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Comparison of green tea and probiotic as alternatives to antibiotic growth promoter in broiler ration

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Abstract

Feed supplements were used up to 35 days in 240 Cobb-500 broilers divided randomly into four groups. The treatments were: control (basal diet; no additives), antibiotic (basal diet + antibiotic), probiotic (basal diet + protexin) and green tea (basal diet + 0.25% green tea powder). Body weight and body weight gain increased significantly (P<0.05) in the antibiotic, probiotic and green tea groups compared to the control. Lower (P<0.05) feed intake and better (P<0.05) feed conversion ratio occurred in the supplemented groups than the control group. Supplementation of antibiotic and green tea increased (P<0.05) crude protein content of the meat, while probiotic and green tea decreased (P<0.05) fat content compared to the control. Gizzard weight increased (P<0.05) in antibiotic group, whereas wing and caeca weight increased in green tea group. Supplemented groups had decreased (P<0.05) caecal microbial number compared to the control group. It is suggested that addition of probiotic and green tea improves growth parameters, composition of broiler meat and reduced microbial population. (*Bangl. vet*. 2018. Vol. 35, No. 1 & 2, 13 – 24)

Introduction

Antibiotics used in animal feeds as growth promoters raise concern about effects on human health. Bacteria that infect men and animals can become resistant. For this reason, European Union banned the use of antibiotics in animal production from 2006 (1831/2003/EC). The phasing out of antibiotic growth promoters will affect the poultry and animal industry at large. To minimize the loss in growth, there is a need to find alternatives. There are alternatives such as organic acids, probiotics, prebiotics, herbs, and immune stimulants.

A probiotic is a microorganism or combination of microorganisms which selectively suppresses the harmful bacteria in the gut (Coppola and Turns, 2004; Fuller, 1989). The advantages of using probiotics include improved health, feed conversion ratio, and growth rate, resistance to disease, and production (Ahmad *et al*., 2006; Tannock, 1999; Murshed *et al*., 2015). Probiotics help in maintaining a healthy gastrointestinal environment through the intake of beneficial microorganisms (FAO/WHO, 2002), which produce vitamin B complex and digestive enzymes, and stimulate intestinal immunity, increasing protection against toxins produced by pathogenic microorganisms (Kyriakis *et al*., 1999; Alexopoulos *et al*., 2004).

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Use of green tea (*Camellia sinensis*) as growth promoter of broiler diet is a new phenomenon in Bangladesh. The physiological and pharmaceutical effects of green tea have been reported (Ishihara *et al*., 2001). Green tea contains as many as 200 bioactive compounds such as flavonoids, amino acids, xanthine alkaloids, vitamins and minerals, which are safe for human health. Low grade green tea and green tea by-products have been used in animal feed (Hossain *et al*., 2012a; Hossain *et al*., 2012b). Green tea has anti-carcinogenic (Mukhatar *et al*., 1999), antimicrobial (Hara–Kudo *et al*., 2005), antioxidant (Nishida *et al*., 2006) and immune modulatory properties (Ko *et al*., 2008). The objective of the study was to compare the effects of antibiotics, probiotics and green tea on growth performance, meat composition, meat yield, internal organ and bone development, and caecal microbial count in poultry in Bangladesh.

Materials and Methods

Birds, diets and management

The study was conducted at Bangladesh Agricultural University Poultry Farm, Mymensingh. A total of 240 one-day-old straight run (mixed sex) Cobb 500 commercial broiler chicks were used for 35 days and randomly distributed in four groups of 15. Starter diet was provided for the first 21 days and grower diet from 22 days of age until end of the study. A corn-soya based diet was formulated (Cobb Breeder Management Guide, 2012) and fed *ad libitum*. The composition of the basal diet is shown in Table 1.

Group 1 was control group with no additives. In group 2, 0.025% antibiotic (oxytetracycline) was mixed with basal diet. In group 3, 0.01% probiotic (protexin) and in group 4, 0.25% green tea were mixed with basal diet. Chicks were given 23 hours and 30 minutes of light and 30 minutes of darkness. Temperatures began at 32°C for one week, with a gradual decrease of 3°C for both the second and third week, before it was settled at a stable 22°C for the study period. The floor space allowed for each bird was 1 sq. ft. A strict biosecurity programme was maintained.

Data collection and record keeping

At the end of the trial, one male and one female broiler having near to pen average weight were taken from each pen. After fasting for 12 hours the birds were slaughtered and bled. Meat was collected from the breast, thigh and drumstick. Composition of meat was determined by the methods of AOAC (2005). Head, neck, shank, viscera, giblet (heart, liver and gizzard) and abdominal fat were removed for determination of meat yield parameters. Total viable microbial counts (TVC) were done for the microbial assessment of caecal digesta. TVC was calculated according to ISO (1995).

Data analysis

The statistical analysis of body weight, body weight gain, feed consumption, feed conversion ratio (FCR), composition of meat, caecal microbial count, meat yield, internal organ and bone development were subjected to analysis of variance (ANOVA) in a completely randomized design (CRD) employing SAS (2009) statistical package program.

Table 1: Composition of experimental diets

Ingredients	Starter (0-21 days)	Grower (22-35 days)
Corn	51.4	61.7
Soybean meal	42.0	31.6
Soybean oil	3.4	3.2
Dicalcium phosphate	1.6	1.7
Calcium carbonate	0.8	0.9
Salt	0.3	0.3
DL-Methionine	0.2	0.2
L-Lysine	0.1	0.1
Vitamin-Mineral Premix	0.3	0.3
Calculated chemical composition (%)		
Dry matter %	86.8	87.1
Metabolizable energy (Kcal/kg)	2985	3070
Crude Protein%	22.5	20.1
Lysine %	1.4	1.1
Cystine %	0.4	0.3
Methionine %	0.6	0.6
Methionine + Cystine %	1.0	0.9
Threonine %	2.0	0.8
Histine %	0.6	0.5
Arginine %	1.7	1.3
Isoleucine %	1.1	0.8
Leucine %	2.0	1.6
Phenylalanine %	1.2	0.9
Valine%	1.2	0.9
Calcium %	0.9	0.9
Available phosphorus %	0.5	0.5

Results and Discussion

Growth performance

Growth performances are presented in Table 2. At 4th week of age, the body weight of the probiotic group was significantly ($P<0.05$) higher than the control group. At the

end of study, body weight and total body weight gain in broilers fed with antibiotic, probiotic and green tea were significantly higher than in the control group (P<0.05). Feed intake of broilers at 4th week of age in the control group was significantly higher than in the green tea group, and higher than in the antibiotic group at 5th week of age. Total feed intake was higher in the control group than the supplemented groups (P<0.05). The FCR was significantly (P<0.05) improved at 5th week of age in the antibiotic group than the control group. However, total FCR was improved (P<0.05) in the supplemented groups than the control group.

Table 2: Growth performance of broilers in different treatment groups

Parameter	Treatments				PSE
	Control	Antibiotic	Probiotics	Green tea	
Body weight (g/bird)					
Day old	44.8	44.5	44.3	44.0	0.7
1st week	159.0	154.3	150.3	152.0	6.0
2nd week	385.0	384.3	391.0	388.25	15.9
3rd week	662.3	649.3	672.0	657.3	39.2
4th week	959.3^{b}	981.8^{ab}	1008.5^{a}	984.8^{ab}	19.1
5th week	1412.5^{b}	1495.0^{a}	1485.0^{a}	1465.0^{a}	26.1
Body weight gain (g/bird)					
1st week	114.3	109.8	106.0	108.0	6.0
2nd week	226.0	230.0	240.8	236.3	13.3
3rd week	277.3	265.0	281.0	269.0	46.8
4th week	297.0	332.5	336.0	327.5	38.6
5th week	453.3^{b}	513.3^{a}	476.5^{ab}	480.3^{ab}	26.2
Total	1367.8^{b}	1450.5^{a}	1440.8^{a}	1421.0^{a}	25.9
Feed intake (g/bird)					
1st week	145.1	145.8	142.7	139.3	4.1
2nd week	349.4	354.1	347.8	341.5	11.8
3rd week	522.6	536.2	537.0	530.3	13.5
4th week	723.5^{a}	694.9^{ab}	708.3^{ab}	681.6^{b}	18.9
5th week	974.6^{a}	929.0^{b}	944.0^{ab}	942.3^{ab}	26.2
Total	2715.1^{a}	2659.9^{bc}	2679.8^{b}	2635.1^{c}	22.0
FCR (feed/gain)					
1st week	1.3	1.3	1.3	1.3	0.1
2nd week	1.5	1.5	1.4	1.5	0.1
3rd week	1.9	2.1	2.0	2.0	0.4
4th week	2.4	2.2	2.1	2.1	0.2
5th week	2.2^{a}	1.8^{b}	2.0^{ab}	2.0^{ab}	0.1
Total	2.0^{a}	1.8^{b}	1.6^{b}	1.6^{b}	0.0

^{a,b,c}Values with different superscripts in the same row differ significantly (P<0.05). PSE= Pooled Standard Error.

Addition of probiotic and green tea in the poultry feed increased weight gain and improved FCR. This is in general agreement with Anjum *et al.* (2005) who obtained similar results with multi-strain probiotics. Ahmad and Taghi (2006) found that broiler supplemented with probiotic (*B. subtilis* and *B. licheniformis*) had significantly higher body weight gain during the grower phase (21-42 days) than control. The role of probiotics as effective alternatives to antibiotic growth promoter in animal nutrition has been reported by many researchers (Ghadban, 2002; Patterson and Burkholder, 2003). Beneficial effects of probiotics on broiler performance (Shim *et al.*, 2012; Ashayerizadeh *et al.*, 2009) have been reported. Biswas and Wakita (2001) reported a higher body weight gain when 0.5% green tea powder was added to the feed for broilers. On the other hand, Yang *et al.* (2003) observed no differences with antibiotic and 0.5% green tea by-products, but body weight was decreased when green tea by-products were fed at 1%. Sarker *et al.* (2010) observed no changes in body weight and body weight gain of broilers fed green tea and fermented green tea at 0.5% and 1%. Mountzouris *et al.* (2007) suggested that probiotics and plant extracts aid digestion and immunity.

The feed intake of probiotic and green tea groups was significantly lower than control group, in agreement with the results of Shim *et al.* (2012) and Afsharmanesh and Sadaghi (2014). The result is consistent with that of Eseceli and Demir (2010) and Erdogan (2007). They reported that probiotic decreased feed intake. Biswas and Wakita (2001) reported a lower feed intake when 1% green tea powder was added to broiler feed for. However, Shomali *et al.* (2012) found no significant differences in feed intake.

The effect of probiotic on FCR is in close agreement with Rahimi (2009) and Zhou *et al.* (2010). They found that supplementing with *B. subtilis* and *B. licheniformis* improved feed conversion efficiency. Moreover, Anjum *et al.* (2005) showed that FCR was significantly improved in chicks fed on protexin, a multi-strain probiotic. Panda *et al.* (2008) reported that dietary *B. subtilis* and *B. licheniformis* enhanced feed efficiency in White Leghorn Breeders. Biswas and Wakita (2001) reported improved FCR with green tea at 1% on broiler. Uuganbayar *et al.* (2006) found better FCR with green tea at 1% in laying hens. However, Shomali *et al.* (2012) found no significant difference in FCR in broilers. The improved performance and FCR upon the supplementation with probiotics and green tea may be due to the increased activity of digestive enzymes caused by probiotic and green tea polyphones particularly catechins, the most abundant of which is *epigallocatechin gallate*.

Dressing parameters, bone development and meat yield of broiler

Dressing parameters were not affected by the supplementation of green tea and probiotic except gizzard, caeca and wing weight (Table 3). Broilers fed green tea showed heavier ($P<0.05$) caeca and wings than antibiotic group, whereas heavier gizzard was observed in antibiotic group than probiotic group. Thigh bone, thigh length, drumstick bone and drumstick length did not differ significantly ($P>0.05$) among groups (Table 4). Meat yield of broiler was not significantly ($P>0.05$) different

between groups (Fig. 1**)**. Abdominal fat content was lower in broilers fed green tea and probiotic compared with those fed antibiotic. In agreement, Luiz *et al.* (2012) reported that broilers fed probiotic had less abdominal fat than the antibiotic and control groups. Similarly, Xiaolu *et al.* (2012) reported that supplementation with *B. licheniformis* decreased fat content.

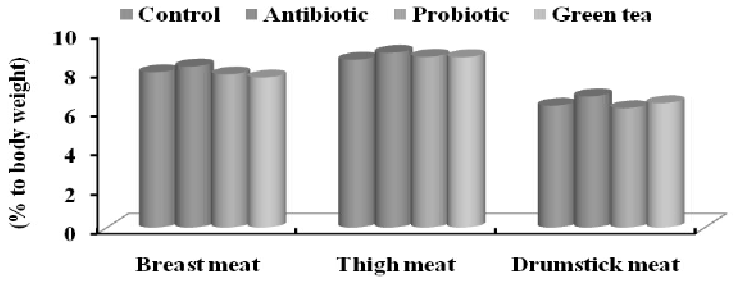

Fig. 1: Meat yield of broiler in different treatment groups.

Table 3: Dressing parameters of broiler in different treatment groups

Parameter (% related to body weight)	Treatment				PSE
	Control	Antibiotic	Probiotic	Green tea	
Blood	4.9	4.5	5.2	5.0	0.7
Feather	3.4	3.7	3.8	3.6	0.4
Skin	6.6	6.6	5.9	5.9	1.0
Head	2.3	2.4	2.5	2.6	0.2
Neck	2.1	2.1	2.1	2.1	0.4
Liver	2.5	2.4	2.6	2.2	0.4
Kidney	0.5	0.5	0.4	0.4	0.1
Heart	0.4	0.4	0.4	0.4	0.0
Abdominal fat	0.9	1.1	0.9	0.7	0.4
Gizzard	1.8^{ab}	1.9^{a}	1.6^{b}	1.9^{ab}	0.2
Ceca	0.7^{ab}	0.5^{b}	0.6^{b}	1.0^{a}	0.2
Wing	5.3^{ab}	5.1^{b}	5.3^{ab}	5.9^{a}	0.4

^{a,b}Values with different superscripts in the same row differ significantly ($P<0.05$). PSE = Pooled Standard Error.

Novak *et al.* (2011) found that supplementation with *B. subtilis* and *B. licheniformis* increased weight of wings. However, yield of wing in probiotic group was not significant in this study but numerically higher than the antibiotic group. Habibi *et al.* (2013) observed most abdominal fat and relative liver weight in the protexin probiotic group and wing weight in bactocell probiotic group, which disagree with our results. Supplementation of green tea at 0.25% in the present study showed lower caeca weight. Sarker *et al.* (2010) observed lower caeca weight in broilers fed green tea at 0.5%, but the weight increased when green tea was fed at 1%. Supplementation of

probiotic and green tea in the present study had no effect on meat yield. Conversely, Molnar *et al.* (2013) reported that *Bacillus spp.* supplementation led to significantly higher breast yield and lower thigh meat yield. Biswas and Wakita (2001) reported higher thigh meat and lower wing meat when green tea was fed at 1.5%. Other authors (Moreira *et al.,* 2001; Loddi *et al.,* 2002) found no significant difference in carcass yield between birds fed probiotic and control diet.

Table 4: Bone development of broiler in different treatment groups

Parameter (% related to body weight)	Treatment				PSE
	Control	Antibiotic	Probiotic	Green tea	
Thigh bone	1.1	1.3	1.4	1.4	0.2
Drumstick bone	1.9	1.8	1.9	2.0	0.2
Thigh length	0.4	0.4	0.4	0.4	0.0
Drum length	0.6	0.6	0.6	0.6	0.0

[a,b]Values with different superscripts in the same row differ significantly (P<0.05). PSE = Pooled Standard Error.

Composition of broiler meat

Incorporation of antibiotic and green tea increased (P<0.5) crude protein content while probiotic and green tea decreased (P<0.5) fat content in broiler meat compared to the control group (Table 5). Moisture and ash content did not differ between groups. Upon the supplementation with green tea, crude protein content increased, and ether extract content decreased in the meat in both antibiotic and probiotic groups. Similarly, Sarker *et al.* (2010) found that crude protein content of meat increased significantly in broilers fed 1.0% fermented green tea compared to other treatments, but ether extract was not changed. The present result is consistent with the findings of Xiaolu *et al.* (2012), who reported that the supplementation with *B. licheniformis* resulted in increased protein content. In contrast, Yang *et al.* (2003) observed lower crude protein in broilers fed green tea at 0.5% than in those fed antibiotics, but no changes in ether extract content.

Table 5: Composition of broiler meat in different treatment groups

Parameter (%)	Treatments				PSE
	Control	Antibiotic	Probiotic	Green tea	
Moisture	74.8	74.6	74.9	74.7	0.3
Crude protein	22.0^{b}	22.4^{a}	22.2^{ab}	22.4^{a}	0.2
Ether extract	2.4^{a}	2.1^{ab}	2.0^{b}	2.0^{b}	0.2
Ash	0.8	0.9	2.0	0.9	0.2

[a,b]Values with different superscripts in the same row differ significantly (P<0.05). PSE= Pooled Standard Error.

Total caecal microbial count

Supplementation of antibiotic, probiotic and green tea significantly decreased ($P<0.05$) total microbial number in the caeca compared to the control group (Fig. 2). The present finding supports the views of Molnar *et al.* (2012) and Adebiyi *et al.* (2012). It was previously reported that green tea extracts improved microflora balance and inhibited pathogenic bacteria (Hara-Kudo *et al.*, 2005). These effects are often concerned with polyphenols, which are mainly composed of catechins. Tea catechins are bactericidal and inhibit the growth of bacterial spores (Hara-Kudo *et al.*, 2005). It was previously reported that green tea extract enhances the growth of some Bifidobacteria, selectively inhibits the growth of clostridia and has no effect on other intestinal bacteria *in-vitro*. The maintenance of the gut environment is now known to be a key part of reducing disease in poultry. Yakhkeshi *et al.* (2011) opined that plant extract and probiotics reduced pathogenic bacteria in digestive tract of broilers, which can improve intestinal health.

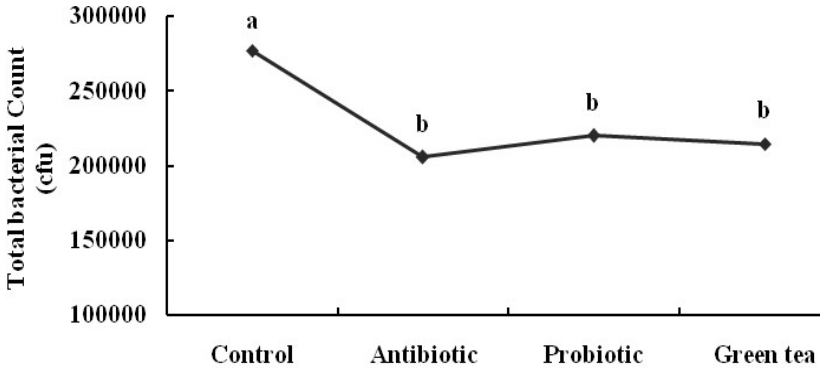

Fig. 2: Caecal microbial number in different treatment groups (cfu/g).

Conclusions

Probiotic and green tea improve growth parameters, internal organs, composition of meat and reduction of microbial population, in a similar way to antibiotic. Use of green tea and probiotic as feed additives in poultry diet, can make antibiotic-free poultry meat, which will be safer for public health.

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