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EFFECT OF DIFFERENT LEVELS OF GREEN TEA (*CAMELLIA SINENSIS*) ON PRODUCTIVE PERFORMANCE, CARCASS CHARACTERISTICS AND ORGANS OF BROILER CHICKENS

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ABSTRACT

In this work we aimed to determine the effect of different levels of green tea in powder form to feed on productive performance, carcass parameters and organs in broiler chickens. Totally 240 day-old broiler chickens Ross 308 were divided to four dietary groups (n = 60) namely control and three experimental groups with supplementation of green tea to feed mixture in levels 0.5%, 1% and 1.5%. Broiler chickens were feeding with commercial feed mixtures and feed and drinking water were provided *ad libittum*. The feeding period lasted 42 days. Individual body weight of broiler chickens was determined at 1, 7, 14, 21, 28, 35 and 42 day, feed sonsumption and mortality per group were determined at 42 day of fattening period. Carcass quality and organs weight of broiler chickens were determined at the end of the experiment. The results indicated that supplementation of different levels of green tea statistically significant decreased body weight gain and we recorded lower body weight in 21 days of age compared with control group. However, in second period of fattening, broiler chickens in experimental groups growing faster and in 42 days of age we found statistically no significantly differences among control and experimental groups. Feed consumption did not differ among the dietary groups at 42 days of fattening. Mortality no affected by supplementation of green tea to broiler chickens diets in comparison with control group. From the carcass parameters addition of green tea significantly decreased percentage of abdominal fat between control and 1.5% green tea level, in other parameters (percentage of breast, percentage of drumstick, carcass yield) were different among control and experimental groups not statistically significant. The caecum and small intestine weights was significantly ($p \leq 0.05$) decreased in chickens fed diets containing 0.5% green tea supplement compared to 1% and 1.5%. For neck, crop, heart, liver, proventriculus, gizzard, pancreas, kidneys, small intestine, caecum and large intestine weights among control and experimental groups we recorded no statistical differences ($p > 0.05$).

Keywords: broiler chicken; green tea; performance; carcass; organs

INTRODUCTION

In history, feed additives, such sub-therapeutic antibiotics, were amply used in order to modulate the intestinal microflora and consequently improving the performance and protect the health status of poultry **(Dibaji et al., 2014; Seidavi and Simões, 2015)**.

Due to the consumer's pressure in whole world, including the prohibition of antibiotic usage as growth promoters in European Union from 2006, the research of alternative natural substances for diet incorporation was enhanced in last years, i.e. probiotis **(Capcarová et al., 2010; Alloui et al., 2013; Ayasan, 2013)**, prebiotics **(Alloui et al., 2013)**, organic acids **(Kopecký et al., 2012)**, bee products **(Haščík et al., 2013; 2015)** and other feed additives **(Hrnčár et al., 2015)** in order to improve nutrient digestibility, control of pathogenic microorganisms, facilitate a favourable intestinal microbial balance, and enhancing absorption of calorigenic nutrients across the gut wall through increasing its absorption capacity **(Al-Harthi, 2002; El-Deek et al., 2003)**.

The blank phytogenic feed additives, e.g. phytobiotics such as green tea (*Camellia sinensis*), also received increased attention **(Seidavi and Simões, 2015)**.

Abdo et al. (2010) found that air-dried green tea leaves contained 7.80% moisture, 92.20% dry matter, 82.40% organic matter, 18.15% crude protein, 8.72% ether extract, 19.32% crude fibre, 9.80% ash, 36.21% nitrogen free extract and 3002 kcal.kg^{-1} calculated metabolisable energy (ME).

Green tea has over 200 bioactive compounds and contains over 300 different substances. The chemical composition of tea is multifaceted, consisting of polyphenols (catechins and flavanoids), alkaloids (caffeine, threobromine, theophylline), volatile oils,

polysaccharides, amino acids, lipids, vitamin C, minerals and other uncharacterised compounds **(Karori et al. 2007; Khan, 2014)**.

Green tea has antimicrobial **(Ishihara et al., 2001; Hara-Kudo et al., 2005; Lee et al., 2006; Erener et al., 2011)**, antioxidant **(Nishida et al., 2006)**, immune modulatory properties **(Ko and Yang, 2008)** and anticoccidial effects **(Jang et al., 2007)**.

Thielecke et al. (2010) observed that green tea has been studied extensively for its potential in the weight management category, with the compound epigallocatechingallate (EGCG), highlighted as a key component. Three mechanisms have been proposed: EGCG could increase energy metabolism and fatty acid oxidation, occurs apidogenesis i.e. inhibit fat cell development and reduce lipid absorption. EGCG has been found to be over 100 times more effective in neutralizing free radicals than vitamin C and 25 times more powerful than vitamin E. Numerous *in vitro* and *in vivo* studies of green tea preparations have demonstrated that the bioactive component of green tea improves the body weight gain and feed efficiency in poultry **(Khan, 2014),** calves **(Sarker et al., 2010a)** and pigs **(Sarker et al., 2010b)**.

This study aims at investigating the effect of different levels of green tea in powder form on productivity, carcass characteristics and organ development of broiler chickens.

MATERIAL AND METHODOLOGY

A total of 240 day-old Ross 308 broiler chicks were housed in a close ventilated broiler house with deep litter. Temperatures were maintained at 33 °C in the 1st week and this was reduced by 2 °C every week then decrease gradually until reach 23 °C in the 6th week. The experiment was realised in housing density 30 $kg.m^{-2}$. Moisture was retained during fattening period between 50 to 60%. Lighting in the poultry house first day was 24 hours and by starting the 5 day became permanent and 23 hours, used the 40 watt bulbs.

Broiler chickens Ross 308 were divided to four dietary groups (n = 60) namely control and experimental groups with supplementation of green tea in powder form to feed (basal +0.5%; basal +1% and basal +1.5%). Broiler chickens were fed commercial feed mixtures (Boskop, a.s., Trencin, Slovak Republic): starter (days 1 to 21) and grower (days 22 to 42), both in powder form. Feeding and watering were *ad libitum*. The nutritive values of the feed mixtures are presented in Table 1.

During the experiment broiler chickens were weighted for individual body weight at 1, 7, 14, 21, 28, 35 and 42 day of age and body weight gain were calculated as the difference between the final and initial chicken weight. Feed consumption and mortality were recorded at 42 day of fattening period.

In 42 day of fattening, representative 10 chickens with body weight similar to the mean were chosen from each group for slaughter weighed and subjected to a 12-hours feed withdrawal. After slaughter, carcasses were weighed and subjected to simplified dissection. Abdominal fat, breast and drumstick were collected and weighed. The organs development was measured by taking weight of the broilers after slaughtering. Neck, crop, heart, proventriculus, gizzard (empty gizzard), liver (without gall bladder), pancreas, caecum, kidney, small intestine and large intestine weights were recorded individually and their percentages in relation to live body weight were calculated. The results obtained were used to calculate dressing percentage and the percentage of carcass components.

Data were analyzed using analysis of variance **(SAS, 2001)**. Significant difference was used at 0.05 probability level and differences between groups were tested using the Duncan's Multiple Range Test **(Duncan, 1955)**.

RESULTS AND DISCUSSION

Table 2 represents the body weight and body weight gain of broiler chickens in control and experimental groups with supplementation of green tea. In period to 21 days of age, the highest ($p \leq 0.05$) body weight was found in

Table 1 Nutritional value of complete feed mixtures.

Nutrient	Unit	Starter (1. – 21. day)	Grower (22. – 42. day)
Crude protein	$g.kg^{-1}$	min. 210.00	min. 190.00
ME	$kJ.kg^{-1}$	min. 12.00	min. 12.00
Lysine	$g.kg^{-1}$	min. 11,00	min. 9.50
Methionine and cistine	$g.kg^{-1}$	min. 7.50	min. 7.50
from that methionine	$g.kg^{-1}$	min. 4.50	min. 4.00
Linoleic acid	$g.kg^{-1}$	min. 10.00	min. 10.00
Calcium	$g.kg^{-1}$	min. 8.00	min. 7.00
Phosphorus	$g.kg^{-1}$	min. 6.00	min. 5.00
Sodium	$g.kg^{-1}$	1.20 – 3.00	1.20 – 2.50
Manganese	$mg.kg^{-1}$	min. 50.00	min. 50.00
Iron	$mg.kg^{-1}$	min. 60.00	min. 60.00
Copper	$mg.kg^{-1}$	min.6.00	min. 6.00
Zinc	$mg.kg^{-1}$	min.50.00	min. 50.00
Vitamin A	$iu.kg^{-1}$	min. 10000	min. 8000
Vitamin B_2	$mg.kg^{-1}$	min. 4.00	min. 3.00
Vitamin B_{12}	$\mu g.kg^{-1}$	min. 20.00	min. 20.00
Vitamin D_3	$iu.kg^{-1}$	min. 1200	min. 1200
Vitamin E	$mg.kg^{-1}$	min. 15.00	min. 15.00

Table 2 Effect of different levels of green tea on body weight and body weight gain in grams.

Day of fattening	Control (mean ±SD)	Green tea 0.50% (mean ±SD)	Green tea 1.00% (mean ±SD)	Green tea 1.50% (mean ±SD)
		Body weight		
1.	44.95 ±3.86	45.03 ±4.03	44.89 ±3.79	45.08 ±3.98
7.	118.24 ±16.74[a]	109.29 ±15.49	108.67 ±16.14	106.94 ±15.88
14.	324.69 ±51.67[a]	305.27 ±49.36	307.91 ±50.46	304.79 ±48.19
21.	748.84 ±97.48[a]	711.65 ±94.21	718.95 ± 96.67	716.42 ±94.11
28.	1219.27 ±151.68	1196.37 ±149.37	1199.87 ±150.38	1193.07 ±147.69
35.	1647.51 ±178.36	1639.66 ±177.29	1643.97 ±178.74	1636.81 ±178.24
42.	2071.62 ±211.86	2078.81 ±213.18	2071.29 ±211.54	2069.57 ±212.67
		Body weight gain		
1. – 7.	10.47 ±2.98[a]	9.18 ±2.75	9.11 ±2.69	8.84 ±2.66
7. – 14.	29.49 ±4.96[a]	28.00 ±4.87	28.46 ±4.71	28.26 ±4.89
14. – 21.	60.59 ±6.59[a]	58.05 ±6.24	58.72 ±6.28	58.80 ±6.27
21. – 28.	67.20 ±8.28	69.25 ±8.44[b]	68.70 ±8.71[c]	68.09 ±8.73[d]
28. – 35.	61.18 ±3.32	63.33 ±3.41[b]	63.44 ±3.44[c]	63.39 ±3.39[d]
35. - 42.	60.59 ±4.79	62.74 ±4.83[b]	61.05 ±4.81	61.82 ±4.84

[a,b,c,d] means within the same row with diff erent superscripts diff er significantly (p <0.05).

chickens in control group compared to all experimental groups. There were almost similar (p >0.05) body weights on all diets with green tea from day old to 21 days of age. These results were equally with **Kaneko et al. (2001)** who reported that 1, 2.5 and 5% of green tea in broiler diets reduced body weight gain of the chicks and **Uuganbayar (2004)** who found that 1 to 1.5% green tea supplement in broiler diet had effect to reduce body weight gain of the chickens. **Biswas and Wakita (2001)** added four levels of green tea powder (0.5, 0.7, 1, and 1.5%) to broiler starter diets. Supplemental green tea powder tended to decrease weight gain at a higher dose. In your experiment, body weight of broiler chickens in experimental groups were similar and were not significant (p >0.05).

Significantly highest weight gain ($p \leq 0.05$) was observed in period from 22 to 42 day of age in 0.5% green tea fed broilers compared to control group. **Sarker et al. (2010)** recorded significantly increased weight gain in broiler chickens during the finishing period at the 0.5% level compared to the 1% level of green tea. In contrast, **Cao et al. (2005)** found that body weight gain from 28 to 42 days of age was not improved. Supplementation of green tea can affect the absorptive processes in the gastrointestinal tract, for example, water, glucose, lipids, cholesterol, amino acids and minerals **(Koo and Noh, 2007; Frejnagel and Wroblewska, 2010)**.

In 42 day we recorded that addition of different levels of green tea not significantly (p >0.05) affected final body weight. **Guray et al. (2011)** supplemented a liquid hydroalcoholic extract of fresh green tea (0.1 or 0.2 $g.kg^{-1}$) in broiler diets. The dietary green tea extract increased the body weight. Recently, **Shomali et al. (2012)** investigated

Table 3 Effects of different levels of green tea on carcass characteristics in %.

Interal organ	Control (mean ±SD)	Green tea 0.50% (mean ±SD)	Green tea 1.00% (mean ±SD)	Green tea 1.50% (mean ±SD)
Breast	30.24 ±0.75	30.31 ±0.81	30.11 ±0.77	30.35 ±0.79
Drumsticks	31.18 ±0.64	30.86 ±0.68	31.11 ±0.59	30.94 ±0.66
Abdominal fat	6.36 ±0.11	6.21 ±0.10	6.19 ±0.11	6.16 ±0.10[a]
Carcass yield	78.87 ±1.84	78.86 ±1.96	78.81 ±1.88	79.02 ±1.93

Note: [a] means within the same row with diff erent superscripts diff er significantly (p <0.05).

Table 4 Effects of different levels of green tea on proportion of internal organs in %.

Interal organ	Control (mean ±SD)	Green tea 0.50% (mean ±SD)	Green tea 1.00% (mean ±SD)	Green tea 1.50% (mean ±SD)
Neck	2.98 ±0.38	3.11 ±0.36	2.96 ±0.39	3.07 ±0.37
Crop	0.29 ±0.08	0.25 ±0.06	0.26 ±0.06	0.28 ±0.07
Heart	0.62 ±0.11	0.64 ±0.13	0.64 ±0.14	0.65 ±0.14
Liver	1.92 ±0.26	1.96 ±0.32	2.08 ±0.35	2.13 ±0.36
Proventriculus	0.35 ±0.09	0.39 ±0.08	0.40 ±0.08	0.36 ±0.09
Gizzard	0.92 ±0.07	0.95 ±0.08	0.97 ±0.08	1.01 ±0.10
Pankreas	0.15 ±0.05	0.16 ±0.04	0.14 ±0.06	0.18 ±0.05
Caecum	0.51 ±0.12	0.49 ±0.09[a]	0.55 ±0.14	0.53 ±0.11
Kidney	0.69 ±0.09	0.72 ±0.13	0.71 ±0.11	0.74 ±0.12
Small intestine	2.331 ±0.32	2.27 ±0.29[a]	2.34 ±0.35	2.35 ±0.31
Large intestine	0.14 ±0.03	0.12 ±0.02	0.15 ±0.02	0.16 ±0.03

Note: [a] means within the same row with diff erent superscripts diff er significantly (p <0.05).

the effects of high levels of greentea powder (1, 2, and 4%) on broiler growth performance for two weeks. Differences in body weight were insignificant. **Yang et al. (2003)** observed no differences in antibiotic and 0.5% green tea by product group, but body weight was decreased when broiler fed green tea by-product at 1% level. Moreover, **Sarker et al. (2010)** observed no changes in body weight and body weight gain of broiler fed green tea and fermented green tea at the level of 0.5 and 1%.

In present study was no significant difference (p >0.05) in feed consumption among control group (1.72kg) and the addition of green tea 0.5% (1.69kg), 1.00% (1.70kg) and 1.50% (1.73kg) during fattening period. **Yang et al. (2003)** determined the optimum level of green tea by-product (0.5, 1, and 2%) in diets and observed non-significant differences in feed efficiency amongst treatments. Similar results were reported by **Cao et al. (2005)** indicating that feed efficiency from 28 days to 42 days of age was not improved. **Shomali et al. (2012)** observed that 1, 2, and 4% levels of green tea powder caused insignificant differences in FCR. In contrast, **Fujiki and Suganuma (2002)** and **Hasan (2014)** observed that potential impovement of feed efficiency upon the supplementation green tea were polyphones particularly catechins, the most abundant of which is epigallocatechin gallate.

The mortality in control and experimental groups with 0.5 and 1.5% levels of green tea was identical (1.67 %), highest mortality we recorded in experimental group with 1% of green tea (3.33%) in 42 days. **Cao et al. (2005)** indicated that mortality was significantly reduced by supplementation with green tea by-products. This finding in green tea addition in broiler diet is also supported by previous studies **(Yang et al., 2003; Uuganbayar, 2004)**.

Carcass yield was not affected by supplementation of green tea; proportions of breast and drumstick were also no influenced (Table 3). **Biswas and Wakita (2001)** recorded that dressing percentage was not affected by green tea added in four levels of green tea powder (0.5; 0.75, 1, and 1.5%). In contrast, **Guray et al. (2011)** supplemented a liquid hydroalcoholic extract of fresh green tea (0.1 or 0.2 $g.kg^{-1}$) in broiler diets and recorded increased dressing percentage by dietary green tea extract. The inconsistency amongst the studies may be explained by the differences in catechins content of the green tea and green tea extract used in these studies **(Khan et al., 2014)**.

The percentage of abdominal fat was decreased significantly (p ≤0.05) with 1.5% green tea addition (Table 3) compared with other groups. Similar findings, namely that when the green tea by-product level was increased the percentage of abdominal fat decreased in broilers, were reported by **Yang et al. (2003)** and **Guray et al. (2011)**. However, the reduction of abdominal fat would have been caused by the suppressive effect of GTP on feed intake, which in turn reduces hepatic lipogenesis a major site of lypogensis in poultry and fat accumulation in adipose tissue and muscles **(Biswas and Wakita, 2001)**.

The results showed in Table 4 that caecum and small intestine weights was decreased significantly (p <0.05) in broilers fed diets containing 0.5% green tea supplement compared to 1 and 1.5% though no significant (p >0.05) difference were observed with other groups. The neck, crop, heart, liver, proventriculus, gizzard, pancreas, kidney and large intestine weights among control and experimental groups didn't show statistical differences (p >0.05). **Uuganbayar (2004)** found that diets containing 0.5% green tea showed a significant weight loss of the small intestine compared to the control diet, which is similar to our study.

The analyzed data in the table 5 indicates that the treatment had no significant effect (p >0.05) on neck, crop, heart, liver, proventriculus, gizzard, pancreas, kidney and large intestine proportions to body weight compared to control group.

CONCLUSION

Our results suggest that green tea supplementation at 0.5, 1, and 1.5% in powder form to broiler chicken diets no affected final body weight of broiler chickens, feed consumption, carcass parameters, carcass yield and majority of internal organs. Addition of green tea is favourable to the consumers because it makes broilers with less fat content without serious adverse effect on general performance. In conclusion, we can stated, that green tea may be good alternative to antibiotic growth promoters in broiler chickens fattening.

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