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Growth Performance, Meat Quality and Caecal Coliform Bacteria Count of Broiler Chicks Fed Diet with Green Tea Extract

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ABSTRACT : This study was conducted to investigate the effect of dietary green tea extract (GTE) on the performance, carcass and gastrointestinal tract (gut) traits, caecal coliform bacteria count, and pH and color (CIE L*, a*, and b*) values of the breast muscle in broilers. A total number of 600 day-old broilers (Ross 308) was allocated to three treatments with four replicates containing 50 (25 males and 25 females) birds. The dietary treatments consisted of the basal diet as the control (0GTE) and diets with GTE at 0.1 (0.1GTE) or 0.2 (0.2GTE) g/kg. Body weights and the feed intake of broilers were measured at 1, 21 and 42 days, the feed intake was measured for different periods and the feed conversion ratio was calculated accordingly. At 42 day four birds per replicate were slaughtered for the determination of carcass and organ weights, caecal coliform bacteria count, and also quality of the breast muscle. The dietary GTE increased the body weight, feed efficiency, carcass weight and dressing percentage and decreased caecal coliform bacteria count of broilers ($p<0.05$). The 0GTE broilers consumed ($p<0.01$) less feed than the 0.1GTE birds in the entire experimental period. The relative abdominal fat weight and gut length of broilers in the 0.2GTE were tended to be lower ($p<0.07$) than those in the 0GTE group. The breast meat from 0.1GTE birds had a lower pH value when compared to that from 0GTE birds. The 0.1GTE broilers had lighter breast meat than 0GTE and 0.2GTE birds. The dietary GTE increased a^* and b^* values of the breast meat. Thus this product appeared to have a measurable impact on CIE color values of the breast meat in broilers. The results of the present study may indicate that the improved production results in the group with added GTE are directly connected with physiological mechanisms such as the regulation of the caecal micro-flora. (**Key Words :** Broiler, Green Tea, Performance, Coliform Bacteria, Breast Muscle Color)

INTRODUCTION

As a result of ban on the sub-therapeutic use of antibiotic growth promoters in animal diets in European Union since January 2006 and growing pressure on livestock producers in other parts of the world, alternative substances and strategies for animal growth promotion are being investigated, among which phytogenic and herbal products have received an increased attention since they have acquired more acceptability among consumers as natural additives (Toghyani et al., 2010). Although action mechanism of phytogenic and herbal feed additives vary, a positive effect can be expressed through the better appetite, improved feed conversion, stimulation of the immune system and increased vitality, regulation of the intestinal micro-flora, etc. Therefore, a number of studies has focused on the antimicrobial properties as well as growth promoting effects of various plants and plant extracts (Hanczakowska and Urbanczyk, 2002; Cross et al., 2007; Ocak et al., 2008; Erener et al., 2010; Sarker et al., 2010; Toghyani et al., 2010). These investigations have, however, shown that the assumption that phytogenic and herbal feed additives, might improve the growth performance of poultry has not been confirmed yet and thus, a systematic approach on the efficacy and safety of compounds used as feed additives for poultry is still missing. The assumption is that differences in results are consequences of numerous factors, such as the type and part of plant used and their physical properties, the time of harvest, the preparation method of phytogenic additive and compatibility with other food components (Yang et al., 2009). Therefore, growth promoter and antimicrobial abilities of various plant extracts are still studied.

Green tea, which is also popular beverage, is obtained from a nonoxidized and unfermented leaves of the evergreen plant *Camellia sinensis* that grows mainly in tropical and sub-tropical climates. The most abundant

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constituent of green tea extracts (GTE) is catechins which has antibacterial activities (Cao et al., 2005; Hara-Kudo, 2005), as well as antitumorigenic, anti-inflammatory, antiproliferative, antiviral, anti-parasitic and antioxidative properties (Crespy and Williamson, 2004; Fujiki, 2005; Jang et al., 2007). The GTE is also a rich source of polyphenolic compounds and hence could possess strong antioxidant properties (Crespy and Williamson, 2004; Fujiki, 2005).

Green tea or its polyphenols has been used as an ingredient or feed additives in animal such as fish (Kono et al., 2000), calves (Ishihara et al., 2001) and pigs (Suzuki et al., 2002; Yang et al., 2003; Basini et al., 2005), laying hens (Uuganbayar et al., 2005; 2006) and broilers (Biswas and Wakita, 2001; Kaneko et al., 2001; Cao et al., 2005; Sarker et al., 2010). These investigations informed that the principle substances, which play an important role to demonstrate the various functions of green tea or tea extract, are catechins and its major components, such as epicatechin, epigallocatechin, epicatechin gallette, epigallocatechin gallette. Biswas and Wakita (2001) reported that supplemental green tea powder tended to decrease the feed intake and body weight gain with a higher dose, but tended to improve the feed conversion ratio. Kaneko et al. (2001) observed the beneficial influence of green tea on the broilers productive performance and lean meat production of the broilers, and also later in other study Sarker et al. (2010) stated that a diet containing 0.5% green tea were suitable for the broiler growth performance and meat chemical composition. While the chemical composition of poultry meat has an important role for a health-driven market or gourmet market due to their fat contents, color changes are an important factor influencing the quality and acceptability of meat and meat products (Carpenter et al., 2007). However, effects of green tea extract (GTE) and its chemical components or major components in catechins on changes in color (CIE L*, a* and b*) characteristics of broiler meat have not been reported. Cao et al. (2005) reported that green tea polyphenols in semi-purified broiler diets can decrease the mortality and change the caecal colonic flora population. Cecum is one of the areas of greatest microbial activities in the gastrointestinal tract of chickens. Intestinal micro-flora plays an important role in the health status of host animals. Therefore, a common approach to maintain host health is to increase the number of desirable bacteria in order to inhibit colonization of invading pathogens (Guo et al., 2004). It was reported that green tea and its chemical components show antibiotic-like effects of non-selectively decreasing total counts of all micro-flora (Cao et al., 2005).

Keeping in view the positive effects of green tea or its polyphenols on animal performance a research study was conducted with the objective to evaluate the impact of two levels of GTE on the growth performance, carcass and gastrointestinal tract traits in broiler chicks. The main aim of the study reported herein was to investigate the changes in pH and color characteristics (CIE *L**, *a** and *b**) and caecal coliform bacteria count as influenced by GTE included in the diets.

MATERIALS AND METHODS

Animals and diets

The management of broilers chicks and all procedures in the present study were performed according to the Animal Experimental Guidelines for Ondokuz Mayis University local Ethical Committee.

Six hundred day-old broiler chicks (Ross 308) were purchased from a local hatchery. On arrival birds were weighed (49.1±0.02 g) and assigned to one of three treatments with four replicates of 50 (25 males and 25 females) birds. The dietary treatments consisted of the basal diet as the control (0GTE) and the diets with GTE at 0.1 (0.1GTE) or 0.2 (0.2GTE) g/kg. The total catechin content of GTE was determined by using the method described by the ISO (2005). The catechin components were isolated by HPLC (Thermo Separation Product). The amounts of supplements were chosen as treatments considering the reported average content of active components in GTE. The liquid GTE measured by measuring cylinder for each of treatments was sprayed onto a small amount of basal diet and then this premix was added to a sufficient amount of feed to achieve the desired final concentration. All diets were prepared daily. Table 1 lists the basal diet (mash form), which was formulated to meet the nutrient requirements of broilers as recommended by NRC (1994). The GTE obtained from a hydrodistillation extract of green tea leaves produced on the eastern Black Sea coast of Turkey, which has a mild climate with high precipitation and fertile soil (Karkim, Karadeniz Kimya, Samsun, Turkey). Chicks were raised on floor pens (3.50×1.75×0.75 cm) littered with wood shavings for 6 weeks and had free access to feed and water through the entire experimental period (0-42 d). The plastic feed troughs were replaced after 2 weeks by cylindrical hanging feeders. The feeder space was 2 cm per bird. The lighting program consisted of a period of 23 h light and 1 h of darkness. The ambient temperature was gradually decreased from 33°C to 25°C on day 21 and was then kept constant.

Data collection and sampling

Body weights of broilers were determined at 1, 21 and 42 days of age. The feed intake and weight gain were recorded in different periods and feed conversion ratio was calculated. Mortality was recorded as it occurred. At 42 days of age, four birds (two males and two females) per

Table 1. Ingredients and composition of the basal diet

Ingredients (g/kg)	Starter (1-21 d)	Grower (22-35 d)	Finisher (36-42 d)
Yellow maize	40.78	32.94	41.51
Soybean meal	29.00	27.62	25.00
Sunflower meal	7.77	-	-
Wheat	10.00	6.50	12.43
Wheat bran	-	20.00	10.00
Meat and bone meal	6.39	6.42	5.19
Vegetable oil	5.20	5.62	5.00
Salt	0.25	0.25	0.25
Vitamin-mineral premix[1]	0.35	0.35	0.35
L-lysine	0.12	0.12	0.10
DL-methionine	0.11	0.18	0.17
Analyzed* and calculated nutrient composition (%)			
Dry matter*	89.8	89.6	89.8
Crude cellulose*	4.00	4.26	4.17
Ash*	5.77	5.28	4.92
Ether extract*	6.48	7.35	7.28
Crude protein	23.00	21.00	19.00
Metabolizable energy (MJ/kg)	12.60	13.20	13.40
L-lysine	1.10	1.00	0.85
DL-methionine	0.50	0.38	0.32
Methionine+cystine	0.90	0.72	0.60
Calcium	1.00	0.90	0.80
Available phosphorus	0.45	0.35	0.30

[1] Contained per kilogram of premix: 6,000,000 IU vitamin A, 1,200,000 IU vitamin D_3, 15,000 mg vitamin E, 2,000 mg vitamin K_3, 1,500 mg vitamin B_1, 3,500 mg vitamin B_2, 12,500 mg Niacin, 5,000 mg Calcium D pantothenat, 2,500 mg vitamin B_6, 7.5 mg vitamin B12, 500 mg Folic acid, 22.5 mg D-Biotin, 62,500 mg Choline chloride, 25,000 mg vitamin C, 750 mg Canthaxanthin, 250 mg Apo carotenoic acid, 30,000 mg Fe, 40,000 mg Mn, 30,000 mg Zn, 2,500 mg Cu, 100 mg Co, 500 mg I, 75 mg Se.

replicate randomly chosen were slaughtered and abdominal fat, liver, empty gizzard, heart, full gastrointestinal tracts (gut) were collected, weighed and calculated as their percentages of body weight and dressing percentage and relative organ weights were recorded, and also the length of gut was measured and calculated its percentage of body weight. The gut weight to the gut length ratio was calculated.

Left breast (*Pectoralis major*) muscles were collected at 12 h postmortem for the evaluation of color characteristics (CIE *L**, *a** and *b**) and pH values. CIE color values (Hunt et al., 1991) of the left breast (*Pectoralis major*) muscle representing lightness (*L**), redness (*a**) and yellowness (*b**) were measured on the surface of the ventral side of the breast muscles at 8 h post-mortem by using a Minolta colorimeter (Minolta Corp., Osaka, Japan). The colorimeter was calibrated throughout the study using white and pink ceramic tiles. Lightness ranges from 100 (white) to 0 (black). While positive *a** and *b** values are a measure of redness and yellowness, respectively, negative *a** and *b** values indicate greenness and blueness. Hence, the higher *L**, *a** and *b** values indicated paler, the more red and yellow meat, respectively. The color was measured at five random locations on each breast meats and mean color values were calculated for each breast meats. The pH value of breast muscle was determined at 8 h post-slaughter in 16 broilers from each experimental group with a pH meter (Sensorex, S175CD Spear Tip, Garden Grove, CA, USA) equipped with an insertion electrode (Cyberscan PC 510) calibrated in buffers at pH 4.01 and 7.01 (Mettler Toledo, Tampa, Florida, USA) at ambient temperature.

The isolation of coliforms from the caecum was completed using the method described by the Food and Drug Administration (1984). The standard plate counts were done for bacterial enumeration. For this purpose, with respect to the total coliform bacteria count, each of 16 caecum samples per treatment was removed from each bird and the fresh excreta of the caecum were gently squeezed and carefully collected in sterilized 25-ml tubes containing pooled excreta for 4 birds per pen at the end of the experiment. Three grams of fresh caecum samples were diluted with 10 ml distilled water and vortexed before pH was measured. One gram of wet sample was diluted with 10 ml of sterilized distilled water, of which 1 ml was transferred into 9 ml of sterilized distilled water. Samples were serially diluted from 10^{-1} to 10^{-7}. One-tenth milliliter of each diluted sample was plated on the Violet Bile Agar for the enumeration of coliform bacterial populations. The plates were incubated at between 35 and 37°C for 18 to 24 h. Coliform bacteria colonies were identified and counted. The average number of live bacteria in gram of the original content of caecal intestine was calculated by the multiplication of counted colonies by the dilution factor. The Dilution factor is a reciprocal value of dilution exponent. Such value is expressed as CFU/g (Colony Forming Units), i.e. units that form colonies (Barnes and Impey, 1970).

Statistical analysis

The data from trials were subjected to one-way ANOVA. All statistical analyses were conducted using SPSS (1999). Coliform counts were transformed to logarithms before analysis. Levels of dietary GTE supplementation were designed analyzed as an orthogonal polynomial. Thus, linear and quadratic effects were determined by orthogonal polynomial contrasts. Means were compared using The Student-Newman-Keuls multiple-range test. Statements of statistical significance are based on p<0.05.

RESULTS

The result of analysis for catechin components of green tea extract used in this experiment is presented in Table 2. The percentage of epicgallocatechin gallette component, which accounted for 55.6%, in total catechins was higher than that of other components. No significant differences in mortality among the treatment groups (2.50%, 2.00%, and 2.50% for the 0GTE, 0.1GTE and 0.2GTE respectively) were observed. The inclusion of the GTE into broiler diet affected the body weight, feed intake and feed efficiency in the first 3 weeks or the entire period (1 to 21 or 42 d of age) of fattening (Table 3). The body weight was increased by the 0.1GTE and 0.2GTE compared to the 0GTE (p<0.05).

Table 2. Catechin components of green tea extract (%, dry matter basis)

Components	%
(+) Catechin	0.51
Epicatechin	2.83
Epigallocatechin	1.33
Epicatechin gallette	1.52
Epigallocatechin gallette	7.74
Total catechins	13.93

The feed intake was decreased (p<0.05) by the 0.2GTE in the first 3 weeks of fattening compared to the 0.1GTE but this reduction was not reflected during the entire period of fattening. The 0GTE broilers consumed (p<0.01) less feed than the 0.1GTE birds during the entire experimental period (0-42 d). The feed efficiency was improved by the 0.2GTE in the first 3 weeks or the entire experimental period comparing with the 0GTE. During the 1 to 42 days of age the effects for the body weight gain, feed intake and feed efficiency were linear, quadratic and linear respectively.

Means for the carcass weight, the relative weight and length of gut and the relative weight of edible inner organs (gizzard+heart+liver), empty gizzard and abdominal fat pad, and also caecal coliform count at slaughter age (42 days) are shown in Table 4. The carcass weight and dressing percentages of broilers in the 0GTE was lower (p<0.05) than those of in the 0.1GTE and 0.2GTE. The inclusion of the GTE into broiler diet decreased the caecal coliform count of broilers compared to the control group. The relative weight and length of gut and the relative weight of edible inner organs and empty gizzard were not markedly affected. The relative abdominal fat weight and relative gut length of broilers in the 0.2GTE was tended to be lower (p<0.07) than those in the 0GTE group. The effects for the carcass, dressing percentage and relative abdominal fat weight were linear.

Table 3. Performance parameters of broilers fed diet with the green tea extract

Parameters	Diet			SEM	p
	0GTE	0.1GTE	0.2GTE		
Body weight (g)					
1 d	49.1	49.1	49.1	0.02	NS
21 d	810^{b}	831^{a}	827^{a}	3.98	*
42 d	$2,447^{b}$	$2,514^{a}$	$2,512^{a}$	11.24	*
Feed intake (g)					
1 to 21 d	$1,378^{ab}$	$1,387^{a}$	$1,368^{b}$	5.75	*
1 to 42 d	$4,429^{b}$	$4,534^{a}$	$4,488^{ab}$	14.52	**
Feed:gain (g:g)					
1 to 21 d	1.70^{a}	1.67^{ab}	1.65^{b}	0.007	*
1 to 42 d	1.81^{a}	1.80^{ab}	1.79^{b}	0.003	*

[a,b] Values, which are means of four pens of 50 birds, in the same row not sharing a common superscript differ significantly.
NS = Not significant, p>0.05; * p<0.05; ** p<0.01. SEM = Standard error of the mean.

Table 4. The **c**arcass weight (g) and relative organ weights or length (g or cm/100 g BW), and caecal coliform counts (cfu/g) of broilers fed diet with the green tea extract

Traits	Diet			SEM	p
	0GTE	0.1GTE	0.2GTE		
Carcass weight	1,838[b]	1,966[a]	2,029[a]	30.17	**
Relative weight of					
Carcass	74.71[b]	75.51[a]	75.64[a]	0.167	**
Edible inner organs	3.73	3.74	3.56	0.044	NS
Abdominal fat	2.08[b]	1.96[ab]	1.81[a]	0.089	*
Empty gizzard	1.16	1.18	1.81	0.033	NS
Gut	6.92	6.65	6.60	0.084	NS
Relative length of gut	0.09[a]	0.08[ab]	0.07[a]	0.011	*
Gut weight:gut length	80.72	81.70	83.09	1.014	NS
Caecal coliform count	7.36[a]	6.87[b]	6.74[b]	0.093	**

[a,b] Values, which are means of 16 birds per treatment, in the same row not sharing a common superscript differ significantly.
NS = Not significant, p>0.05; * p<0.07; ** p<0.05. SEM = Standard error of the mean.

As Table 5 exhibits the pH and color values of breast muscle were affected by diets supplemented with GTE. The 0.1GTE resulted in the breast meat color that was lighter than that found in the other treatment birds (p<0.01). The breast muscle from the 0GTE birds had lower (p<0.01) *a** and *b** values than those from the 0.1GTE and 0.2GTE birds, respectively. The effect for the L* of breast meat was quadratic while the effects for a* and b* of breast meat were linear. The pH value of breast muscle from broilers in the 0.1GTE was tended to be lower (p<0.07) than that in the 0GTE group. The effect for the pH values of breast meat was quadratic.

DISCUSSION

The GTE used in the present study was obtained from a liquid hydroalcoholic extract of fresh green tea (*Camellia sinensis*) and was similar in composition to that found in some green tea powders in literature **(**Uuganbayar et al., 2005, 2006). Indeed Uuganbayar et al. (2006) reported that epicgallocatechin gallette is the main catechin compounds accounting for more than half of the total catechins in Korean, Japanese and Chinese green tea powders as observed in our study. It must be underline that a higher amount of epicgallocatechin gallette is usually a good quality indicator for the GTE due to many physiological and biochemical functions including antioxidant and antimutagenic effects.

The results of the present study shows that the feeding diet with GTE caused a measurable variation in the meat quality characteristics such as pH and color values as well as the performances, carcass and digestive tract traits and caecal coliform count of broilers, in which the 0.2 g/kg level tended to be more effective. The main objective of using these substances in broiler diets is to improve their feed efficiency as well as body weight (Kaneko et al., 2001; Cao et al., 2005; Sarker et al., 2010). A higher feed intake observed in broilers fed diet with GTE at 0.1 g/kg in the entire experimental period might be due to the facts that the nutrient requirements of birds with rapid growth rates and a large body size are bigger than those of birds with slow growth rates and a small body size (NRC, 1994). The most efficient FCR in broilers fed diets supplemented with GTE at 0.2 g/kg reveals that the impact of growth promoter substances, such as phytogenic products, on performance could be related to a more efficient use of nutrients, which in turn results in an improved FCR (Lee et al., 2003; Schiavone et al., 2007; Ocak et al., 2008). Richards (2003) noted that the feed intake is a basic and important factor that determines the rate of growth and body composition achieved by animals throughout their lifecycles. The improvement in the body weight and feed efficiency of

Table 5. The color and the pH values of breast muscle (*Pectoralis major*) of broilers fed diet with the green tea extract

Traits	Diet			SEM	p
	0GTE	0.1GTE	0.2GTE		
*L**, lightness	57.34[b]	63.08[a]	58.60[b]	0.473	**
*a**, redness	2.02[b]	2.53[a]	2.64[a]	0.082	**
*b**, yellowness	-1.74[b]	0.13[a]	0.21[a]	0.215	**
pH	5.67[a]	5.48[b]	5.61[ab]	0.035	*

[a,b] Values, which are means of 16 birds per treatment, in the same row not sharing a common superscript differ significantly.
* p<0.07; ** p<0.01. SEM = Standard error of the mean.

birds fed with diets containing the GTE shows that the use of these products is a feasible alternative to antimicrobial feed additives used as growth promoters. These findings are in general agreement with previous studies using the green tea or its polyphenols in broiler chickens diets (Kaneko et al., 2001; Cao et al., 2005; Sarker et al., 2010) but not with study by (Biswas and Wakita, 2001). The discrepancy between the studies may be explained that the differences in total catechin content and its major components, such as epicatechin, epigallocatechin, epicatechin gallette, epigallocatechin gallette, of the green tea and green tea extract used in the studies.

Although the action mechanism of phytogenic and herbal feed additives varies depending on numerous factors (Yang et al., 2009), the significant influence of the additive on the final body weight and feed efficiency in our study could be attributed to the composition of the basal diet, origin and polyphenols of the green tea used and the time of harvest, the preparation method of phytogenic additive and/or the environmental conditions. The growth promoting agents may have more impact when the diet used is less digestible and well-nourished, healthy chicks do not respond to antibiotic supplements provided that they are housed under the clean and disinfected conditions (Lee et al., 2003; Hernandez et al., 2004; Cross et al., 2007; Toghyani et al., 2010). Therefore, the result with respect to the body weight and feed efficiency indicate that the experiment was not performed under ideal conditions, because the diets were consisted of highly digestible ingredients in different periods so that the total coliform bacteria counts in the caecal intestine probably may have been limited which could not affect the degree of the growth promotion. Indeed, it has been reported that antibiotic-like effects of the green tea polyphenols causing a decrease on all colonic floras in broilers (Cao et al., 2005). Therefore, the higher body weight, improved FCR and the regulation of the caecal micro-flora observed in broilers on the GTE diets may be related to the reported properties of the green tea and to its chemical components (Crespy and Williamson, 2004; Cao et al., 2005; Friedman, 2007; Jang et al., 2007). The differences in body weight among the experimental groups were evident in the dressed bird weights at slaughter. Therefore, discrepancies in the feed intake, the amount of metabolizable energy and the protein ingested by the birds can be explained by the differences observed in carcass yields.

The extract used in the present study was obtained from a hydrodistillation extract of green tea leaves produced on the eastern Black Sea coast of Turkey and differed in composition to that found in other sources such as the Japanese green tea powder (Biswas and Wakita, 2001; Kaneko et al., 2001), the Japanese and Chinese green tea or their polyphenols (Cao et al., 2005) and the Korean green tea powder (Sarker et al., 2010). The dosage of the GTE additives applied in current study has been probably such a level that would cause a beneficial effect on productive traits although the linear effects observed for the body weight and feed efficiency in the entire period of fattening indicate that the concentrations of GTE used in this experiment were still below the critical level to yield appreciable additive effects on the performances of the broiler chickens. There were reports of significant reduced the body weight gain in broilers receiving diets supplemented with 1.0, 2.5 and 5.0% green tea (Kaneko et al., 2001), 1.5% green tea powder (Biswas and Wakita, 2001) and 1.0% (Sarker et al., 2010) which are considerably higher levels of active principles compared to levels used in our research. Based on the mortality result, there was no clear effect of GTE on health-related problems in broiler chickens, confirming the suggestion of Cao et al. (2005).

The product used in the current appeared to have a measurable impact on CIE color values of breast meat in broilers. The color of muscle tissue was lighter from chickens with a lower pH in accordance with other studies on broilers in which final pH was determined (Fletcher, 1999). According to CIE lightness values of meats in poultry, Qiao et al. (2002) classified as follows: lighter (pale, $L^*>53$), normal ($48<L^*<51$) and darker (dark, $L^*<46$), while Petracci et al. (2004) reported that corresponding values were $L^*>56$, $50\leq L^*\leq 56$ and $L^*<50$, respectively. Previous studies reported that pale meat had a lower a* and pH value than normal and dark meat and is associated with higher b* values (Fletcher, 1999; Qiao et al., 2001). Based on these values and results, the L*, a*, and b* values for all treatments in the current study were in a normal range and would not be considered excessively pale although the diet with GTE at 0.1 g/kg produced lighter (pale) or the diet with GTE at 0.1 and 0.2 g/kg produced more redness and yellowness than the control diet. As known, the color of GTE is due to chlorophyll and partly because of the polyphenols in tea, and catechins, such as epigallocatechin gallette in GTE, are among the most potent natural antioxidants. The color and antioxidant properties of GTE may be given possible a lighter and more redness meat that may not have any relation to pH value. Unfortunately this situation was not investigated in the present study. The fact that feeding with 0.1 g GTE/kg supplement affected the pH profiles indicates that the water-holding capacity determined as the percentage of drip loss in meat samples affected by 0.1 g GTE/kg supplementation. The pH value of meat from birds fed the diet with GTE shows that the less will be diminution in water-holding capacity of their meats in the present study. Indeed, it has been reported that the overall lower final pH did not result in an overall decrease in water-holding capacity (Young et al., 2003).

The results of the present study may indicate that the improved production results in the group with added GTE are directly connected with physiological mechanisms such as the regulation of the caecal micro-flora. Also, it appears to have a measurable impact on CIE color values of breast meat. Considering the parameters, diets with GTE at 0.2 g/kg were found to be suitable for the broiler growth performance and meat quality. Due to the fact that the report on the supplementation of GTE in poultry is limited, it can be considered as the first evidence presenting the effect of the GTE on the body weight gain, feed efficiency ratio, carcass weight, dressing percentage and the total coliform bacteria counts in the caecal, and also CIE color values of breast meat of broiler. In conclusion, this study is helpful for poultry nutritionist and the sector although more detailed studies are still needed to elucidate the effect of GTE on poultry nutrition under various circumstances.

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