



Evaluation of the effect of Garlic Powder and Thyme leaves on Productive Performance, Blood parameters, and Antioxidant Status in Japanese Quails

تقييم تأثير مسحوق الثوم وأوراق الزعتر على الأداء الإنتاجي وخصائص الدم والحالة المضادة للأكسدة في طائر السمان الياباني

By

Jamal Al-Mukhtar Mubarak

Department of Zoology, Faculty of Science, Sabratha University,
Libya

Doi: [10.21608/asajs.2025.420135](https://doi.org/10.21608/asajs.2025.420135)

استلام البحث : ٢٠٢٥/١/١٩

قبول النشر : ٢٠٢٥/١/٣١

Mubarak, Jamal Al-Mukhtar (2025). Evaluation of the effect of garlic powder and thyme leaves on productive performance, blood parameters, and antioxidant status in japanese quails. *The Arab Journal of Agricultural Sciences*, Arab Institute for Education, Science and Arts, Egypt, 8 (26), 161 -186.

<http://asajs.journals.ekb.eg>

Evaluation of the effect of Garlic Powder and Thyme leaves on Productive Performance, Blood parameters, and Antioxidant Status in Japanese Quails

Abstract:

This investigation sought to assess the impact of incorporating garlic powder and thyme leaves on the growth performance, carcass attributes, specific hematological parameters, and antioxidant capacity in Japanese quails throughout the growth phase (7–42 days). A total of 225 seven-day-old Japanese quail chicks were allocated into three distinct dietary treatments (75 birds/treatment) with three replicates for each treatment (25 birds/replicate). The chicks were systematically assigned to the following treatments: T1: Administered a basal diet devoid of any additives (control). T2: Administered a basal diet augmented with 10 g of garlic powder per kg of feed. T3: Administered a basal diet augmented with 10 g of thyme leaves per kg of feed. The findings from the statistical analysis revealed that body weight, weight gain, and feed conversion efficiency exhibited significant enhancement ($P \leq 0.05$) commencing at 21 days of age and persisted until 42 days of age (the conclusion of the experiment). Nevertheless, no significant discrepancies were observed among treatments regarding feed intake. The findings further indicated that levels of total protein, albumin, globulin, and glucose experienced significant elevation in diets supplemented with garlic powder and thyme leaves. Conversely, the inclusion of these additives significantly ($P \leq 0.05$) diminished cholesterol levels in the blood of quails within the experimental groups in comparison to the control group. Additionally, a marked reduction in total lipid levels was noted in the additive groups relative to the control group. The study also demonstrated a notable decrease in

malondialdehyde (MDA) concentration alongside a significant increase in glutathione (GSH) levels within the additive groups. In summary, the incorporation of garlic powder and thyme leaves into the diet positively influenced growth performance, select blood parameters, and the antioxidant status of Japanese quails.

Keywords: Garlic powder, Thyme leaves, Quail, Growth performance, Blood parameters, Antioxidants.

المستخلص:

استهدفت الدراسة تقييم تأثير إضافة مسحوق الثوم واوراق الزعتر على أداء النمو، وخصائص الذبيحة، وبعض صفات الدم وحالة مضادات الأكسدة لطائر السمان الياباني خلال فترة النمو (٧-٤٢) يوماً، تم توزيع (٢٢٥) فرخ طائر السمان الياباني بعمر ٧ أيام على ٣ معاملات غذائية (٧٥/طائر/معاملة)، ٣ مكررات (٢٥/طائر/مكرر)، تم تقسيم الكتاكيت إلى ثلاثة معاملات على النحو التالي: T1: تمت تغذيته على علف أساسي بدون أي إضافات (السيطرة)، T2 تم تغذيته على علف أساسي مكمل ب ١٠ جم من مسحوق الثوم/ كجم من العليقة، T3 تم تغذيته على ١٠ جم من أوراق الزعتر /كجم من العليقة. أشارت نتائج التحليل الإحصائي إلى أن وزن الجسم والزيادة الوزنية ومعدل التحويل الغذائي قد تحسنت معنوياً ($P \geq 0.05$) بداية من عمر ٢١ يوم واستمرت حتى عمر ٤٢ يوماً (نهاية التجربة)، في حين لم يكن هناك فروقات معنوية بين المعاملات في معدل استهلاك العلف، وأظهرت النتائج كذلك أن مستوى البروتين الكلي والألبومين والجلوبيولين والجلوكوز زاد معنوياً في العلائق المحتوية على مسحوق الثوم واوراق الزعتر، بينما كان تأثير الإضافة على مستوى الكوليسترول بشكل معنوي ($P \geq 0.05$) في دم طائر السمان حيث انخفض في معاملي الإضافة، كذلك نلاحظ انخفاض معنوي في مستوى الليبيدات الكلية لمجموعة الإضافة مقارنة مع مجموعة السيطرة، وحيث أظهرت النتائج أيضاً أن هناك انخفاض معنوي في تركيز MDA ، وزيادة معنوية في (GSH). وخلصت هذه الدراسة إلى أن إضافة مسحوق الثوم واوراق الزعتر أدت لتحسين معدل الأداء وبعض صفات الدم ومضادات الأكسدة لطائر السمان الياباني.

الكلمات المفتاحية: مسحوق الثوم، أوراق الزعتر، السمان، أداء النمو، صفات الدم، مضادات الأكسدة.

Introduction

The transformation of lifestyle patterns in numerous nations, propelled by escalating living standards and economic advancement, has resulted in a progressively heightened daily requirement for protein-dense foods that are crucial for development, such as poultry and eggs. These food items are characterized by their elevated levels of unsaturated fatty acids (**Adeola et al., 2006**), which are indispensable for human health and development. Among the various poultry species, the Japanese quail is notable for its high production of table eggs and meat while maintaining a relatively low economic burden. The cholesterol concentration in quail meat is quantified at 14.22 mg/kg (**Aloui et al., 2013**). Consequently, considerable scholarly focus has been directed towards identifying factors that mitigate cholesterol levels in meat and eggs, as well as enhancing the quality of fatty acids in these products through the application of antioxidant agents. These antioxidants are derived from a multitude of plant sources and serve a critical function in the prevention of diseases in humans, animals, and avians owing to their bioactive properties (**Chowdhury et al., 2002**). Poultry meat is characterized by substantial concentrations of unsaturated fatty acids, rendering it susceptible to biochemical alterations, predominantly oxidation (**Mortran et al., 1987**). Oxidative processes culminate in rancidity, as well as the generation of undesirable odors, flavors, and tastes, which consequently diminish the quality of the meat (**Olorunsanya et al., 2009**). This advancement has also introduced obstacles, including the emergence of poultry diseases attributable to accelerated growth rates and diminished immunity resulting from the excessive application of synthetic antibiotics (**Grashorn et al., 2010**). In response to the widespread incidence of diseases in poultry, researchers have investigated natural

alternatives to chemical additives aimed at bolstering immunity by stimulating the immune system and integrating these agents into poultry feed (**Alagawany et al., 2020**).

Currently, a primary focus within the domain of poultry agriculture and the production of white meat is the exploration of novel alternatives to feed additives that enhance animal well-being and augment both quantitative and qualitative production metrics (**Gerzilov et al., 2015**). Numerous medicinal flora exhibit a variety of biological properties attributable to the rich presence of active compounds that bolster animal growth and immunity (**Morsy et al., 2018**). The utilization of medicinal herbs or their extracts represents one of the most expedient and effective methodologies for the incorporation of natural antioxidants into the physiology of animals (**Soltan et al., 2018**). Moreover, antioxidants are instrumental in preserving animal health, fortifying the immune system, and optimizing production efficiency (**Qi et al., 1998**).

Among the botanicals recognized for their medicinal attributes are garlic (*Allium sativum*) and thyme (*Thymus vulgaris*). Garlic is characterized by the presence of allicin, a compound that exhibits antibiotic-like effects. It acts to inhibit the proliferation of pathogenic bacteria and fungi responsible for the production of aflatoxins (**Meraj et al., 1998**). Investigators **Samanta and Dey (1991)** reported that the incorporation of garlic powder into quail diets was associated with an increase in live body weight. In a similar vein, **Aporn et al. (2008)** discovered that the inclusion of 0.7–1.3% garlic in dietary formulations markedly enhanced weight gain and feed conversion ratio, without adversely impacting abdominal fat deposition or the cholesterol content of the meat. Additional research has indicated that the supplementation of garlic in broiler diets has been shown to stimulate immune responses,

diminish glutathione peroxidase activity in hepatic tissue, and reduce oxidative stress markers in the bloodstream (**Zsolt *et al.*, 2009**). Thyme, an essential aromatic herb, derives its efficacy from the presence of thymol and carvacrol. **Dorman *et al.* (2000)** and **Giannenas *et al.* (2013)** elucidated the antibacterial, antiparasitic, and antifungal characteristics of thyme extracts. **Williams *et al.* (2001)** noted that thyme exerted a beneficial effect on the digestive system and enhanced production efficiency in poultry. Various investigations have demonstrated that the addition of thyme to broiler diets at varying ages and proportions significantly augmented live body weight, weight gain, and feed conversion efficiency (**Jamil, 2008**). Furthermore, thyme has been shown to exert a favorable influence on certain carcass characteristics and hematological parameters in broilers (**Al-Qubaisi and Jamil, 2009; Saleh *et al.*, 2014**).

The significance of this study resides in the examination of the impact of garlic and thyme supplementation on productive performance, blood parameters, antioxidant status, and Japanese quails.

Materials and Methods

This study was conducted in a private poultry house on a farm in Surman City from February 8, 2024, to March 14, 2024, over five weeks. The aim was to evaluate the effect of adding garlic powder and thyme powder to the diet on productive performance, carcass characteristics, and blood biochemical parameters in Japanese quails.

225 unsexed Japanese quails (white, gray, and black plumage) aged one week were randomly divided into three experimental groups, each with three replicates of 25 birds per replicate. The birds were reared in cages inside a closed hall equipped with the necessary environmental conditions for quail farming. Electric heaters were used to maintain appropriate

warmth, and the lighting system provided 24 hours of light daily. Feed and water were offered ad libitum throughout the trial. The thyme and garlic powders were procured from local markets. The experiment included three dietary treatments as follows:

Control group: No additives.

Treatment 2: Diet supplemented with 1% thyme powder.

Treatment 3: Diet supplemented with 1% garlic powder.

The birds were fed a diet formulated according to **NRC (1944)** recommendations.

Measured Traits

Live Body Weight: Birds were weighed at the end of each week, from the start of the experiment until the fifth week, using a precision scale.

Weight Gain: Weight gain was calculated as follows:

Weight gain (g) = Final body weight – Initial body weight.

Total Feed Intake: Total feed intake was determined using the formula:

Total feed intake = Feed offered at the beginning of the week – Feed leftover at the end of the week.

Feed Conversion Ratio (FCR): FCR was calculated, as the amount of feed (g) required achieving 1 g of weight gain.

Blood Biochemical Parameters

At the end of the experiment, four birds from each replicate were slaughtered, and blood samples were collected. The serum was separated and used to measure total protein, albumin, globulin, fibrinogen, glucose, cholesterol, HDL, LDL, and triglycerides. These parameters were determined using ready-to-use test kits supplied by **Biolabo, France**, following the manufacturer's instructions. Measurements were conducted with a spectrophotometer, and concentrations were calculated based on the equations provided by the manufacturer.

Antioxidant Status

Glutathione (GSH): GSH levels in red blood cells were measured as an indicator of antioxidant status, using the modified method of **Burtis and Ashwood (1999)**.

Malondialdehyde (MDA): **Beuge and Aust (1978)** assessed MDA levels in serum, as an indicator of lipid peroxidation, using the modified Thiobarbituric Acid Reaction Substance (TBARS) method.

2.4 Statistical Analysis

Data were analyzed using SPSS software version 25. Analysis of variance (ANOVA) was employed to evaluate the data and mean differences among treatments were compared using Duncan, 1955 test.

The statistical model used was:
$$Y_i = M + T_i + E_{ijk}$$

Where: Y_i = Response variable, M = Overall mean, T_i = Effect of treatment, E_{ijk} = Experimental error.

Results and Discussion

Productive Performance

1. Body Weight and Weight Gain: The results presented in Table (1) show the effect of adding garlic powder and thyme leaves on the live body weight of Japanese quails during the experiment. Statistical analysis revealed no significant differences in initial body weight among the experimental groups. Similarly, no significant differences were observed in body weight at 14 and 21 days of age. However, starting from 21 days of age, significant differences in body weight were observed between the supplementation treatments (T2 and T3) and the control group (T1). The average body weights at 21 days were 86.14 g (T1), 89.55 g (T2), and 90.53 g (T3). Although the differences between T2 and T3 were numerical, and not statistical, both treatments significantly outperformed the control

group ($P \leq 0.05$) in live body weight at 28, 35, and 42 days of age. The final body weights at 42 days were 195.22 g (T1), 188.17 g (T2), and 201.35 g (T3). **Dorman and Deans (2000)** who reported similar findings, where thyme supplementation led to significant increases in broiler body weight due to the presence of active biological compounds such as thymol and carvacrol, which act as digestive stimulants. These results are consistent with previous studies by **Khalaji (2011)**, which demonstrated significant improvements ($P \leq 0.05$) in live body weight when thyme powder was added to poultry diets. Conversely, this study's results contradict those of **Sadeghi et al. (2012)**, who reported no significant effect of thyme powder supplementation (5 g/L in drinking water) on live body weight. Likewise, **Narimani et al. (2003)**, concluded that adding 200–300 mg/kg of carvacrol (a thyme essential oil) to broiler diets improved weight gain and overall performance. Similarly, **Toghyani et al. (2010)** found that thyme powder at 5 g/kg increased daily weight gain and live body weight.

The observed improvements in productive traits are likely due to the antioxidant properties of garlic and thyme. These plants contain compounds with antibacterial and antibiotic-like properties that combat harmful gut bacteria, enhancing the efficiency of nutrient utilization (**Kabouche et al., 2005**). Additionally, thyme contains menthol, which acts as an aromatic agent, purifying the digestive system, reducing harmful microbes, and increasing pancreatic secretions. These effects enhance digestion and absorption, ultimately improving growth performance (**Kabouche et al., 2005; Lin et al., 2006**). Garlic's effects on weight gain may stem from its ability to enhance feed flavor and stimulate appetite. This could also be attributed to the allicin compound, which reduces cortisol (stress hormone) levels, as **Kothari et al. (2019)** suggested. Furthermore, the

results align with findings from Cross et al. (2007), who demonstrated thyme oil and flower supplements' positive effects on growth and feed conversion. Thyme's essential oils balance gut microbiota and stimulate digestive enzyme secretion, enhancing nutrient absorption (Singh et al., 2019). , garlic and thyme enhance growth by improving digestive enzyme activity, nutrient absorption, and feed conversion efficiency, resulting in better immunity and higher body weight.

Table (1): Effect of Adding Garlic Powder and Thyme Leaves on Live Body Weight of Japanese Quails

Experimental Treatments	Live body weight (g)			P.Value
	T1 (Control)	T2 (Garlic)	T3 (Thyme)	
Initial Weight (7 days)	25.12 ± 0.11 (a)	26.34 ± 0.16 (a)	26.68 ± 0.17 (a)	0.084
Weight at 14 days	55.22 ± 1.20 (a)	56.87 ± 1.34 (a)	57.43 ± 1.38 (a)	0.070
Weight at 21 days	86.14 ± 1.70 (b)	89.55 ± 1.60 (a)	90.53 ± 1.78 (a)	0.034
Weight at 28 days	123.55 ± 2.21 (b)	129.48 ± 2.16 (b)	132.45 ± 2.11 (a)	0.019
Weight at 35 days	160.17 ± 2.12 (c)	168.22 ± 2.37 (b)	175.17 ± 2.50 (a)	0.0001
Final Weight at 42 days	198.17 ± 2.42 (c)	205.22 ± 2.16 (b)	211.35 ± 2.61 (a)	0.0001

(Means followed different letters in the same row indicate significant differences differences $P \leq 0.05$).

The results presented in Table (2) show the effect of adding garlic powder and thyme leaves on the weight gain of quail. The results indicated no significant differences between the supplementation treatments and the control group at 7 days and 14 days. However, statistical analysis revealed significant differences ($P \leq 0.05$) between the supplementation treatments (T3, T2) and the control group (T1) starting from the third week of the experiment, with weight gains of 41.92, 39.93, and 37.41

g, respectively. There were no significant differences between the supplementation treatments. In the fourth week, significant differences were ($P \leq 0.05$) observed in the T3 supplementation group compared to the T2 supplementation group and compared to the control group. Statistical analysis showed no significant differences between the supplementation treatments and the control group in the fifth week of the experiment. The total weight gain of the quail significantly improved in the ($P \leq 0.05$) supplementations treatments (T3, T2) compared to the control group (T1), with total gains of 163.05, 168.88, and 174.67 g, respectively. The results of this study are consistent with the findings of **Singh (2019)**, as well as the addition of garlic powder (1%, 1.5%) in line with the results of **Singh et al. (2019)**. The interpretation of these results is attributed to the effect of garlic essential oil as a natural growth promoter. This effect may also be due to the fermentation of inulin in the colon by beneficial bacteria, which is associated with enhancing the digestive system and immune function. Additionally, garlic has been shown to increase the absorption of calcium and magnesium. Allicin, a compound in garlic, inhibits the growth of intestinal bacteria such as *Staphylococcus aureus* and *Escherichia coli* and prevents fungal aflatoxins, thereby improving feed consumption, feed conversion efficiency, and body weight gain.

Singh et al. (2019) found that garlic significantly enhances the number of villous and crypt cells in the duodenum and jejunum of birds. These intestinal morphological changes improve nutrient absorption. Furthermore, allicin's ability to suppress the growth of intestinal bacteria (*Staphylococcus aureus* and *Escherichia coli*) and prevent aflatoxin production in fungi leads to better nutrient absorption in the intestines. This, in

turn, improves feed conversion, increases glycogen levels in the liver and muscles, and enhances metabolism.

Table (2): Effect of Adding Garlic Powder and Thyme Leaves on Weight Gain of Japanese Quails

Experimental Treatments	Weight gain (g)			P.Value
	T1 (Control)	T2 (Garlic)	T3 (Thyme)	
7–14 days	30.1 ± 0.16 (a)	30.53 ± 0.22 (a)	30.75 ± 0.42 (a)	0.097
14–21 days	30.92 ± 0.17 (a)	32.68 ± 0.21 (a)	33.1 ± 0.23 (a)	0.073
21–28 days	37.41 ± 0.30 (b)	39.93 ± 0.67 (a)	41.92 ± 0.42 (a)	0.0001
28–35 days	36.62 ± 0.34 (c)	38.74 ± 0.56 (b)	42.72 ± 0.65 (a)	0.0001
35–42 days	38.00 ± 0.15 (b)	37.00 ± 0.12 (a)	36.18 ± 0.18 (a)	0.021
Total Weight Gain (7–42 days)	173.05±2.11 (c)	178.88 ± 2.51 (b)	184.67 ± 2.16 (a)	0.0001

(Means followed different letters in the same row indicate significant differences differences $P \leq 0.05$).

2. Feed Consumption and Feed Conversion Efficiency:

The results presented in Table (3) illustrate the impact of adding garlic powder and thyme leaves on feed consumption rates. The data show significant differences in total feed consumption between the supplementation treatments and the control group. By the end of the experiment, the total feed consumption rates for the experimental groups were reported as follows: [values from the table should be included here for precision].

The total feed consumption rates at the end of the experiment were recorded as **537.30 g**, **536.64 g**, and **573.74 g** for the control group, garlic powder group, and thyme leaves group, respectively. These findings align with those of the study (62), which reported no significant differences in feed consumption rates between laying hens fed a diet supplemented with thyme leaves powder (at 0.5% and 1%) and those fed a control diet.

However, these results differ from those of **Al-Naeef et al. (2010)**, who observed a significant reduction in feed

consumption among laying hens in treatments supplemented with crushed thyme leaves compared to the control. Similarly, **Kazim et al. (2009)** reported a significant increase in feed consumption when crushed thyme leaves were added to the diet, favoring thyme-supplemented treatments compared to the additive-free control diet.

Table (3): Effect of Adding Garlic Powder and Thyme Leaves on Feed Intake of Japanese Quails (g/bird/week)

Experimental Treatments	Feed intake (g)			P.Value
	T1 (Control)	T2 (Garlic)	T3 (Thyme)	
7–14 days	84.70 ± 1.25 (a)	83.92 ± 1.31 (a)	84.13 ± 1.21 (a)	0.087
14–21 days	94.42 ± 1.45 (a)	94.22 ± 0.67 (a)	95.11 ± 1.23 (a)	0.067
21–28 days	104.11 ± 1.70 (a)	105.16 ± 1.37 (a)	106.12 ± 1.85 (a)	0.076
28–35 days	117.22 ± 1.82 (a)	116.12 ± 1.35 (a)	117.22 ± 1.42 (a)	0.098
35–42 days	136.35 ± 1.62 (a)	137.22 ± 1.52 (a)	135.16 ± 1.63 (a)	0.064
Total Feed Intake (7–42 days)	537.30 ± 2.16 (a)	536.64 ± 2.41 (a)	537.74 ± 2.16 (a)	0.098

(Means followed different letters in the same row indicate significant differences $P \leq 0.05$).

Table (4) illustrates the impact of adding garlic powder and thyme leaves on Japanese quail's feed conversion efficiency (FCE). A significant improvement ($P \geq 0.05$) in FCE was observed with adding garlic powder and thyme leaves. For the first week, the FCE values were **2.73, 2.74, and 2.81 g** for the control group, T2 (garlic powder), and T3 (thyme leaves), respectively, with no significant differences between the supplementation treatments. Additionally, the total feed conversion efficiency (g/1 g weight gain) improved significantly ($P \geq 0.05$) across all experimental periods, with final FCE values of **2.91, 3.00, and 3.10 g** for the control group, T2, and T3,

respectively. These results are consistent with the findings of **Kazim (2009)** and **Al-Naeef (2010)**, who reported significant improvements in FCE when thyme leaf powder was added to the diet.

Table (4): Effect of Adding Garlic Powder and Thyme Leaves on Feed Conversion Ratio (FCR) of Japanese Quails (g feed/g weight gain)

Experimental Treatments	Feed conversion ratio (FCR)			P.Value
	T1 (Control)	T2 (Garlic)	T3 (Thyme)	
7–14 days	2.81 ± 0.12 (a)	2.74 ± 0.16 (b)	2.73 ± 0.16 (b)	0.035
14–21 days	3.06 ± 0.35 (a)	2.88 ± 0.28 (b)	2.87 ± 0.17 (b)	0.024
21–28 days	2.78 ± 0.42 (a)	2.63 ± 0.11 (b)	2.53 ± 0.18 (c)	0.038
28–35 days	3.20 ± 0.51 (a)	2.99 ± 0.16 (b)	2.74 ± 0.12 (c)	0.021
35–42 days	3.58 ± 0.11 (b)	3.70 ± 0.12 (a)	3.73 ± 0.21 (a)	0.021
Total FCR (7–42 days)	3.10 ± 0.21 (a)	3.00 ± 0.11 (b)	2.91 ± 0.14 (c)	0.033

(Means followed different letters in the same row indicate significant differences differences $P \leq 0.05$).

However, these findings contrast with the study by **Zweil et al. (2006)**, which found no significant differences in FCE between quail fed a diet with thyme powder (1–2 g/kg feed) and those fed a control diet.

The observed improvement in FCE reflects the weight gain stability achieved alongside a consistent feed consumption rate. This improvement may be attributed to thyme's inhibitory effect on Gram-positive and Gram-negative bacteria in the bird's digestive tract due to its active compounds, such as thymol and carvacrol. These compounds disrupt bacterial cell membranes, leading to bacterial death, as reported by **Al-Jugifi (2015)**, and **Isa (2013)**.

Moreover, thyme contains key digestive enzymes, such as lipase, amylase, and protease, which enhance the breakdown and absorption of fats, carbohydrates, and proteins. This enzymatic

activity, as noted by Al-Hadeethy et al. (2006), further enhances the nutritional benefits of the feed, increasing its utilization and contributing to better overall health and vitality of the birds.

The findings of this study align with the results of **Bollinger et al. (1998)**, who reported that Vitamin E improves feed conversion efficiency due to its antioxidant properties and its role in enhancing fat metabolism in the body.

2. Blood Measurements:

The results presented in Table (5) show the effect of adding garlic powder and thyme leaves on some biochemical blood indices in Japanese quail. The findings indicated a significant increase in total protein, albumin, and globulin levels ($P \geq 0.05$) in diets containing garlic powder and thyme leaves compared to the control group. This can be attributed to garlic's ability to improve digestion in birds (**Gardzielewska et al., 2003**), contributing to an increase in nutrients, including protein bound to glutathione in the liver, and subsequently enhancing protein released into the blood (**Wang et al., 1997**). Additionally, an increase in Y-globulin protein levels was observed in the blood (**Ali, 2001**).

Table (5): Effect of Adding Garlic Powder and Thyme Leaves on Blood Biochemical Parameters of Japanese Quails

Blood Parameters	T1 (Control)	T2 (Garlic)	T3 (Thyme)	P.Value
Total Protein (g/dl)	4.29 ± 0.2 (b)	4.66 ± 0.3 (a)	4.64 ± 0.2 (a)	0.034
Albumin (g/dl)	1.44 ± 0.06 (b)	1.51 ± 0.05 (a)	1.66 ± 0.06 (a)	0.025
Globulin (g/dl)	2.85 ± 0.05 (b)	2.97 ± 0.03 (a)	3.10 ± 0.03 (a)	0.031
Cholesterol (mg/dl)	222 ± 6.8 (a)	182 ± 5.7 (b)	185 ± 6.3 (b)	0.025
Glucose (mg/dl)	217 ± 5.32 (b)	250 ± 6.12 (a)	242 ± 4.41 (a)	0.045
Triglycerides (mg/dl)	150 ± 6.21 (a)	84.86 ± 2.32 (b)	97.47 ± 4.35 (b)	0.023
*HDL	140 ± 6.52 (b)	183.29 ± 4.12 (a)	172.22 ± 6.19 (a)	0.001
**LDL	35.46 ± 3.11 (a)	24.27 ± 3.32 (b)	26.06 ± 3.17 (b)	0.001

(Means followed different letters in the same row indicate significant differences $P \leq 0.05$).

***HDL** high-density lipoprotein.

****LDL** Low-density lipoprotein.

The results also showed a reduction in blood cholesterol levels in the supplementation groups compared to the control. This aligns with the findings of **Nasir et al. (2005)**, who reported a decrease in total cholesterol in the serum of laying hens fed a diet containing 1.5% thyme leaves. Similarly, **Aporn et al. (2008)** observed a cholesterol reduction when garlic was added to broiler diets at 0.7–1.3%.

Furthermore, blood glucose levels increased significantly in the garlic and thyme groups compared to the control group. This agrees with **Meraj et al. (1998)**, who suggested that the increase in protein bound to glutathione contributes to the elevated levels of various nutrients, including glucose. These findings are consistent with previous research (**Amad et al., 2011**), which highlighted the effectiveness of certain medicinal and aromatic plants in reducing blood cholesterol due to their active essential oils (**Lee, 2009**).

The reduction in blood cholesterol levels in the supplementation groups can be attributed to carvacrol and thymol in herbs like garlic and thyme (**Zargari, 2001**). These compounds affect cholesterol and triglycerides by reducing harmful LDL cholesterol levels (**Zargari, 2001**). Additionally, garlic components can inhibit cholesterol synthesis in the liver by suppressing HMG-CoA reductase, a rate-determining enzyme in cholesterol biosynthesis (**Chen et al., 2002**).

Table (5) also indicates that thyme leaves may help prevent an increase in blood triglycerides without affecting cholesterol metabolism (**Lee et al., 2009**). Garlic powder preparation reduces the oxidation of lipoproteins both in vitro and in vivo (**Kourounakis and Rekka, 1991**).

The noticeable increase in HDL is a critical indicator of anti-hypercholesterolemic activity. High HDL levels have been associated with a reduced risk of cardiovascular diseases (CVD) (Yousef, 2004). This implies that HDL may play a protective role by reversing cholesterol transport, inhibiting LDL oxidation, and preventing atherosclerosis caused by oxidized LDL.

3. Antioxidants:

The results in Table (6) demonstrate the effect of garlic powder and thyme leaves supplementation on malondialdehyde (MDA) and glutathione (GSH) levels in Japanese quail blood serum. The study found that adding garlic powder and thyme leaves significantly increased ($P \geq 0.05$) glutathione levels while reducing malondialdehyde levels compared to the control group. This indicates enhanced antioxidant capacity in quail, which aligns with findings by **AL- Hameed et al. (2021)**, confirming garlic powder's ability to reduce malondialdehyde levels and lipid peroxidation in blood serum.

Similarly, the results agree with **Abo Ghanima et al. (2023)** and **Zweil et al. (2016)**, who reported that feeding Japanese quail varying levels of garlic powder reduced malondialdehyde levels and increased glutathione levels. This highlights garlic powder's potent antioxidant activity.

This is consistent with **Shaaboun (2011)**, who observed improved antioxidant status in broiler hens given an aqueous extract of thyme leaves (5–10%) in drinking water. It also agrees with **Al-Qattan et al. (2006)**, who found that administering thyme capsules (1000 mg/kg body weight) to local male rabbits significantly increased glutathione levels and reduced malondialdehyde levels in liver tissue compared to the control.

The improvement in antioxidant status is attributed to compounds like carvacrol and thymol in thyme, which enhance the activity of antioxidant systems by increasing the

effectiveness of enzymes responsible for lipid peroxidation regulation (Hashemipour et al., 2013).

Table (6): Effect of Adding Garlic Powder and Thyme Leaves on Antioxidant Status in Blood Serum

Parameter	T1 (Control)	T2 (Garlic)	T3 (Thyme)	P.Value
MDA (nmol/L)	24.34 ± 0.45a	22.54 ± 0.25b	20.14 ± 0.15c	0.0001
GSH (μmol/L)	10.34 ± 0.32c	11.12 ± 0.15b	14.14 ± 0.21a	0.0001

(Means followed different letters in the same row indicate significant differences differences $P \leq 0.05$).

Conclusion:

This study concludes that incorporating 1% garlic powder and 1% thyme leaves into the diet enhances the production performance of Japanese quail by improving digestion and metabolism. The antimicrobial properties of these supplements contribute to better health outcomes, including improved biochemical blood components and enhanced antioxidant status. These findings support the use of garlic powder and thyme leaves as a safer, more economical alternative to antibiotics, addressing concerns over the potential adverse effects of synthetic additives in poultry diets.

References:

- Abo Ghanima, M. M., Aljahdali, N., Abuljadayel, D. A., Shafi, M. E., QaL[dhi, A., Abd El-Hack, M. E., & Mohamed, L. A. (2023).** Effects of dietary supplementation of Amla, Chicory and Leek extracts on growth performance, immunity and blood biochemical parameters broilers. *Italian Journal of Animal Science*, 22(1), 24-34.
- Adeola, O. (2006).** Review of research in duick nutrient utilization. *Mti. J. Poultry Science*. 5: 210-218.
- Alagawany, M., El-Hack, M. E. A., Farag, M. R., Dhama, K., Tiwari, R., Alam, G. M., & Elnesr, S. S. (2020).** Nutritional significance and health benefits of designer eggs: A review. *World's Poultry Science Journal*, 76(1), 5-16.
- Al-Hadeethy S.T.(2006).** The Qualitative properties of local and cultivated Thyme as employed as antibacterial and anti-oxiant agents for oil M. Sc. Thesis, Baghdad University.
- Alawi, M. H. H., Al-Rubaie, A. L., & Al-Bakri, N. A. (2013).** Reducing cholesterol content in quail eggs using alcoholic extracts of ginger, propolis, and cinnamon. *Al-Furat Journal of Agricultural Sciences*, 5(3), 65–75.
- Al-Hameed. & Mohammed, H. A, S. A. (2021).** Effect of Dietary Black Cumin Seeds (*Nigella Stavia*), Garlic (*Allium Sativum*) and Lettuce Leaves (*Lactuca Sativa*) on Performance and Egg Quality Traits of Native Layer Hens. In *IOP Conference Series: Earth and Environmental Science* (Vol. 910, No. 1, p. 012001). IOP Publishing.
- Ali. N. A. (2011).**The infrastructure of Adding (*Thymus vulgaris*) leaves powder to the diet on certain blood traits of broiler chickens. *Almustanserya journal* (22)6:1-28.(in arabik).
- Al-Naeef H. H. (2010).**Effect of adding different levels of crushed black seeds and (*Thymus vulgaris*) leafs for hens

ration individually or together in productive and physiological traits and some quantity traits of eggs .Ph.D.Thesis , Al-Anbar university (in Arabic).

- Al-Qaisi, G. A. M., & Jameel, Y. J. (2009).** The effect of adding thyme (*Thymus vulgaris*) and cinnamon (*Cinnamomum verum*) plants on the productive performance and some blood traits of broiler chickens. *Iraqi Veterinary Journal*, 33(2), 84–90.
- Amad, A. A., Männer, K., Wendler, K. R., Neumann, K., & Zentek, J. (2011).** Effects of a phytogenic feed additive on growth performance and ileal nutrient digestibility in broiler chickens. *Poultry Science*, 90(12), 2811–2816.
- Apron, S.; Adcharatt, S.; Usa, O.; Reawadee, S.; penal, p. (2008).** Effect of Garlic supplementation in the diet of boilers on productive performance , meat cholesterol & sensory quality.
- Buege, J. A., & Aust, S. D. (1978).** Microsomal lipid peroxidation. *Methods in Enzymology*, 52, 302–310.
- Bollengier-Lee, S., Mitchell, M. A., Utomo, D. B., Williams, P. E. V., & Whitehead, C. C. (1998).** Influence of high dietary vitamin E supplementation on egg production and plasma characteristics in hens.
- Burtis, C. A., & Ashwood, E. R. (Eds.). (1999).** *Tietz Textbook of Clinical Chemistry* (3rd ed.). W.B. Saunders. ISBN.
- Chen, S.-C., Yen, Z.-S., Wang, H.-P., Lin, F.-Y., Hsu, C.-Y., & Chen, W.-J. (2002).** Ultrasonography is superior to plain radiography in the diagnosis of pneumoperitoneum. *British Journal of Surgery*, 89(3), 351–354.
- Chowdhury, S. R.; Chowdhury, S. D. and Smith, T. K. (2002).** Effects of dietary garlic on cholesterol metabolism in laying hens. *Poultry Science*, 81: 1856-1862)

- Cross, D. E., McDevitt, R. M., Hillman, K., & Acamovic, T. (2007).** The effect of herbs and their associated essential oils on performance, dietary digestibility and gut microflora in chickens from 7 to 28 days of age. *British poultry science*, 48(4), 496-506
- Dorman, H. D., & Deans, S. G. (2000).** Antimicrobial agents from plants: antibacterial activity of plant volatile oils. *Journal of applied microbiology*, 88(2), 308-316.
- Duncan DB (1955).** Multiple range and multiple F tests. *Biometrics*, 11: 1-42.
- Gardzielewska, J., Pudyszak, K., Majewska, T., Jakubowska, M., & Pomianowski, J. (2003).** Effect of plant-supplemented feeding on fresh and frozen storage quality of broiler chicken meat. *J. Polish. Agric. Univ*, 6(2)
- Gerzilov, V., Nikolov, A., Petrov, P., Bozakova, N., PENCHEV, G., & Bochukov, A. (2015).** Effect of a dietary herbal mixture supplement on the growth performance, egg production and health status in chickens. *Journal of Central European Agriculture*
- Giannenas, I., Bonos, E., Christaki, E., & Florou-Paneri, P. (2013).** Essential oils and their applications in animal nutrition. *Med. Aromat. Plants*, 2(140), 2167-0412.
- Grashorn, M. A. (2010).** Use of phytobiotics in broiler nutrition—an alternative to infeed antibiotics. *Journal of Animal and Feed Sciences*, 19(3), 338-347
- Hashemipour, H., Kermanshahi, H. Golian, A. and Veldkamp. T. (2013).** Effect of thymol and carvacrol feed supplementation on performance, antioxidant enzyme activities, fatty acid composition, digestive enzyme activities, and immune response in broiler chickens. *Poultry Science*. 92(8): 2059-69

- Isa, M.A., Abar, F.M. and Talal, A. (2013).** study of inhitor activity of (thymus vulgaris) oil aginst some pathological bacteria. *Tikrit Journal for Agricultural Sciences Special Issue (13):67-72.*
- Jameel, Y. J. (2008).** The effect of adding thyme (Thymus vulgaris) and cinnamon (Cinnamomum verum) plants on the productive performance and some blood traits of broiler chickens. Master's thesis, College of Veterinary Medicine, University of Baghdad.
- Kabouche, A., Kabouche, Z., & Bruneau, C. (2005).** Analysis of the essential oil of Thymus numidicus (Poiret) from Algeria. *Flavour and fragrance journal, 20(2), 235-236.*
- Kazim, S.S., Al-Bandar.L.K. and AL-Khelany,F.M. (2009).**Effect of using (Thymus vulgaris) in quail ration in productive performance and egg quality. *Iraqi Journal of Agricultural Sciences 14(5):34-43.*
- Khalaji, S., Zaghari, M., Hatami,K., Hedari-Dastjerdi, S., Lotfi, L., and Nazariant, H. (2011).** Black cumin seeds, Artemisia leaves (Artemisia Sieberi), and Camellia L. plant extract as phytogetic products in broiler diets and their effects on performance, blood constituents, immunity, and cecal microbial population. *Poult. Sci. 90: 2500-2510.*
- Kothari, D., Lee, W. D., Niu, K. M., & Kim, S. K. (2019).** The genus Allium as poultry feed additive: A review. *Animals, 9(12), 1032.*
- Lee, S. J., Shin, J. H., Kang, M. J., Yang, S. M., Ju, J. C., & Sung, N. J. (2009).** Effect of garlic and medicinal plants composites on antioxidant activity and lipid levels of liver in hypercholesterolemic rats. *Journal of Life Science, 19(12), 1769-1776.*
- Lin, H., Sui, S. J., Jiao, H. C., Buyse, J., & Decuyper, E. (2006).** Impaired development of broiler chickens by stress

mimicked by corticosterone exposure. *Comparative Biochemistry and Physiology Part A: Molecular & Integrative Physiology*, 143(3), 400-405.

Lovkova, Z (1977). Methods for diagnosis of fish disease . Ameruno publishing ,Co , PVT ,Ltd New Deihi , Bomby ,New York.

Marino, M., Bersani, C., &Comi, G. (2001). Impedance measurements to study the antimicrobial activity of essential oils from Lamiaceae and Compositae. *International journal of food microbiology*, 67(3), 187-195.

Meraj, I. C. A. (1998). *Effect of garlic and neem leaves supplementation on the performance of broiler chickens* (Doctoral dissertation, M. Sc. Thesis, Department of Poultry Science, University of Agriculture, Faisalabad, Pakistan.

Mortran D.S. (1987) Lipid oxidation and flavor in meat and meat products. *Food Sci Techno Today*; 1:159- 162.

Morsy, A. S., Eissa, M. M., Anwer, M. M., Ghobashy, H., Sallam, S. M. A., Soltan, Y. A., &Sadik, W. M. (2018). Colostral immunoglobulin concentration and milk production of ewes fed salt tolerant forages as alternatives to berseem hay. *Livestock Science*, 210, 125-128.

Nasir, Z., Abid, A. R., Hayat, Z., &Shakoor, I. (2005). Effect of Kalongi (*Nigella sativa*) seeds on egg production and quality in White Leghorn layers.

Narimani-Rad.; nobakht ,A.;Sharyar ,H.A.;Sharyar H.A.;Newsholme,Prescott ,J.;Lima,M.M.R.; pithy – Curi,T.C.and funnctio'.*Cell Biochemistry and function*. 21: 1-9.2003.

Olorunsanya OA, Olorunsanya EO, Akanbi AS and RMO Kayode.(2009). Antioxidant properties of rice husk extract

in raw and cooked pork patties. *J. Applied Agricultural research*. 1:143-147.

Qi, G. H., & Sim, J. S. (1998). Natural tocopherol enrichment and its effect in n- 3 fatty acid modified chicken eggs. *Journal of Agricultural and Food Chemistry*, 46(5), 1920-1926.

Kourounakis, P. N., & Rekka, E. A. (1991). Effect on active oxygen species of alliin and *Allium sativum* (garlic) powder. *Research Communications in Chemical Pathology and Pharmacology*, 74(2), 249–252.

Sadeghi, G. H., Karimi, A., PadidarJahromi, S. H., Azizi, T., & Daneshmand, A. (2012). Effects of cinnamon, thyme and turmeric infusions on the performance and immune response in of 1-to 21-day-old male broilers. *Brazilian Journal of Poultry Science*, 14, 15-20.

Saleh, N., Allam, T., El-Latif, A. A., & Ghazy, E. (2014). The effects of dietary supplementation of different levels of thyme (*Thymus vulgaris*) and ginger (*Zingiber officinale*) essential oils on performance, hematological, biochemical and immunological parameters of broiler chickens. *Global Veterinaria*, 12(6), 736-74.

Samantha A.R. and A .Dey.(1991) Effect of feeding garlic (*A.satirum*) as a growth promoter in Japanese quails (*C.coturnix Japonica*) and its influence on dressing parameters India *J. Poult* .

Sha'non, A. Q. (2011). The effect of using aqueous extract of ginger and thyme on reproductive performance in broiler breeders. Ph.D. thesis, College of Agriculture, Tikrit University.

Singh, P. K., Kumar, A., & Tiwari, D. P. (2019). Effects of dietary supplementation of black cumin, garlic and turmeric on the production performance and egg quality of White

Leghorn hens. *Animal Nutrition and Feed Technology*, 19(3), 361-370.

Soltan, Y. A., Hashem, N. M., Morsy, A. S., El-Azrak, K. M., El-Din, A. N., & Sallam, S. M. (2018). Comparative effects of Moringaoleifera root bark and monensin supplementations on ruminal fermentation, nutrient digestibility and growth performance of growing lambs. *Animal Feed Science and Technology*, 235, 189-201.

Toghyani, M., Tohidi, M., Gheisari, A. A., & Tabeidian, S. A. (2010). Performance, immunity, serum biochemical and hematological parameters in broiler chicks fed dietary thyme as alternative for an antibiotic growth promoter. *African journal of biotechnology*, 9(40), 6819-6825.

Wang, S. T., Chen, H. W., Sheen, L. Y., & Lii, C. K. (1997). Methionine and cysteine affect glutathione level, glutathione-related enzyme activities and the expression of glutathione S-transferase isozymes in rat hepatocytes. *The Journal of nutrition*, 127(11), 2135-2141.

Williams, P. and Losa, R. (2001). The use of essential oils and their compounds in poultry nutrition. *World Poult.* 17: 14 – 15.

Yousef, M. I. (2004). Aluminium-induced changes in hemato-biochemical parameters, lipid peroxidation and enzyme activities of male rabbits: protective role of ascorbic acid. *Toxicology*, 199(1), 47-57.

Zargari, A., Eshaghi, H., Bäck, O., Johansson, S., & Scheynius, A. (2001). Serum IgE reactivity to *Malassezia furfur* extract and recombinant *M. furfur* allergens in patients with atopic dermatitis. *Acta Dermato-Venereologica*, 81(6), 418–422.

Zweil, H. S., Genedy, S. G., & Bassiouni, M. (2006). Effect of probiotic and medicinal plant supplements on the production and egg quality of laying Japanese quail hens

Z solt, A.Marta , E, Nikols, M (2009). Effect Of rosemary & garlic oil supplementation on glutathione redox system of broiler chickens.

Zweil ,H.S.;Zahran, S.M.; Adb El Rahman,M. H.; Desoky , W .M.; Abu Hafsa, S.Hafsa, S.H.and Mokhtar .A.A. (2016). Effect of using bee propolis as natural supplement on productive and physiological performance of Japanese quail. Egyptian poultry Science Journal, 36 (1), 161-175. DOI: 10.