J. Animal and Poultry Prod., Mansoura Univ., Vol.5 (2): 73 - 85, 2014

EFFECT OF DIETARY SUPPLEMENTATION WITH DRIED GARLIC AND THYME ON GROWTH PERFORMANCE OF JAPANESE QUAIL

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ABSTRACT

The present study was carried out to investigate the effect of dietary inclusion of dried garlic and thyme on productive performance, carcass traits and some blood parameters of growing Japanese quail. Two experiments were conducted simultaneously. In each experiment, three hundreds, two-week-old, unsexed Japanese quail were randomly divided into five experimental groups, each with three equal replications. Ten experimental diets were formulated to contain graded levels of dried garlic (0.0, 1.0, 2.0, 3.0 and 4.0%) or dried thyme (0.0, 0.5, 1.0, 1.5 and 2.0%) and used in experiments 1 and 2, respectively. All quail were fed their respective experimental diets and managed similarly from 2 to 6 weeks of age. Growth performance of Japanese quail were evaluated as feed intake (FI), live body weight (LBW), body weight gain (BWG), feed conversion ratio (FCR) and economic efficiency of production (EEP). At 6 weeks of age, some carcass traits and certain blood plasma parameters of quail were also estimated. The results obtained could be summarized as follows: In experiment 1, quail fed the garlic-containing diets attained significantly heavier final LBW and better FCR; but FI and carcass traits were not affected, compared with their control counterparts. Feeding the garlic-containing diets up to 2.0% positively affected EEP compared with the control group. In addition, feeding the garlic-containing diets led to significant reductions in blood plasma levels of glucose, triglycerides, total cholesterol and low density lipoprotein-cholesterol (LDL-C), and activity of aspartate aminotransferase (AST) while level of high density lipoprotein-cholesterol (HDL-C) was significantly increased; but activity of alanine aminotransferase was not affected, compared with the control group. Quail fed diets containing 2.0 and 3.0% dried garlic showed significantly higher levels of plasma total protein and albumin compared with those of the control birds. In experiment 2, quail fed thyme-containing diets gave superior means of final LBW, FCR and in EEP (up to 1.5% of DT), but FI and carcass traits were not affected compared with their control group. Blood plasma levels of glucose, triglycerides, total cholesterol and LDL-C, and activity of AST were significantly decreased, while levels of total protein, albumin and HDL-C were increased but activity of alanine aminotransferase was not affected, due to feeding the thyme-containing diets compared with the control group. In conclusion, taking the economical aspect into account, the obtained results indicate that dietary supplementation with dried garlic (up to 2%) and dried thyme (up to 1.5%) can exert a beneficial effect on the performance of Japanese quail under the conditions of the present study.

Keywords: Dietary garlic, thyme, growth performance, carcass traits, blood parameters, quail.

INTRODUCTION

Poultry diets are regularly fortified with pharmacological products, either as preventives or as growth promoters, primarily for young chicks

(Doyle, 2001). Several non-pharmacological products such as prebiotics, probiotics, organic acids, essential oils and herbal plants are also used as natural growth promoters, alternatives to antibiotics (Griggs and Jacob, 2005). The medicinal properties of garlic and thyme, as herbal plants, are well known (Rana *et al.*, 2011; Khan *et al.*, 2012).

It is generally known that garlic (*Allium sativum* L.) has antimicrobial, antioxidative and antihypertensive properties (Sivam, 2001). Some reports presented an evidence that dietary garlic can lower serum and liver cholesterol (Qureshi *et al*., 1983) and inhibit bacterial growth (Amagase, 2006). According to the recent literature, dietary garlic has positive effects on growth performance of different classes of poultry (Tollba and Hassan, 2003; El-Mallah *et al.,* 2005; Khalil *et al.*, 2007; Stanacev *et al.,* 2011). There is a wide range in the inclusion level of different preparations of garlic in poultry diets, depending upon processing method (chopping, crushing, dehydration or extraction), garlic form (fresh garlic, paste or powder), garlic oil or extract and duration and target of study. In this context, dietary inclusion of garlic reached 6% for broiler chicks (Al-Homidan, 2005)), 4% for growing Japanese quail (Khalil *et al.*, 2007), 10% for laying hens (Chowdhury *et al.*, 2002) and 4% for laying Japanese quail (Canogullari *et al.*, 2010).

In view of importance of using some herbal plants in poultry nutrition, thyme (*Thymus vulgaris* L.) 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 (El-Ghousein and Al-Beitawi, 2009; Toghyani *et al.* (2010). The incorporation of thyme in poultry diets is also variable according to its composition (*i.e.* whole plant, thyme leaves, flowers, seeds or their extract), processing technique and duration of study (Khan *et al.*, 2012). The inclusion level of thyme, as phytogenic feed additive for poultry, was reported to be 0.1% (as thyme flowers) for growing Japanese quail (Zeweil, 2003), 0.2% (as thyme leaves) for broiler chicks (Ocak *et al.*, 2008), 0.5% (as thyme powder) for broiler chicks (Toghyani *et al.*, 2010), 0.3 or 0.6% (as thyme extract) for broiler chicks (Amouzmehr *et al.*, 2012), 2% (as thyme leaves) for broiler chicks (Dahal and Farran, 2011) and 2% (dried crushed thyme) for broiler chickens (El-Ghousein and Al-Beitawi, 2009). In this regard, Ocak *et al.* (2008) reported that when broiler chicks were fed 0.2% thyme from 7 to 35 days of age, they had better body weight gain compared to their control group, although feed intake, feed efficiency and carcass quality did not differ. Similar response was observed by Toghyani *et al.* (2010), who found that thyme powder (5.0 g/kg) increased weight gain in broiler chicks. In addition, El-Ghousein and Al-Beitawi (2009) reported beneficial effects of dietary thyme on growth performance and carcass yield of broiler chickens. Recently, Mansoub (2011) found that 1.0 g/kg of thyme fed to broilers resulted in improved body weight gain and feed efficiency.

Therefore, the purpose of the present study was to investigate the effect of dietary inclusion of dried garlic and thyme on productive performance, carcass characteristics and some blood parameters of growing Japanese quail.

MATERIALS AND METHODS

The present experiment was carried out at a private farm during the period from November to December, 2011. The objective of the present study was to investigate the effect of dietary inclusion of dried garlic or thyme on growth performance, carcass characteristics and some blood parameters of Japanese quail. Six hundreds unsexed 2-week-old Japanese quail were divided into two halves and used in two experiments, conducted simultaneously. In each experiment, three hundreds unsexed Japanese quail were randomly distributed into five dietary treatments, with three replicate groups of 20 birds each. Five experimental diets were formulated to contain graded levels of dried garlic (0.0, 1.0, 2.0, 3.0 and 4.0%) and used in experiment 1. Other five experimental diets were formulated to contain graded levels of dried thyme (0.0, 0.5, 1.0, 1.5 and 2.0%) and used in experiment 2. Nutrient composition of garlic powder used in the present study was 93.43% DM, 3.28% EE, 17.55% CP, 0.73% CF, 3.31% ash and 75.13% NFE (dry matter basis), as reported by Bhowmik *et al.* (2008). Thyme nutrient composition, used in the present study, was 81.50% DM, 7.76% EE, 9.20% CP, 33.43% CF, 18.03% ash and 28.25% NFE (dry matter basis), as reported by Jugifi (2009).Composition and chemical analysis of the experimental diets are presented in Table 1. Birds of each replicate group were kept in battery cages (with the following dimensions: 33.5 cm width, 80 cm depth and 25 cm height) and fed their respective experimental diets from 2 to 6 weeks of age. Feed and water were provided on *ad libitum* basis. The birds were subjected to 16 hours light daily and managed similarly. In both experiments, growth performance of quail were evaluated in terms of live body weight (LBW), body weight gain (BWG), feed intake (FI), feed conversion ratio (FCR) and economic efficiency of production. Live body weights of quail were recorded at the beginning of each experiment and on a weekly basis thereafter. Weekly records on FI and BWG of quail were also maintained on a replicate group basis. Accordingly, FCR was calculated as the amount of feed consumed per unit of BWG. Economic efficiency of production (EEP) was calculated as net revenue times 100 divided by total costs of quail production. Net revenue was estimated as total revenue minus total costs of production. Purchasing price of two-week-old quail chicks was 0.6 L.E. and sale price of one kg final live body weight of quail was 18 L.E. Cost per kg of the experimental diets was given in Table 1.

At the end of the experimental period (6 weeks of age), a slaughter test (18 birds per treatment) was performed to evaluate carcass characteristics of quail, as measured by carcass yield (*i.e.* eviscerated carcass), edible organs (*i.e.* liver, heart and gizzard) and dressing-out percentage (*i.e.* total edible parts), relative to live body weight of quail at slaughter. During slaughtering, blood samples were collected from nine birds per treatment in heparinized tubes. They were immediately centrifuged for 15 min at 4000 r.p.m to obtain blood plasma. The obtained plasma samples were frozen at –20ºC until later analysis. Blood plasma concentrations of glucose, total protein, albumin, triglycerides, total cholesterol and high density

lipoprotein-cholesterol (HDL-C), as well as activity of transaminases [alanine aminotransferase (ALT) and aspartate aminotransferase (AST)] were determined by commercial kits. The levels of blood plasma glucose (Trinder, 1969), total cholesterol (Allain *et al*., 1974), total protein (Doumas *et al*., 1981), albumin (Doumas *et al*., 1971) and triglycerides (Fossati and Prencipe, 1982) were determined. Activities of ALT and AST in blood plasma were also estimated according to the methods of Reitman and Frankel (1957). Blood plasma level of HDL-C was also determined according to the method of Sawle *et al.* (2002). The level of LDL-C in blood plasma was estimated by the equation adopted by Friedewald *et al*. (1972), as follows: LDL-C = Total Cholesterol – (HDL-C + VLDL); where VLDL are very low-density lipoprotein which was calculated as concentration of plasma triglycerides divided by 5.

A completely randomized design was used in this study. Data were statistically analyzed (SPSS, 1996) by one-way analysis of variance. The significant differences among means of different variables in both experiments were separated by Duncan's multiple range test (Duncan, 1955).

Table(1):Composition and calculated analysis of the experimental diets containing graded levels of dried garlic and thyme(Exp.1 and 2)

Feed ingredients (%)	Level of dried garlic meal (%)					Level of dried thyme meal (%)				
	0.0	1.0	2.0	3.0	4.0	0.0	0.5	1.0	1.5	2.0
Ground yellow corn	51.85	51.15	50.45	49.75	49.15	51.75	51.55	51.00	51.00	51.00
Soybean meal (44%)	10.00	9.7	9.40	9.10	8.70	10.00	10.00	10.35	9.90	9.00
Wheat bran	13.90	13.90	13.90	13.90	13.90	14.10	13.70	13.40	12.90	12.90
Dicalcium phosphate	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50
Ground limestone	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50
Corn gluten meal	19.80	19.80	19.80	19.80	19.80	19.70	19.80	19.80	20.25	20.65
Common salt (NaCl)	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30
Vit. and min. premix*	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30
DL-Methionine	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
L-Lysine.HCl	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80
Dried garlic	...	1.0	2.0	3.0	4.0	….	….	….	….	….
Dried thyme	...	….	….	….	….	….	0.5	1.0	1.5	2.0
Total	100	100	100	100	100	100	100	100	100	100
Calculated analysis (NRC, 1994)										
ME (kcal/kg)	2908	2911	2914	2917	2921	2903	2900	2891	2896	2896
CP (%)	24.04	24.01	24.00	23.96	23.90	24.00	24.02	24.12	24.16	24.05
EE (%)	2.96	2.96	2.96	2.96	2.97	2.96	2.98	2.98	3.01	3.04
CF (%)	3.62	3.59	3.56	3.54	3.50	3.65	3.73	3.85	3.91	3.98
Ca (%)	0.95	0.95	0.95	0.95	0.95	0.96	0.96	0.96	0.96	0.96
NPP (%)	0.37	0.37	0.37	0.37	0.37	0.38	0.38	0.38	0.37	0.37
Lysine (%)	1.31	1.31	1.30	1.29	1.27	1.32	1.31	1.32	1.31	1.29
Meth. (%)	0.53	0.53	0.53	0.52	0.52	0.53	0.53	0.53	0.53	0.53
Meth. + cyst (%)	0.95	0.95	0.94	0.93	0.93	0.95	0.95	0.95	0.96	0.95
Cost/kg diet (L.E.)	3.03	3.25	٣,٤٨	3.55	3.94	3.03	3.12	3.21	3.32	3.42

***: Premix at 0.30% of the diet supplies the following per kg diet: Vit. A, 1000 IU; Vit. D_3, 2000 IU; Vit. E, 10 mg; Vit. K, 1 mg; Vit. B_1, 5 mg; Vit. B_2, 5 mg; Vit. B_6, 1.5 mg; Vit. B_{12}, 0.01 mg; Folic acid, 0.35 mg; Biotin, 0.05 mg; Pantothenic acid, 10 mg; Niacin, 30 mg; Choline, 250 mg; Fe, 30 mg; Zn, 50 mg; Cu, 4 mg and Se, 0.1 mg.**

¶: Garlic and thyme, used herein, were in powder form and purchased from the local market.

RESULTS AND DISCUSSION

Growth performance of quail:

The effects of dietary dried garlic and thyme on growth performance of quail are presented in Table 2. No significant differences (P>0.05) were

observed in initial body weights of quail among the different dietary treatments in both experiments. Quail fed the garlic-containing diets exhibited significantly better (P≤0.01) final LBW, BWG and FCR but FI was not affected (P>0.05), compared with their control counterparts. The best means of LBW, BWG and FCR were achieved by birds fed the 2.0% dried garlic (DG) as compared to the other dietary treatments. Feeding the DG-containing diets up to 2.0% positively (P≤0.01) affected EEP, but when DG reached 3 or 4% DG-diets means of EEP were comparable to that of the control, with no significant differences among them. Since feed intake of quail, investigated herein, was not affected (P>0.05) by feeding the DG-containing diets, the observed growth-promoting effect of garlic in this study could be related to its role in inhibiting the growth of pathogenic bacteria (Sivam, 2001) and/or its positive effect on gut morphology, leading to enhanced rates of nutrient absorption through the enterocytes (Adibmoradi *et al*., 2006; Oladele *et al*., 2012). On the other hand, quail fed the diets containing dried thyme (DT) had positive effects on LBW, BWG, FCR and EEP compared with their control group. Significantly better (P≤0.05) means of LBW, BWG, FCR and EEP were attained by birds fed the 1.5 % DT as compared to their control counterparts. The positive effect of feeding the DT-containing diets on growth performance of quail, reported herein, might be related to thyme antibacterial action, as suggested by El-Ghousein and Al-Beitawi (2009) or to its stimulating effect on the nutrient digestibility of the experimental diets (Langhout, 2000; Hernandez *et al.*, 2004; Khan *et al.*, 2012). Part of the improvement in FCR of quail fed the DT-containing diets might be related to superior BWG and/or improved nutrient digestibility since their feed intakes were not affected.

Table 2: Performance of growing Japanese quail as affected by feeding graded levels of dried garlic or thyme from 2 to 6 weeks of age

Dietary treatments	ILBW[1] (g)	FLBW[2] (g)	BWG[3] (g)	FI[4] (g)	FCR[5] (g: g)	EEP[6] (%)
Experiment 1:						
Control	49.42	170.0^{c}	120.6^{c}	565.8	4.70^{c}	32.3^{cd}
1.0% garlic	49.42	198.8^{ab}	149.4^{ab}	554.3	3.71^{ab}	49.1^{ab}
2.0% garlic	49.75	210.8^{a}	161.1^{a}	552.7	3.45^{a}	50.8^{a}
3.0% garlic	49.33	198.3^{ab}	149.0^{ab}	553.6	3.71^{ab}	39.4^{bc}
4.0% garlic	49.25	189.7^{b}	140.4^{b}	557.7	3.98^{b}	22.2^{d}
SEM¶	0.08	4.32	4.21	2.83	0.12	3.61
Significance	NS	**	**	NS	**	**
Experiment 2:						
Control	49.42	176.7^{b}	127.3^{b}	551.8	4.34^{b}	40.2^{c}
0.5% thyme	49.42	208.0^{a}	158.5^{a}	585.0	3.69^{a}	53.3^{a}
1.0% thyme	49.50	211.4^{a}	161.9^{a}	591.3	3.67^{a}	52.2^{ab}
1.5% thyme	49.75	219.2^{a}	169.4^{a}	599.7	3.54^{a}	52.7^{ab}
2.0% thyme	49.67	205.0^{a}	155.5^{a}	576.4	3.71^{a}	43.7^{bc}
SEM¶	0.06	4.31	4.29	6.02	0.08	2.95
Significance	NS	**	**	NS	**	*

a-c: Within each experiment, means in the same column bearing different superscripts differ significantly (P≤0.05).

[1-6]: Denotes to initial live body weight, final live body weight, body weight gain, feed intake, feed conversion ratio and economic efficiency of production, respectively. ¶: Standard error of the means.

NS: Not significant; *: Significant at P≤0.05; **: Significant at P≤0.01.

As regards the response of growing Japanese quail to dietary garlic, the present results agree with those obtained by Khalil *et al.* (2007), who fed Japanese quail on garlic-containing diets and observed better means of LBW, BWG, and FCR of birds as compared to the control ones. In harmony also with the present findings, El-Mallah *et al.* (2005) observed superior growth performance (as assessed by LBW, BWG and FCR) of Broad Breasted Bronze turkey males fed garlic-containing diet from 12 to 24 weeks of age compared with the control group. Recently, Oladele *et al*. (2012) found that dietary supplementation with garlic improved BWG and FCR of broiler chickens. More recently, Elagib *et al*. (2013) investigated the effects of incorporating garlic powder on growth performance of broiler chicks. They found that dietary garlic significantly improved LBW, BWG and efficiency of feed utilization of broilers. However, a lack of positive effect of dietary garlic on growth performance of broiler chicks was reported by other investigators (Sarica *et al*., 2005; Choi *et al.*, 2010; Raeesi *et al.,* 2010).

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 BWG and FCR of growing Japanese quail due to feeding thyme flowers-containing diet. Also, Ocak *et al.* (2008) found improved BWG of broiler chicks due to feeding thyme from 7 to 35 days of age compared to their control group. Similar response was observed by Toghyani *et al.* (2010), who found that dietary thyme powder increased BWG of broiler chicks. In addition, El-Ghousein and Al-Beitawi (2009) obtained beneficial effects of dietary thyme on growth performance of broiler chickens. On the contrary, some investigators failed to find positive effects of thyme on growth performance of broiler chickens (*e.g.* Hernandez *et al.*, 2004; Demir *et al.*, 2008; Dahal and Farran, 2011). Absence of any effect of thyme on growth performance of birds may be related to diet composition and environmental conditions of the experiment (Lee *et al.,* 2003), and may depend also on other factors such as dose of added thyme, its composition (*i.e.* thyme whole plant, leaves, flowers or their extract), extraction method (processing technique), duration of study and/or avian factors like bird type, age and gender (Khan *et al.*, 2012).

Carcass traits of quail:

The effects of dietary dried garlic and thyme on carcass traits of 6-week-old Japanese quail are given in Table 3. There were no significant differences (P>0.05) among dietary treatments in carcass traits of quail, measured in the present study in both experiments, including relative weights of carcass yield, total giblets, individual edible organs (*i.e.* liver, heart and gizzard) or dressing-out percentage.

In accordance with the present results, Khalil *et al.* (2007) indicated that carcass characteristics of quail were not affected by feeding garlic-containing diets. Working with broiler chicks, Mahmood *et al*. (2009) found that dietary garlic (0.5%) did not significantly affect dressing percentage or relative weight of giblets. Similar findings were also obtained by Ocak *et al.* (2008), who observed no effect of feeding thyme leaves on carcase weight, carcase yield or the relative weights of the edible organs of broiler chicks. In harmony also

with the present findings, Dahal and Farran, (2011) found no effect of feeding thyme-containing diet on carcass traits of broiler chicks. The present results are also in agreement with those obtained by Amouzmehr *et al.* (2012), who demonstrated that carcass characteristics of broiler chicks (including carcass yield, breast, thigh and abdominal fat) were not affected by feeding diets containing thyme or garlic extract. In addition, Elagib *et al*. (2013) found that dietary garlic had no significant effect on carcass characteristics of broiler chicks.

Conversely, some authors provided evidence that feeding thyme-containing diets exerted positive effects on carcass traits of broiler chicks (*e.g.* Abdel-Latif *et al.*, 2002; El-Ghousein and Al-Beitawi, 2009). Also, Raeesi *et al.* (2010) reported that feeding garlic-supplemented diets to broiler chicks led to better carcass characteristics compared with those of the control group.

Table 3: Carcass traits of 6-week-old Japanese quail as affected by feeding graded levels of dried garlic or thyme

Dietary treatments	LBW (g)	CY (%)	Liver (%)	Heart (%)	Gizzard (%)	TG (%)	DP (%)
Experiment 1:							
Control	201.3	75.63	2.28	0.76	2.51	5.55	81.18
1.0% garlic	203.3	74.42	2.37	0.77	2.52	5.66	80.08
2.0% garlic	202.6	74.87	2.29	0.78	2.50	5.57	80.44
3.0% garlic	202.6	74.10	2.28	0.77	2.49	5.54	79.64
4.0% garlic	202.4	76.22	2.26	0.76	2.24	5.26	81.48
SEM¶	5.13	0.49	0.03	0.005	0.04	0.06	0.44
Significance	NS	NS	NS	NS	NS	NS	NS
Experiment 2:							
Control	202.4	76.25	2.00	0.50	1.94	4.44	80.69
0.5% thyme	203.7	76.71	1.74	0.53	1.81	4.08	80.79
1.0% thyme	203.3	76.68	1.85	0.50	1.73	4.08	80.76
1.5% thyme	203.0	75.87	2.08	0.50	1.87	4.45	80.32
2.0% thyme	203.5	75.98	1.91	0.50	1.81	4.22	80.20
SEM¶	5.04	0.43	0.005	0.006	0.04	0.07	0.64
Significance	NS	NS	NS	NS	NS	NS	NS

LBW, CY, TG and DP denotes to live body weight at slaughter, carcass yield, total giblets and dressing-out percentage, respectively. ¶: Standard error of the means. NS: Not significant.

Blood parameters of quail:

The effects of dietary dried garlic and thyme on blood parameters of 6-week-old Japanese quail are given in Table 4. The obtained results indicated that quail fed diets containing 2.0 and 3.0% dried garlic showed significantly higher (P≤0.01) levels of plasma total protein and albumin compared with those of the control counterparts. But birds fed 1.0 and 4.0% DG in their diets exhibited no significant differences (P>0.05) in levels of plasma total protein or albumin as compared to the control group. Blood plasma levels of glucose, triglycerides, total cholesterol and LDL-C, and activity of AST of growing Japanese quail were significantly decreased (P≤0.01) whereas level of HDL-C was significantly increased (P≤0.01), but activity of ALT was not affected

(P>0.05) due to feeding the diets containing DG compared with their control counterparts. On the other hand, the above results (Table 4) indicated also that quail fed thyme-containing diets showed significantly higher (P≤0.01) levels of plasma total protein, albumin and HDL-C compared with those of the control birds. However, blood plasma levels of glucose, triglycerides, total cholesterol and LDL-C, and activity of AST were significantly decreased (P≤0.01) but activity of ALT was not affected (P>0.05) due to feeding the thyme-containing diets compared with the control group.

In fact, the mechanism by which garlic preparations reduce blood plasma lipids in human and animals is not completely confirmed yet. But, it is generally accepted that dietary garlic supplementation inhibits the hepatic activities of lipogenic and cholestrogenic enzymes in chickens (Qureshi *et al.*, 1983), pigs (Qureshi *et al.*, 1987) and rats (Mathew *et al.*, 2004). In agreement with the present results, Tollba and Hassan (2003) studied the effect of feeding garlic-containing diets on the physiological performance of broiler chicks and observed significant increases in plasma total protein and albumin in response to feeding the garlic-containing diets. Similarly, significant reductions in blood plasma concentrations of glucose and triglycerides were observed in broiler chicks (Al-Homidan, 2005) and Japanese quail (Khalil *et al*., 2007) in response to feeding garlic-supplemented diets compared with their control birds. The present results are in accordance also with the findings obtained by Prasad *et al*. (2009), who found that blood plasma total cholesterol, triglycerides, low density lipoprotein and very low density lipoprotein were significantly decreased, while high density lipoprotein was significantly increased by garlic supplementation in broiler chickens in comparison to the control group. In addition, Choi *et al.* (2010) indicated that dietary garlic powder significantly decreased total and low-density lipoprotein cholesterol and increased high-density lipoprotein cholesterol in broiler blood.

On the other hand, the hypocholesterolemic and antilipidemic effects of thyme on blood parameters have been supposed to be exerted through inhibiting the activity of β-hydroxy-β-methylglutaryl-CoA reductase (the rate-limiting enzyme in cholesterol synthesis), decreasing fat absorption from the gastrointestinal tract or *via* lipid catabolism for gluconeogenesis (El-Ghousein and Al-Beitawi (2009). Several reports appeared in scientific literature which have confirmed the hypocholesterolemic and antilipidemic effects of thyme in poultry (*e.g.* Toghyani *et al.*, 2010; Dahal and Farran, 2011). Other investigators failed to find any beneficial effects of thyme on the cholesterol level in birds (for example, Sengül *et al.* (2008). The current results agree also with the findings of Rostami *et al*. (2012), who found that supplemental dietary thyme significantly decreased blood serum levels of triglycerides and total cholesterol in Japanese quail. Similar results were also obtained by Khaksar *et al*. (2012), who reported that Japanese quail fed thyme essential oil-supplemented diet exhibited significantly lower levels of serum glucose, triglycerides and total cholesterol compared with the control birds. However, Sengül *et al.* (2008) reported that levels of blood plasma cholesterol, triglycerides, high density lipoprotein, very low density lipoprotein were not affected by feeding thyme extracts-containing diets compared with the control group.

Conclusion

Taking the economical aspect into account, the obtained results indicated that dietary supplementation with dried garlic (up to 2%) and dried thyme (up to 1.5%) can exert a beneficial effect on the performance of Japanese quail under the conditions of the present study.

Table 4: Blood plasma parameters of 6-week-old Japanese quail as affected by feeding graded levels of dried garlic or thyme

Dietary treatments	TPR[1] g/dL	ALB[2] g/dL	GLU[3] mg/dL	TRI[4] mg/dL	TC[5] mg/dL	HDL-C[5] mg/dL	LDL-C[6] mg/dL	AST[7] IU/L	ALT[8] IU/L
Experiment 1:									
Control	4.11^{b}	2.06^{b}	306.8^{a}	134.2^{a}	196.6a	51.0^{d}	118.7^{a}	82.7^{a}	24.4
1.0% garlic	4.19^{b}	2.06^{b}	293.9^{b}	128.1^{b}	186.8^{b}	53.2^{c}	107.9^{b}	75.7^{b}	22.6
2.0% garlic	4.52^{a}	2.20^{a}	283.9^{c}	125.2^{c}	178.9^{c}	59.0^{a}	95.0^{d}	74.4^{c}	20.8
3.0% garlic	4.48^{a}	2.16^{a}	285.8^{c}	125.3^{c}	180.1^{c}	58.1^{a}	97.2^{cd}	74.6^{c}	21.0
4.0% garlic	4.14^{b}	2.06^{b}	295.4^{c}	129.7^{b}	180.4^{c}	56.7^{b}	98.4^{c}	76.6^{b}	22.9
SEM¶	0.04	0.01	1.30	0.63	1.05	0.44	1.38	0.50	0.26
Significance	**	**	**	**	**	**	**	**	NS
Experiment 2:									
Control	3.63^{b}	1.86^{b}	299.8^{a}	134.0^{a}	197.3^{a}	49.7^{d}	120.9^{a}	82.0^{a}	24.1
0.5% thyme	4.46^{a}	2.16^{a}	293.9^{b}	131.7^{b}	189.3^{b}	51.8^{c}	111.2^{b}	76.3^{b}	22.3
1.0% thyme	4.52^{a}	2.17^{a}	294.1^{b}	131.0^{b}	188.9^{b}	52.0^{bc}	110.7^{b}	75.1^{c}	21.8
1.5% thyme	4.65^{a}	2.19^{a}	284.7^{c}	123.6^{c}	183.0^{c}	56.4^{a}	101.8^{d}	75.0^{c}	21.2
2.0% thyme	4.56^{a}	2.18^{a}	286.8^{c}	124.9^{c}	183.8^{c}	52.9^{b}	105.9^{c}	74.9^{c}	21.3
SEM¶	0.08	0.02	0.89	0.65	0.82	0.36	1.01	0.44	0.18
Significance	**	**	**	**	**	**	**	**	NS

a-d: Within each experiment, means in the same column bearing different superscripts differ significantly (P≤0.05).

[1-8]: Denotes to total protein, albumin, glucose, triglycerides, total cholesterol, high density lipoprotein-cholesterol, low density lipoprotein-cholesterol, aspartate aminotransferase and alanine aminotransferase, respectively.

¶: Standard error of the means. NS: Not significant; **: Significant at P≤0.01.

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تأثير تدعيم الغذاء بمسحوق الثوم والزعتر على أداء النمو للسمان الياباني

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أجريت الدراسة الحالية لبحث تأثير إدخال مسحوق الثوم والزعتر في العليقة على الأداء الإنتاجي وصفات الذبيحة وبعض قياسات الدم للسمان الياباني النامي. تم إجراء تجربتين متزامنتين: تضمن كل منها على عدد ٣٠٠ كتكوتا مختلطة الجنس عمر أسبوعين من السما٣ن الياباني. تم تقسيم طيور كل تجربة عشوائيا إلى ٥ مجموعات تجريبية، إحتوت كل منها على ٣ مكررات متساوية. تم تكوين عشرة علائق تجريبية تحتوى على خمسة مستويات متدرجة من مسحوق الثوم الجاف (صفر، ١%، ٢%، ٣%، ٤%) استخدمت في التجربة الأولى،أو من مسحوق الزعتر الجاف (صفر، ٠,٥%، ١%، ١,٥%، ٢%) استخدمت في التجربة الثانية. تم تغذية طيور السمان على العلائق التجريبية الخاصة بها وخضعت لنفس المعاملات الإدارية خلال الفترة من ٢ - ٦ أسابيع من العمر. وتضمنت معايير أداء النمو: وزن الجسم الحي للطيور، والزيادة في الوزن، واستهلاك الغذاء، ومعامل التحويل الغذائي، والكفاءة الإقتصادية للإنتاج. كما تم قياس بعض خصائص الذبيحة، وبعض معايير بلازما الدم في الطيور في نهاية كل تجربة. وأمكن تلخيص النتائج المتحصل عليها كما يلي: في التجربة الأولى: حققت طيور السمان المغذاة على العلائق المحتوية على الثوم وزن جسم نهائي أعلى ومعدل تحويل غذائي أفضل معنويا بينما لم يتأثر إستهلاك الغذاء أو صفات الذبيحة مقارنة بطيور العليقة الضابطة. كما حققت التغذية على العلائق المحتوية على الثوم حتى مستوى ٢% أثرا ايجابيا على الكفاءة الإقتصادية لإنتاج السمان مقارنه بمجموعة الكنترول. أحدثت التغذية على العلائق ألمحتوية على الثوم نقصا معنويا في مستويات بلازما الدم من الجلوكوز والجليسريدات الثلاثية والكوليستيرول الكلى والكوليستيرول الليبوبروتيني منخفض الكثافة، ونشاط إنزيم أسبارتيت أمينوترانسفيريز بينما إزداد معنويا مستوى الكوليستيرول الليبوبروتيني مرتفع الكثافة، ولم يتأثر نشاط إنزيم ألانين أمينوترانسفيريز مقارنة بالمجموعة غير المدعمة. أظهرت التغذية على العلائق المحتوية على الثوم حتى بمستوى ٢ أو ٣% زيادة معنوية في مستويات بلازما الدم من البروتين الكلي والألبيومين مقارنة بطيور العليقة الضابطة. في التجربة ٢الثانية: أعطت طيور السمان المغذاة على العلائق المحتوية على الزعتر متوسطات أفضل معنويا لوزن الجسم النهائي للطيور ومعدل التحويل الغذائي والكفاءة الإقتصادية للإنتاج (حتى مستوى ١,٥%) بينما لم يتأثر إستهلاك الغذاء، صفات الذبيحة أو نشاط إنزيم ألانين أمينوترانسفيريز مقارنة بطيور العليقة الضابطة. أدت التغذية على العلائق ألمحتوية على الزعتر إلى نقص معنوي في مستويات بلازما الدم من الجلوكوز والجليسريدات الثلاثية والكوليستيرول الكلى والكوليستيرول الليبوبروتيني منخفض الكثافة، ونشاط إنزيم أسبارتيت أمينوترانسفيريز بينما حدثت زيادة معنوية في مستويات البروتين الكلي والألبيومين والكوليستيرول الليبوبروتيني مرتفع الكثافة، ولم يتأثر نشاط إنزيم ألانين أمينوترانسفيريز مقارنة بالمجموعة غير المدعمة. نستخلص من النتائج المتحصل عليها أنه بأخذ الناحية الإقتصادية في الاعتبار، فإن إضافة مسحوق الثوم (حتى مستوى ٢%) أو مسحوق الزعتر (حتى مستوى ١,٥%) في الغذاء يمكن أن يحقق تأثيرا إيجابيا على أداء النمو لطيور السمان الياباني، تحت ظروف هذه الدراسة.

قام بتحكيم البحث

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