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EFFECT OF DIETARY GINSENG AND GINSENOSIDES SUPPLEMENTATION ON PRODUCTIVE, PHYSIOLOGICAL, IMMUNOLOGICAL PARAMETERS AND MEAT QUALITY OF GIMMIZAH COCKERELS

1. DURING GROWING PERIOD

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ABSTRACT: The present study was carried out to investigate the effect of dietary ginseng (Gn) and ginsenosides (GnD) supplementation on productive, physiological, immunological parameters and meat quality of Gimmizah cockerels. A total number of 140 cockerels of Gimmizah native breed were individually weighted and randomly divided into 7 equal treatment groups with 5 replicates (4 chicks per each cage) from 4 - 16 wks of age. The first group fed the basal diet without any supplementation and served as a control. The other six treatments were fed the basal diet supplemented with 100, 200 and 300 mg of ginseng or ginsenosides / kg diet, respectively. All birds received feed and water ad-libitum throughout the experimental period. During the whole experimental period cocks fed basal diet supplemented with different level of Gn and GnD significantly improved BWG and FCR compared with the control group. The concentration of cholesterol, LDL and ALT were significantly improved due supplementation different levels of Gn and GnD compared with control group. Supplementation basal diet with different levels of Gn and GnD significantly improved the Lysozyme and Bactericidal activity, IgM, MDA, TAC and SOD compared with the control group except SOD for the group fed basal diet supplemented with 100 mg of Gn /kg diet which did not significantly differ from control group. However, the groups fed basal diet supplemented with different level of GnD and 200 or 300 mg /kg diet Gn significantly improved interleukin-6 (IL-6) and tumor necrosis factor alpha (TNF-α) compared with the control group. The intestinal total aerobic, total coliform and anaerobic counts had been decreased with supplementation of basal diet with Gn and GnD at different levels compared with the control group. The psychrophilic and coliform bacteria counts, in stored breast and thigh meats, had been significantly decreased for groups fed basal diet supplied with Gn or GnD at level 300 mg/kg diet compared to other experimental treatments. The optical density values of meat muscles recorded for groups supplied with 300 mg Gn or GnD /kg diet were greater than values which measuring in the control group. **In conclusion,** supplementation cockerel's diet with 300 mg ginseng /kg diet improved the productive performance, immune response and meat quality of Gimmizah cockerels during the growing period.

Key Words: Ginseng, Ginsenosides, cockerels, growth, blood parameters, immunity.

INTRODUCTION

In recent years, researches have progressed on feed enzymes, probiotics, prebiotics, organic acids, and phytogenic feed additives such as aromatic plants, their extracts and essential oils. It has increased the interest with these herbs such as many features (antioxidant, anti-stress, lowering cholesterol, cancer prevention, etc.) from phenolic compounds in the composition of aromatic plant or their extracts.

Panax ginseng C.A. Meyer (Araliaceae), also called Asian ginseng, is one of the most renowned herbal plants worldwide, but particularly in Asian countries, and has been used for thousands of years to maintain homeostasis and enhance vital energy (Choi, 2008; Yıldırım and Erener, 2011). It is considered an adaptogenic agent that helps to enhance physical performance, promote vitality and stimulate metabolic function. It has previously been documented that bioactive components such as saponins, antioxidants, peptides, polysaccharides, alkaloids, lignans and polyacetylenes are present in *P. ginseng* (Palazon et al., 2003; Lu et al., 2009). Saponins (ginsenosides) are considered the principal bioactive ingredients (Palazon et al., 2003), believed to possess anti-fatigue and hepatoprotective properties (Wu and Zhong, 1999), and improve cardiovascular system dysfunction (Kang et al., 1995). Likewise, numerous studies have demonstrated the pharmaceutical effects of *P. ginseng* on physical, chemical and biological stress (Shim et al., 2010), systemic immune function (Spelman et al., 2006) and glucose metabolism (Lim et al., 2009). The presence of ginsenosides in the *P. ginseng* complex contributed to the improvement in the parameters evaluated by its antimicrobial and antioxidant potential, as confirmed by Zhang et al. (2008) and Lim et al. (2009).

Ginsenosides are frequently used as main index for ginseng product evaluation. Methods have been developed for simultaneous analysis of the main ginsenosides, possessing a variety of pharmacological activities, including anti-inflammatory (Wang et al., 2013), antioxidant (Lee et al., 2012), and immunomodulatory activities, etc. Recently, saponins isolated from the ginseng stems and leaves (GSLS) have been found to be an immune-stimulating agent in chickens. Zhai et al. (2011 a; b; 2014) reported that administration of GSLS in drinking water in chickens significantly enhanced the immune responses to vaccination against Newcastle disease, avian influenza, and infectious bursal disease. Wei et al. (2012 a; b) found that ginsenosides Rg^3 (a fraction of saponins from Gn) is active in both immune-stimulating and antioxidant effects. Studies from animal experiments have shown that the ginseng reduced blood pressure, (Kang et al., 1995), had a relaxing effect on vascular smooth muscle and anti-inflammatory properties as well as anti-stress effect (Peng et al., 1995).

Considering the above benefits, we hypothesize that ginseng and ginsenosides may exert the positive effects on chick's performance. Therefore, the objective of this study was to investigate the effect of graded levels of dietary ginseng and ginsenosides supplementation on productive, physiological, immunological parameters and meat quality of Gimmizah cockerels.

MATERIALS AND METHODS

A total number of 140 cockerels of Gimmizah local strain were individually weighted and randomly divided into 7 equal treatment groups with 5 replicates (4 chicks per each cage) from 4 -16 wks of age. All cockerels were kept under similar management conditions in rearing pens. Feed and water were provided ad libitum throughout the experimental period (12 weeks). Diets were kept isocaloric and cover nutrient requirements according to Feed Composition Table for Animal and Poultry Feedstuffs in Egypt (2001), as shown in Table (1).The cockerels were treated as follow:

1. Basal diet without any supplementation (control).
2. Basal diet + 100 mg ginseng /kg diet (Gn100).
3. Basal diet + 200 mg ginseng /kg diet (Gn200).
4. Basal diet + 300 mg ginseng /kg diet (Gn300).
5. Basal diet + 100 mg ginsenosides /kg diet (GnD100).
6. Basal diet + 200 mg ginsenosides /kg diet (GnD200).
7. Basal diet + 300 mg ginsenosides /kg diet (GnD300).

Measurements

All cocks were individually biweekly weighed (g). Feed intake (FI) during these periods was also recorded. Body weight gain (BWG) was calculated and used to determine feed conversion ratio (FCR, g feed/g gain).

Hematological and biochemical parameters

At the end of the experiment, in the morning (at 09.00 to 10.00 O'clock) two blood samples (3 ml, each) were collected from the brachial vein, (one into heparinized tube for separate plasma and the other one into unheparinized tube for separate serum) of five birds / treatment. Plasma and serum were separated by centrifugation of the blood at 3000 rpm for 20 minutes and stored at -20°C for later analysis. Biochemical indicators such as glucose, total protein, albumin, globulin, triglyceride, cholesterol, high density lipoprotein (HDL), low density lipoprotein, (LDL), aspartate amino transferase (AST), and alanine amino transferase (ALT), were determined by using available commercial kites. Immune indices such as Interleukin-6 (IL-6) and tumor necrosis factor alpha (TNF-α), Mu immunoglobulin (IgM), and Gamma immunoglobulin (IgG), concentrations were analyzed using ELISA kits (Becton, Dickinson and Company, Franklin Lakes, NJ) following the manufacturer’s instructions. Serum total antioxidant capacity (TAC), superoxide dismutase (SOD) and Malondialdehyde (MDA) were colorimetrically determined using commercial Kits. The phagocytic and Lysozyme activity were measured as suggested by Leijh *et al*. (1986) and Engstad *et al*. (1992). The fresh blood samples were used to determine the hematological parameters such as red blood cell (RBC) and White blood cells (WBC´s) were counted according to method described by Hawkeye and Dennett (1989).

Carcass traits

At the end of the experiment ten cocks from each treatment were selected randomly and slaughtered for carcass evaluation. Carcass was eviscerated and head and shank were removed, liver, gizzard, heart, pancreas, testes and spleen were dissected from the viscera and weighed. Each portion was expressed as a relative weight of live BW.

Meat quality and Microbiological study

At 16 weeks of age five cocks per each treatment were taken randomly and slaughtered for microbiological study and meat quality. Intestinal aerobic and anaerobic microflora counts were determined. Aerobic plate count (APC), total coliform count and total anaerobic count were carried out according to American Public Health Association (A.P.H.A, 1985). Serial tenfold dilution was done on standard plate count agar, Bacto MacConkeys's broth (Difco) and anaerobic agar medium respectively. A portable pH meter was used to measure pH in fresh breast and thigh meats, 4 wks postmortem and 6 wks postmortem. The determination method was described by Schilling et al. (2008). Water-holding capacity (WHC) was estimated by determining expressible juice using a modification of the filter paper press method described by Wierbicki and Deatherage (1958). Samples were cut to the size 1.0 x 2.0 x 0.5 cm for shear analysis the texture analyzer equipped with a Warner-Bratzler shear apparatus (Dawson et al., 1991). After slaughter, optical density (OD) of meat color was measured according to the method described by Musa et al. (2006).

Statistical analysis

Data were statistically analyzed according to SAS program (SAS, 1996) using GLM Procedure. Mean differences were tested by Duncan's New Multiple range (Duncan, 1955).

RESULTS

1-Productive parameters:

Body weight and body weight gain:

Supplementation basal diet with different levels of Gn and GnD had insignificant effect on body weight (BW) recorded at 4 and 12 wk of age (Table 2). While, cocks fed basal diet supplemented with different levels of GnD or 300 mg Gn /kg diet, BW was significantly increased compared with the other treatment groups, at 8 wk of age. During the whole experimental period supplied diets with different levels of Gn and GnD recorded the significant higher BW compared with control. Generally, supplementation of Gn and GnD with different levels significantly increased BWG during 4-8, 8-12 and 4-16 wks of age compared with the control group. While, during 12-16 wks of age BWG for cocks fed basal diet supplemented with 200 mg or 300 mg Gn /kg diet, was significantly increased compared with the other treatment groups.

Feed intake and feed conversion ratio:

Supplementation basal diet with different levels of Gn and GnD had insignificant effect on feed intake (FI) recorded during different periods of the experiment,Table (2). Results of feed conversion ratio (FCR) were significantly affected during all experimental periods, Table (2). During the first period (4 – 8 wks of age) the best FCR (3.88) was recorded for the group supplied with 200 mg GnD / kg diet. During 8-12wks of age supplied basal diet with 100 mg of Gn /kg diet recorded the best FCR (2.95) compared with the other experimental groups and statistically equal with the FCR recorded for the groups supplied with 100 and 200 GnD /kg diet. However, during the 12-16 wks of age, supplementation of 300 mg

Gn /kg diet recorded the significant best FCR (5.46) compared with the other experimental groups. On the other hand, during the whole experimental period supplementation of 300 and 200 mg Gn or GnD /kg diet recorded the significant best FCR (4.37 and 4.30, respectively) compared with the control and the other treatment groups.

Hematological and biochemical parameters:

Supplementation basal diet with different levels of Gn or GnD had insignificant effect on leukocytes and its differentiation, Table (3). Hematological values for cocks supplemented with different levels of Gn or GnD showed that there were no significant effect of treatments on RBC counts, Hb, Ht and mean corpuscular hemoglobin (MCH). Supplementation of 300 mg Gn/ kg diet recorded the highest values of MCV compared with the other treatment groups, Table (3). Supplementation basal diet with different levels of Gn or GnD significantly improved the Lysozyme and Bactericidal activity and the IgM concentration compared with the control group, Table (4). The groups fed basal diet supplemented with 200 or 300 mg GnD /kg diet significantly increased IgG compared with the rest groups. On the other hand, the groups fed basal diet supplemented with different level of GnD and 200 or 300 mg Gn /kg diet significantly improved IL-6 and TNFα compared with the control group. Supplementation basal diet with different levels of Gn or GnD significantly improved MDA, TAC and SOD compared with the control group except SOD for the group fed basal diet supplemented with 100 mg Gn /kg diet which did not significantly differed compared control group. Concentrations of plasma total protein and globulin for the cocks fed basal diet supplied with 100 or 200 mg Gn or GnD /kg diet significantly increased compared with the rest groups, Table (5). Total albumin and glucose concentrations and activity of AST enzyme did not significantly differed among different treatments. However, activity of ALT enzyme was significantly improved due to supplementation of different levels of Gn or GnD compared with the control group. Cholesterol and LDL concentrations were significantly improved due to supplementation diets with different levels of Gn or GnD compared with control group. On the other hand, the HDL concentration was not significantly affected among different treatments groups. However, the groups supplied with 300 mg of GnD and different levels of Gn significantly decreased triglyceride concentration compared with those supplied with 100 or 200 g GnD and the control groups. Moreover, the group supplied with 300 mg Gn /kg diet recorded the significantly lowest level of triglyceride compared with the other experimental groups.

Carcass characteristics:

Results of Table (6) demonstrated that the relative weights of dressing, liver, gizzard, spleen, testes, pancreas and intestine for cocks fed basal diet supplemented with different level of Gn or Gnd did not significantly differ from control group except dressing relative weight for cocks fed basal diet supplemented with 100 mg of GnD /kg diet which significantly increased compared with the control group.

Microbiological study and meat quality:

The effect of different levels of Gn and GnD supplementation on the intestinal microbial counts is shown in Table (7). The intestinal total aerobic, total coliform and anaerobic counts had been decreased due to supplementation of basal diet with Gn and GnD at different levels as compared to control. The greatest reduction of total aerobic and coliform bacteria counts were observed for the cocks fed basal diet supplemented with 300 mg Gn /kg diet. Also, total anaerobic count almost undetected for the groups fed basal diet supplied with 200 or 300 mg GnD or 300 mg Gn/kg diet.

Results on Table 8 illustrated the psychrophilic and coliform bacteria counts in fresh breast and thigh meats stored for 4 and 6 wks after slaughtered. The psychrophilic and coliform bacteria counts, in fresh breast and thigh meats, had been significantly decreased for the groups fed basal diet supplied with 300 mg Gn or GnD /kg diet compared with the control and other treatment groups, at slaughter time (fresh meat) and during each period of storage (4 and 6wk). However, the psychrophilic and coliform bacterial counts significantly affected by the storage time, since the psychrophilic and coliform bacteria counts were increased with the increasing storage time. Supplementation of Gn or GnD with different levels or the storage time had not significant effects in the pH values of breast and thigh meat of cocks compared with control, Table (9).

Result in Table (9) illustrated the water holding capacity (WHC), shearing force and the optical density (OD) of fresh cock's meat. There were no significant differences on WHC and shear force in the same muscles of the cocks Table (9). The OD values of muscles for the groups supplied with 300 mg Gn or GnD /kg diet were greater than values which measuring in the control group.

DISCUSSIONS

Alternative feeding strategies have been incorporated into poultry diets to improve gut health of the birds and enhance productive performance (Olobatoke and Mulugeta, 2011). Results obtained in this study demonstrated that supplementation of 100, 200 and 300 mg/kg diet of Gn or GnD improved the BW by 8.32, 13.51, 12.94, 10.31, 12.8 and 8.75%, respectively and BWG by 4.97, 5.37, 9.78, 6.97, 9.86 and 5.77%, respectively compared with the control group. Moreover, the final FCR was significantly improve for the groups supplied with 300 mg Gn/kg diet and 200 mg GnD/kg by 13.64 and 15.02%, respectively compared with the control group (Table, 2). Moreover, this improvement may be due to Gn and GnD, possess antimicrobial activities and antioxidant properties that make them useful as natural animal feed additives (Faixova and Faix, 2008). Also, herbs and plant extracts present a mechanism of action based on the increasing enzyme secretion and improving morph-histological maintenance of the gastrointestinal tract and antioxidant activity (Fascina et al., 2012). These results are in agreement with Chung and Choi (2016) who shown that the inclusion of different types of red ginseng in poultry diets may be an effective strategy to improve broiler growth performance. On the other hand, Ao et al. (2011) suggested that diet containing fermented red ginseng extract (1, 2 and 4 g kg^{-1}) or red ginseng marc (3%) as feed additive had no positive effect on the performance of broilers.

In the current study, the groups supplied with 300 mg of GnD or different levels of Gn significantly improved triglyceride concentration compared with control and other experimental groups. Also, plasma total cholesterol concentration significantly decreased due to supplied basal diet with Gn at different levels compared with the other experimental groups, while the supplementation of different levels of Gn or GnD significantly reduced LDL values compared with control group Table (5). These results are in agreement with Kim et al. (2014) who reported that increasing red ginseng level to 3% reduced the total cholesterol, LDL and triglyceride levels, and increased the HDL levels compared with those found in the other treatments. This is presumably because of the ability of saponins to form insoluble complexes with cholesterol in the digesta, which in turn inhibits intestinal cholesterol absorption and endogenous cholesterol synthesis (Rao and Gurfinkel, 2000).

The addition of antioxidants rich formulations in various fresh and cooked meat products have potential to reduce oxidation problems by hindering the formation of free radicals. These additions beyond providing the protection against oxidative damage to meat products, also improve the safety and overall quality of processed meat products. Several studies have demonstrated that their in vitro effect against pathogens because of antimicrobial and antifungal activities, in addition to powerful antioxidant effects (Petrolli et al., 2012). Supplementation of Gn and GnD causing hug reduction in intestinal total aerobic plate, total coliform and total anaerobic bacteria counts compared with that measuring in the intestinal of the control group. However, supplied basal diet with 300 mg of Gn reduced the total aerobic plate from $27x10^8$ to $5x10^1$ and the total coliform count from $26x10^7$ to $10x10^1$. Also, addition of 200 and 300 mg of GnD and 300 mg of Gn almost prevent the contamination of total anaerobic bacteria counts (-ve), Table (7). The storage time (from 0 to 6 wks) significantly increased the counts of psychrophilic and coliform bacteria measuring in breast and thigh meat (Table, 8). However, supplied basal diet with 300 mg of Gn or GnD had a powerful to reduce significantly both of psychrophilic bacteria and coliform bacteria in the breast and thigh meat with the time of storage. These results compatible with the fact that Gn and its extract GnD had a mechanism of action based on the alteration of the intestinal microbiota, improve the gastrointestinal tract and antioxidant activity (Fascina et al., 2012). Palazon et al. (2003) demonstrated that saponins (ginsenosides) are considered to be the principal bioactive ingredients and are believed to exert immune-stimulatory, anti-fatigue and hepatoprotective physiological effects (Wu and Zhong, 1999).

In general, WHC and shear force values are used as the most important meat quality parameters because meat products vary in firmness and texture (Kim et al., 2009). Our study results were similar to the findings of Kim et al. (2002) in that the addition of Gn or GnD with different levels to cocks diet did not influence WHC and shear force values. These results are expected because the relationship between WHC and muscle pH is well established (Judge et al., 1989). Results reported herein are in agreement with Kim et al. (2014) who reported that increasing levels of red ginseng and a combination of red ginseng marc and α-tocopherol affected chicken thigh meat quality by decreasing the pH which is inconsistent with the results of prior studies (Ao et al 2010).

Currently, meat processing industries are looking for natural antioxidant based formulations to enhance storability and volatile flavor compounds in cooked meat products. There are desire to develop formulations to be directly incorporated in meat products to retard lipid and protein oxidation as well as off flavor volatile compounds production. Also, color is an important quality attribute that influences consumer acceptance of many food products, including poultry meat. Consumers will often reject products in which the color varies from the expected normal appearance. Birren (1963) pointed out that color is everywhere and that psychological responses to color, as they relate to appetite, are considered important to processors and consumers. However, supplied basal diet with 300 mg of GnD and the different levels of Gn significantly improved the optical density (OD) of cocks meat as compared to the OD recorded for the control group (Table, 9). Moreover, addition of antioxidants also improved color characteristics and overall quality attributes of chicks meat products (Delles et al., 2014). It is also an essential micronutrient for maintaining the health and wellbeing of living organism due to antioxidant properties. Also, Kim et al. (2014) demonstrated that supplied poultry diets with 3% red ginseng marc remarkably improved meat quality in broilers.

Interleukins are composed of cytokines, which are important components of the immune system. They exhibit important functions in inflammation and systemic inflammatory status, and pathological disorders occur when there is imbalance in terms of cytokine production or dysregulation in a cytokine process (Tayal and Kalra 2007). The cytokines, including TNF-α and IL-6 (known as pro-inflammatory cytokines) has the most endocrine activity such as involving in the functioning of metabolism (Gabler and Spurlock, 2008) and is generated by different cell types such as antigen presenting cells and B cells. Despite its pro-inflammatory role (Xing et al. 1998), IL-6 is a pleiotropic cytokine that expresses anti-inflammatory effects (Scheller et al. 2011). The results of our study indicated that high dosage of Gn or GnD might improvement immunological status of cocks and increase their susceptibility to resistance disease during growth period.

In conclusion, supplementation cocks diet with 300 mg ginseng /kg diet improved the productive performance, immune response and meat quality of Gimmizah cockerels during the growing period. Further studies are needed to investigate the effect of supplementation ginseng and its extract (ginsenosides) on the performance of poultry production.

Table (1): Composition and calculated analysis of the basal experimental diets

Ingredients (%)	Starter (0-8 wks)	Grower (8-16wks)
Yellow corn	64.00	63.00
Soybean meal (44% CP)	32.10	17.60
Wheat bran	------	15.68
Dicalcium phosphate	1.80	1.25
Limestone	1.40	1.80
DL-Methionine	0.10	0.07
NaCl	0.30	0.30
Vit. and mineral (premix)*	0.30	0.30
Total	100	100
Calculated analysis**		
Crude protein (%)	19.56	15.56
ME (Kcal/kg diet)	2860	2707
C/P ratio	146.2	174
Crude fat (%)	2.69	3.01
Crude fiber (%)	3.65	4.34
Calcium (%)	1.03	0.97
Phosphorus available (%)	0.47	0.39
Methionine (%)	0.41	0.33
Methionine + Cysteine (%)	0.74	0.54
Lysine (%)	1.03	0.73
Arginine (%)	1.25	0.95

*Three kg of vitamin- mineral premix per ton of feed supplied each kg of diet with Vit. A 12000 IU; Vit. D_3 2000 IU; Vit. E. 10mg; Vit. K3 2mg; Vit.B_1 1mg; Vit. B_2 4mg; Vit. B_6 1.5 mg; Pantothenic acid 10mg; Vit.B_{12} 0.01mg; Folic acid 1mg; Niacin 20mg; Biotin 0.05mg; Choline chloride (50% choline) 500 mg; Zn 55mg; Fe 30mg; I 1mg; Se 0.1mg; Mn 55mg; ethoxyquin 3000 mg.

**Calculated values were according to NRC (1994) text book values for feedstuffs.

Table (2): Effect of different dietary levels of ginseng and ginsenosides on live body weight (g), body weight gain (g), feed intake (FI, g/bird/4wks), feed conversion ratio (FCR, g feed/g weight gain) of Gimmizah cocks at different ages

Treatment	Body weight (g)				Body weight gain (g)			
	4wk	8wk	12wk	16wk	4-8 wk	8-12 wk	12-16wk	4-16 wk
Control	207.90	485.00^{b}	931.80	1406.60^{b}	276.90^{c}	446.80^{c}	474.50^{bc}	1248.70^{b}
Gn100	207.95	493.10^{b}	1005.60	1523.90^{a}	284.80^{b}	512.50^{b}	468.70^{c}	1310.95^{a}
Gn200	208.80	483.10^{b}	1026.20	1596.60^{a}	285.60^{b}	543.10^{a}	540.20^{a}	1315.80^{a}
Gn300	209.05	517.40^{a}	1035.30	1588.25^{a}	308.40^{ab}	518.90^{b}	532.80^{a}	1370.20^{a}
GnD100	207.90	533.70^{a}	1073.60	1551.30^{a}	325.90^{a}	539.90^{ab}	477.3^{bc}	1335.40^{a}
GnD200	208.10	536.10^{a}	1077.30	1586.25^{a}	327.80^{a}	541.20^{ab}	509.60^{b}	1370.15^{a}
GnD300	208.45	514.50^{a}	1051.80	1529.00^{a}	306.00^{ab}	537.30^{ab}	477.70^{bc}	1320.55^{a}
SEM	3.372	18.450	16.503	36.781	17.282	19.066	23.458	35.595

Treatment	FI				FCR			
	4-8 wk	8-12 wk	12-16wk	4-16 wk	4-8 wk	8-12 wk	12-16wk	4-16 wk
Control	47.30	58.70	110.45	72.20	4.79^{b}	3.68^{a}	6.51^{a}	5.06^{a}
Gn100	48.50	59.20	103.80	70.50	4.76^{b}	2.95^{c}	6.21^{a}	4.50^{b}
Gn200	49.65	65.30	107.70	74.20	5.87^{a}	3.28^{b}	5.58^{b}	4.49^{b}
Gn300	49.50	62.35	103.85	71.85	4.49^{b}	3.25^{b}	5.46^{c}	4.37^{c}
GnD100	48.10	59.35	105.30	70.90	4.13^{bc}	3.09^{bc}	6.17^{a}	4.43^{b}
GnD200	45.50	59.80	106.60	70.60	3.88^{c}	3.09^{bc}	5.86^{b}	4.30^{c}
GnD300	48.85	63.75	107.45	73.35	4.47^{b}	3.32^{b}	6.30^{a}	4.67^{b}
SEM	0.868	1.396	1.385	1.385	0.187	0.095	0.157	0.077

^{a,b,c} Means within each column have no similar letter(s) are significantly different ($P \leq 0.05$).
SEM: Standard error for means
Control: fed basal diet without any supplementation, Gn100: basal diet+ 100 mg ginseng /kg diet, Gn 200: basal diet + 200 mg ginseng /kg diet, Gn 300: basal diet + 300 mg ginseng /kg diet, GnD 100: basal diet + 100 mg ginsenosides /kg diet, GnD 200: basal diet+200 mg ginsenosides /kg diet, GnD 300: basal diet + 300 mg ginsenosides /kg diet.

Table (3): Effect of different dietary levels of ginseng and ginsenosides on blood hematology parameters of Gimmizah cocks

Treatment	WBCs $x10^3$ /mm^3	Heter %	Lym %	H/L ratio	Mono %	Eosi %	RBC $x10^6$/ mm^3	Hb g/dl	Ht %	MCV μm^3 /RBC
Control	17.42	36.25	54.25	66.82	5.75	3.75	2.89	13.58	39.13	136^{b}
Gn100	17.23	35.50	56.00	80.69	5.25	3.25	2.77	13.48	38.30	138^{ab}
Gn200	17.83	36.00	55.00	71.63	6.00	3.00	3.03	14.18	42.73	141^{ab}
Gn300	17.29	38.25	54.25	74.76	4.50	3.00	3.05	14.78	44.23	145^{a}
GnD100	18.27	40.75	50.50	63.39	5.25	3.50	3.09	14.88	43.35	141^{ab}
GnD200	17.64	38.50	53.75	65.64	4.75	3.00	3.07	14.25	42.23	137^{ab}
GnD300	17.81	39.25	52.50	84.53	4.75	3.50	2.82	13.33	39.28	139^{ab}
SEM	3.76	2.40	2.15	2.31	0.44	0.37	0.10	0.52	1.57	2.26

[a, b….]Means within each column have no similar letter(s) are significantly different ($P \leq 0.05$).
SEM: Standard error for means.
WBCs: Total white blood cell(10^3 / mm^3), Heter: Heterophil, Lym: Lymphocyte, H/L ratio: Heterophil: Lymphocyte ratio, Mono: Monocyte, Eosi: Eosinophil, RBC: red blood cell (10^6 / mm^3), Hb: hemoglobin concentration (g/dl), Ht: haematocrit %, MCV: Mean Corpuscular Volume (μm^3), Control: fed basal diet without any supplementation, Gn100: basal diet + 100 mg ginseng /kg diet, Gn 200: basal diet + 200 mg ginseng /kg diet, Gn 300: basal diet + 300 mg ginseng /kg diet, GnD 100: basal diet + 100 mg ginsenosides /kg diet, GnD 200: basal diet+200 mg ginsenosides /kg diet. GnD 300: basal diet + 300 mg ginsenosides /kg diet.

Table (4): Effect different dietary levels of ginseng and ginsenosides on some immune indices and antioxidant parameters of Gimmizah cocks

Treatments	Lysozyme activity µg/ml	Bactericidal activity %	IgM mg /100ml	IgG mg /100mL	IL-6 pg/ml	TNFα pg/ml	MDA Mmol/dL	TAC nmol/L	SOD U/dl
Control	0.41^{c}	15.92^{c}	166^{b}	893^{b}	22.79^{a}	55.41^{a}	1.80^{a}	7.61^{c}	123^{c}
Gn100	0.49^{b}	20.22^{b}	171^{a}	892^{b}	19.31^{b}	45.11^{ab}	1.63^{b}	12.91^{b}	135^{c}
Gn200	0.52^{b}	27.91^{b}	170^{a}	880^{b}	10.12^{d}	35.45^{c}	1.30^{c}	12.13^{b}	158^{b}
Gn300	0.51^{b}	33.63^{ab}	177^{a}	891^{b}	15.13^{c}	44.11^{b}	1.22^{cd}	12.31^{b}	160^{b}
GnD100	0.49^{b}	23.61^{b}	183^{a}	894^{b}	11.10^{c}	30.25^{bc}	1.25^{c}	15.14^{a}	173^{a}
GnD200	0.63^{a}	36.86^{a}	176^{a}	931^{a}	7.98^{de}	22.15^{d}	1.23^{c}	13.11^{ab}	170^{a}
GnD300	0.62^{a}	40.81^{a}	180^{a}	910^{a}	6.12^{e}	16.22^{d}	1.10^{d}	15.11^{a}	176^{a}
SEM	0.02	7.3	40.0	150.1	2.11	6.01	0.10	0.51	5.91

$^{a, b,c,d,e}$ Means within each column have no similar letter(s) are significantly different ($P \leq 0.05$).
SEM: Standard error for means.
IgM: Mu immunoglobulin, IgG: Gamma immunoglobulin, IL-6: Interleukin-6, TNF-α : tumor necrosis factor alpha, MDA: Malondialdehyde, TAC: Total antioxidant capacity, SOD: Super oxide dismutase, Control: fed basal diet without any supplementation, Gn100: basal diet+ 100 mg ginseng /kg diet, Gn 200: basal diet + 200 mg ginseng /kg diet, Gn 300: basal diet + 300 mg ginseng /kg diet, GnD 100: basal diet + 100 mg ginsenosides/kg diet, GnD 200: basal diet+200 mg ginsenosides /kg diet, GnD 300: basal diet + 300 mg ginsenosides /kg diet.

Table (5): Effect of different dietary levels of ginseng and ginsenosides on some biochemical parameters of Gimmizah cocks

Treatment	T.Prot g/dl	Albu g/dl	Glob g/dl	Glu mg/dl	AST U/L	ALT U/L	Trig Mol/L	Chol mg/dl	HDL mg/dl	LDL mg/dl
Control	6.1[b]	3.1	3.0[b]	210.1	33.0	19.0[a]	3.21[a]	100.4[a]	70.2	20.9[a]
Gn100	7.4[a]	3.4	4.0 [a]	210.0	37.0	15.2[b]	2.83[c]	81.0[c]	72.3	16.1[c]
Gn200	7.5[a]	3.3	4.1[a]	212.1	36.1	12.2[c]	2.76[cd]	80.2[c]	72.0	14.5[d]
Gn300	5.3[c]	3.4	2.9[b]	220.0	32.1	12.8[c]	2.50[e]	82.1[c]	72.2	14.3[d]
GnD100	7.2[a]	3.1	4.1[a]	215.1	38.2	14.3[c]	3.11[a]	88.0[b]	70.0	18.7[b]
GnD200	7.3[a]	3.2	4.1[a]	210.3	37.4	15.7[b]	3.01[a]	89.0[b]	71.2	18.2[b]
GnD300	6.3[b]	3.3	3.0[b]	215.1	37.3	14.0[c]	2.90[b]	87.1[b]	72.7	16.4[c]
SEM	0.51	0.30	0.62	16.39	0.53	0.94	0.10	2.19	0.31	0.10

[a, b,c,d] Means within each column have no similar letter(s) are significantly different ($P \leq 0.05$).
SEM: Standard error for means.
T.Prot: Total Protein, Albu: Albumin, Glob: Globulin, Glu: Glucose, AST: Aspratate amino transferase, ALT: Alanine amino transferase. Trig: Triglyceride, Chol: Cholesterol, HDL: high density lipoprotein, LDL: low density lipoprotein, Control: fed basal diet without any supplementation, Gn100: basal diet+ 100 mg ginseng /kg diet, Gn 200: basal diet + 200 mg ginseng /kg diet, Gn 300: basal diet + 300 mg ginseng /kg diet, GnD 100: basal diet + 100 mg ginsenosides/kg diet, GnD 200: basal diet+200 mg ginsenosides /kg diet, GnD 300: basal diet + 300 mg ginsenosides /kg diet.

Table (6): Effect of different dietary levels of ginseng and ginsenosides on carcass characteristics of Gimmizah cocks

Treatments	Dressing g/100g BW	Liver g/100g BW	Gizzard g/100g BW	Spleen g/100g BW	Intestine Weight g/100g BW	Intestine Length Cm/100g BW	Pancreas g/100g BW	Testes g/100g BW
Control	67.96[b]	2.08	2.23	0.21	3.74	9.35	0.21	1.25
Gn100	68.37[b]	2.08	2.12	0.25	3.95	8.53	0.29	1.25
Gn200	68.01[b]	2.08	2.21	0.25	3.91	8.91	0.22	1.07
Gn300	69.28 [ab]	2.05	2.17	0.25	3.69	8.67	0.22	1.42
GnD100	70.12[a]	2.06	2.03	0.25	3.39	8.77	0.30	1.18
GnD200	69.44[ab]	2.06	1.99	0.28	3.52	8.84	0.31	1.31
GnD300	68.59[b]	2.04	2.23	0.29	3.41	8.56	0.23	1.31
SEM	0.44	0.12	0.10	0.03	0.16	0.41	0.04	0.20

[a, b] Means within each column have no similar letter(s) are significantly different ($P \leq 0.05$).
SEM: Standard error for means.
Control: fed basal diet without any supplementation, Gn100: basal diet+ 100 mg ginseng /kg diet, Gn 200: basal diet + 200 mg ginseng /kg diet, Gn 300: basal diet + 300 mg ginseng /kg diet, GnD 100: basal diet + 100 mg ginsenosides/kg diet, GnD 200: basal diet+200 mg ginsenosides /kg diet, GnD 300: basal diet + 300 mg ginsenosides /kg diet.

Table (7): Effect of different dietary levels of ginseng and ginsenosides on intestinal aerobic plate, total coliform and total anaerobic bacteria counts of Gimmizah cocks

Type of bacteria / Treatments	Aerobic plate count	Total coliform Count	Total anaerobic Count
Control	$27x10^8$	$56x10^7$	$17x10^3$
Gn100	$19x10^1$	$15x10^2$	$4x10^1$
Gn200	$8x10^2$	$12x10^2$	$3x10^1$
Gn300	$5x10^1$	$10x10^1$	-ve
GnD100	$20x10^3$	$28x10^4$	$5x10^1$
GnD200	$16x10^4$	$21x10^4$	-ve
GnD300	$10x10^2$	$14x10^3$	-ve

[a, b] Means within each column have no similar letter(s) are significantly different ($P \leq 0.05$).
SEM: Standard error for means.
Control: fed basal diet without any supplementation, Gn100: basal diet+ 100 mg ginseng /kg diet, Gn 200: basal diet + 200 mg ginseng /kg diet, Gn 300: basal diet + 300 mg ginseng /kg diet, GnD 100: basal diet + 100 mg ginsenosides/kg diet, GnD 200: basal diet+200 mg ginsenosides /kg diet, GnD 300: basal diet + 300 mg ginsenosides /kg diet.

Table (8): Effect of different dietary levels of ginseng and ginsenosides on psychrophilic bacteria and Coliform bacteria (10^2) in breast and thigh meat of Gimmizah cocks stored for different period

Storage time / Treatments	Brest meat psychrophilic				Brest meat coliform			
	Fresh	4 wk	6 wk	SEM	Fresh	4 wk	6 wk	SEM
Control	4.66^{a}C	4.91^{a}B	5.20^{a}A	0.032	4.59^{a}C	4.80^{a}B	5.20^{a}A	0.025
Gn100	4.39^{a}C	4.55^{a}B	5.22^{a}A	0.031	4.52^{a}C	4.62^{a}B	5.22^{a}A	0.027
Gn200	4.34^{a}C	4.43^{a}B	5.15^{a}A	0.026	4.46^{a}C	4.53^{a}B	5.03^{a}A	0.041
Gn300	3.50^{b}C	3.66^{b}B	4.85^{b}A	0.024	3.74^{b}C	3.90^{b}B	4.41^{b}A	0.034
GnD100	4.35^{a}C	4.51^{a}B	5.18^{a}A	0.022	4.55^{a}C	4.62^{a}B	5.08^{a}A	0.031
GnD200	4.40^{a}C	4.53^{a}B	5.13^{a}A	0.025	4.53^{a}C	4.60^{a}B	5.03^{a}A	0.025
GnD300	3.46^{b}C	3.60^{b}B	4.83^{b}A	0.025	3.10^{b}C	3.16^{b}B	4.39^{b}A	0.032
SEM	0.021	0.03	0.036		0.03	0.04	0.04	
Treatments	Thigh meat psychrophilic				Thigh meat coliform			
Control	4.00^{a}C	4.75^{a}B	5.85^{a}A	0.025	4.53^{a}C	4.80^{a}B	5.73^{a}A	0.031
Gn100	4.16^{a}C	4.46^{a}B	5.63^{a}A	0.027	4.26^{a}C	4.33^{a}B	5.41^{a}A	0.033
Gn200	3.54^{b}C	3.83^{b}B	4.93^{a}A	0.043	4.10^{a}C	4.52^{a}B	5.41^{a}A	0.036
Gn300	3.00^{b}C	3.10^{b}B	4.20^{b}A	0.034	3.00^{b}C	3.30^{b}B	4.24^{b}A	0.026
GnD100	4.01^{a}C	4.51^{a}B	5.70^{a}A	0.032	4.26^{a}C	4.43^{a}B	5.52^{a}A	0.032
GnD200	4.12^{a}C	4.53^{a}B	5.73^{a}A	0.025	4.31^{a}C	4.42^{a}B	5.61^{a}A	0.025
GnD300	3.16^{b}C	3.41^{b}B	4.74^{b}A	0.036	3.24^{b}C	3.63^{b}B	4.11^{b}A	0.035
SEM	0.03	0.05	0.04		0.03	0.04	0.03	

^{a,b} Means within each column have no similar letter(s) are significantly different ($P \leq 0.05$).
A, B and C Means within each raw have no similar letter(s) are significantly different ($P \leq 0.05$)
SEM = Standard error for means.
Control: fed basal diet without any supplementation, Gn100: basal diet+ 100 mg ginseng /kg diet, Gn 200: basal diet + 200 mg ginseng /kg diet, Gn 300: basal diet + 300 mg ginseng /kg diet, GnD 100: basal diet + 100 mg ginsenosides/kg diet, GnD 200: basal diet+200 mg ginsenosides /kg diet, GnD 300: basal diet + 300 mg ginsenosides /kg diet.

Table (9): Effect of different dietary levels of ginseng and ginsenosides on breast and thigh meats pH stored for different period and physical characteristics of cock's meat at the end of the experimental period

Storage time / Treatments	pH of breast meat			pH of thigh meat			physical characteristics of cock's meat		
	Fresh	4 wks	6 wks	Fresh	4 wks	6 wks	WHC (Pound water, %)	Shearing force (kg/40g meat)	Optical density
Control	5.91	6.61	6.77	6.91	6.92	7.14	81.25	215	0.045[c]
Gn100	6.73	6.64	6.97	6.29	7.11	7.36	82.40	240	0.057[b]
Gn200	6.89	6.79	6.91	6.41	7.21	7.32	82.75	241	0.061[ab]
Gn300	6.71	6.71	7.12	6.40	7.23	7.50	81.10	230	0.070[a]
GnD100	5.99	6.53	6.87	5.98	7.13	7.25	83.11	264	0.047[c]
GnD200	6.76	6.63	6.81	6.12	6.77	7.19	80.75	260	0.048[bc]
GnD300	6.14	6.73	6.88	6.72	7.13	7.25	80.13	253	0.073[a]
SEM	0.22	0.30	033	0.29	0.26	0.59	1.19	35.95	0.007

[a, b] Means within each column have no similar letter(s) are significantly different ($P \leq 0.05$).
SEM: Standard error for means.
Control: fed basal diet without any supplementation, Gn100: basal diet+ 100 mg ginseng /kg diet, Gn 200: basal diet + 200 mg ginseng /kg diet, Gn 300: basal diet + 300 mg ginseng /kg diet, GnD 100: basal diet + 100 mg ginsenosides/kg diet, GnD 200: basal diet+200 mg ginsenosides /kg diet, GnD 300: basal diet + 300 mg ginsenosides /kg diet.

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الملخص العربى

تاثير اضافة الجنسنج والجنسينوسيد بالعلائق على الصفات الانتاجية والفسيولوجية والمناعية وجودة اللحم فى ذكور دجاج الجميزة

1- خـــلال مــرحــلة الـنمــو

محمد السيد عيد فراج ، منى محمود أحمد ، بهاء محمد السيد ابوشحيمة ، على عبد الهادى
محطة بحوث الدواجن بالصبحية "الاسكندرية"- معهد بحوث الانتاج الحيوانى – مركز البحوث الزراعية

أجريت هذة التجربة لدراسة تاثير اضافة الجنسنج والجنسينوسيد فى العلائق على الصفات الانتاجية والفسيولوجية والمناعية وجودة اللحم فى ديوك الجميزة خلال مرحلة النمو. استخدم فى هذة الدراسة عدد 140 ديك عمر 4 أسابيع من سلالة الجميزة. حيث تم وزن الطيور فرديا وقسمت عشوائيا الى سبع مجموعات كل مجموعة تتكون من خمس مكررات (عدد 4 ديوك / قفص) حتي نهاية التجربة عند 16 أسبوع. أستخدمت المجموعة الأولي كمجموعة مقارنه (كنترول) وتم تغذيتها علي العليقة الأساسية بدون إضافات؛ المجموعة الثانية والثالثة والرابعة فتم تغذيتها على العليقة الاساسية مضافا اليها الجنسنج بمعدل 100، 200، 300 مليجرام/ كجم علف على الترتيب، اما المجموعة الخامسة والسادسة والسابعة فتم تغذيتها على العليقة الاساسية مضافا اليها الجنسينوسيد بمعدل 100، 200، 300 مليجرام/ كجم علف على الترتيب. أوضحت النتائج ان اضافة الجنسينج والجنسينوسيد عند جميع المستويات يحقق تحسن معنوي فى كلا من وزن الجسم ومعدل الزيادة فى وزن الجسم وكذلك الكفاءه التحويلية للعلف مقارنة بمجموعة المقارنة وذلك خلال الفترة الكليه للتجربة. ادى اضافة الجنسينج والجنسينوسيدعند جميع المستويات الى تحسن معنوى فى الكلسترول الكلى والكلسترول منخفض الكثافة ونشاط انزيم الألنين ترانس فيريز ودليل اكسدة الدهون (المالونالدهيد) والكفاءة الكلية لمضادات الاكسدة مقارنة بالمجموعة المقارنة. ادى اضافة الجنسينج والجنسينوسيدعند جميع المستويات الى تحسن معنوى فى الاستجابة المناعية للديوك حيث لوحظ تحسن معنوي فى النشاط البلعمي والنشاط الليسوسومى وكذلك الجلوبيولينات المناعية من النوع ميو. اوضحت النتائج ان اضافة الجنسينج والجنسينوسيد عند جميع المستويات يودى الى خفض العدد البكتيرى للميكروبات الضارة بالقناة الهضمية للطيور. كذلك اوضحت ان استخدام المستوي الأعلى من الجنسنج والجنسينوسيد (300 مجم/كجم علف) يؤدى الى انخفاض معنوى فى العدد البكتيرى للبكتريا الضارة المقدرة فى لحوم الصدر والساق عند جميع فترات التخزين. كما ان استخدام المستوى الأعلى من الجنسنج والجنسينوسيد (300 مجم/كجم علف) يؤدى تحسن معنوى فى قيمة الكثافة الضوئية (تحسن لون الذبيحة) مقارنة بمجموعة الكنترول.
الخلاصة: اضافة الجنسنج بمعدل 300مجم / كجم علف يؤدى الى تحسن الآداء الانتاجي والاستجابة المناعية و جودة اللحم لذكور الجميزة خلال مرحلة النمو.