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Dietary *Camellia sinensis* Influences the Broilers: A Review

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ABSTRACT

This study was conducted in order to understand the impact of using dietary *Camellia sinensis* in broilers. In this regards several studies were explored and obtained findings were found to be much interesting and useful. In summary it has been reported by researchers that *Camellia sinensis* supports the feed intake (4480 g/b), water intake (8960 ml/b), live body weight (2356.8 g/b), weekly weight gain (2322.8 g/b), carcass weight (1381.8 g/b) and feed conversion ratio (1.92). Further, it was stated that *Camellia sinensis* reduces the relative weight of heart, liver, spleen, proventriculus, intestine and fat pad by 13.53, 61.1, 2.26, 58.13, 10.2 and 81.41%, respectively compared to their normal weights. *Camellia sinensis* enhances the immunity of broilers that results lower infection rate and mortality rate. Concerning digestibility it was indicated by researchers that digestibility of crude protein improves by 80.33%, ether extract by 76%, crude fiber 33.83% and metabolizable energy by 79.66%. In conclusion, *Camellia sinensis* has been proved an important dietary supplement for the broilers. It supports birds' immunity, production and performance.

Key words: Broiler, Diet, Immunity, Performance, Production.

Camellia sinensis is a rich source of polyphenolic compounds known as flavonoids. The predominant flavonoids in *Camellia sinensis* are catechins. These components are known to have diverse beneficial effects such as anti-mutagenic, antioxidant, anticancer and antiosteoporotic properties as well as antibacterial, antitoxin, antiviral and antifungal effects *in vivo* or *in vitro* (Sommer *et al*., 2010). *Camellia sinensis* has been used for centuries by Korean, Japanese and Chinese people as an anti-aging herb. The *Camellia sinensis* is commonly used in Chinese herbalism, where it is considered to be one of the 50 fundamental herbs (Kaneko *et al.,* 2001).

Modern research has shown that there are many health benefits to drinking *Camellia sinensis*, including its ability to protect the drinker from certain heart diseases. It has also been shown that drinking *Camellia sinensis* can protect the teeth from decay, because of the fluoride naturally occurring in this plant (Shen *et al.,* 2009). For dietary use, the leaves of *Camellia sinensis* are dried that contain polyphenols. These phenolics are antioxidants and help to protect the body against heart diseases, stroke and cancer (Maron *et al*., 2003). Catechins differ slightly in chemical structure from other flavonoids, but share their chemoprotective properties. The most common catechins are gallic esters, named epicatechin (EC), epicatechin gallate (ECG) and epigallocatechin gallate (EGCG). All are found in *Camellia sinensis* and are thought to be responsible for the protective benefits of this beverage (Henning *et al*., 2004).

The European Union has banned the use of several antibiotics in animal feeds, because of the fear of development of "cross-resistance" in bacteria that is resistance-genes may be exchanged between bacteria (Friedman, 2007). Thus, antibiotic supplementations have been limited in poultry diets nowadays. The development of antibiotic free diets is a major problem in poultry production. Recently, green *Camellia sinensis* has attracted attention as a natural product that is non-toxic (Krul *et al*., 2001). There have been several reports that *Camellia sinensis* provides several functional activities related to free radicals and reduction in the incidence of cancer, blood cholesterol and to blood pressure. Also, *Camellia sinensis* has anti-tumor and anti-diabetes effects in the human body (Mukhtar and Ahmad, 1999). Keeping in view these facts current study was planned in order to investigate whether *Camellia sinensis* have any influence on broiler chicks.

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Dietary use of *Camellia sinensis*

Medicinal plants are frequently used in the animal nutrition as possible natural alternatives for antibiotic growth promoters (Hazzit *et al*., 2006; Cross *et al*., 2007). In particular, the biological, physiological and pharmaceutical effects of *Camellia sinensis* have been widely studied in the past decade (Ishihara *et al*., 2001; Kondo *et al*., 2004; Zanchi *et al*., 2008). *Camellia sinensis* components have been found to maintain micro flora balance and exert antimicrobial effects

against pathogenic bacteria without affecting lactic acid bacteria (Hara-kudo *et al*., 2005). Administration of *Camellia sinensis* with probiotics was found to have no negative effect on weight gain, feed efûciency, carcass composition or reduction of the values of thiobarbituric acid-reactive substances (TBARS), but inûuenced humoral and cell-mediated immunity of pigs (Ko and Yang, 2008). In addition, treatment with *Camellia sinensis* does not alter the blood components of beef cattle or calves (Lee 2005; Sarker *et al*., 2010). The ability of *Camellia sinensis* polyphenols to increase *lactobacilli* populations and decrease bacteroidaceae in chicken cecal contents (Terada *et al*., 1993), porcine faeces (Hara *et al*., 1995) and ruminants (Bureenok *et al*., 2007) has already been reported.

Chemical composition of *Camellia sinensis*

The chemical composition and other properties of *Camellia sinensis* are complex. Abdo *et al.* (2010) found that air-dried *Camellia sinensis* 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 calculated metabolizable energy (ME). *Camellia sinensis* has over 200 bioactive compounds and contains over 300 different substances (Labdar, 2010). The chemical composition of *Camellia sinensis* is multifaceted, consisting of polyphenols (catechins and flavanoids), alkaloids (caffeine, threobromine and theophylline), volatile oils, polysaccharides, amino acids, lipids, vitamin C, minerals and other uncharacterized compounds (Karori *et al.,* 2007).

Camellia sinensis contains many amino acids, but L-theanine, specific to the tea plant, is the most abundant, accounting for 50% of the total amino acids. This form of theanine acts as an antioxidant, protecting cells from free radical damage and also helping to induce relaxation and prevent anxiety by increasing serotonin and dopamine levels in nerve cells. Amino acid degradation is involved in the biogenesis of the tea aroma (Balentine, 1997). Abdo *et al.,* (2010) reported that *Camellia sinensis* leaves contained amino acids as 1.35% aspartic, 0.64% therionine, 0.67% serine, 1.98% glutamic, 0.68% proline, 0.76% glycine, 0.78% alanine, 0.78% valine, 0.55% isoleucine, 1.17% leucine, 0.57% tyrosine, 0.78% phenylalanine, 0.32% histidine, 0.85% lysine, 0.74% argnine, 0.37% methionine and 0.14% cystine. More than 600 different molecules of volatile fractions of tea have been isolated.

Amongst the bio-active compounds found in *Camellia sinensis*, the largest component present in *Camellia sinensis* leaves is carbohydrates (cellulosic fibre). The simplest compounds are catechins, a group of flavanoids called flavan-3-ols (Yilmaz, 2006). These catechins are synthesised in *Camellia sinensis* leaves through malonic acid and shikimic acid metabolic pathways with gallic acid as an intermediate derivative (Naidu, 2000). Catechins are colourless, water-soluble compounds that impart bitterness and astringency to *Camellia sinensis* infusions (Wang *et al.,* 2000). Catechins constitute 15% to 30% of dry weight of *Camellia sinensis* leaves, as opposed to 8% to 20% of oolong and 3% to 10% of black tea (Biswas *et al*., 2000). *Camellia sinensis* extract contains six primary catechins, namely epicatechin (EC), epicatechin gallate (ECG), epigallocatechin (EGC) and epigallocatechin-3-gallate (EGCG). Kajiya *et al.,* 2004). Epigallocatechin-3-gallate is the most important and well-studied tea catechin owing to its high content (50%) in tea. It also has the most potent physiological properties in comparison to other components (Taylor *et al.,* 2005). Ester-type catechins ECG and EGCG are more bitter and astringent than EC and EGC and these flavanoids have a greater synergistic action than individual tea components (Fujiki, 1999). Uuganbayar *et al.,* (2006) reported that total catechin contents were 15.73% for Korean *Camellia sinensis*, 15.60% for Japanese *Camellia sinensis* and 14.04% for Chinese *Camellia sinensis*. Of the total catechin components, EGC was predominant, accounting for 67.50% (Korean *Camellia sinensis*), 67.90% (Japanese *Camellia sinensis*) and 63.80% (Chinese *Camellia sinensis*) of the total catechin contents. In another study, *Camellia sinensis* leaves contained active constituents of 1.01% total phenols, 105 mg/kg caffeine, 50 mg/kg catechin, 35 mg/kg EC, 185 mg/kg ECG and 17.5 mg/kg ascorbic acid (Abdo *et al*., 2010). The catechin content showed considerable variability in one study. The levels of EGCG ranged from 117 mg/L – 442 mg/L, EGC from 203 mg/L – 471 mg/L, ECG from 16.9 mg/L – 150.0 mg/L, EC from 25 mg/L – 81 mg/L and catechin from 9.03 mg/L – 115.00 mg/L. Moreover, caffeine contents in the *Camellia sinensis* infusions studied were between 141 mg/L and 338 mg/L (Reto *et al.,* 2007).

Minerals comprise about 4% – 9% of the inorganic matter of tea (Chaturvedula and Prakash, 2011). Abdo *et al.,* (2010) assayed the mineral content profile in *Camellia sinensis* leaves as 4.66% calcium, 1.62% total phosphorus, 865.1 mg/kg manganese, 146.3 mg/kg zinc and 858.1 mg/kg selenium. Similarly, Reto *et al.,* (2007) evaluated some minerals in *Camellia sinensis* samples and reported that potassium was found in larger amounts (92 mg/L – 151 mg/L), whereas the content of sodium, calcium, fluoride, aluminium, manganese and iron were 35 mg/L – 69 mg/L, 1.9 mg/L – 3.5 mg/L, 0.8 mg/L – 2.0 mg/L, 1.0 mg/L – 2.2 mg/L, 0.52 mg/L – 1.90 mg/L, 0.020 mg/L – 0.128 mg/L, respectively. Costa *et al*. (2002) observed large variations in the mineral content (aluminium, calcium, magnesium and manganese) in *Camellia sinensis* from different origins. Shu *et al.,* (2003) observed marked variations amongst different tea varieties in accumulating fluoride and aluminium. Xu *et al.* (2003) reported that the content of selenium in *Camellia sinensis*s was greatly increased by foliar application of selenium-enriched fertilizers; moreover, the selenium-enriched *Camellia sinensis* exhibited significantly higher antioxidant activity than regular *Camellia sinensis*.

Influence of *Camellia sinensis* on broilers

Only limited information is available for response of avian species, particularly in broiler chickens, to supplemental dietary *Camellia sinensis* powder. In our previous study on

laying chicken in long term, supplemental *Camellia sinensis* powder (0.6%) caused decrease in body weight gain and also observed significant reduction of total fat in egg yolk either expressed as an absolute or relative weight (Biswas *et al*., 2000). It is basically consistent with present observation in broiler chickens that *Camellia sinensis* powder markedly reduced absolute weight, percentage of abdominal fat, cholesterol levels of liver and blood serum. Significant increase of thigh percentage with *Camellia sinensis* powder feeding is not clearly explainable, though this may enhance behavioral activity of the broilers (Biswas and Wakita, 2001). *Camellia sinensis* containing high catechin may have an inhibitory effect on intestinal absorption of lipid (Ikeda *et al*., 1992). This may prevent an excessive accumulation of lipid in the liver and other tissues. The reduction in tissue cholesterol may also be explained by a negative effect of tea catechin on formation of micell that mediates reabsorption of bile acid (Muramatsu *et al*., 1986). Such increase of unabsorbable bile acids may also lead to reduction in liver cholesterol and blood serum cholesterol of *Camellia sinensis* powder feed broilers. The possible explanation is on tea fiber that there is a great deal of evidence that dietary fiber could reduce the level of cholesterol in animals (Evans *et al*., 1992) through adsorbing bile acids and various lipids on it. In addition, the phenolic compound in tannic acid plays an important role in the catabolism of liver cholesterol (Yugarani *et al*., 1992). Conversion of cholesterol to bile acids occurs exclusively in the liver and represents the major pathway for the elimination of cholesterol from the body. This may also explain the reduced cholesterol levels. Furthermore, it has been suggested that *Camellia sinensis* has thermogenic properties and promotes fat oxidation beyond that explained by its caffeine (Dulloo *et al*., 2000).

In another study it was stated that the *Camellia sinensis* extract may play a role in the control of body composition via sympathetic activation of thermogenesis, fat oxidation, or both in humans (Dulloo *et al*., 1999). This may be also one of the reasons. However, the reduction of carcass fat would have been caused by the suppressive effect of *Camellia sinensis* powder on feed intake, which in turn reduce hepatic lipogenesis a major site of lypogensis in poultry and fat accumulation in adipose tissue and muscles (Saadoun and Leclercq, 1983). Therefore, to make conclusion clear on fat and cholesterol reduction, further experiment with restricted feeding should be carried out. However, the dietary *Camellia sinensis* powder could be employed to reduce the undesirable carcass fat without altering general performance on carcass in broiler chickens. There was a tendency that *Camellia sinensis* powder feeding improves feed conversion ratio. This has been also observed in other feeding experiments using layers (Biswas *et al*., 2000; Yamane *et al*., 1999). All the results point out the decreased feed intake by *Camellia sinensis* powder supplementation without change of body weight gain or egg production. Even though the mechanisms involved in these improvements are not precisely understood, *Camellia sinensis* powder could be a potent feed additive for broilers as well as layers (Biswas and Wakita, 2001). Further, it has been reported that *Camellia sinensis* inclusion in broiler diets had positive effects on growth performance and lean meat production of the broilers. Biswas and Wakita, (2001) added four levels of *Camellia sinensis* powder (0.5%, 0.75%, 1% and 1.5%) to broiler starter and finisher diets. Supplemental *Camellia sinensis* powder tended to decrease feed intake and body weight gain at a higher dose, but tended to improve FCR. Dressing percentage was not affected by *Camellia sinensis*, although proportions of some parts of the carcass were influenced. The proportion of thigh meat was increased by the 1.50% level feed while that of wing meat was decreased in all treatment groups. The quantity and percentage of abdominal fat were decreased significantly with supplementation. Yang *et al.,* (2003) and Guray *et al.,* (2011) reported that when the *Camellia sinensis* by-product level was increased, the percentage of abdominal fat reduced in broilers. Kaneko *et al.,* (2001) reported that 1%, 2.50% and 5% of *Camellia sinensis* in broiler diets linearly reduced body weight gain of the chicks. Similarly, Uuganbayar (2004) also reported that 1% to 1.5% *Camellia sinensis* supplement in broiler diet had the effect of reducing body weight gain of the chicks. Yang *et al.,* (2003) determined the optimum level of *Camellia sinensis* by-product (0.5%, 1% and 2%) in diets without antibiotics and evaluated its effect on broiler performances. They observed non-significant differences in feed intake and feed efficiency amongst treatments.

Cao *et al.,* (2005) indicated that body weight gain, feed intake and feed efficiency from 28 days to 42 days of age were not improved; however, mortality was significantly reduced by supplementation with *Camellia sinensis* by-products. Recently, Shomali *et al.,* (2012) investigated the effects of high levels of *Camellia sinensis* powder (1%, 2%, or 4%) on broiler growth performance for two weeks. Differences in body weight, feed intake and FCR were insignificant as well. In contrast to the above studies, Sarker *et al.,* (2010) observed significantly increased weight gain (1210.61 g/bird) in broilers during the finishing period at the 0.5% level compared to the 1% (1033.36 g/bird) level of *Camellia sinensis*. Guray *et al.,* (2011) supplemented a liquid hydroalcoholic extract of fresh *Camellia sinensis* (0.1 g/kg or 0.2 g/kg) in broiler diets. The dietary *Camellia sinensis* extract increased the body weight, feed efficiency, carcass weight and dressing percentage. The broilers in *Camellia sinensis* supplemented groups consumed more feed than the control birds throughout the entire experimental period. The relative gut length of broilers in the high level of *Camellia sinensis* group tended to be lower than those in the control group. The dietary *Camellia sinensis* extract increased redness (1) and yellowness (2) values of the breast meat. Thus, the *Camellia sinensis* extract appeared to have a measurable impact on CIE colour values of the breast meat in broilers. The authors concluded that the improved

production results in the broilers with added *Camellia sinensis* extract are directly associated with physiological mechanisms such as the regulation of the caecal microflora. The production sources of *Camellia sinensis* used in all of the above studies were different, for example: Japanese *Camellia sinensis* powder (Biswas and Wakita, 2001; Kaneko *et al.,* 2001); Japanese and Chinese *Camellia sinensis* or their polyphenols (Cao *et al.,* 2005); Korean *Camellia sinensis* powder (Sarker *et al.,* 2010; Yang *et al.,* 2003) and eastern black sea coast of Turkey tea powder. All of these *Camellia sinensis* sources had different compositions. The inconsistency amongst the studies may be explained by the differences in total catechin content and its major components such as epicatechin, epigallocatechin, epicatechin gallette, epigallocatechin gallette, of the *Camellia sinensis* and *Camellia sinensis* extract used in these studies (Guray *et al.,* 2011).

CONCLUSION AND SUGGESTIONS

Present study concludes that *Camellia sinensis* significantly supports the broilers production as well as overall performance. It has negative effect on visceral organs, whereby least weight of heart, liver, spleen, proventiculus, intestine, fat pad are noticed among the birds having *Camellia sinensis* in the diet. However, feed intake, water intake, live body weight, weight gain, carcass weight, nutrients digestibility and feed conversion ratio (FCR) are considerably favored with the use dietary *Camellia sinensis* in broilers. *Camellia sinensis* also supports the immune system and that results minimum mortality.

Moreover, it is recommended that *Camellia sinensis* should be incorporated in broilers' rations for obtaining maximum digestibility, production and overall birds' performance. Further studies should be conducted on the effect of supplementation of *Camellia sinensis* on blood biochemistry and genotype of all poultry birds. Histopathological studies on the effect of *Camellia sinensis* supplementation are also required be carried out in broilers as well as other poultry birds.

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