



**SOME PRODUCTIVE AND PHYSIOLOGICAL RESPONSES OF GROWING JAPANESE QUAILS TO SUDANESE PROPOLIS ADDITION**

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**ABSTRACT:** The current study was performed aiming to investigate the untraditional natural additives such as different levels of Sudanese propolis as prospective alternatives through studying their effect on productive performance, physiological parameters and oxidative status of Japanese quails. A total number of 480 unsexed Japanese quails at 7 days of age were randomly distributed for four equal treatments; every treatment contains 120 birds for each treatment. Four equal treatments were received four dietary treatments depending on addition of Propolis levels from 7 days to 42 days of quails age as follows: T1: Control (basal diet without Propolis addition). T2: basal diet + 250 mg Propolis /kg diet. T3: basal diet + 500 mg Propolis /kg diet. T4: basal diet + 750 mg Propolis /kg diet. Results showed that body weight at 42 days was heavier significantly ( $p=0.0020$ ) with 750 and 500 mg propolis addition treatments than control and 250 mg treatments. The same trend found in body weight gain during growing period of quails, which increased significantly ( $p=0.0035$ ) by 5 and 8% with 500 and 750 mg/kg diet Propolis addition than control, respectively. Moreover, feed conversion ratio was improved significantly ( $p=0.0239$ ) by 3, 7.5 and 11% compared to control with the three levels of Propolis, respectively. Red blood cells, hemoglobin and hematocrit values were significantly increased with the three levels of Propolis compared to control. Total lipids, cholesterol, triglycerides and LDL were significantly decreased with the three levels of Propolis compared to control. While, HDL was significantly increased with the three levels of Propolis compared to control. Furthermore, IgM, lymphocytes, globulin and total antioxidant capacity were significantly increased with the three levels of Propolis compared to control. From these results we can conclude that, addition of Propolis caused significant improvements in quails' productive performance and anti-oxidative status.

**Key words:** Propolis, growth performance, blood parameters, Japanese quails.

## INTRODUCTION

Recently, and due to decrease in the use of un-natural growth promoters in poultry diets, studies have been conducted to find other growth promoters of natural sources, to increase benefits from feed and keep animals wellbeing.

Propolis, also called “bee glue”, is a resinous substance gathered by honey bees (*Apis mellifera* L.) from various sources of plants containing of the bioactive components of propolis included of flavonoids, aromatic acids, caffeic acid, terpenes and their derivatives, which are also responsible for the bactericidal, antiviral, antifungal, analgesic, anti-inflammatory, antioxidant, and immunomodulating effects of these compounds in humans and animals constituents are the main components that achieve propolis effects (Orsolčić et al., 2004; Krocko et al., 2012 and Klaric et al., 2018). Recently, numerous studies have proven the propolis activity against (gram positive) bacteria, viruses, fungi, oxidants, inflammation, tumors, parasites, protozoa and it may act against methanogenesis (Alencar et al., 2007; Aguiar et al., 2014; Morsy et al., 2013 and 2015). Several investigations on propolis have proved that flavonoids in propolis are powerful antioxidants that are capable to scavenge free radicals (Basnet et al., 1997; Banskota et al., 2000).

Several researchers have proved the improving effects of propolis on performance of growth and immunity in poultry. They stated that feed intake, feed efficiency and weight gain, were significantly improved with propolis feeding in quails (Denli et al., 2004), broilers (Biavatti, et al., 2003; Ziaran et al., 2005; Shalmany and Shivazad, 2006; Hassan and Abdulla, 2011 and

Daneshmand et al., 2012). Results also indicated that propolis may counteract the negative effects of oxidative stress on the body defense system (EL-Khawaga et al., 2003; Mannaa et al., 2011; Tatli Seven et al., 2012). Moreover, Propolis was shown to have several beneficial effects as improving nutrient utilization (Tatli et al., 2009), increasing plasma total protein, albumin and globulin with propolis treatment on chicks (Shreif and El-Saadany., 2017), and increasing serum IgG and IgM when added to broiler’s and laying hens diets (Çetin et al., 2010; Shihab and Ali., 2012).

Moreover, Sudanese propolis was first analyzed in 2016 by Abd El-Hady et al., who reported that Sudanese propolis contains Nitrogenous, Aliphatic acids/esters, Phenolic acid/ ester, Caffeoyl quinic acid ester, Sugars, Tetracyclic triterpene, Flavonoid compounds, Flavones, Flavones, Flavones and others. They also proved in in-vivo studies that it plays an important role as acetylcholinesterase inhibitor, cytotoxic, antimicrobial and an antioxidant.

Therefore, the present study was carried out to study the effects of Sudanese Propolis on the productive performance, physiological parameters and Oxidative status of Japanese quails.

## MATERIAL AND METHODS

The present study was carried out at the Poultry Research Center, Faculty of Agriculture, Alexandria University during the period from May to August 2019. Chemical analyses were performed in the Central Laboratory of the Faculty of Agriculture, Alexandria University according to the procedures outlined by (A.O.A.C.,1990).

### Source of Propolis:

Raw Sudanese brown Propolis was collected from White Nile state, Kordofan

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state, Darfur state and border areas with South Sudan an area with a wet tropical climate. Raw Propolis was collected manually from colonies of Mellifera bees. Propolis was cleaned, weighed, bottled and stored at  $-18^{\circ}\text{C}$  until being subjected to extraction and analysis according to (Morsy et al., 2015). Chemical constituents of ethanolic extracts of Sudan Propolis are found in Table (1).

### **Birds, treatments, and experimental design:**

A total number of 480 unsexed Japanese quails at 7 days of age were randomly distributed for four equal treatments; every treatment contains 120 birds for each treatment. The experimental period lasted from 7 days to 42 days of age.

Birds received four dietary treatments depending on addition of Propolis levels throughout the studied experimental period as follows: T1: Control (basal diet + 0 mg Propolis /kg diet). T2: basal diet + 250 mg Propolis /kg diet. T3: basal diet + 500 mg Propolis /kg diet. T4: basal diet + 750 mg Propolis /kg diet. Commercial quail diets were used as a basal diet contained 24% crude protein and 2900 kcal/kg ME, which supplemented with different levels of Propolis from 7 days of quails age until the end of the experimental period. Basal diet was formulated to meet all nutritional requirements of growing Japanese quails (NRC 1994).

### **Studied traits:**

#### **Live body weight (LBW) and Body Weight Gain (BWG):**

All birds from each treatment were individually weight in grams at the beginning and end of the experimental period, at 7 and 42 days of age. Total body weight gains in grams during the whole experimental period (7-42 days)

were estimated as subtracting the initial live weight (IW) from the final one (FW).

#### **Feed intake (FI) and Feed Conversion Ratio (FCR):**

Total feed intake per treatment was calculated at the end of the experimental period. Feed conversion ratio was calculated to present the amount of feed in grams required to produce one gram of weight gain.

#### **Blood parameters:**

##### **Hematological parameters:**

At the end of the experimental period, blood samples, were collected at slaughter for biochemical analysis. Non-coagulated blood samples were shortly tested after collection for estimating the complete blood picture. Red blood cells (RBCs) as well as white blood cells (WBCs) were counted; and their types of lymphocyte, Heterophils and monocyte cells were also determined according to (Feldman et al., 2000) and hemoglobin (Hb) concentration according to (Drew et al., 2004). And also, packed cell volume (PCV) % was determined according to (Schalm., 1986).

##### **Biochemical parameters**

Blood samples were collected in dry clean centrifuge tubes without anticoagulant for serum separation. Clear serum samples were stored at  $-20^{\circ}\text{C}$  pending chemical analysis. Biochemical characteristics of blood were determined calorimetrically on Hitachi 901 spectrophotometer using STANBIO commercial kits and diagnostic examinations. Total protein concentration (TP) was quantitatively measured as (g/dl) based on colorimetric determination as described by (Henry et al., 1964). Albumin concentration (Al b) was determined as (g/dl) by using special kits delivered from sentinel CH. Milano, Italy according to the method of (Doumas

et al.,1977). Globulin concentration was calculated by subtracting the values of the albumin from total protein values. Then albumin globulin ratio was estimated. Total lipids concentration (TL) was determined as (mg/dl) in blood serum according to the recommendation of (Fringes et al.,1972). Cholesterol concentration (Cho) was determined as (mg/dl) on individual base using the specific kits according to the recommendation of (Bogin and keller (1987, high density lipoprotein (HDL) and low density lipoprotein (LDL) (mg/dL) were assessed calorimetrically using commercial kits (Biosystems S.A. Costa Brava, Barcelona, Spain). Triglyceride concentration (TG) was determined as (mg/dl) depending on the method of (Allain et al.,1974). Uric acid concentration (UA) was determined as (mg/dl) using RANDOX commercial kits according to the method of (Barham and Trinder.,1972). Creatinine concentration (Creat.) was determined as (mg/dl) by the method of (Fabiny and Ertingshausen.,1971). Glucose concentration (Glu.) was measured as (mg/dl) by the method of (Trinder.,1969) using commercial kits. Calcium concentration (Ca) was determined as (mg/dl) by the method of (Gindler and King.,1972). Available Phosphorus concentration (P) was determined as (mg/dl) by the method of (Muñoz et al. ,1983). Transaminase enzymes activities of serum alanine amino transferase (ALT) and serum aspartate amino transferase (AST), as U/dl, were determined by calorimetric method of (Reitman and Frankel., 1957). Alkaline phosphatases (ALP) concentration was determined according to the color metric method of (Bauer.,1982). Total antioxidant capacity and malondiadehyde were determined by

the method of (Gonzalez et al.,2007). Plasma immunoglobulin, IgG and IgM were determined using the method of Leslie and Frank (1989).

#### **Statistical analysis:**

Data were subjected to analysis of variance, using the General Liner Model (GLM) procedure of SAS program (SAS, Institute, 2004; version 9.1). The significant tests for the differences between each two means for any studied trait were done according to (Duncan.,1955). In preliminary analysis of data, all first order interactions between main effects of treatments for combine sex were observed to be statistically insignificant. So, these values were excluded from the final model. Treatment effects were considered significant at  $P \leq 0.05$ .

## **RESULTS AND DISCUSSION**

### **Productive traits**

Data presented in Table (2) indicate homogeneousness in quails' body weight at the beginning of the experiment ( $p=0.1124$ ). By experiment end at 42 days of age, quails' body weight differed significantly among treatments. Whereas, the lowest body weight was observed with the lowest Propolis addition with a 2.4% decrease than control. Meanwhile, quails' body weight increased by 4.5 and 7.4% than control, with the 500 and 750 mg/kg diet Propolis addition, respectively ( $p=0.0020$ ). Consequently, Total body weight gain Table (2) revealed the same trend. Where the lowest body weight gain was gained by the lowest Propolis addition with a 2% decrease than control and total body weight gain increased by 5 and 8% than control, with the 500 and 750 mg/kg diet Propolis addition, respectively ( $p=0.0035$ ).

Total feed consumption data presented in Table (2) indicate a decrease in feed

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consumption in treated groups to reach 95, 97, and 96% of control with the three doses of Propolis addition, respectively ( $p=0.0336$ ). Accordingly, feed conversion ratio Table (2) was improved by 3, 7.5 and 11% compared to control with the three doses of Propolis, respectively ( $p=0.0239$ ).

These findings are in good agreement with many authors who observed that feed intake, feed efficiency and weight gain, were significantly improved when propolis was fed to quails (Denli *et al.*, 2004), and broilers (Biavatti, *et al.*, 2003; Ziaran *et al.*, 2005; Shalmany and Shivazad, 2006; Hassan and Abdulla, 2011 and Daneshmand *et al.*, 2012). The decrease in feed intake and can be due to the flavor of the flavonoids in propolis, and/or due to components such as benzoic and 4-hydroxybenzoic acid, which can cause improvement in the digestibility of nutrients like protein and ash, which can explain the improvement in FCR (Tatli Seven, 2008; Seven *et al.*, 2012). The improvement in BW and BWG observed can also be attributed to the presence of micronutrients, high flavonoids and phenolic acids found in propolis that enhance the microbial gut content and cause positive effects on birds' performance (Shreif and El-Saadany, 2017 and Klaric *et al.*, 2018).

### **Blood parameters:**

#### **Erythrocytes profile:**

Red blood cells, hemoglobin and hematocrit values significantly increased ( $p=0.0073$ ,  $0.0475$  and  $0.0241$ , respectively) with the three doses of Propolis (Table 3). The increase in red blood cells was by 12, 16 and 16%, Hemoglobin increased by 7, 8 and 8% and Hematocrit increased by 7, 10 and 11% compared to control with the three Propolis doses, respectively.

This comes in agreement with the findings of (Cetin *et al.*, 2010) on laying hens as erythrocyte count significantly increased in birds given  $3 \text{ g.kg}^{-1}$  of propolis combined by increase in hematocrit and hemoglobin. It was suggested that propolis may stimulate the synthesis of RBCs. Our findings are also in the line with Orsolić and Basic., (2005), who found that RBCs are increased in mice and proposed that propolis exert its effects on hematopoietic bone marrow cells and improves their growth and differentiation. The increased hemoglobin level, due to propolis addition, was suggested to be due to that propolis enhance iron utilization and hemoglobin regeneration (Haro *et al.*, 2000).

#### **Protein profile**

Blood protein components, total protein, albumin, globulin and albumin globulin ratio data are presented in Table (4). Total protein was significantly affected by Propolis treatments, ( $p= 0.0261$ ) where it increased by 11.4, 23.5 and 23.3% compared to control with the three doses of Propolis, respectively. Although non-significant ( $p=0.5368$ ), there was a slight increase in albumin by 7, 10 and 9.6 compared to control with the three doses of Propolis, respectively. Globulin in the other hand increased significantly ( $p=0.0351$ ) by 15.7, 38 and 38.7% compared to control with the three doses of Propolis, respectively. Meanwhile, albumin globulin ratio was not significantly affected ( $p=0.8009$ ).

Our findings are in agreement with Abdel-Kareem and El-Sheikh., (2015) who reported that propolis addition to layer diets increased total plasma protein, albumin and globulin. Also, with the findings of Shreif and El-Saadany., (2017) on Bandara chicks. The increasing

effects of propolis on protein fraction can be attributed to the stimulatory effect of propolis on liver, which cause an anabolic effect resulting in protein synthesis. The improvement in protein profile observed may be also attributed to bird's liver being able to synthesize globulins for immunologic purposes that may preserve protein from degeneration (Khalil.,2006)

#### **Lipid profile**

All blood lipid components were significantly affected by Propolis treatments Table (4). Total lipids were decreased by 2.7, 11 and 44% (0.0371), cholesterol by 6.3, 11 and 13% (0.0465), triglycerides by 10, 24 and 28% (0.0308) and LDL by 7, 25 and 35% (0.0459) compared to control with the three doses of Propolis, respectively. Meanwhile, HDL significantly increased by 39, 64 and 75% (p=0.0382) compared to control with the three doses of Propolis, respectively.

Similar effects of Propolis were observed on chicks (Shreif and El-Saadany.,2017) as they showed that total plasma lipids, cholesterol and triglycerides were significantly improved, and they suggested that the hypocholesterolemic effect of propolis can be related to its antioxidating effects. Moreover, Eraslan et al., (2007) proved the steroids, flavonoids, phenolic acids and their esters content of propolis suggesting their ability to prevent lipid peroxidation and regulate synthesis of cholesterol. Similar effects of Propolis were confirmed on broilers, laying hens and Japanese quail (Attia et al., 2014; Shreif and El-Saadany., 2016 and Zeweil et al., 2016 a,b).

#### **Immune status**

Immunoglobulin G Table (4) was not significantly affected by Propolis treatments (p=0.7812). On the other hand,

immunoglobulin M (Table 4) increased significantly in a dose inverse manner were the highest level of immunoglobulin was obtained with the lowest Propolis treatment (p=0.0426) as immunoglobulin M was increased by 13, 7.3 and 5.3% compared to control with the three doses of Propolis, respectively.

White blood cells showed a slight non-significant increase (p= 0.6586) compared to control, by 4, 5 and 7%, with the three Propolis doses, respectively. Meanwhile lymphocytes increased significantly (p=0.0261) to reach 107, 106 and 113% of control, with the three Propolis doses, respectively. This increase in lymphocytes with heterophils not being affected, caused a significant decrease (p=0.0491) in heterophils to lymphocytes ratio, as it was decreased by 6, 8 and 16% compared to control, with the three Propolis doses, respectively. Monocytes increased in a dose dependent manner to reach 117, 133 and 142% of control, with the three Propolis doses, respectively (Table 3).

Similar results were obtained by (Shreif and El-Saadany.,2017) who reported that supplementation of chicks' diets with propolis, increased plasma IgG and IgM values in a dose dependent manner. In the same respect, it was noticed that treatment with propolis caused increase in IgG and IgM and it was suggested that the improvement in immunity may be related to propolis content of flavonoids that can elevate cytokines, which stimulate B lymphocytes to produce immunoglobulins (Cetin et al., 2010 and Freitas et al., 2011). (Park et. al., 2004) had also related the increased levels of IgG in birds treated with propolis to the stimulation of B lymphocytes by increasing macrophage activity and increasing concentrations of cytokines

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such as interleukin-1, interleukin-2, and interleukin-4. These cytokines further stimulate B lymphocytes to become plasma cells, producing immune globulins (Dimov *et al.*, 1991). These effects should be attributed to the benzene and flavonoids components of propolis.

It has also been established that propolis has a direct effect on immune cells properties (Ansorge *et al.*, 2003). Artepillin C as one of propolis constituents can activate the immune system by increasing number of lymphocytes and phagocytic activity (Kimoto *et al.*, 1998). Propolis extract may increase lymphocyte production causing activation of factor IL-1 that improve B- and T-cell proliferation (Orsolich and Basic., 2003; Chu., 2006).

### **Kidney function**

Uric acid showed a non-significant decrease ( $p=0.7340$ ) to reach 98, 92 and 94% of control with the three doses of Propolis, respectively. Creatinine on the other hand was decreased significantly ( $p=0.0324$ ) to reach 85, 73 and 78% of control with the three doses of Propolis, respectively (Table 4).

Which comes in agreement with the findings of (Osman and Tantawy.,2013) who studied the effect of propolis supplementation on the gentamicin-induced nephrotoxicity in rabbits, they reported that, propolis has a protective effect against nephrotoxicity caused by gentamicin. Also, these rabbits serum profile showed improvement as serum creatinine and urea levels became lower than those recorded in rabbit treated with gentamicin alone. Also, feeding broilers with propolis (200 mg/kg diet) resulted in a significantly lower plasma creatinine and uric acid concentration (Rabie *et al.*, 2018).

### **Liver function**

Both aspartate amino transferase and alanine amino transferase were decreased significantly ( $p=0.0442$  and  $0.0344$ , respectively) in a dose dependent manner (Table 4). Aspartate amino transferase decreased to reach 82, 75 and 67%, and alanine amino transferase to reach 88, 86 and 81% of control with the three doses of Propolis, respectively. Which indicates that the supplementation of propolis in diet caused a reduction in ALT and AST activities compared to control. Accordingly, we may argue that propolis have a role in the prevention of liver injury and/or hepatoprotective effects.

Which is in harmony with the findings of (Babińska *et al.*, 2012) who demonstrated that propolis addition into chicken diet protected hepatic tissue from adverse effects of different hepatotoxic factors, and suggested that this property of propolis can be due to its phenolic components (including flavonoids) and their anti-oxidizing effect. Moreover, Shreif and El-Saadany (2017) reported a significant reduction in chicks' ALT and AST with increasing propolis levels in the diet.

### **Calcium and phosphorus concentrations:**

Alkaline phosphatase (Table 4) increased significantly ( $p=0.0456$ ) in a dose dependent manner by 13, 20 and 25% compared to control with the three doses of Propolis, respectively. Moreover, calcium was increased significantly ( $p=0.0308$ ) by 5.5, 7.6 and 13% compared to control with the three doses of Propolis, respectively. Meanwhile, phosphorous showed a slight non-significant ( $p= 0.6733$ ) increase (Table 4) by 3, 6 and 5% compared to control with the three doses of Propolis, respectively.

These findings are in the same track of those of Seven *et al.*, (2016) who reported a significant increase in blood calcium when quails were fed propolis. This result may be due to the antimicrobial activity of the components of the propolis extracts, resulting in better intestinal health and improving digestion and absorption (Denli *et al.*, 2005). Also, (Haro *et al.*, 2000) attributed the increase in calcium to the increase in the digestibility of calcium due to the acid derivatives, such as benzoic, 4-hydroxybenzoic, which are found in propolis.

#### **Oxidative status**

Malondialdehyde was decreased although non-significantly to reach 93, 86 and 85% of control with the three doses of Propolis, respectively. Meanwhile total antioxidant capacity increased significantly ( $p=0.0416$ ) in a dose dependent manner by 4, 14 and 26%

compared to control with the three doses of Propolis, respectively (Table 4).

This comes in agreement with Kumazawa *et al.*, (2004), who stated that the antioxidant activities/ properties of propolis were confirmed in vitro by the presence of a strong defense against oxidative stress. Moreover, the antioxidant capacity of propolis can be attributed to some of its biological effects, including chemoprevention. Flavonoids in propolis are powerful antioxidants, capable of scavenging free radicals and protecting the cell membrane against lipid peroxidation (Kolankaya *et al.*, 2002).

It can be concluded that propolis in quails' diet can act as a growth promoter, production enhancer, antibacterial, antioxidant and immune stimulant without detrimental effects on their health or wellbeing.

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**Table (1):** Gas chromatography-mass spectrometry (GC-MS) analysis of ethanolic extract of propolis.

<b>Compounds</b>	<b>Retention time(min)</b>	<b>% Of total ion current</b>	<b>compounds</b>	<b>Retention time(min )</b>	<b>% Of total ion current</b>
<b>Glycodeoxycholic benzoic acid</b>	7.407	0.34	<b>Cholestan-3-one</b>	26.14	6.04
<b>Glycerol</b>	8.306	1.47	<b>β-d-Galactofuranose</b>	14.703	0.05
<b>α-Terpineol</b>	10.5	0.02	<b>d-Fructose</b>	15.27	1.11
<b>4-βH,5α-Eremophi1Đ1(10)-ene</b>	20.498	3.21	<b>1,4-Anhydroglucitol</b>	15.537	0.12
<b>1-(5-Ethenyltetrahydro-5-methyl-2-furanyl) Đ1-methylethanol</b>	20.706	4.34	<b>Quercetin7,3`,4`-Trimethoxy ester</b>	16.058	2.04
<b>α-d-Mannopyranose</b>	17.075	10.4	<b>cinnamic acid</b>	16.21	0.08
<b>hexadecanoic acid</b>	17.256	0.73	<b>1-Naphthalenemethanol, Decahydro-1,10-dimethyl-6-methenyl-5-(5-hydroxy-3-pentene)</b>	16.513	2.19
<b>ferulic acid</b>	17.631	0.09	<b>oleic acid</b>	18.853	4.72
<b>caffeic acid isomer-1</b>	28.994	0.05	<b>3-α,5- β-Pregnan-20-one</b>	20.297	2.28
<b>dehydroabietic acid</b>	32.722	2.55	<b>androstan-1,17-dimethyl-17-hydroxy-3-one</b>	20.68	12.71
<b>Phenols/flavones</b>	32.827	6.34	<b>Baicaline</b>	21.127	3.82
<b>caffeic acid isomer-2</b>	33.283	0.06	<b>docosa-8,14-diyn-cis-1,22-diol</b>	21.594	12.05
<b>butanedioic acid</b>	8.773	0.19	<b>isopimaric acid</b>	22.016	26.88

**Table (2):** Effects of different levels of Propolis on some performance traits at different age of growing Japanese quail

Traits	Treatment				MSE	P-value
	Control T1	Propolis 250mg/kg diet T2	Propolis 500mg/kg diet T3	Propolis 750mg/kg diet T4		
LBW, g. (7days)	26.39	26.02	26.64	26.72	1.96	0.1124
LBW, g. (42days)	228.8 <sup>b</sup>	223.3 <sup>b</sup>	239.1 <sup>a</sup>	245.7 <sup>a</sup>	12.03	0.0020
BWG, g. (7- 42days)	202.05 <sup>b</sup>	197.9 <sup>b</sup>	212.3 <sup>a</sup>	218.8 <sup>a</sup>	10.42	0.0035
TFC, g.(7- 42days)	588.7 <sup>a</sup>	557.3 <sup>c</sup>	571.6 <sup>b</sup>	565.9 <sup>b</sup>	11.32	0.0336
FCR, (7-42days)	2.91 <sup>a</sup>	2.82 <sup>a</sup>	2.69 <sup>b</sup>	2.58 <sup>b</sup>	0.14	0.0239

a ,b,c Means within the same row in the same trait with different superscripts are significantly different (P≤0.05).

**Table (3):** Effect of dietary additive with different levels of Propolis on serum hematological at the end of experimental period (42 days) of growing Japanese quails

Traits	Treatment				MSE	P-value
	Control T1	Propolis 250mg/kg diet T2	Propolis 500mg/kg diet T3	Propolis 750mg/kg diet T4		
Red blood cell/mL	3.52 <sup>b</sup>	3.95 <sup>a</sup>	4.08 <sup>a</sup>	4.07 <sup>a</sup>	0.16	0.0073
Hemoglobin (g/100ml)	13.68 <sup>b</sup>	14.62 <sup>a</sup>	14.74 <sup>a</sup>	14.82 <sup>a</sup>	0.65	0.0475
PCV %	44.98 <sup>b</sup>	48.20 <sup>a</sup>	49.60 <sup>a</sup>	49.88 <sup>a</sup>	2.04	0.0241
White blood cell 10 <sup>3</sup> /ml	15.46	16.11	16.18	16.48	1.30	0.6586
Heterophils%	31.20	31.00	30.40	30.20	2.66	0.9212
Lymphocytes %	50.40 <sup>b</sup>	54.00 <sup>ab</sup>	53.60 <sup>ab</sup>	57.20 <sup>a</sup>	4.80	0.0261
Hetero/ lympho	0.62 <sup>a</sup>	0.58 <sup>ab</sup>	0.57 <sup>ab</sup>	0.52 <sup>b</sup>	0.07	0.0491
Monocytes %	2.40 <sup>b</sup>	2.80 <sup>ab</sup>	3.20 <sup>a</sup>	3.40 <sup>a</sup>	0.31	0.0482

a, b,c Means within the same row in the same trait with different superscripts are significantly different (P≤0.05).

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**Table (4):** Effect of different levels of Propolis on biochemical constituents at end of experimental period (42 days) of growing Japanese quails.

Traits	Treatment				MSE	P-value
	Contro l T1	Propolis 250mg/kg diet T2	Propolis 500mg/k g diet T3	Propolis 750mg/k g diet T4		
<b>Total Protein (g/dl)</b>	3.52 <sup>b</sup>	3.92 <sup>ab</sup>	4.35 <sup>a</sup>	4.34 <sup>a</sup>	0.44	0.0261
<b>Albumin (g/dl)</b>	1.87	2.01	2.06	2.05	0.15	0.5368
<b>Globulin (g/dl)</b>	1.65 <sup>b</sup>	1.91 <sup>ab</sup>	2.28 <sup>a</sup>	2.29 <sup>a</sup>	0.43	0.0351
<b>Albumin / globulin</b>	1.18	1.12	0.92	0.93	0.26	0.8009
<b>Total lipid (mg/dl)</b>	332.0 <sup>a</sup>	323.0 <sup>a</sup>	294.2 <sup>b</sup>	186.4 <sup>c</sup>	37.78	0.0371
<b>Cholesterol (mg/dl)</b>	117.2 <sup>a</sup>	109.8 <sup>b</sup>	104.6 <sup>b</sup>	102.4 <sup>b</sup>	9.83	0.0465
<b>Triglycerides (mg/dl)</b>	147.8 <sup>a</sup>	133.0 <sup>ab</sup>	111.6 <sup>b</sup>	106.2 <sup>b</sup>	20.55	0.0308
<b>LDL (mg/dl)</b>	43.40 <sup>a</sup>	40.40 <sup>ab</sup>	32.40 <sup>ab</sup>	28.00 <sup>b</sup>	9.54	0.0459
<b>HDL (mg/dl)</b>	21.60 <sup>b</sup>	30.00 <sup>ab</sup>	35.40 <sup>a</sup>	37.80 <sup>a</sup>	9.69	0.0382
<b>Glucose(mg/dl)</b>	216.6	220.2	225.4	224.8	22.54	0.9156
<b>Uric acid(mg/dl)</b>	3.97	3.88	3.66	3.74	0.48	0.7340
<b>Creatinine (mg/dl)</b>	0.41 <sup>a</sup>	0.35 <sup>ab</sup>	0.30 <sup>b</sup>	0.32 <sup>b</sup>	0.05	0.0324
<b>Aspartate amino transferees(UI )</b>	66.60 <sup>a</sup>	54.40 <sup>ab</sup>	49.80 <sup>b</sup>	44.40 <sup>b</sup>	13.27	0.0442
<b>Alanine amino transferees (UI)</b>	30.40 <sup>a</sup>	26.70 <sup>ab</sup>	26.20 <sup>ab</sup>	24.60 <sup>b</sup>	5.02	0.0344
<b>Alkaline phosphatase (g/dl)</b>	188.4 <sup>b</sup>	213.4 <sup>ab</sup>	225.6 <sup>a</sup>	234.8 <sup>a</sup>	31.84	0.0456
<b>Calcium (mg/dl)</b>	14.25 <sup>b</sup>	15.04 <sup>ab</sup>	15.34 <sup>ab</sup>	16.08 <sup>a</sup>	0.87	0.0308
<b>Available phosphorus</b>	5.83	6.03	6.18	6.14	0.49	0.6733
<b>Malondildehyde Iu/L</b>	1.93	1.79	1.66	1.64	0.22	0.1716
<b>Total antioxidant capacity mM/l</b>	24.86 <sup>b</sup>	25.84 <sup>b</sup>	28.26 <sup>ab</sup>	31.44 <sup>a</sup>	2.79	0.0416
<b>Ig G (mg/dl)</b>	20.70	21.46	21.24	21.10	1.19	0.7812
<b>Ig M (mg/dl)</b>	34.16 <sup>b</sup>	38.54 <sup>a</sup>	36.66 <sup>ab</sup>	35.98 <sup>ab</sup>	2.27	0.0426

a, b,c Means within the same row in the same trait with different superscripts are significantly different (P≤0.05).

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## الملخص العربي

### بعض الاستجابات الإنتاجية والفسيوولوجية للسمان الياباني النامي لإضافه البروبوليس السوداني

آيات على جمعه على<sup>١</sup>، عزة عبد الله السباعي<sup>٢</sup>، سمر على النجار<sup>٢</sup>، أميرة اسماعيل الدلبشاني<sup>٢</sup>  
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أجريت الدراسة الحالية بهدف التحقق من المضافات الطبيعية غير التقليدية مثل المستويات المختلفة من البروبوليس السوداني كبديل محتمل من خلال دراسة تأثيرها على الأداء الإنتاجي والمعايير الفسيولوجية والحالة التأكسدية للسمان الياباني. العدد الكلي ٤٨٠ سماعة غير مجنسة عمر ٧ أيام تم توزيعهم عشوائياً لأربع معاملات متساوية، كل معاملة تحتوي على ١٢٠ طائر. تم معاملة الأربع معاملات المتساوية بمعاملات غذائية تعتمد على مستوى إضافة البروبوليس من عمر ٧ أيام إلى ٤٢ يوم من عمر السمان كما يلي: T1: مقارنة (العليقة الأساسية بدون إضافة البروبوليس)، T2 : العليقة الأساسية + ٢٥٠ مجم بروبوليس/كجم عليقة، T3: العليقة الأساسية + ٥٠٠ مجم بروبوليس/كجم عليقة، T4: العليقة الأساسية + ٧٥٠ مجم بروبوليس/كجم عليقة. أظهرت النتائج أن وزن الجسم عند عمر ٤٢ يوم كان أثقل معنوياً ( $P = 0.0020$ ) مع معاملات إضافة البروبوليس ٧٥٠ و ٥٠٠ مجم عن معاملي المقارنة و ٢٥٠ مجم من البروبوليس. وقد وجد نفس الاتجاه في صفة زيادة وزن الجسم خلال فترة نمو السمان ، والتي زادت بصورة معنوية ( $p = 0.0035$ ) بنسبة ٥ و ٨٪ مع إضافة ٥٠٠ و ٧٥٠ مجم / كجم من البروبوليس عن معاملة المقارنة على التوالي. علاوة على ذلك ، تم تحسين معدل التحويل الغذائي معنوياً ( $p = 0.0239$ ) بنسبة ٣ و ٧.٥ و ١١٪ مقارنة مع معاملة المقارنة لمستويات البروبوليس الثلاث على التوالي. وزادت قيم خلايا الدم الحمراء والهيموجلوبين والهيماتوكريت معنوياً مع المستويات الثلاث من البروبوليس مقارنة بالمجموعة المقارنة. انخفضت نسبة الدهون الكلية والكوليسترول والدهون الثلاثية و LDL بشكل معنوي مع المستويات الثلاث من البروبوليس مقارنة بالمعاملة المقارنة. بينما ، زاد HDL بشكل معنوي مع المستويات الثلاث من البروبوليس مقارنة مع المعاملة المقارنة. علاوة على ذلك ، تم زيادة IgM ، الخلايا الليمفاوية ، الجلوبيولين والقدرة الكلية لمضادات الأكسدة بصورة معنوية مع المستويات الثلاث من البروبوليس مقارنة مع المعاملة المقارنة. من هذه النتائج يمكننا أن نستنتج أن إضافة البروبوليس أدى إلى تحسن معنوي لكل من أداء النمو والمعايير الفسيولوجية والحالة المناعية ومضادات الأكسدة في السمان الياباني.