



## IMPACT OF DIETARY THYME (*Thymus vulgaris* L.) AND *Achillea fragrantissima* ON GROWTH PERFORMANCE OF GROWING QUAIL BIRDS

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### ABSTRACT

This study was conducted to investigate the effects of thyme (*Thymus vulgaris* L.) and *Achillea fragrantissima* plants on growth performance of quail birds. A total number of 450 unsexed quail birds, 7 days old were randomly divided into six equal experimental groups with three replicates of 25 birds each for 42 days. The first group was fed on the basal diet as a control. The 2<sup>nd</sup> and 3<sup>rd</sup> groups were fed on 5 and 10 g thyme powder/kg diet respectively. The 4<sup>th</sup> and 5<sup>th</sup> groups were fed on 5 and 10 g achillea powder/kg diet, respectively. The 6<sup>th</sup> group was fed on 5 g of each thyme and achillea powder/kg diet. The results indicated that adding of 5 g achillea/kg diet increased the live body weight and body weight gain but not significant ( $P > 0.05$ ) differ in control group. While birds fed on diet with 5 g achillea significantly ( $P < 0.05$ ) decreased feed intake and improved feed conversion compared to the control group. However, no significant ( $P > 0.05$ ) change on carcass characteristics due to thyme and achillea adding to quail diets compared to the control group. Additionally, no significant ( $P > 0.05$ ) effects were observed in total protein, albumin, globulin and albumin/globulin ratio and triglycerides due to the treatments. Birds fed on diet with 5 g achillea/kg diet significantly ( $P < 0.05$ ) decreased the serum low-density lipoprotein (LDL), Aspartate transaminase (AST) and Alanine transaminase (ALT) and increased high-density lipoprotein (HDL) compared with the control group.



## INTRODUCTION

Antibiotic have been widely used as growth promoters in poultry production for several years. The use of antibiotics as feed additives is of many hazardous due to cross-resistance and multiple resistances of pathogens (Chokshi *et al.*, 2019).

Today alternative sources for antibiotics as a feed additives and growth promoter are needed in poultry production. Therefore, the medicinal plants as a natural feed additive are considered to be safer, healthier and less regarded as chemical hazards than synthetic additives (Fawaz *et al.*, 2021). Herbs and herbal products are incorporated in poultry diets to replace synthetic

products in order to stimulate or promote the effective use of feed nutrients which may subsequently result in more growth rates and improved feed efficiency (Kheiri *et al.*, 2018; Tayeb *et al.*, 2019; Adam *et al.*, 2020; Hussain *et al.*, 2021). Moreover, active components of herbs may improve digestion and stimulate the immune function in broilers (Toghyani *et al.*, 2011; Sharifi *et al.*, 2013; Norouzi *et al.*, 2015; Soltaninejad *et al.*, 2021).

So that, the current study was carried out to evaluate the effects of different levels of Thyme (*Thymus vulgaris* L.) and *Achillea fragrantissima* plants and their mixture in the diet on growth performance, blood parameters, carcass characteristics and

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economic efficiency of quail birds under North Sinai conditions.

## MATERIALS AND METHODS

This study was carried out at the Poultry Research Farm, Department of Animal and Poultry Production, Faculty of Environmental Agricultural Sciences, Arish University, El Arish, North Sinai, Egypt during the period from October to December 2021.

A total number of 450 unsexed seven day-old quail chicks are having nearly equal live weights assigned to sex treatments with three replicates each of 25 birds based during 42 days. Quail birds of the first group was served as control group was fed the basal diet without any addition, while the 2<sup>nd</sup> and 3<sup>rd</sup> groups were fed diet containing 5 and 10 g thyme powder/kg diet, respectively the 4<sup>th</sup> and 5<sup>th</sup> groups were fed diet containing 5 and 10 g achillea powder/kg diet, respectively and the 6<sup>th</sup> group was fed diet containing 5 g. of each thyme and achillea powder/ kg diet. Fresh wild thyme and achillea plants were collected from the desert of North Sinai Governorate. The plants were air-dried under shade until the moisture of collected plants roughly reached 10%. The plants were finally milled, sieved (1 mm mesh) and stored in a well tight polyethylene bags at room temperature of 25°C.

All experimental diets were formed to meet the **NRC (1994)** nutrient recommendations of quail birds for starter (7-21 days) and grower (21-42days) periods (Tables 1 and 2). Experimental diets and fresh water were offered *ad-libitum* over all periods. Weekly, Body weight and feed consumption were recorded.

Average body weight gain and feed conversion ratio were calculated for each period. Prices of experimental diets and feed medicinal plants were calculated according to the price of local market at the

time of the experiment October 2021. Also, the net revenue, economic efficiency and relative economic efficiency were calculated as describe by **Asar *et al.* (2010)**.

At the experimental **end** (42 days of age), five birds from each treatment were selected and slaughtered to obtain the carcass; giblets, gizzard, liver heart, head, leg, lung and gut weights. Blood samples were taken from the jugular vein of the birds, at the same time of slaughtering. Blood serum were individually separated by centrifugation at 3000 rpm for 10 minutes and stored in vials at -20°C for later analysis. Serum total protein, albumin, globulin, total cholesterol, triglyceride, high-density lipoprotein (HDL), low-density lipoprotein (LDL), Aspartate transaminase (AST) and Alanine transaminase (ALT) were determined using commercial kits (from Biomerieux, Poains, France).

The obtained data was statistically analyzed using the general linear model procedure described in SAS User's Guide (**SAS, 2004**). Differences among means were tested using Duncan's multiple range test (**Duncan, 1955**).

## RESULTS AND DISCUSSION

### Growth Performance

Results in Table 3 presented the effect of thyme (*Thymus vulgaris* L.) and *Achillea fragrantissima* plants and their mixture during the experimental period from 7-42 day on growth performance (Table 3).

The results of the body weights at 42 days showed that the quail birds fed on basal diet with 5g/kg diet achillea powder were significantly higher in live body weight than those of the 5 and 10 g/kg diet of thyme but without any differ with the control and 10 g/kg diet of achillea. The results of the present study are similar to those reports by **Toghyani *et al.* (2011)** who reported that broiler chicks fed on diet

**Table 1. Composition and calculated analysis of starter diets (7-21 days of age)**

Ingredients (%)	T1	T2	T3	T4	T5	T6
Yellow corn (grain) %	55	55	55	55	55	56
Soybean 44	36	36	35.3	36	35.3	36
Wheat bran	2	2	2	2	2	0
Protein concentration 45 % CP*	5	5	5	5	5	5
Calcium carbonate	1.7	1.2	1.4	1.2	1.4	1.7
Salt (NaCl)	0.3	0.3	0.3	0.3	0.3	0.3
Thyme (g)	-	0.5	1	-	-	0.5
Achillea (g)	-	-	-	0.5	1	0.5
<b>Total</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>
<b>Calculated Analysis</b>						
Crude protein (%)	23.17	23.08	22.96	23.08	22.96	23.08
Metabolizable energy (ME kcal / kg diet)	2791	2804	2803	2804	2803	2845
Lysine (%)	1.40	1.50	1.50	1.50	1.50	1.40
Methionine %	0.45	0.50	0.46	0.50	0.46	0.45
Methionine +Cystine (%)	0.87	0.90	0.88	0.90	0.88	0.80
Calcium (%)	0.90	1.00	0.90	1.00	0.90	0.90
Available phosphorus (%)	0.31	0.35	0.32	0.35	0.32	0.30
Crude fat (%)	2.80	2.90	2.80	2.80	2.80	2.70
Crude fiber (%)	4.40	4.50	4.60	4.50	4.60	4.40

\* Each 1 kg contains the following: 120000 UI Vitamin. A, 20000 UI Vitamin. D3, 100 mg Vitamin. E, 10 mg Vitamin. K3, 10 mg Vitamin. B1, 50 mg Vitamin. B2, 15 mg Vitamin. B6, 100 µg Vitamin. B12, 300 mg niacin, 500 µg biotin, 10 mg folic acid, 100 mg pantothenic acid, 2500 mg choline, 500 mg zinc, 600 mg manganese, 40 mg copper, 300 mg iron, 5 mg iodine, 1 mg cobalt, 1 mg selenium.

\*\* Metabolizable energy: calculated according to **Ellis (1981)**.

**Table 2. Composition and calculated analysis of grower diets (21-42 days of age)**

Ingredients (%)	T1	T2	T3	T4	T5	T6
Yellow corn (grain) %	64	64	63.4	63.4	63.4	63
Soybean 44	27.2	27	27	27.5	27	27.2
Wheat bran	2	2	1.8	1.8	1.8	2
Protein concentration 45 % CP*	5	5	5	5	5	5
Calcium carbonate	1.5	1.2	1.5	1.5	1.5	1.5
Salt (NaCl)	0.3	0.3	0.3	0.3	0.3	0.3
Thyme	-	0.5	1	-	-	0.5
Achillea	-	-	-	0.5	1	0.5
<b>Total</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>
<b>Calculated Analysis</b>						
Crude protein (%)	20.16	19.98	20.00	20.15	20.00	20.14
Metabolizable energy **(ME kcal / kg diet)	2909	2912	2911	2903	2911	2909
Lysine (%)	1.00	1.20	1.20	1.20	1.20	1.00
Methionine %	0.38	0.42	0.42	0.42	0.42	0.39
Methionine +Cystine (%)	0.70	0.79	0.78	0.79	0.78	0.70
Calcium (%)	0.90	0.90	0.90	0.90	0.90	0.90
Available phosphorus (%)	0.29	0.30	0.30	0.30	0.30	0.29
Crude fat (%)	2.90	3.00	2.9	3.00	2.90	2.90
Crude fiber (%)	3.70	4.00	4.20	4.00	4.20	3.80

\* Each 1 kg contains the following: 120000 UI Vitamin. A, 20000 UI Vitamin. D3, 100 mg Vitamin. E, 10 mg Vitamin. K3, 10 mg Vitamin. B1, 50 mg Vitamin. B2, 15 mg Vitamin. B6, 100 µg Vitamin. B12, 300 mg niacin, 500 µg biotin, 10 mg folic acid, 100 mg pantothenic acid, 2500 mg choline, 500 mg zinc, 600 mg manganese, 40 mg copper, 300 mg iron, 5 mg iodine, 1 mg cobalt, 1 mg selenium.

\*\* Metabolizable energy: calculated according to **Ellis (1981)**.

**Table 3. Effect of feeding dietary levels of natural feed additives on growth performance of quail chicks during the experimental period (7 - 42 day)**

Term	Control (T1)	Thyme 5g/kg (T2)	Thyme 10g/kg (T3)	Achillea 5g/kg (T4)	Achillea 10 g/kg (T4)	Thyme 5g + Achillea 5g / kg (T6)
Initial live body weight (g)	45.33a ± 0.58	44.93a ± 1.27	46.40a ± 0.83	45.60a ± 0.61	45.33a ± 1.76	46.13a ± 1.53
Final live body weight (g)	208.47ab ± 7.28	200.71b ± 7.65	199.70b ± 4.71	222.66a ± 1.30	207.65ab ± 5.80	204.72ab ± 2.90
Body Weight Gain (g)	163.14ab ± 6.79	155.77b ± 6.63	153.30b ± 4.56	177.06a ± 1.89	162.32ab ± 4.04	158.58b ± 3.31
Feed Intake (g)	523.46a ± 2.31	515.81ab ± 1.06	517.16ab± 6.06	512.17b ± 3.15	518.15ab± 0.80	527.59ab ± 1.61
Feed conversion ratio (g. feed/g. gain)	3.21a ± 0.12	3.32a ± 0.14	3.37a ± 0.10	2.89b ± 0.03	3.19ab ± 0.07	3.26a ± 0.07

a,b.Means followed by the same letter within each row are not significantly different at 0.05 level of probability

supplemented with 5 g achillea/kg diet did not affect live body weight at 41 days old. Also, **Yakhkeshi *et al.* (2012)** showed that live body weight in broilers fed on diet supplemented with achillea at 1.5 and 3% of diet were not affected compared with the control group at 41 days old. Additionally, **Norouzi *et al.* (2015)** did not find any effects of yarrow on live body weight when broiler chicks fed on diet supplemented with yarrow (*Achillea millefolium*) 0.5, 1.0, or 1.5% of yarrow herb compared with the control group at 41 days old. For thyme, **Tayeb *et al.* (2019)** found that the feeding broilers with 5 and 10 g/kg thyme resulted in an increase in live body weight in broiler chicks at 42 day old. The same results for thyme were obtained by **Adam *et al.* (2020)** who noticed no effect of feeding 2.5 and 5 g thyme powder/kg diet, on live body weight of broiler chicks at 35 days. On contrary **Wade *et al.* (2018)** reported that the chicks fed with 5 g/kg thyme had significantly higher live body weight at 42 day old.

The results revealed that quail birds fed with 5g/kg achillea leave powder had the significantly ( $P < 0.05$ ) higher averages in terms of body weight gain compared with those fed on 5, 10 g/kg thyme and the mixture groups but without differ with birds

fed on control group and 10g/kg achillea. This results are in agreement with **Toghyani *et al.* (2011)** who found that broiler chicks fed on diet that supplemented with yarrow (*Achillea millefolium*) powder at levels of 5 or 10 g/kg does not affect ( $P > 0.05$ ) on body weight gain compared to the control group through 42 days. On the other side, **Sharifi *et al.* (2013)** observed that 0.2% yarrow (*Achillea millefolium* L.) supplementation had a negative effect on body weight gain of broiler chicks during period 5 - 42 days compared to the control treatment. In contrary, **Norouzi *et al.* (2015)** indicated that broiler chicks fed diet supplemented with yarrow (*Achillea millefolium* L.) at different levels (0.5, 1.0, or 1.5%) had better average daily gain compared with the control group through 42 days. In addition, **Soltaninejad *et al.* (2021)** observed increase ( $P < 0.05$ ) in body weight gain in broiler chicks which received yarrow (*Achillea millefolium*) essential oil at 100 mg/kg diet than the control group. The same results for thyme were obtained with, **Fallah and Mirzaei (2016)** who concluded that using thyme (*Thymus vulgaris* L.) powder at 5 g/kg diet did not affect weight gain of broiler chicks compared with the control group. On contrary **Hassan and Awad (2017)** indicated that the chicks fed on diet

supplemented with 5 g/kg thyme powder significantly ( $P < 0.05$ ) increased body weight gain compared with the control group. Also, **Tayeb *et al.* (2019)** observed a significant increase ( $P < 0.05$ ) in body weight gain of broiler chicks fed on diet supplemented with 5 and 10 kg of thyme compared with the control group.

There were significant effects on feed intake of treated chicks ( $P < 0.05$ ) during the experimental period (7-42 day). The results indicated that the amount of feed intake were in birds consuming the basal diet compared to the birds consuming the basal diet inclusion with 5 g/kg achillea leave powder but without differ with birds fed on 5, 10 g/kg thyme, 10 g/kg achillea and the mixture group. These results are in the same line with **Soltaninejad *et al.* (2021)** who found the birds fed on diet supplemented with 200 mg/kg of yarrow essential oil had lower ( $P < 0.05$ ) feed intake compared with the control group through 42 days. On contrary, **Toghyani *et al.* (2011)** showed insignificant ( $P > 0.05$ ) effect on feed intake in birds fed on diet supplemented with 5 and 10 g/kg of yarrow powder compared with control group. Additionally, **Norouzi *et al.* (2015)** showed no differences ( $P < 0.05$ ) in feed intake between chick birds fed in 0.5, 1.0, or 1.5% of yarrow herb and those fed in control diet during 0-42 days old. On the other side, **Sharifi *et al.* (2013)** showed significant ( $P > 0.05$ ) increase in feed intake when broiler chicks fed on diet supplemented with 0.2% yarrow (*Achillea millefolium* L.) compared to the control group during 0 – 42 days. **Fallah and Mirzaei (2016)** showed that using thyme powder at 5 g/kg diet did not affect the feed intake of broilers compared with the control group. On the other hand, **Khafar *et al.* (2019)** noticed that the broiler chicks fed on thyme essential oil at 150 and 200 mg/kg of diet decreased the feed intake ( $P < 0.05$ ) compared with control group.

Quail birds fed the diet supplement with achillea at the level of 5 g/kg diet had the better ( $P < 0.05$ ) feed conversion ratio value compared with the control, 5, 10 g/kg thyme and mixture groups without any differ with birds fed on diet with 10 g/kg achillea. Result of this experiment corresponds with consequences reported from, **Norouzi *et al.* (2015)** who showed that 1.5 % yarrow (*Achillea millefolium* L.) powder supplementation in the broiler diet had improved ( $P < 0.05$ ) feed conversion compared with the control treatment. Also, **Soltaninejad *et al.* (2021)** showed that the broiler chicks fed on diet supplemented with yarrow (*Achillea millefolium* L.) essential oil at 100 mg/kg diet significantly ( $P < 0.05$ ) had the best feed conversion ratio compared to the control group. On contrary, **Toghyani *et al.* (2011)** noted that there was not any effect on feed conversion ratio of broiler chicks fed a diet supplemented with yarrow powder at levels of 5 and 10 g/kg compared with control group. Also, **Yakhkeshi *et al.* (2012)** observed that 1 and 3% yarrow (*Achillea millefolium* L.) herb supplementation in the broilers diet insignificantly ( $P > 0.05$ ) improved the feed conversion ratio as compared with the control group. However, **Fallah and Mirzaei (2016)** showed insignificant ( $P > 0.05$ ) effect on feed conversion of broiler chicks fed on diet supplemented with 5 g/kg compared with the control group. Also, **Kheiri *et al.* (2018)** observed that the Japanese quails (*Coturnix japonica*) birds fed diet supplemented with 2 g thyme/kg had insignificant ( $P > 0.05$ ) effects on feed conversion ratio compared with the control group. On contrary, **Adam *et al.* (2020)** indicated that the broiler chicks fed on diet supplemented with 5 g/kg of thyme had better feed conversion ratio compared with the control group.

### Carcass Characteristics

Results of carcass traits of the quail birds at 42 days fed diets inclusion with natural

feed additives (thyme, achillea plant and their mixture) are summarized in Table 4.

The results indicated that dietary inclusion with achillea, thyme powder and their mixture did not significantly ( $P \geq 0.05$ ) effect on pre slaughter, carcass, gizzard, liver, leg, head, lung and total giblet weights compared to the control group. These results are in the same tone with **Jang (2011)** who indicated that the broiler chicks fed on diet supplemented with 2 g/kg, achillea powder had no effect on gizzard compared with the control group. Likewise, **Toghyani *et al.* (2011)** noted that the 5 and 10 g/kg of yarrow powder supplementation in the broiler diet had no effect on the weight of gizzard, heart. On the other side, **Norouzi *et al.* (2015)** indicated that broiler chicks fed on diet supplemented with yarrow at level of 0.5, 1.0, or 1.5% significantly ( $P < 0.05$ ) decreased the carcass weight and increased the liver weight compared with the control treatment. For thyme plant, **Toghyani *et al.* (2010)** noted that carcass yield, liver and gizzard, weight was not affected by adding thyme powder (5 and 10g/kg diet) in broilers compared to the control groups. Similarly, **Adam *et al.* (2020)** showed that fed broiler chicks on diet inclusion of thyme powder at 2.5 and 5 g had not significant effect on percentage of dressing, gizzard and liver compared with the control group. On the other side, **Tayeb *et al.* (2019)** recorded an increase ( $P < 0.05$ ) in dressing percentage and liver weights in broiler fed in diet supplemented with 5 g/kg thyme (*Thymus vulgaris* L.) compared with the control group.

Quails fed diet included 5g/kg of achillea significantly ( $P \leq 0.05$ ) had the higher values for heart compared with those fed on mixture powder but without any different ( $P \geq 0.05$ ) with the control group and other treatments. Same trend was observed for gut weight, the birds fed on

5g/kg of achillea significantly ( $P \leq 0.05$ ) achieved the higher gut weight compared with those fed on 5, 10 g thyme, 10 g achillea and their mixture but without any different ( $P \geq 0.05$ ) effect with the control group (11.46 g). However, birds fed on basal diet with 10 g/kg of achillea significantly ( $P \leq 0.05$ ) had higher testis weight compared with those fed on basal diet with 10 g/kg of achillea and mixture group but without any different ( $P \geq 0.05$ ) effect with the control group. On the other side the highest giblet weight ( $P \geq 0.05$ ) was recorded in group fed on basal diet with 10 g/kg of thyme, the birds fed on diet with 10 g/kg of achillea achieved the smallest weight but without any different ( $P \geq 0.05$ ) effect with the control, 5 g/kg thyme, 5 g/kg achillea and mixture groups. This result in agreement with, **Sharifi *et al.* (2013)** who found broiler fed diets containing 0.2% yarrow (*Achillea millefolium* L.) insignificantly had enlarged gut compared with the control group. However, **Toghyani *et al.* (2011)** found that the 5 and 10 g/kg of yarrow powder supplementation in the broiler diet had no effect on heart compared with the control group.

### Blood Constituents

The effects of adding thyme and achillea leaf powder on the serum biochemical parameters of quail birds were shown in Table 5. The results indicated that dietary thyme, achillea plant and their mixture had no significant ( $P \geq 0.05$ ) effect on total protein, albumin, globulin and albumin/globulin (A/G) ratio compared with the control group. These results are in the same line with **Tayeb *et al.* (2019)** who found no significant effect on serum total protein and globulins on broiler chicks fed on 5 or 10g/kg thyme powder compared with the control group. Also, **Toghyani *et al.* (2010)** indicated that adding thyme powder 5 and 10 g/kg diet did not have any effects on the total protein, albumin, A/G ratio compared with control group. On the

**Table 4. Effect of experimental diets on carcass traits of quail chicks**

<b>Term</b>	<b>Control (T1)</b>	<b>Thyme 5g/kg (T2)</b>	<b>Thyme 10g/kg (T3)</b>	<b>Achillea 5g/kg (T4)</b>	<b>Achillea 10 g/kg (T5)</b>	<b>Thyme 5g + Achillea 5g / kg (T6)</b>
<b>Slaughter weight, (g)</b>	219.71a ± 7.10	214.07a ±4.01	216.76a ± 4.08	217.06a ±2.10	213.77a ± 4.78	204.29a ± 7.33
<b>Carcass , (g)</b>	153.80a ± 5.28	148.35a ±2.36	155.72a ± 3.83	154.61a ± 1.92	148.89a ± 4.45	145.23a ± 5.49
<b>Gizzard , (g)</b>	4.32a ± 0.22	4.31a ±0.22	4.88a ± 0.19	4.43a ± 0.28	4.24a ± 0.21	4.65a ± 0.34
<b>Liver , (g)</b>	4.18a ± 0.24	4.50a ±0.36	4.57a ±0.38	4.67a ± 0.22	3.85a ± 0.26	4.18a ± 0.25
<b>Heart , (g)</b>	2.41ab ± 0.04	2.72ab ± 0.12	2.84ab ± 0.21	2.98a ±0.44	2.53ab ± 0.09	2.23b ±0.17
<b>Leg , (g)</b>	4.77a ± 0.12	4.86 a ± 0.20	4.88 a ± 0.25	4.77a ±0.13	4.72a ±0.19	4.56 a ±0.21
<b>Head , (g)</b>	8.10a ±0.22	7.59 a ± 0.17	7.91 a ± 0.20	7.99 a ±0.23	7.93 a ± 0.16	7.51a ± 0.16
<b>Gut, , (g)</b>	11.46ab ±0.60	11.12bc ± 0.41	10.58abc ± 0.31	11.98a ± 0.35	9.84c ± 0.31	10.25bc ± 0.62
<b>Lung , (g)</b>	2.21a ± 0.20	2.41a ± 0.11	2.25a ± 0.24	2.66a ± 0.33	2.03a ±0.14	2.05a ± 0.15
<b>Testis , (g)</b>	6.67ab ± 0.61	5.89ab ±0.56	6.02ab ± 0.54	5.52b ± 0.53	7.63a ± 0.77	5.15b ± 0.57
<b>Giblet, (g)</b>	10.92ab ±0.42	11.53ab ± 0.4	12.44a ±0.82	11.95ab ± 0.50	10.63b ± 0.27	11.07ab ± 0.50
<b>Total giblet , (g)</b>	164.72a ±5.59	159.88a ± 2.48	168.16a ± 4.31	166.56a ± 2.18	159.52a ± 4.34	156.30a ± 5.91

a,b...Means followed by the same letter within each row are not significantly different at 0.05 level of probability

**Table 5. Effect of dietary levels of natural feed additives on blood biochemical parameters of quail chicks**

Term	Control (T1)	Thyme 5g/kg (T2)	Thyme 10g/kg (T3)	Achillea 5g/kg (T4)	Achillea 10 g/kg (T4)	Thyme 5g + Achillea 5g / kg (T6)
<b>Total protein (g/dl )</b>	4.29a ±0.11	5.59a ±0.97	4.66a ± 0.05	4.71a ± 0.21	5.06a ± 0.20	4.91a ± 0.22
<b>Albumin (g/ dl )</b>	3.29a ±0.10	3.41a ±0.11	3.17a ±0.39	2.90a ±0.15	3.95a ±1.00	2.72a ±0.15
<b>Globulin (g/dl)</b>	1.51a ±0.18	1.64a ±0.13	1.80a ±0.10	1.42a ±0.14	1.65a ±0.12	1.86a ±0.06
<b>A/G ratio</b>	2.25a ± 0.32	2.09a ±0.10	1.97a ±0.33	2.09a ±0.29	2.52a ±0.86	1.45a ±0.03
<b>Total Cholesterol (mg/dl)</b>	269.00ab ±17.09	283.00ab ±17.21	216.00 bc ±14.25	215.67bc ± 47.68	299.33a ± 16.66	174.33c ± 12.99
<b>Triglycerides, mg/dl</b>	73.33ab ±6.06	83.66ab ±10.91	82.66ab ± 3.92	66.33b ±15.16	111.00a ±13.83	84.33ab ±15.71
<b>HDL (mg/dl)</b>	40.00 b ± 2.51	51.00ab ± 5.13	47.33ab ± 4.25	53.33a ± 2.96	43.00ab ±4.50	46.66ab ± 2.33
<b>LDL (mg/dl)</b>	235.00a ± 14.52	215.00ab ±14.57	152.00 bc ±5.03	117.33c ±12.23	139.00c ± 14.08	207.33ab ±15.02
<b>AST U/ L</b>	49.00 a ± 2.08	36.00 ab ± 2.88	32.33b ±2.42	30.00b ±3.78	34.66ab ± 4.09	44.00ab ±4.93
<b>ALT U/ L</b>	11.00 a ± 0.57	8.33ab ± 2.02	6.66b ± 0.66	8.00ab ± 1.15	7.66ab ± 0.68	10.66 a ± 0.88

a,b...Means followed by the same letter within each row are not significantly different at 0.05 level of probability

other hand, **Kheiri *et al.* (2018)** indicated that the quail birds fed in diet supplemented with 2 g/kg thyme plant significantly increased serum total protein and albumin compared with the control group. The same results for achillea plant were obtained by, **Toghyani *et al.* (2011)** observed no significant effects on serum protein, albumin, globulin and albumin to globulin ratio of broiler chicks fed on diet supplemented with 5 and 10 g/kg yarrow (*Achillea millefolium*) compared with the control group.

The serum total cholesterol and triglyceride showed significantly affected by the medicinal plants. Quail birds given the 10 g/kg of thyme, 5 g/kg of achillea and the mixture leave powder significantly ( $P \leq 0.05$ ) decreased the total cholesterol values but without any different effect with control ( $P \geq 0.05$ ). Birds received 10 g/kg of achillea recorded the highest value. These results are in agreement with **Tayeb *et al.* (2019)** who found that serum cholesterol decreased in birds fed in 5 and 10 g/kg thyme powder compared with the control group. However, **Toghyani *et al.* (2010)** reported that broiler chicks fed on diet supplemented thyme powder at level of 5 and 10 g/kg diet did not have any effects on blood total cholesterol compared with the control group. For achillea, **Jang (2011)** observed that the value of the serum total cholesterol was decreased in broiler chicks fed on diet supplemented with 2 g/kg compared with control group. In contrast, **Yakhkeshi *et al.* (2012)** noted that broiler chicks fed on diet supplemented with 3% yarrow had higher ( $P < 0.05$ ) serum blood cholesterol compared with the control group. Meanwhile **Sharifi *et al.* (2013)** found that the serum triglyceride was higher in chicks fed diets containing 2 g/kg yarrow (*Achillea millefolium*) compared with those in control group.

Serum triglyceride was significantly reduced ( $P \leq 0.05$ ) in birds fed on diet

inclusion with 5 g/kg of achillea treatments compared with the 10 g/kg of achillea but without any different effect with the control and other groups ( $P \geq 0.05$ ). The previous results are in the same tone with **Toghyani *et al.* (2011)** showed that the serum triglyceride level in broiler chicks fed diet supplemented with 5 g/kg of yarrow significantly decreased than control group. Similarly, **Jang (2011)** found that the broiler chicks fed on diet supplemented with 2 g/kg. achillea powder significantly decreased the serum triglyceride. In contrary, **Yakhkeshi *et al.* (2012)** noted that broiler chicks fed on diet supplemented with 3% yarrow had higher ( $P < 0.05$ ) triglyceride compared with control group. Also, **Sharifi *et al.* (2013)** observed an increase in serum triglyceride and level in chicks fed diets containing 2 g/kg yarrow (*Achillea millefolium*) compared with control group. Regarding to thyme, **Najafi and Torki (2010)** found no significant effect on triglyceride concentration of the broiler chickens fed on diets containing thyme essential oil (200 mg/kg) compared with the control group. In addition, **Toghyani *et al.* (2010)** reported that adding thyme powder 5 and 10 g/kg diet did not have any effects on serum triglyceride of broilers chicks when compared to control groups. Also, **Kheiri *et al.*, (2018)** observed no significant effects on triglyceride in the quail birds fed on diet supplemented with 2 g/kg thyme compared with the control group. On the other side, **Moustafa *et al.* (2020)** showed that the broiler chicks fed on diet supplemented with 100 mg/kg of thyme essential oil significantly ( $p < 0.05$ ) decreased serum level of triglycerides compared to control groups. Also, **Aldik *et al.* (2020)** indicated that *Thymus vulgaris* leaves at levels of 4 or 6 g/kg feed significantly decreased the concentration of serum triglycerides compared with the control group.

The HDL and LDL significantly affected due to the medicinal plants. The HDL concentrations of birds fed on 5 g/kg of achillea was significantly ( $P \leq 0.05$ ) higher than those of the control but without any different effect with the other groups ( $P \geq 0.05$ ). Birds fed on 10 g/kg of thyme, 5 and 10 of g/kg of achillea had lower ( $P \leq 0.05$ ) LDL compared with the control group which had the highest LDL. These results are in agreement with **Yakhkeshi *et al.* (2012)** who indicated that broiler chicks fed in diet supplemented with 3 % yarrow significantly ( $p < 0.05$ ) increased the serum high density lipoprotein and decreased ( $P \geq 0.05$ ) LDL compared with the control group. Similarly, **Sharifi *et al.* (2013)** showed that the level of serum HDL significantly increased in birds fed on 2 g/kg yarrow (*Achillea millefolium*) compared with those fed on basil diets. Also, the same level of yarrow decreased the LDL but without any differ with the control group. On contrary, **Jang (2011) and Toghyani *et al.*, (2011)** indicated no significant changes in the levels of serum HDL and LDL of broiler chicks fed with diets enriched with yarrow (*Achillea millefolium*) compared with the control group. Concerning the thyme effects, **Toghyani *et al.* (2010)** indicated that adding thyme powder 5 and 10 g/kg to the broiler basal diet did not have any effects on LDL but significantly increased HDL compared with the control group. However, **Kheiri *et al.* (2018)** showed that the quail birds fed in diet supplemented with 2 g/kg thyme plant significantly decreased HDL-cholesterol compared with the control group.

The serum levels AST and ALT showed significant effects from the dietary treatments. The results indicate that birds fed on 10 g/kg of thyme and 5 g/kg of achillea significantly ( $P \leq 0.05$ ) decreased AST compared to the control group but without any different effect with the other

groups ( $P \geq 0.05$ ). The ALT values were significantly lower for birds fed on 10 g/kg of thyme than those fed on control and mixture groups but without any different effect with the other groups ( $P \geq 0.05$ ). This results is in agreement with **Tayeb *et al.* (2019)** who noted that broilers chicks fed on basal diet that 10g/kg thyme powder did not affect serum concentration of AST and ALT enzyme. In addition, **Ragaa *et al.* (2016)** observed that dietary including 1g thyme powder /kg did not affect serum ALT and AST enzyme in broiler chicken. Also, **Saleh *et al.* (2014)** observed that addition of thyme oil at 100, 200 and 300 mg/kg to broiler diet had non- significant effect on serum concentration of ALT and AST enzyme. On contrary of our finding for achillea **Bahabadi *et al.* (2014)** found that a significant increase in ALT and AST enzyme activity was observed in the fish fed with 1% yarrow extract diet compared with control group.

### Economic Evaluation

The economics of the experimental birds under different treatment groups are presented in Table 6. Results indicated that the highest values of net revenue, economic efficiency and relative economic efficiency were recorded for quail chicks fed diet supplemented with 5 g /kg of achillea plant which recorded 3.08, 1.44% and 107.91. These results are in the same line with, **El-Kashef *et al.* (2017 a&b)** and **Hussain *et al.* (2021)** they found that the higher total revenue and economic efficiency were in quail and broiler chick birds fed in medicinal plants compared with the control group.

### Conclusion

Under the conditions of this study, it was concluded that, quail bird fed basal diet with 5 g achillea fragrantissima/kg diet improved the performance, carcass characteristics and economic efficiency without any adverse.

**Table 6. Effect of dietary levels of natural feed additives on economic efficiency of quail chicks**

Term	Control (T1)	Thyme 5g/kg (T2)	Thyme 10g/kg (T3)	Achillea 5g/kg (T4)	Achillea 10 g/kg (T4)	Thyme 5g + Achillea 5g/kg (T6)
<b>Fixed cost (LE)</b>	3.20	3.20	3.20	3.20	3.20	3.20
<b>Total feed cost (LE)</b>	3.81	3.76	3.79	3.74	3.79	3.86
<b>Total cost (LE)</b>	7.01	6.96	6.99	6.94	6.99	7.06
<b>Final LBW (Kg.)</b>	0.21	0.20	0.20	0.22	0.21	0.20
<b>Total revenue (LE)</b>	9.38	9.03	8.99	10.02	9.34	9.21
<b>Net revenue (LE)</b>	2.37	2.07	2.00	3.08	2.35	2.15
<b>Economic efficiency</b>	1.34	1.30	1.29	1.44	1.34	1.30
<b>Relative economic efficiency (%)</b>	100.00	96.92	96.12	107.91	99.85	97.49

1- Fixed cost: Bird price + rearing cost.

2- The price was calculated due to the local market the price of one kg/ thyme and achillea (100 L. E.)

3- Total revenue: Assuming that the selling price of 1 kg live body weight is 45 L. E.

4- Net revenue: total revenue – total cost.

5- Economic efficiency (E.E.): Net revenue per unit total cost.

6- Relative economic efficiency (R.E.E): Assuming that the relative economic efficiency of the control.

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### المخلص العربي

## تأثير التغذية على نباتي الزعتر والقيصوم على الاداء الإنتاجي لطيور السمان النامي

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أجريت هذه الدراسة لتقييم تأثير تغذية السمان النامي على علائق تحتوي على نباتي الزعتر والقيصوم على الأداء الإنتاجي وصفات الذبيحة ومكونات الدم والكفاءة الاقتصادية خلال المدة من عمر 7 الى 42 يوم. تم استخدام عدد 450 كتكوتاً عمر 7 أيام قسمت عشوائياً الى 6 مجموعات تحتوي كل مجموعة على 75 طائراً في ثلاثة مكررات بكل مكررة 25 طائراً. أظهرت النتائج عدم وجود أي زيادة معنوية في متوسط وزن الجسم والزيادة في وزن الجسم في الطيور المغذاة على نباتي الزعتر والقيصوم مقارنة بالطيور المغذاة على عليه الكنترول. أوضحت النتائج ان الطيور المغذاة على عليه تحتوي على 5 جم من نبات القيصوم /كجم علف أفضل معدل تحويل غذائي بالمقارنة بباقي المعاملات. استهلكت الطيور المغذاة على عليه الكنترول أعلي كميته علف مقارنة بباقي المعاملات بينما استهلكت الطيور المغذاة على 5 جم من نبات القيصوم /كجم علف اقل كميته علف. لا توجد اي اختلاف في اوزان الوزن قبل الذبح والذبيحة والقانصة والقلب والرئتين والراس والمعدة والكبد والارجل والاجزاء المأكولة في الطيور المغذاة على علائق تحتوي على نباتي الزعتر والقيصوم وخليطهما مقارنة بالطيور الأخرى التي غذيت على عليه كنترول. أوضحت النتائج عدم وجود اي تغير في مستوي الدم من البروتين الكلي والألبومين والجلوبيولين والدهون الثلاثية. انخفض مستوي الكوليسترول في دم الطيور المغذاة على خليط من نباتي الزعتر والقيصوم. اوضحت النتائج انخفاض مستوي الدم من الكوليسترول الضار (LDL) ومستوى انزيم أسبرتات أمينو ترانسفيراز (AST) وإنزيم الانين أمينو ترانسفيراز (ALT) وزيادة الكوليسترول النافع (HDL) مقارنة بالطيور المغذاة على العليقة الكنترول. حققت الطيور المغذاة على عليه تحتوي 5 جرام من مسحوق نبات القيصوم أفضل عائد وكفاءة اقتصادية مقارنة بالمجموعة الكنترول والمعاملات الأخرى. نستنتج من ذلك أن إضافة مسحوق نبات القيصوم بمعدل 5 جم/كجم من ادي الي تحسن الاداء الإنتاجي والفسولوجي للسمان النامي.

الكلمات الاسترشادية: السمان، الزعتر، القيصوم، الاداء الإنتاجي.

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