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GREEN TEA FLOWERS *(CAMELLIA SINENSIS)* AS NATURAL ANTI-OXIDANTS FEED ADDITIVES IN GROWING JAPANESE QUAIL DIETS

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Abstract: *An experiment was conducted to evaluate the effect of diets containing different levels of powdered green tea flowers (PGTF), as safe fed additives on growth performance, lipid metabolism and immuno response of the growing Japanese quail. Three hundred and twenty day old unsexed Japanese quail were used in this study .The chicks were distributed randomly and divided equally into four experimental group (80 birds) , each in four replicates (20 chicks each).Diets were formulated to meet the nutrient requirement's of growing Japanese quail according to NRC (1994).The tested diets contained PGTF at levels of 0.25 ,0.50 and 0.75%. Chicks were brooded in batteries from one day old to the end of experiment at similar conditions and received continuous lighting program through the whole experimental period which lasted for 6 weeks. The results showed that the addition of PGTF in diets of growing Japanese quail resulted in an improvement ($P<0.05$) in growth performance and antibodies titer production .Results of feeding trial cleared that raising the level of PGTF from 0.25 to 0.75 % tend to significantly ($P<0.05$) decrease blood lipids fractions and mortality rate. However, high density lipoprotein (HDL) increased. The results also demonstrated that the abdominal and liver fat decreased as the levels of PGTF increased. Moisture and ash percentages were not significantly ($P<0.05$) affected by increasing PGTF levels. While carcass protein was increased. The ether extract percentage showed the inverse trend.*

INTRODUCTION

It is well known that feed additives can be used safely in poultry ration to improve their performance. Additives added to diets in very small quantities with the objective of obtaining some special effect. Green tea is one of the most medicinal plants which have beneficial effect. Catechins is the main components of green tea that have many biological and biochemical effects such as anti-carcinogenesis and anti-oxidation. Moreover, green tea have a hypocholesterolemic effects (*Sayama et al., 2000). Lee et al. (1992)*

reported that body weight gain and feed efficiency were significantly ($P<0.05$) reduced in rats when fed on diets containing green tea as compared to control group. Also, adipose tissues weight and triglycerides concentration in liver and plasma were reduced. Furthermore,*Deng et al. (1998)*showed that blood triglycerides and sugar were significantly reduced in rats fed diets containing green tea compared to the control diets. *Lin et al. (1998)* indicated that serum total cholesterol, high density lipoprotein (HDL) and triglycerides were significantly ($P< 0.05$) decreased in rats when fed diets included 2.5 % green tea. Also, body weight was decreased by about 10 -18 % as compared to those of control group.

Results reported by *Raederstorff et al. (2003)* showed that catechins compounds derived from green tea reduced plasma cholesterol levels as well as cholesterol absorption was decreased to 73.3 % in group of rat fed 1% green tea .They also added that epigallocatechin found in green tea affect lipid metabolism by interfering with micellar solubilization of cholesterol in digestive tract, which in turn decreased cholesterol absorption. However, *Hasegawa et al. (2003*) observed that the oral treatment of 130 mg of powdered green tea per day of Zucker rats depressed body weight, while feed intake was unaffected. They indicated that group fed green tea showed a decrease in plasma protein,triglycerides and lower liver weight than control group .In recent studies reported by *Al-Harthi (2004)* indicated that lipid and cholesterol content of laying hen significantly decreased when diet contained green tea as feed additives.

The aim of this study was to investigate the effect of using different levels of green tea flowers (PGTF) on growth performance, immune response, blood lipids profile of growing Japanese quail. Also carcass characteristics and meat composition were taken into consideration.

MATERIALS AND METHODS:

The experimental work was carried out at the Poultry research station belonging to Department of Animal Production, Faculty of Agricultural, AL-Azhar University, Cairo, Egypt. A total number of 320 day old unsexed Japanese quail chicks were distributed randomly and equally divided to four experimental groups, each group contained four replicate of 20 chicks each. Birds were brooded in batteries temperature at 35 C^0 for the first tow weeks, then the temperature gradually decreased according to usual brooding practices. Basal diets were formulated according to *NRC (1994)* to be nearly isocaloric and isonitrogenous. Basal diets were supplemented with different levels of powdered green tea flowers (PGTF) at, 0.0 (control group), 0.25, 0.50 and 0.75

% levels respectively. Chemical analysis of diets and powdered green tea flowers were given in Table (1and 2).Diets and water were supplemented *ad libitum* along the experimental period. Light was provided 24 hours during the experiment.

Individual body weight was obtained at one day, three and six weeks of age to the nearest of one gram .Feed consumption ,feed conversion ratio (g feed/ g gain), protein intake, metabolizable energy intake ,protein efficiency ratio, efficincy of energy utilization (ME consumed Kcal /g gain)and mortality rate were recorded. Mortality rate were culled daily and was taken into consideration to adjust feed intake data on chicks day basis. The immunological studies were carried out at 14,28 and 42 days of age on 10 birds which were randomly selected from each group and wing marked. Birds were inoculated individually with one ml of 1.0 % suspension of red blood cells (SRB's) as an antigenic stimulants *(Gross, 1986)* .Blood samples were collected from inoculated birds at 14,28 and 42 days for measuring the material antibodies level by using Enzyme-Linked Immunosorbent Assay (ALISA).

At the end of experiment (6 weeks of age), 10 birds (5 females and 5 males) were randomly taken from each group to measure carcass characteristics. Birds were weighed and slaughtered by slitting the Jugular vein, then scalded and defeathered. Carcass organs were manually eviscerated and weighed. Thymus, spleen and Bursa of fabricius were also removed and weighed as a percentage of live weight as indication of immune responses. Also, blood samples were collected at four weeks of age and at the end of experimental period (6 th weeks of age).Then centrifuged at 3000 rpm for 15 minutes to obtained plasma and stored at -20 until analysis .

Total plasma protein, A/G ratio, total lipids,total glucose,total triglycerides, total cholesterol,and high density lipoprotein (HDL) were determined calorimetrically by using commercial kits purchased from El-Nasr Company (Cod No.T17 -819).Globulin values were calculated by difference, while Atherogenic index values (A.I) calculated as (total cholesterol -high density lipoprotein / high density lipoprotein) as listed by *Lee et al. (1992).*

Statistical analysis of the obtained data was performed using general model procedure and differences among means were tested using *Duncan's multiple range test (Duncan's1955) according to statistical analysis system (SAS, institute1996).*

RESULTS AND DISCUSSION

Results shown in Table(3) indicated that average of initial weight of chicks at the start of experiment ranged from 8.73 to 8.96 g, and differences in initial weight among the experimental group were insignificant indicating complete randomization of dividing the individual into experimental group at the start of the experiment. With the progress of age from 3 to 6 weeks body weight of growing Japanese quail was not significantly (P< 0.05) affected among experimental groups fed different levels of PGTF. While, body weight at the end of experiment (6 th weeks of age) significantly (P< 0.05) increased when the inclusion levels of PGTF was increased. The greatest increase in body weight was recorded for group fed diet supplemented with 0.75 % PGTF by about 13.82 % over that of the control group. Also, the groups fed other levels of PGTF were statistically (P< 0.05) heavier in body weight as compared with that of the control group by about 5.93 and 7.08 for groups fed 0.25 and 0.50 % PGTF, respectively (Table3). The improvement of weight for groups fed diets containing PGTF may be due attributed to flavonaids compounds of green tea which represents 26 to 30 % *(Lin et al., 1998)* of the leaves dry matter that influence the intestinal micro flora by either reducing microbial activity or by flavorably promoting eubiosis of the micro flora resulting in better nutrient utilization and absorption or stimulation of the immune system. These results are in agreement with the finding of *Sayama et al. (2000) who* found that body weight of mice was increased as feeding diet containing 2 and 4 % green tea. In contrast , *Lin et al. (1998)* reported that body weigh of mice was decreased by about 10-18 % when fed diet containing 2.5 % green tea when compared to control group. *Biswas et al. (2000)* indicated also that body weight of laying Japanese quail was decreased when fed diet containing powdered green tea as compared to control group.

Data presented in Table (3) showed that feed consumption significantly (P<0.05) decreased as inclusion PGTF levels were increased. These results are in accordance with those of *Sayama et al. (2000*) who found that feed intake was suppressed by feeding mice on diet containing 4 % PGTF.*Biswas et al. (2000)* indicated also that feed intake decreased as feeding of 6 % PGTF in diets of laying Japanese quail .In contrast, *Sano et al. (1996) and Lin et al. (1998*) found that feeding broiler chickens on diets containing 3% green tea leaves had no effect on dietary intake when compared to control group. Also, *Hasegawa et al. (2003*) reported that feed intake was not affected by the oral treatment of 130 mg powdered green tea per day of Zucker rat.

Data presented in Table (3) revealed that body weight gain of chicks was not significantly (P<0.05) affected during period (0-3) weeks of age.

While during the later period (3-6) weeks and whole period (0-6) weeks of age, body weight gain significantly (P<0.05) increased as inclusion levels of PGTF were increased. It can be noticed that the best body weight gain was observed in group fed 0.75% PGTF, although the fed consumption decreased with increases of PGTF. The increase of body gain may be due to the biological function of PGTF have some extracts such as phenolic acids,catechins and B-carotene which acts antimicrobial *(Yoshino et al., 1996)* and caused sterilization of gastrointestinal tract. So the feed utilization of ingredients were increased .These results are in accordance with those obtained by *Hara (1993) who* showed that putrefaction products as well as deadly bacteria (*Colstridium Botlimum, Staphylococcus,Aureus* and *Vibrio Colera)* were effectively inhibited by PGTF polyphenols.*Miura et al. (2001*) found that ingestion of green tea improved growth rate of mice. However, *El-Yamany and mostafa (2004)* showed that body weight gain of Japanese quail improved when birds fed diets containing green tea.

The effect of different levels of green tea on feed conversion ratio, protein intake and metablizable energy intake are presented in Table (3). Results indicated that presence of PGTF in the diet of Japanese quail caused a significant (P< 0.05) improve in feed conversion ratio at the three experimental period studied compared to the control group. This may be due to that chicks were very efficient in utilizing of feed nutrients to build up body. The data showed that feed conversion ratio was best when chicks fed PGTF at a level of 0.75 % than those of the other levels or control group. This improvement in feed conversion may be attributed to the biological role of flavonoids present in PGTF which, acts as antimicrobial, anti-fungal, antiseptic activities and anti-inflammatory*(Varilek et al. 2001).*Also, PGTF acting as antioxidants (*Yoshino et al. 1996*), it reduced mold growth and so can inhibit completely formation of aflatoxins and accordingly lead to higher utilization efficiency of nutrients in the feed*(Cao et al. 1996 and Lin et al. 1998)* .These results are in agreement with the finding of *Lee et al. (1992)* who observed that feed efficiency of rats was better when diet contained green tea as compared to control group.

As shown in Table (3) similar to the results of feed consumption protein and metabolizable energy intake were significantly (P < 0.05) decreased as the level of PGTF increased, this decrease resulted from the decrease in feed consumption. The inferior value was observed in the group fed high level of 0.75%.PGTF. However, the statistical analysis indicated a significant (P< 0.05) improvements in protein conversion ratio, while efficiency of energy utilization decreased when levels of PGTF were increased during different periods of the study. It is evident clear that the addition of PGTF in diets of growing Japanese quail converted protein into body weight gain more than the control group, however the body gain in group fed higher levels of PGTF (0.75%) was superior than the other two groups .This may be due to that PGTF have components which have Epigallocatechin gallate (EGGG) *(Fujiki and Suganuma, 2002)*, this active substrate make the birds to utilize the nutrients of the feed consumed with more efficiency.

Data of Table (3) show the effect of PGTF on mortality rate. These results indicated that mortality rate of Japanese quail significantly (P<0.05) decreased when the levels of PGTF increased .However, increasing inclusion levels of PGTF up to 0.75 % PGTF recorded no mortality at any time of experimental period. It may be attributed to that PGTF has polyphenols which was effective in reversing the decrease in white blood cells and platelets and protecting normal immune function of the spleen and thymus gland. Also, polyphenols increased immunocyte number and mitosis index of granulocytes of bone marrow *(Cao-Ming and Cao 1998)*.However ,addition of PGTF affect on pathogenic microorganisms that may attack chicks particularly at younger age *(Hara 1993)*.Indeed, decrease of mortality rate may be due to PGTF prevention of liver injury causing sudden death syndrome in chickens *(Lin et al. 1998)*.It could be concluded that addition of PGTF in diets of growing Japanese quail was efficient in improving growth, feed conversion and decrease mortality rate, especially with group fed higher PGTF levels.

As shown in Table (4) the statistical analysis indicated significant (P<0.05) differences in all carcass studied traits. The results showed that dressing carcass percentage were higher for groups fed different levels of PGTF compared to control group, although insignificant differences were observed among PGTF levels (Table 4). It is clear from these results that the liver weight percentage increased as compared to control group .Also, the status of liver were in good condition, this may be due to the theanine (glutamic acid-gama ethylamide) present in PGTF which identified as the active compounds in preventing of liver injury *(He et al 2000)*,also PGTF possess preventive effect on certain types of liver injury such as that induced by D-galactosamine and that different constituents of high and low molecular weight contribute to the liver injury preventive effect of PGTF *(Sugiyama et al.1998)*. However, increasing liver percentage for quail fed different levels of PGTF may be attributed to polyhenoles in activating the function of the liver.

The beneficial effect of PGTF in decreasing abdominal and gizzard fat without affecting body weight are shown in Table (4),may be due to the compound in PGTF (catechin –polyphenopls and caffeine) it capable of inhibiting catechol-o-methyle (that enzyme that degrades nor adre naline) and caffeine to inhibit trnacellular phosphodiesterases (enzyme that break down nor adre naline induced). Such a synergistic interaction between catchin-polyphenols and caffeine to augment and prolong sympathetic stimulation of thermogenesis could be of value in assisting the management of obesity (*Dulloo et al., 2000).* Also, green tea acting as inhibiting of lipogenesis in adipose tissue *(Hasegawa et al., 2003).* These results are in accordance with the finding of *Lee et al. (1992)* who found that rats fed diets containing 0.15 % caffeine and 6.1 % powdered green tea showed a reduction of white adipose tissue weight.

Chemical composition of different cuts of carcass as affected by PGTF levels are presented in Table (5).It is clear that the moisture and ash percentage of breast, hind and whole carcass were not significantly ($P<0.05$) affected by adding PGTF in the diets. However, crude protein percentage of different cuts significantly ($P< 0.05$) increased, meanwhile ether extract percentage decreased as the level of PGTF increased. These results are in agreement with those obtained by *Wang et al. (2003)* who found that crude fat of thigh muscle decreased and protein increased in birds fed three different kinds of traditional Chinese plants compared to control group.

Data in Table (6) indicated that increasing level of PGTF in the diets from 0.25 % to 0.75 % significantly ($P<0.05$) increased the percentages of spleen, thymus bursa of fibricius and antibody titer production as compared to control group (Table 6). Antibody titer production against sheep red blood cells(RBC,s) was tested at the end of the 14,28 and 42 days of age. The values of antibody titer production significantly ($P<0.05$) increased by adding of PGTF in growing Japanese quail ration up to 0.75 % over that those of control group .These results could explained that the active material compounds of PGTF known as catechin polyphenols that may increase globulin levels in the blood. It is well known that globulin is formed by lymphatic tissues including the spleen, thymus and bursa of fibricius ,so these organs had a considerable role in birds immunity *(Jones and Bark, 1979).*Also, the improve in antibody titer production values may be due to the high level of iron content in PGTF (342 mg / Kg) which may affect the transport of oxygen needed for hemoglobin synthesis in the blood. This mean that PGTF is useful as a herbal bio-stimulation induced immune response in quail chicks. These results are in accordance with those obtained *Cao-Ming and Cao (1998)* who found that polyphenols of green tea were effective in reversing the decreased in white blood cells and thymus, as well as increased immunocyte number and the mitosis index of granulocytes of bone marrow in mouse. Also, *Huang (1999)* reported that herbs had a stimulate effect on the immune system of an animal.

Table (7) showed that total plasma protein , albumin , globulin and A/G ratio significantly (P<0.05) increased when PGTF inclusion levels increased .It is interesting to note that the gradual increase in globulin fraction by feeding quail chicks on different levels of PGTF, reflects the significant role of its components in increasing the immunity of chicks. However, albumin is one of the important proteins which keep the osmotic pressure stable in the blood. The increase either plasma protein or globulin as PGTF levels increased reflects the ability of chicks under such condition to store reserve protein even after the body has reached its maximum capacity for depositing tissues. In addition, the increase of A/G ratio indicated an increase in production of albumin by the liver reflecting good hepatic function of birds which related with the high immunity of birds (Table 7).These results are in agreement with the finding of *Stroev (1989)* who found that it is well known that albumin is one of the important proteins in the blood and also keep the osmotic pressure stable in the blood .Moreover, *Hasegawa (2003)* who reported that plasma protein increased in male Zucker rats fed 130 mg of powdered green tea per day as compared with that of control group. *Jones and Bark (1979)* indicated that the liver is the site of albumin synthesis, but globulin is formed by lymphatic tissues. In addition, the decrease in A/G ratio indicated a decrease in production of albumin by the liver reflecting mal hepatic functions *(Zimmerman 1976).*

Data of Table (7) indicated that plasma lipids, triglycerides , cholesterol and Atheriogenic index (A.I) calculated as (cholesterol –HDL /HDL) significantly (P< 0.05) decreased as PGTF levels increased in the experimental diets .It is clear that the most beneficial effect of PGTF in diets is inhibition of lipid metabolism. This may be attributed to that PGTF containing active substrate called epigallocatchin gallate (EGGG) which inhibit cholesterol in the liver and affect lipid metabolism by interfering with miceller solubiliztion of cholesterol in digestive tract ,which in turns decreased cholesterol absorption .However, PGTF increase excretion of fecal bile acids cholesterol *(Yang and Koo, 2000).*Also, PGTF reduced pancreatic lipase activity and gastric lipase which resulted in a drastic decrease in gastric lipase ,that causes inhibition of digestive lipids and so likely to reduce fat digestion *(Deng et al. 1998 and Juhel et al. 2000).*On the other hand, plasma high density lipoprotein (HDL) levels significantly (P< 0.05) increased when inclusion levels of PGTF increased. The increase of HDL in the blood was very beneficial effect since it bind with cholesterol deposited in tissues and blood and decreased of its levels.

As shown in Table (7) the values of plasma glucose were significantly (P< 0.05) decreased as increase inclusion of PGTF in the diets .These results are in agreement with the results of *Lee et al. (1992*) who showed that plasma HDL decreased in rats when fed diets contained green tea.Also, Atherogenic index decreased compared to the control group. Furthermore, *Vinson and Dabbagh (1998)* found that plasma lipid profile of Hamster rate fed diets high in cholesterol content was significantly improved by drinking green tea. *Lin et al. (1998)* reported that total serum cholesterol and triglycerides were significantly (P<0.05) decreased in rats fed diets containing 2.5 % green tea .*Raederstorff et al. (2003)* indicated that catechins compounds derived from green tea have been found to reduce plasma cholesterol level and the rate of cholesterol absorption .

As a general conclusion PGTF, could be used as a safe fed additive in diets of growing Japanese quail up to 0.75 % to decrease lipid metabolism and increase immune response without any adverse effect on their performance. Also evidences indicated that PGTF can decrease blood lipid fractions, however further research is still require to better understanding for the role of PGTF in animal nutrition and their relation to human health.

Table (1): Composition and calculated analysis of experimental diets used for feeding growing Japanese quail.

Ingredients	*Green tea levels %*			
	Control	*0.25*	*0.50%*	*0.75%*
Ground yellow corn (8.5%).	52.50	52.00	52.00	51.00
Soybean meal (44%).	35.00	31.00	32.00	32.00
Broiler concentrate (52%).	10.00	10.40	10.00	10.00
Wheat bran (15.7%).	02.30	03.00	02.30	03.50
Green tea powdered (23.1%).	-	00.25	00.50	00.75
Sunflower oil.	02.00	02.20	01.95	01.50
Limestone (Ca Co3).	00.40	00.40	00.50	00.50
Sodium chloride(NaCl).	00.20	00.20	00.20	00.20
Vitamin and mineral premix*.	00.50	00.50	00.50	00.50
Dl-Methionine.	00.10	00.05	00.05	00.05
Total (Kg)	**100.00**	**100.00**	**100.00**	**100.00**
Calculated diet composition:				
Crude protein %.	24.10	24.00	24.16	24.29
Metabolizable energy (Kcal/ Kg).	2912	2913	2901	2911
Lysine %.	01.31	01.32	01.33	01.33
Methionine %.	00.55	00.50	00.50	00.50
Methionine+ Cystine %.	00.83	00.84	00.83	00.84
Calcium %.	00.94	00.97	00.99	01.00
Available phosphorus %.	00.43	00.41	00.41	00.41
Metabolizable energy / Protein ratio.	120.00	121.00	120.00	120.00
Analyzed:				
C.P %.	24.30	23.98	24.32	24.03
E.E %.	02.96	02.90	02.93	02.98
C.F %.	03.93	03.97	04.01	04.05
Ash %.	03.66	03.69	03.68	03.66

Each 1Kg of pre-mix contain:Vit.A,12000 IU;Vit. $D_3$2000IU;Vit. E10 mg; Vit. K 2mg; Vit.B_1 1mg; Vit. B6 1.5 mg;Vit.B_{12}10mcg;Vit.B_2 4mg ;Pantothenic acid 10 mg ; Nicotinic acid 20 mg Folic acid 1 mg; Biotin 50 mcg; Choline chloride 500 mg; Copper 10 mg ;Iron 30 mg ;Manganese 55 mg; Zinc 55 mg and Selenium 0.1 mg.

Table (2): Proximate analysis of powdered green tea flowerers (PGTF).

Items	%
Moisture (%).	10.33
Crude protein %.	23.10
Ether extract (%).	2.55
Ash (%).	4.30
Nitrogen free extract (%).	43.42
Organic matter (%).	85.37
Gross energy (Kcal /Kg.).	3288
Metabolizable energy (calculated).	2872
Crude fiber (%).	16.3
Calcium (%).	1.09
Total phosphorus (%).	0.86
Magnesium (%).	0.29
Manganese (mg/ Kg).	33.3
Copper (mg /Kg).	61.50
Cobalt (mg/ Kg).	19.30
Iron (mg /Kg).	342.0
Sodium (%).	0.09
Potassium (%).	0.39
Lysine (%).	0.80
Methionine (%).	0.09
Cystine (%).	0.12
Argnine (%).	1.96

Table (3): Means (x-) and standard error (S.E) of growth performance of growing Japanese quail fed different levels of green tea.

Items	Control group	Green tea %		
		0.25	0.50	0.75
Live body weight, g.				
Initial	8.96±2.85[a]	8.90±2.73[a]	8.73±2.0[a]	8.77±2.05[a]
3 weeks	83.6±8.22[a]	84.00±8.11[a]	83.96±7.04[a]	85.12±8.46[a]
6 weeks	170.12±12.18[c]	180.20±12.11[b]	182.16±11.33[b]	193.63±12.14[a]
Feed consumption g/ bird/ period				
0-3	235.33±4.18[a]	210.80±3.36[b]	20.11±4.09[c]	189.50±3.36[d]
3-6	428.00±5.56[a]	388.20±5.10[b]	365.00±5.22[c]	350.10±5.38[d]
0-6	663.33±7.11[a]	599.00±8.12[b]	566.11±8.0[c]	539.60±8.12[d]
Body weight gain, g.				
0-3	74.69±8.32[a]	75.10±8.38[a]	75.23±8.00[a]	76.35±8.21[a]
3-6	86.47±9.11[c]	96.20±9.60[b]	98.20±9.10[b]	108.51±9.12[a]
0-6	161.16±10.02[c]	171.30±10.22[b]	173.43±10.60[b]	184.86±10.12[a]
Feed conversion ratio.				
0-3	3.15±0.08[a]	2.81±0.05[b]	2.67±0.03[c]	2.48±0.01[d]
3-6	4.94±0.1[a]	4.03±0.09[b]	3.72±0.06[c]	3.23±0.04[d]
0-6	4.11±0.02[a]	3.50±0.04[b]	3.26±0.11[c]	2.92±0.18[d]
Protein intake, g/ bird /period				
0-3	56.70±0.89[a]	50.59±0.93[b]	48.59±0.98[c]	46.03±0.81[d]
3-6	103.15±1.30[a]	93.17±1.99[b]	88.18±1.92[c]	85.04±1.13[d]
0-6	159.86±2.13[a]	143.76±2.50[b]	136.77±2.13[c]	131.07±1.98[d]
Metabolizable energy intake Kcal / bird / period				
0-3	685.28±9.60[a]	614.90±12.36[b]	584.20±8.39[c]	552.60±8.36[d]
3-6	1246.30±10.36[a]	1132.40±13.23[b]	1060.30±9.36[c]	1020.90±8.0[d]
0-6	1931.60±11.33[a]	1747.30±11.39[b]	1644.50±9.32[c]	1573.50±7.23[d]
Protein conversion ratio				
0-3	1.31±0.05[d]	1.48±0.04[c]	1.55±0.03[b]	1.66±0.01[a]
3-6	0.84±0.03[d]	1.03±0.01[c]	1.11±0.08[b]	1.28±0.02[a]
0-6	1.00±0.02[d]	1.19±0.06[c]	1.27±0.02[b]	1.41±0.03[a]
Efficiency of energy utilization				
0-3	9.17±5.23[a]	8.19±3.35[b]	7.77±3.21[c]	7.24±4.03[c]
3-6	14.41±5.03[a]	11.77±3.50[b]	10.79±3.12[c]	9.41±3.33[d]
0-6	11.98±4.12[a]	10.20±3.34[b]	9.75±4.0[c]	8.51±3.93[d]
Mortality rate %	18.75	6.25	3.75	0.00

a,b, c……. means in the same row have the same letter are not significantly different ($P \leq 0.05$).

Table (4): Means (x^-) and standard error (S.E) for carcass characteristics of growing Japanese quail at the end of experimental period.

Parameters	Green tea %			
	Control group	**0.25**	**0.50**	**0.75**
Body weight,g.	169.28 ± 1.07^{c}	180.15 ± 1.18^{b}	183.60 ± 1.50^{b}	192.00 ± 1.95^{a}
Absolute carcass weight,g	119.28 ± 3.73^{c}	140.15 ± 4.11^{b}	139.60 ± 4.01^{b}	149 ± 5.39^{a}
Dressing carcass %.*	70.46 ± 2.13^{b}	77.80 ± 1.38^{a}	76.04 ± 2.62^{a}	77.60 ± 1.93^{a}
Liver %.	2.38 ± 0.68^{c}	3.00 ± 0.94^{b}	3.40 ± 0.69^{b}	3.91 ± 0.33^{a}
Gizzard %.	3.63 ± 0.43^{a}	2.94 ± 0.62^{b}	2.43 ± 0.48^{b}	2.16 ± 0.34^{b}
Heart %.	1.15 ± 0.09^{a}	0.95 ± 0.03^{b}	0.96 ± 0.08^{b}	1.00 ± 1.06^{b}
Giblets %.	7.16 ± 1.12^{a}	6.89 ± 1.0^{b}	6.79 ± 1.08^{b}	7.07 ± 1.09^{b}
Abdominal and gizzard fat %.	1.71 ± 0.73^{a}	1.41 ± 0.52^{b}	0.68 ± 0.33^{c}	0.58 ± 0.25^{d}

a,b, c……. means in the same row have the same letter are not significantly different ($P \leq 0.05$).
* % of body weight.

Table (5): Means (x-) and standard error (S.E) of body composition of Japanese quail fed different levels of green tea *(% of dry matter)*.

Items	Cut	Control group	Green tea %		
			0.25	0.50	0.75
Moisture %.	Breast	70.26±0.28^{a}	70.17±0.29^{a}	69.00±0.22^{a}	70.03±0.27^{a}
	Hind	69.66±0.23^{a}	69.10±0.21^{a}	71.00±0.31^{a}	70.47±0.29^{a}
	Whole carcass	70.22±0.29^{a}	70.96±0.30^{a}	70.02±0.32^{a}	70.13±0.32^{a}
Crude protein %.	Breast	61.41±0.39^{d}	65.60±0.39^{c}	67.30±0.49^{b}	69.70±0.78^{a}
	Hind	58.60±0.71^{d}	60.63±0.83^{c}	63.90±0.86^{b}	65.00±0.91^{a}
	Whole carcass	63.16±0.81^{d}	61.12±0.91^{c}	63.01±0.75^{b}	68.10±0.99^{a}
Ether extract %.	Breast	26.60±0.28^{a}	23.80±0.21^{b}	18.80±0.37^{c}	13.50±0.17^{d}
	Hind	30.60±0.16^{a}	24.10±1.03^{b}	21.00±0.43^{c}	14.10±0.38^{d}
	Whole carcass	31.11±0.20^{a}	28.12±0.21^{b}	22.00±0.23^{c}	16.11±0.35^{d}
Ash %.	Breast	5.00±0.09^{a}	5.70±1.02^{a}	5.50±1.09^{a}	5.30±0.06^{a}
	Hind	5.10±0.08^{a}	5.60±1.03^{a}	5.07±1.00^{a}	4.90±0.07^{a}
	Whole carcass	5.50±0.09^{a}	5.40±1.03^{a}	5.40±1.03^{a}	5.00±1.18^{a}

a,b, c……. means in the same row have the same letter are not significantly different ($P \leq 0.05$).

Table (6): Means (x-) and standard error (S.E) of immunization and antibody titer production of growing Japanese quail.

Parameters	Green tea %			
	Control group	0.25	0.50	0.75
Spleen %	0.03 ± 0.02^{c}	0.04 ± 0.01^{c}	0.06 ± 0.01^{b}	0.09 ± 0.01^{a}
Bursa of fabricius %	0.06 ± 0.03^{d}	0.07 ± 0.02^{c}	0.07 ± 0.02^{b}	0.08 ± 0.02^{a}
Thymus %	0.04 ± 0.02^{d}	0.06 ± 0.01^{c}	0.07 ± 0.02^{b}	0.09 ± 0.01^{a}
Antibody titer production:				
At 14 days.	7.60 ± 0.64^{b}	7.50 ± 0.40^{b}	8.80 ± 0.39^{a}	8.50 ± 0.50^{a}
At 28 days.	6.50 ± 0.31^{c}	8.30 ± 0.55^{b}	9.20 ± 0.45^{a}	9.10 ± 0.29^{a}
At 42 days.	7.00 ± 1.33^{c}	8.50 ± 0.48^{b}	8.60 ± 0.91^{b}	9.50 ± 0.4^{a}

a,b, c……. means in the same row have the same letter are not significantly different ($P \leq 0.05$).

Table (7): Means (x-) and standard error(S.E) of blood plasma constituents of growing Japanese quail fed different levels of green tea.

Parameters	Control group	Green tea %		
		0.25	0.50	0.75
Total plasma protein (g /100ml).	5.01±0.09[d]	6.04±0.06[c]	6.18±0.07[b]	6.30±0.05[a]
Total plasma albumin (g/ 100ml).	2.12±0.03[d]	2.63±0.04[c]	2.71±0.09[b]	2.80±0.06[a]
Total plasma globulin (g /100ml).	2.89±0.12[c]	3.41±0.10[c]	3.47±0.11[b]	3.50±0.13[a]
A/ G ratio.	0.73±0.02[c]	0.77±0.01[b]	0.78±0.03[b]	0.80±0.02[a]
Total plasma lipids (mg /100 ml).	5413.0±6.11[a]	4690±8.96[b]	4311.0±7.09[c]	4011.0±4.50[d]
Total plasma triglyceride (mg /100m).	228.80±8.01[a]	207.83±6.10[b]	191.43±7.12[c]	176.74±10.60[d]
Total plasma cholesterol (mg /100ml).	183.56±13.60[a]	154.05±19.11[b]	136.90±20.10[c]	118.70±18.11[d]
Total plasma HDL (mg/ 100 ml).	50.43±0.81[c]	55.53±0.73[b]	56.26±.0.70[b]	58.70±0.66[a]
Atherogenic index (A.I).	2.64±0.06[a]	1.77±0.05[b]	1.43±0.03[c]	1.02±0.04[d]
Total plasma glucose (mg /100ml).	99.64±0.61[a]	75.55±0.55[b]	67.73±0.44[c]	41.15±0.37[d]

a,b, c……. means in the same row have the same letter are not significantly different ($P \leq 0.05$).

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الملخص ا لعربي

استخدام أزهار الشاي الأخضر كمضاف غذائي ومضادة للأكسدة في علائق السمان الياباني النامي

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أجريت هذه التجربة بمحطة بحوث الدواجن التابعة لقسم الإنتاج الحيواني بكلية الزراعة جامعة الأزهر بهدف دراسة تأثير مستويات مختلفة من الشاي الأخضر على الأداء الإنتاجي وميتابولزم دهون الدم وكذالك الاستجابة المناعية للسمان الياباني. استخدم في هذه الدراسة عدد ٣٢٠ كتكوت عمر يوم (غير مجنس)، وقسم هذا العدد إلى أربع مجامع متساوية بواقع ٨٠ كتكوت في كل مجموعة واحتوت كل مجموعة على أربع مكررات في كل مكررة عدد ٢٠ كتكوت. واستخدمت علائق متساوية الطاقة والبروتين بحيث تقابل الاحتياجات الغذائية في هذه الفترة. استخدم ثلاث مستويات من الشاي الأخضر.٢٥و. , ٥٠ و. , ٧٥ و. % . تم تحضين الكتاكيت في بطاريات مزودة بمصدر للحرارة وكانت الإضاءة بمعدل ٢٤ ساعة طول فترة التجربة (٦ أسابيع).

أوضحت النتائج أن إضافة الشاي الأخضر إلي العلائق نتج عنة تحسن معنوي في الأداء الإنتاجي وكذالك الاستجابة المناعية للكتاكيت . كما أدت إضافة الشاي الأخضر إلى نقص معنوي في مستوى الدهون في الدم , بينما زاد معنويا مستوى البروتين الدهني العالي الكثافة (HDL) .كما

أوضحت النتائج أيضا أن زيادة مستوى الإضافة من الشاي الأخضر آدت إلى انخفاض مستوى الدهون في الكبد وتجويف البطن. كما انخفضت معنويا نسبة النفوق بزيادة مستوى الإضافة من الشاي الأخضر بالعلائق.