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Effect of Green Tea (Camellia Sinensis)-Supplemented Diets on Growth Performance, Some Blood Parameters and Antioxidant Status of Broiler Chicks

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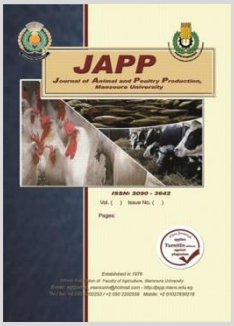

ABSTRACT

In this study, the effects of four different doses of green tea (0.0, 0.250, 0.50, and 0.750 g/kg) on the nutritional status, blood profiles, and antioxidant status of broiler chickens were investigated. A total of four equal groups, each with four duplicates, and ninety sex-day-old, unsexed broiler chicks were reared in battery cages. Feed and water were offered *ad libitum* till the termination of the trial at 6 weeks of age. Throughout the whole trial period, the treatment supplemented with 0.750 g/kg of dietary green tea had the highest LBW. In contrast to the other groups, feeding the diet containing 0.500 g/kg of green tea increased FI during the whole study period. Over the course of the entire experiment, broilers fed a food supplemented with 0.500 g/kg green tea demonstrated considerably higher FCR than other experimental groups. Green tea-fortified diets did not significantly affect any group's bilirubin or HDL levels. However, dietary supplementation with green tea for broiler chicks resulted in significantly higher plasma levels of lipid profile and activity on transaminases compared to the control group. The positive impact of green tea addition in diets on the growth performance and blood parameters of broiler chickens was indicated by study findings.

Keywords: broilers, green tea, productive performance, lipids profile, antioxidant status

INTRODUCTION

Consumers became more and more interested in the natural dietary components of domestic animals as they became more and more focused on poultry feed and production in daily life. One of the most popular drinks in the world is tea. Particularly green tea, which has the largest concentration of catechins, has a lot of phenolic compounds and catechins. As a result, green tea is thought to provide a variety of advantages, such as impacts on animal obesity and anti-inflammation. Chacko et al., 2010 .In biomedicine and physiology, green tea (Camellia sinensis) is extensively studied and used for its beneficial effects as feed additives, natural feed supplement, and an alternative to antibiotics (Cao et al., 2005; Kojima and Yoshida, 2008).For both humans and animals, green tea is recognized as a potentially valuable source of healthy nutrients, an antibiotic substitute, and secure natural antioxidants. (Cyril and Jozef, 2017). In order to feed domestic animals, green tea and its extracts or derivatives are frequently used as natural feed ingredients and crucial supplements (Jelveh et al., 2018; Seidavi et al., 2017). Four different types of tea can be produced depending on the degree of oxidation: white, green (both of which are unoxidized), oolong (partially oxidised), and black (completely oxidised). Green tea leaves contain 10–30% (dry weight) polyphenols, which are known to have a variety of biological actions. These polyphenols include catechins, flavonols, flavanones, phenolic acids, glycosides, and the aglycones of plant colours(Crespy and Williamson, 2004).In order to use natural compounds as free radical scavengers in animal feed instead of synthetic antioxidants, research is continuing. Green tea extracts (GTEs) and flavan-3-ols, which are the main active component of GTEs, can be used as strong, secure, and organic antioxidants. Catechin, epicatechin, gallocatechin, epigallocatechin, gallocatechingallate, epicatechin gallate, and epigallocatechin gallate are the mainflavan-3-ols found in green tea (Ninomiyaet al.,1997). Green tea contains a variety of biologically active components, including caffeine, theobromine (methylxanthine), l-theanine, theaflavins, flavonol glycosides (quercetin, kaempferol, and myricetin), flavonol glycosides, and volatile organic compounds Saptadip (2002). Additionally, polyphenols including flavanols, flavandiols, flavonoids, and phenol acids, which have antioxidant and antibacterial properties, are abundant in it Abdo et al., 2010.In this way, the goal of this study was to evaluate the impact(s) of dietary green tea on the blood profile and performance of broiler chickens.

MATERIALS AND METHODS

Between July and August 2015, this study was carried out at the Poultry Production Farm, Center for Agricultural Research and Experiments, Faculty of Agriculture, Mansoura University. The current study's goal was to assess how green tea (Camellia sinensis) affected broiler chicken lipid peroxidation, certain blood metabolites, and growth performance.

Experimental Design and Management:

Four treatment groups, each with four duplicates, were created from Cobb 500 one-day-old broiler chickens (n=96) (cages). Four dietary treatments were given to the groups: the control group (basic diet), the 0.250, 0.50, and 0.750 g/kg green tea groups. In accordance with the nutritional programme, broilers were raised in battery cages measuring 0.168 m3 (70 cm long, 60 cm wide, and 40 cm high). Up to 42 days of age, the birds were fed their individual experimental diets. From the first dayto day 21, chickens were raised on a

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beginning diet that contained 20.11% CP and 2997 kcal of ME/kg. From 21 to 42 days of age, chickens were fed a grower diet (3010 kcal of ME/kg and 18.11% CP).The experimental meals were designed to provide broiler chicks with the required nutritional dosages, per NRC (1994). Freshwater and mash-style food were provided without charge. Table 1 displays the composition analysis of the experimental diets.

Table1. Composition and Chemical Analysis of the Basal Diets:

Ingredients (%)	Starter Diet	Grower Diet
Yellow corn	62.0	62.88
Soybean meal, 44% CP	18.2	8.00
Corn Gluten Meal, 60.2% CP	15.0	15.0
Wheat bran	0.0	10.0
Dicalcium Phosphate	1.70	1.50
Limestone	2.00	1.50
DL-methionine	0.10	0.00
L-Lysine HCL	0.40	0.52
Sodium chloride	0.30	0.30
Vit. + Min. Premix[1]	0.30	0.30
Total	100	100
Chemical analysis: (As-fed)		
Metabolizable energy, kcal/kg	3052	2991
Crude protein, %	23.01	20.22
Crude Fiber, %	2.83	3.24
Ether extract, %	2.88	3.13
Calcium, %	1.18	0.94
Total Phosphorus, %	0.68	0.70
Nonphytate Phosphorus, %	0.44	0.39
Methionine, %	0.55	0.41
Meth. + Cys. (TSAA, %)	0.94	0.71
Lysine, %	1.12	1.00

"1Premix Contained per kg diet: VA 2654 µg; VD3 125 µg; VE 9.9 mg; VK3 1.7 mg; VB1 1.6 mg; VB12 16.7 µg; riboflavin, 5.3 mg; niacin 36mg; calcium pantothenate, 13mg; folic acid,0.8 mg; d-biotin,0.1mg; choline chloride,270; BHT, 5.8; Fe 50 mg; Cu 12 mg; I 0.9mg; Zn 50mg; Mn 60 mg; Se 0.2mg; Co 0.2mg.

Performance of broiler chickens:

Weekly measurements of feed intake (FI), live body weight (LBW), and body weight growth (BWG) were taken throughout the trial on a replicate group basis. A grammefeed:gram gain ratio was used to calculate the feed conversion ratio (FCR). Before getting any food or water, chickens were weighed (in kilogrammes) in the early morning at the start of the experiment and once a week until the finish. On a replicate group basis, weekly records for FI and BWG of broilers were also computed.

Blood sampling and biochemical analysis:

Blood samples were taken during slaughter and centrifuged for 15 minutes at 4000 rpm in heparinized tubes. Additionally, the plasma was collected and kept at -20°C until analysis. Commercially available kits were used to measure the following plasma biochemical components and metabolites: total protein (TP), albumin (ALB), total cholesterol (Chol), triglycerides (TG), alanine aminotransferase (ALT), aspartate aminotransferase (AST), high-density lipoprotein (HDL), low-density lipoprotein (LDL), very low-density lipoprotein (vLDL), uric acid, creatine, bilirubin,

Statistical analysis:

One-way analysis of variance was used for statistical analysis of the collected data (SAS, 2006). To differentiate between means with significant differences, the Tukey multiple range test was used (Tukey, 1977).

RESULTS AND DISCUSSION

Live body weight:

Table 2 displays the impact of increased green tea levels on broiler chicks' live body weight (LBW) over the course of the entire experiment. In the first week of the trial, there was no significant difference in the LBW of broiler chicks between the control group and the green tea supplementation groups. There are noticeable differences between the control group and the other treatments supplemented with green tea in the second, third, fourth, fifth, and sixth weeks. but during the entire trial period, the treatment supplemented with 0.750 g/kg of dietary green tea had the highest LBW. this result was in agreement with Farahatet al., 2016 the heaviest LBW was observed in broilers fed on diets supplemented with 500 and 250 mg/kg of green tea extract, respectively.Gurayet al.(2011)Broiler diets were supplemented with a liquid hydroalcoholic extract of fresh green tea (0.1 or 0.2 g/kg). The consumption of green tea extract enhanced body weight. This result agrees with Shahid et al. (2013)broiler chickens' growth performance improved when their diets were supplemented with 200 mg/kg of green tea extract. Nevertheless, Khalajiet al. (2011)did not see a significant difference in growth performance in a feed diet supplemented with 300 mg/kg of green tea extract. Moreover,Hrnčárand Bujko(2017)noticed no difference in feed intake between the control group (1.72kg) and the addition of green tea at 0.5% (1.69kg), 1.00% (1.70kg), and 1.50% (1.73kg) during the fattening phase that was statistically significant ($p > 0.05$).

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Table 2. Effects of diet supplemented Green tea on live body weight (LBW;G)of broiler chicks from one to days of age.

Main effects	LBW 1-day old	LBW 7-d- old	LBW 14-d-old	LBW 21-d -old	LBW28-d-old	LBW35-d-old	LBW42-d-old
Control (0.0 g/kg)	0.042	0.1405^{c}	0.3755^{a}	0.6165^{a}	0.9363^{a}	1.4703^{a}	1.9703^{a}
Green tea (0.250g/kg)	0.0418	0.1383^{c}	0.3570^{b}	0.5615^{b}	0.8158^{b}	1.2808^{b}	1.8688^{b}
Green tea (0.500g/kg)	0.0418	0.1433^{b}	0.3593^{b}	0.5515^{b}	0.8955^{a}	1.4715^{a}	2.0260^{a}
Green tea (0.750g/kg)	0.0415	0.1463^{a}	0.3573^{a}	0.5948^{ab}	0.9370^{a}	1.4635^{a}	2.0325^{a}
Pooled SEM	0.0002	0.0005	0.0013	0.0118	0.0125	0.0211	0.0156
P value	0.5174	0.0001	0.0001	0.0076	0.0001	0.0001	0.0001

Means in the same column with various superscripts differ considerably (P 0.05) in the range a to c

Body weight gain:-

The results relating to the influence of green tea levels on body weight gain at 42 d of age are shown in Table 3. Dietary green tea levels did not significantly influence BWG ($P > 0.05$) during the period from 14 to 21 and 35 to 42day, whereas during the period from 1 first, 2nd , 4th ,5th and whole experimental period a significant difference was observed in BWG of broilers supplemented with green tea compared with the control treatment ($P > 0.01$). The group fed 0.250 g/kg green tea was significantly lower in their BWG as compared to other groups in the whole experimental period. This was confirmed in a recent study by Jelveh et al.(2018)wherein broilers fed green tea extract, which has a polyphenol content of 10.2%, had better feed intake and weight increase than those fed green tea powder, which has a polyphenol content of 14.9%.Kaneko et al. (2001) showed that adding 1, 2.5, and 5% of green tea to broiler diets lowered the body weight gain of the chicks, while Uuganbayar (2004) discovered that adding 1 to 1.5% of green tea to broiler diets had a similar impact

Table 3. Effects of diet supplemented Green tea on body weight gain(BWG; kg) of broiler chicks from one to 42 day of age.

Main effects:	BWG 0-7 day	BWG 7-14 day	BWG 14-21 day	BWG 21-28 day	BWG 28-35 day	BWG 35-42day	TBWG 0-42 day
Control (0.0 g/kg)	0.0995^{b}	0.235^{a}	0.241	0.3203^{ab}	0.534^{ab}	0.5003	1.929^{a}
Green tea (0.250g/kg)	0.0967^{c}	0.21875^{c}	0.2048	0.2543^{b}	0.4648^{b}	0.5883	1.827^{b}
Green tea (0.500g/kg)	0.1020^{ab}	0.216^{c}	0.1925	0.3443^{a}	0.576^{a}	0.555	1.985^{a}
Green tea (0.750g/kg)	0.1045^{a}	0.2293^{b}	0.2198	0.3425^{ab}	0.5265^{ab}	0.569	1.991^{a}
Pooled SEM	0.0006	0.0013	0.0130	0.0212	0.0205	0.0248	0.0157
P value	0.0001	0.0001	0.1024	0.0362	0.0180	0.1279	0.0001

Means in the same column with various superscripts differ considerably (P 0.05) in the range a to c

Feed intake:-

The effect of feeding diets supplemented with green tea to broiler chicks for the whole experimental period on feed intake are presented in Table 4. FI of broiler chicks between 35 to 42 days of age was not significantly different between the control group fed on the basal diet and the other groups supplemented with the green tea of diet (P > 0.05). Whereas in the rest of the periods and the whole period from 0 to 42 days a significant difference was observed between the group fed on the basal diet and the other groups supplemented with the green tea of diet. However, feeding the diet having 0.500 g/kg green tea enhanced FI during the whole experimental period as compared to other groups. According to Thomas et al. (2022) both forms of green tea (regular and oolong) reduced feed intake (P0.05) (green tea or selenium-rich green tea). Both varieties of green tea decreased weight increase and feed consumption (P0.05) during the course of the 35-day feeding period. Jelveh et al. (2018)wherein broilers fed green tea extract, which has a polyphenol level of 10.2%, had better feed intake than those fed green tea powder, which has a 14.9% polyphenol content.

Table 4. Effect of diet supplemented Green tea on FI(G) of broiler chicks at 42 days of age.

Main effects:	FI 0-7 day	FI 7-14 day	FI 14-21 day	FI 21-28 day	FI 28-35 day	FI 35- 42 day	TFI 0- 42 day
Control (0.0 g/kg)	0.0635^{C}	0.426^{a}	0.3883^{b}	0.7198^{a}	0.779^{a}	1.2023	3.5788^{a}
Green tea (0.250g/kg)	0.1438^{a}	0.3375^{d}	0.5248^{a}	0.5835^{b}	0.7548^{a}	1.1315	3.4758^{a}
Green tea (0.500g/kg)	0.130^{a}	0.3438^{c}	0.4368^{ab}	0.6218^{b}	0.6238^{b}	1.1215	3.2775^{b}
Green tea (0.750g/kg)	0.108^{b}	0.3808^{b}	0.4255^{ab}	0.6285^{b}	0.747^{a}	1.1233	3.4125^{ab}
Pooled SEM	0.0039	0.0010	0.0239	0.0172	0.0184	0.0268	0.0410
P value	0.0001	0.0001	0.0107	0.0008	0.0003	0.1575	0.0018

Means in the same column with various superscripts differ considerably (P 0.05) in the range a to c

Feed conversion ratio:

The effect of green tea supplementation treatments on feed conversion ratio in broiler chicks at 42 d of age are presented in Table 5. During the trial period of age, the feed conversion ratio of broiler chicks was significantly different between the control group and the other treatments supplemented with green tea. Broilers fed the diet fortified with 0.500 g/kg green tea displayed significantly better FCR than did other experimental groups during whole experimental periods. This result agrees with Abd El - Hack et al. (2020) Feed conversion ratio (FCR) for broiler diets was 8% lower when green tea extract (0.2–1.0%) was added. According to Thomas et al. (2022)Both forms of green tea enhanced (P0.05) observation on feed per gain (normal green tea or selenium-rich green tea). Both varieties of green tea increased feed per gain (P0.05) across the 35-day feeding period.

Table 5. Effects of diets supplemented green tea on feed conversion ratio (feed: gain) of broiler chicks from one to 42 day of age.

Main effects:	FCR 0- 7 day	FCR 7-14 day	FCR 14-21 day	FCR 21-28 day	FCR 28-35 day	FCR 35- 42 day	TFCR 0- 42 day
Control (0.0 g/kg)	0.6398^{d}	1.8168^{a}	1.6418^{c}	2.3565	1.461^{a}	2.4103^{a}	1.8555^{a}
Green tea (0.250g/kg)	1.4875^{a}	1.5433^{c}	2.594^{a}	2.3248	1.630^{a}	1.9325^{b}	1.9020^{a}
Green tea (0.500g/kg)	1.2775^{b}	1.5923^{c}	2.2713^{ab}	1.8103	1.0855^{b}	2.032^{b}	1.65225^{b}
Green tea (0.750g/kg)	1.0295^{c}	1.6615^{b}	1.9375^{cb}	1.8423	1.4295^{a}	1.9833^{b}	1.714^{b}
Pooled SEM	0.0432	0.0124	0.1420	0.1918	0.0552	0.0804	0.0244
P value	0.0001	0.0001	0.0028	0.1182	0.0001	0.0048	0.0001

Means in the same column with various superscripts differ considerably (P 0.05) in the range a to c

Blood plasma parameters: -

Results of plasma parameters (plasma total protein, albumin, globulin, antioxidant status, ALT , AST , uric, creatin, Bilirubin, cholesterol, triglycerides, HDL ,LDL and vLDL) for the different experimental groups of broiler chickens fed diets supplemented with green tea are illustrated in Table 6 and 7. Feeding diets fortified with green tea had no significant effect on bilirubin and HDL among all groups. But achieved significantly higher plasma levels of lipids profile (cholesterol, triglycerides, LDL and vLDL) were dietary supplementation with green tea for broiler chickens compared control group.

According to Shomali et al. (2012), supplementing the diet for two weeks with green tea powder had no effect on the blood markers, including the lipid profile concentrations in broiler chicks. Furthermore, there were no statistically significant differences in the serum lipid markers total cholesterol, LDL-c, HDL-c, and triglycerides between the control and green tea-fed groups. Previous research show that green tea's catechins reduce blood cholesterol levels in broiler chickens fed cholesterol Koo and Yang (1997). According to Yang et al., 2003 broiler chickens' blood cholesterol levels were unaffected by food supplements including green tea byproducts. However, green tea was shown to dramatically enhance HDL-C and decrease blood lipids (total cholesterol and TG) by Afsharmanesh and Sadaghi (2014).the experimental groups fed the fortified diets achieved significantly lower concentrations of SOD, particularly when the levels of green tea supplementation. On the other hand, dietary supplementation with green tea levels caused a significant increase in plasma levels of MDA compared with the control group. According to studies (Yokozawa et al., 2002), green tea catechins enhance total plasma antioxidant activity. Superoxide dismutase activity in serum and catalase expression in the aorta are both increased by the consumption of green tea extracts; these enzymes are associated with cellular defense against reactive oxygen species Negishi et al., 2004. Nitric oxide plasma concentration is reduced as a result of this action, which also has an impact on oxygen species directly Yokozawa et al., 1999. After consuming green tea, malondialdehyde, a measure of oxidative stress, also drops Yokozawa et al. 2002. These findings imply that catechins

may have an impact either directly (antioxidant) or indirectly (increased activity or expression). The oxidation of other antioxidants, such as vitamin E, may be stopped by catechins since they have antioxidant properties in vitro. However, consuming green tea catechins in vivo had no effect on the plasma status of vitamins E and C in Alessio et al.2003. However, according to one study (Tijburg et al., 1997), catechins raise the amount of vitamin E present in low-density lipoprotein, which could shield it from oxidation Yokozawa et al., 2002.

Feeding the diets fortified with green tea had a significant effect on plasma total protein, albumin and globulin. But, the experimental groups received diets containing green tea with lower concentrations of plasma total protein, albumin, and globulin compared with the control group. This result agreed with Yang et al., 2019 discovered that, in comparison to the control, dietary supplementation with tea polyphenol significantly reduced serum total protein levels.

Feeding diets fortified with green tea had a significantly higher concentration of plasma activity on transaminases (AST and ALT). this result with agreed Yang et al., 2019 The total protein content (TP) in the serum of the treated group and the control group considerably decreased after 42 days of eating the diet supplemented with tea polyphenols. Many chronic and cardiovascular disorders, particularly cardiovascular diseases, can be somewhat alleviated by EGCG found in polyphenols. Zhang et al. (2018) There may be a link between some liver illnesses and the rise in total protein content. Ikuko et al., 2010 as a result, we assume that adding tea polyphenols will also help to avoid liver disorders.

Table 6. Influence of green tea supplementation on plasma total protein, Albumin, globulin, antioxidant status, ALT, AST and uric in 6-week-old broiler chickens.

Main effects:	Total Protein	ALbumin	Globulin	SOD	MDA	ALT	AST	Uric
Control (0.0 g/kg)	5.140^{a}	2.570^{a}	2.570^{a}	199.2^{a}	3.27^{b}	11.43^{b}	179.5^{c}	9.625^{ab}
Green tea 0.250g/kg)	4.527^{b}	2.337^{ab}	2.190^{b}	174.7^{b}	3.57^{ab}	18.66^{a}	210.0^{c}	11.80^{a}
Green tea (0.500g/kg)	4.597^{b}	2.297^{b}	2.300^{ab}	168.3^{b}	3.84^{a}	16.02^{a}	230.5^{ab}	8.650^{ab}
Green tea (0.750g/kg)	4.547^{b}	2.255^{b}	2.292^{ab}	161.4^{b}	4.02^{a}	17.36^{a}	244.7^{a}	8.368^{b}
Pooled SEM	0.0511	0.0641	0.0862	4.334	0.1165	0.9107	7.537	0.7563
P value	0.0001	0.0199	0.0479	0.0003	0.0037	0.0006	0.0003	0.0295

Means in the same column with various superscripts differ considerably (P 0.05) in the range a to c

Table 7. Influence of green tea supplementation on plasma creatin, cholesterol, triglycerides, HDL ,LDL and vLDL in 6-week-old broiler chickens

Main effects:	Creatin	Bilirubin	CHOL	TG	HDL	LDL	vLDL
Control (0.0 g/kg)	0.3325^{b}	0.3300	89.65^{b}	60.00^{b}	42.000	35.66^{b}	12.00^{b}
Green tea (0.250g/kg)	0.4300^{a}	0.3700	120.0^{a}	76.00^{ab}	40.525	64.30^{a}	15.20^{ab}
Green tea (0.500g/kg)	0.4600^{a}	0.3500	136.7^{a}	69.00^{b}	43.37	76.77^{a}	13.80^{b}
Green tea (0.750g/kg)	0.4600^{a}	0.3525	131.7^{a}	91.25^{a}	49.00	64.40^{a}	18.250^{a}
Pooled SEM	0.0218	0.0329	4.704	4.209	3.756	5.312	0.8419
P value	0.0040	0.8617	0.0001	0.0015	0.4377	0.001	0.0015

Means in the same column with various superscripts differ considerably (P 0.05) in the range a to b

CONCLUSION

Based on the results thus far, it can be said that adding green tea to the diet can increase the effectiveness of production performance and blood parameters in broiler chickens**.**

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تأثير العلائق المدعمة بالشاي الأخضر على أداء النمو ، وبعض مقاييس الدم والحالة التأكسدية لكتاكيت التسمين

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الملخص

أجريت هذه الدراسة بهدف دراسة تأثير التغذية علي علائق مدعمة بأربع مستويات مختلفة من الشاي الأخضر (0,0 ، 0,25 ، 0,50 ،0,75جم / كجم علف) على الأداء الإنتاجي، بعض قياسات الدم، والحالة التأكسدية لكتاكيت التسمين. حيث تم توزيع عدد 96 كتكوت عمر يوم غير مجنسة علي أربع مجموعات متساوية،بكل منها أربع مكررات، وسكنت في بطاريات. تم تقديم العلف والماء بصورة حرة حتى نهاية التجربة في عمر 6 أسابيع. وقد أوضحت النتائج أن المجموعة المغذاه علي عليقة مدعمة بـ 0,75 جرام من الشاي الأخضر/كجم علف حققت أعلى وزن جسم مقارنة بالمجموعات الأخرى. كما أظهرت النتائج أن تدعيم العلائق بمستوى0,5 جرام من الشاي الأخضر /كجم علف أدى إلى زيادة معدل استهلاك العلف خلال فترة التجربة وكان ذلك مصحوبا بتحسن فى معامل التحويل الغذائي لهذه المجموعة مقارنة بالمجموعات التجريبية الأخرى. لم تؤثر التغذية علي العلائق المدعمة بالشاي الأخضر بشكل كبير على مستويات البيلوروبين أو الدهون الليبوبروتينية عالية الكثافة مقارنة بمجموعة الكنترول. ومع ذلك، أظهرت المجموعات المغذاه علي علائق مدعمة بالشاي الأخضر مستويات أعلى معنوية لمستوي الدهون في بلازما الدم وكذلك نشاط إنزيمات الكبد مقارنة بالمجموعة القياسية. أشارت نتائج الدراسة إلى التأثير الإيجابي لإضافة الشاي الأخضر بمستويات (0,25 ، 0,50 ،0,75جم / كجم علف) للعلائق على أداء النمو وبعض قياسات الدم لكتاكيت التسمين من سلالة كوب-500.