً بثلاث مكررات ، بواقع 15 طائراً في كل مكرر. تم تطبق نظام التغذية الحرة لكل المعاملات .وتشير النتائج الى وجود زيادة معنوية ($P\leq0.05$) في الوزن النهائي والزيادة الوزنية الجسم. لم تكن هناك فروقات معنوية ($P\leq0.05$) في كمية العلف المستهلك في كل المعاملات وكان هناك تحسن معنوي في كفاءة التحويل الغذائي ($P\leq0.05$) .كانت هناك تحسن معنوي ($P\leq0.05$) في نسبة التصافي بين المعاملات في الاناث في حين لم يلاحظ اي فروقات معنوية ($P\leq0.05$) بين الذكور. كما تحسنت نسبة الصدر والأجنحة والساقين والظهر معنويا ($P\leq0.05$) في كل من الذكور والإناث في المعاملات التي تحتوي على مسحوق الزعتر. واظهرت النتائج انخفاضا معنويا ($P\leq0.05$) في مستويات الكوليسترول والدهون الثلاثية في الدم وزادت نسبة HDL بشكل معنوي ($P\leq0.05$) وكذلك انخفضت نسبة LDL بشكل معنوي ($P\leq0.05$) في كل من الذكور والإناث التي تغذت على علائق تحتوي على مسحوق الزعتر. في الختام ، يمكن استخدام مسحوق الزعتر 1% كإضافة علفية الى علائق طائر السمان لتحسين الأداء الانتاجي وخصائص الذبيحة وصفات دهون الدم .

الكلمات المفتاحية: السمان الياباني ، مسحوق الزعتر، مصل الدم ، الدهون في الدم