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Research Article

Influence of *Camellia sinensis* on nutrients digestibility in broiler

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Citation

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Abstract

Study was conducted on 192 day-old broiler (*Gallus gallus domesticus*) chicks purchased from a commercial distributor of Hyderabad and shifted to the Poultry Experimental Station, Department of Poultry Husbandry, Faculty of Animal Husbandry and Veterinary Sciences, Sindh Agriculture University Tandojam. The birds were divided into 4 groups (A, B, C and D) each group comprised of 48 chicks. The birds in group A were supplemented with 5g/L of *Camellia sinensis*, group B supplemented with 10g/L of *Camellia sinensis*, group C supplemented with 15g/L of *Camellia sinensis* and group D was kept as control without supplementation of *Camellia sinensis*. The findings of the current study indicated maximum increase of crude protein digestibility (80.33%) in group A where the birds were supplemented with 5g/L of *Camellia sinensis* and minimum (74.5%) was recorded in group C where the birds were supplemented with 15g/L of *Camellia sinensis*. Maximum ether extract digestbility (76%) was seen in the group D (Control) while minimum (68%) was recorded in the group C, where the birds were supplemented with 15g/L of *Camellia sinensis*. Maximum crude fiber digestbility (33.83%) was noted in the group C, however minimum (30.33%) was recorded in the group A. Maximum metabolizable energy (79.66%) was noted in the group D (Control) and minimum metabolizable energy (70%) was recorded in the group C. Statistically, there was significant ($p<0.05$) difference in digestibility of crude protein among all groups (A, B, C and D), significant ($p<0.05$) difference was also seen in the digestibility of ether extract among all groups (A, B, C and D). However, concerning digestibility of crude fiber although significant ($p<0.05$) difference was noted in the group A compared to B, in C compared D, but among group B and C no significant ($p>0.05$) difference was observed. In conclusion, birds who were supplemented with 5g/L of *Camellia sinensis* showed maximum digestibility of crude protein, but the birds whose diet was free from *Camellia sinensis* indicated higher digestibility of ether extract and metabolizable energy. Comparatively, the birds though were supplemented with 15g/L of *Camellia sinensis* showed maximum digestibility of crude fiber.

Keywords: Broiler; Digestibility; Ether extract; Metabolizable energy; Nutrient; Protein

Introduction

Medicinal plants are frequently used in the animal nutrition as possible natural alternatives for antibiotic growth promoters [1]. In particular, the biological, physiological and pharmaceutical effects of *Camellia sinensis* have been widely studied in the past decade [2]. Its components have been found to maintain microfloral balance and exert antimicrobial effects against pathogenic bacteria without affecting lactic acid bacteria [3]. Administration of *Camellia sinensis* with probiotics was found to have no negative effect on weight gain, feed efficiency, carcass composition or reduction of the values of thiobarbituric acid-reactive substances (TBARS) while influencing humoral and cell-mediated immunity [4]. The ability of *Camellia sinensis* polyphenols to increase *lactobacilli* populations and decrease bacteroidaceae in chicken cecal contents [5].

Camellia sinensis leaves contain 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) [6]. It has over 200 bioactive compounds and contains over 300 different substances [7]. 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 [8]. *Camellia sinensis* contains many amino acids especially L-theanine 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. Amongst the bio-active compounds found in *Camellia sinensis*, the largest component is carbohydrates (cellulosic fibre). The simplest compounds are catechins, a group of flavanoids called flavan-3-ols [9]. These catechins are synthesised in leaves through malonic acid and shikimic acid metabolic pathways with gallic acid as an intermediate derivative. Catechins are colourless, water-soluble compounds that impart bitterness and astringency to *Camellia sinensis* infusions [10].

Limited information is available for response of avian species, particularly in broiler chickens, to supplemental dietary *Camellia sinensis* powder. It has been reported that laying chicken in long term supplemental *Camellia sinensis* powder (0.6%) result decrease in body weight gain and also observed significant reduction of total fat in egg yolk either expressed as an absolute or relative weight [11]. 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 [12]. *Camellia sinensis* containing high catechin may have an inhibitory effect on intestinal absorption of lipid [13]. 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. Such increase of unabsorbable bile acids may also lead to reduction in liver cholesterol and blood serum cholesterol of *Camellia sinensis* powder feed broilers [14].

The *Camellia sinensis* extract may play a role in the control of body composition via sympathetic activation of thermogenesis, fat

oxidation, or both **[15]**. 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 **[16]**. 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 **[11]**. 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 **[17]**.

It has been reported by **[18]** that when liquid hydroalcoholic extract of fresh *Camellia sinensis* (0.1 g/kg or 0.2 g/kg) was supplemented 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 that reflects that *Camellia sinensis* might have influence on nutrients digestibility in broiler. Thus current study was planned in order to observe the influence of *Camellia sinensis* on broilers.

Materials and methods

Birds and management

A total 192 day-old broiler (*Gallus gallus domesticus*) chicks were purchased from a commercial distributor of Hyderabad and shifted to the Poultry Experimental Station, Department of Poultry Husbandry, Faculty of Animal Husbandry and Veterinary Sciences, Sindh Agriculture University Tandojam.

Chicks were placed in the floor housing system having one square feet space for chick. Before arrival of chicks, poultry house was entirely cleaned, disinfected and washed with fresh water. Entire shed was smeared with limestone and allowed to dry for 24 hours. The wooden dust was used as litter and speared after using dry limestone on floor. Paper sheets were used to cover the litter and also to provide comfort to the chicks during first week of brooding.

Artificial brooding preparation was completed two days before arrival of the day-old broiler chicks. One brooder was provided to each group. During the first week of brooding, the temperature was maintained between 90 to 95°F followed by a reduction of 5°F each week till 70°F house temperature is attained. During brooding 60/100 watt electric bulbs were fitted into brooder and placed in the center of each allocated area. One thermometer was installed at the height of 12 inches near brooder to maintain temperature. A cane containing coal and chargeable batteries was installed at suitable place as alternate source of energy during electric failure.

Experimental procedures

Experimental trial was carried out on a total 192 day-old broiler chicks. The chicks were initially weighed and randomly divided into 4 groups like A, B, C and D containing 48 chicks in each group. Each group was further divided into three replicates and every replicate possessed 16 birds. The same housing and bedding facility was provided to each group. Birds in group A were given 5g/L *Camellia sinensis*, in group B 10g/L and group C 15g/L in their normal diet, however group D was kept as control and

Camellia sinensis free was provided (Table 1). On day 36th three chicks were randomly selected from each replicate and placed in individual battery cages for the digestibility study. The birds were allowed a three-day adjustment period. Measured quantity of experimental diets and water was given to each bird every morning and evening and the residual was weighed at the next morning to calculate feed intake and water intake by each bird. Feces were collected from each treatment group, bulked and for three days. Obtained quantity was milled and further processed in the Laboratory of Animal Nutrition, Faculty of Animal Husbandry and Veterinary Science, Sindh Agriculture University Tandojam for the determination of crude protein, ether extract, crude fiber and metabolizable energy. Further, provided feed was also sampled and analyzed in the Laboratory for nutrients composition. The nutrient digestibility coefficient (NDC) was calculated using the formula shown below:

$$(\text{NDC }\%) = \frac{(\text{Nutrients in diet x feed intake}) - (\text{Nutrient in feces x fecal output})}{\text{Nutrient in diet x feed intake}} \times 100$$

Table 1. Diet composition of proposed rations

Ingredients	Starter ration				Finisher ration			
	Groups				Groups			
	A	B	C	D	A	B	C	D
Guar meal	2	2	2	2	2	2	2	2
Soybean meal	5	5	5	5	5	5	5	5
Sunflower Meal	9	9	9	9	9	9	9	9
Rice Polish	17.5	17	16.5	18	19.5	19	18.5	20
Canola Meal	10	10	10	10	10	10	10	10
Fish Meal	6	6	6	6	4	4	4	4
Corn meal	20	20	20	20	20	20	20	20
Rice meal	18	18	18	18	18	18	18	18
Cotton gluten 30%	5	5	5	5	5	5	5	5
Cotton gluten 60%	3	3	3	3	3	3	3	3
DLM	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
L-lysine	1.5	1.5	1.5	1.5	1	1	1	1
Dicalcium phosphate	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Lime Stone	1.5	1.5	1.5	1.5	2	2	2	2
Camellia sinensis	5	10	15	0	5	10	15	0
Total	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**
	Calculated nutrients composition							
M.E (kcal/kg)	2412	2405	2401	2407	2719	2794	2787	2709
C.P (%)	22.5	22.2	22.6	22.4	19.2	19.4	19.3	19.6
E.E (%)	1.8	1.7	1.9	1.8	2.6	2.8	2.9	2.7
C.F (%)	2.8	3.1	3.2	2.9	2.7	2.9	3.1	2.8

For crude protein, sample was digested with concentrated H_2SO_4 in the presence of catalyst mixture containing K_2SO_4 and $HgSO_4$. The digested sample was diluted to a definite volume with water. A known aliquot of the diluted sample was mixed with 40% NaOH solution to an excess alkaline reaction and mixture was distilled

with steam in micro-kjeldahl apparatus. The ammonia so liberated was collected in 10ml N/20HCL having a few drops of methyl red as an indicator. The excess of the acid was measured by titrating against standard N/20 NaOH solution. The amount of N/20 NH liberated was determined by difference. Nitrogen and CP contents were worked out by the following formula:

N (%) = ml N/20 NH3 x 0.0007

CP (%) = %N x 6.25

Ether extract was determined by measuring 5g of sample and transferring it to asbestos thimble. The mouth of thimble was plucked with fat free absorbent cotton. The thimble was placed in the glass jacket and 150ml diethyl ether was taken in the receiving flask of soxhlet's apparatus. The apparatus were placed in the heating assembly maintained at specific temperature. The extraction continued for about 8 hours. The ether was allowed to evaporate under hood and extract was completely dried in an oven for 30 minutes at 105^0C. The weight of extract was recorded after cooling the beaker in the desiccator. Percentage of ether extract was calculated by the following formula;

EE (%) = (wt. of EE/ wt. of sample) x 100

Data analysis

A complete randomized model was used to analyze data for various parameters. The collected data was tabulated and analyzed by 1-way ANOVA (JMP software, SAS 9.0, SAS Institute Inc., Cary, NC). Significant differences among means were evaluated by using Tukey's comparison test at P<0.05 (2008).

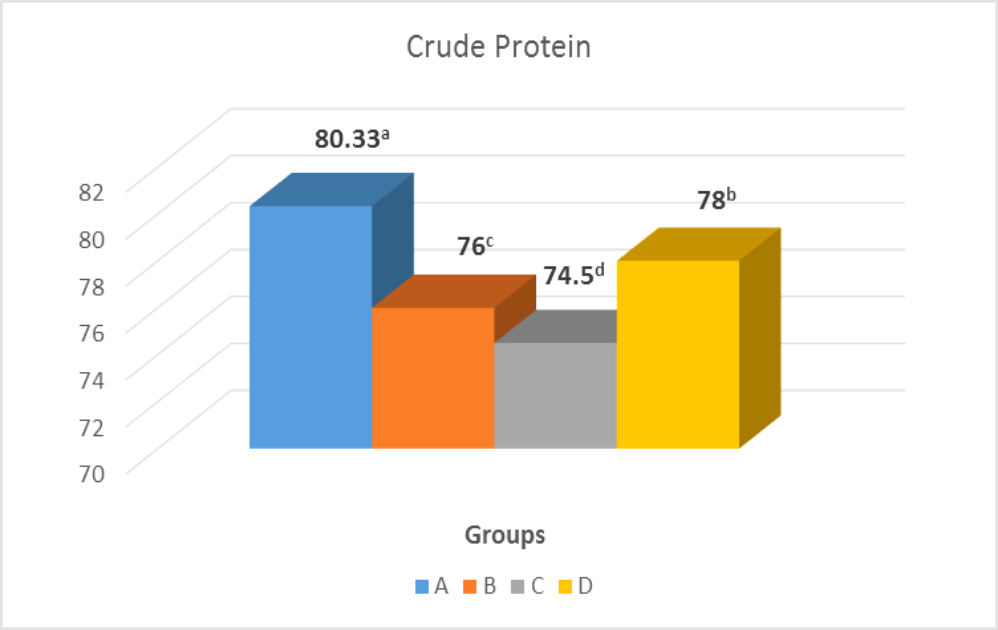
Results and discussion

Crude protein

Results regarding the digestibility of crude protein as influenced by different levels of *Camellia sinensis* supplementation are shown in (Figure 1). There was significant ($p<0.05$) difference in crude protein digestibility among all groups (A, B, C and D). Maximum crude protein digestibility (80.33%) was noted in group A (where the birds were supplemented with 5g/L of *Camellia sinensis*) and minimum (74.5%) was recorded in the group-C (where the birds were supplemented with 15g/L of *Camellia sinensis*). These results are resemblance with the findings of **[11]**. **[11]** stated that supplementation of *Camellia sinensis* powder (0.6%) support the digestibility, feed intake and weight gain. Similar results were reported by **[19]** indicating that body weight gain, carcass weight and digestibility was improved by supplementation of *Camellia sinensis* powder.

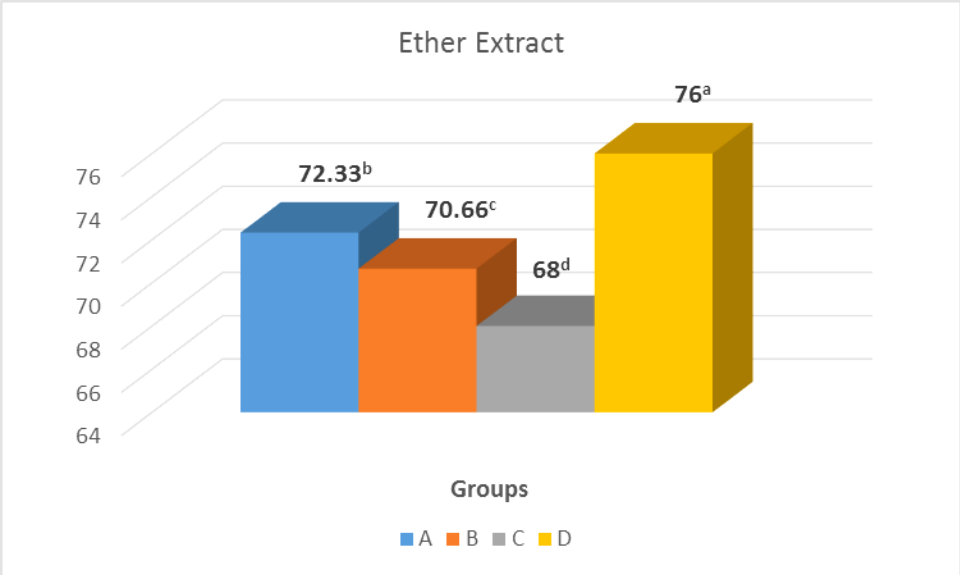
Ether extract

The digestibility of ether extract as influenced by different levels of *Camellia sinensis* supplementation is shown in the (Figure 2). Maximum ether extract digestibility (76%) was seen in the group D (control) and minimum (68%) was recorded in group-C (where the birds were supplemented with 15g/L of *Camellia sinensis*), respectively. Statistically, there was significant ($p<0.05$) difference among all groups (A, B, C and D) against in ether extract digestibility. These findings are linked with minimum with the study of **[20]** who stated that supplemental *Camellia sinensis* powder tended to decrease fat digestibility. **[21]** also stated that *Camellia sinensis* powder in broiler ration impair with the ether extract digestibility.



SE± = 1.0069, LSD at 0.05 = 2.4638, P-value = 0.0053, Remarks = Significant

Figure 1. Influence of *Camellia sinensis* supplementation on digestibility of crude protein



SE± = 1.6611, LSD at 0.05 = 4.0646, P-value = 0.0160, Remarks = Significant

Figure 2. Influence of *Camellia sinensis* supplementation on digestibility of ether extract

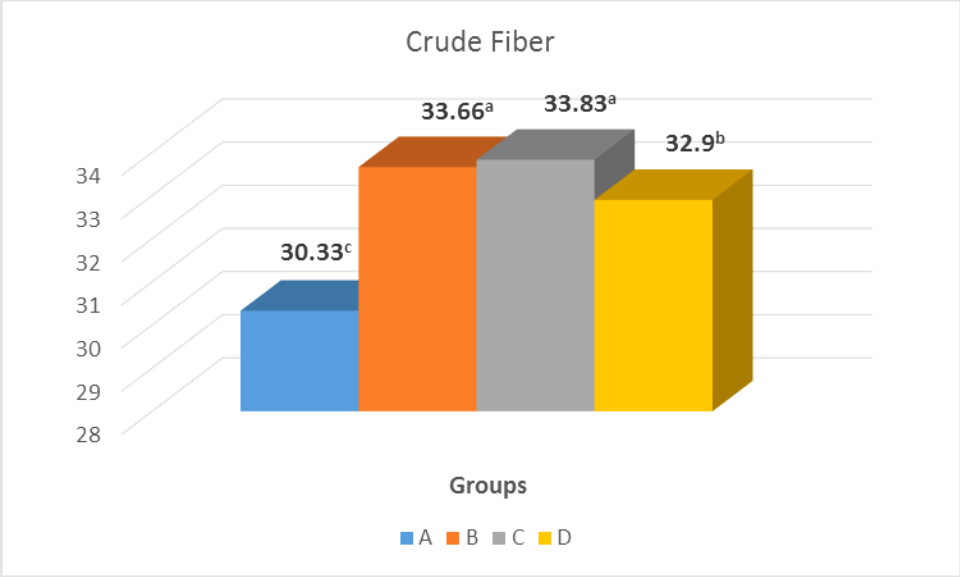
Crude fiber

Concerning digestibility of crude fiber influenced at different levels of *Camellia sinensis* supplementation results are depicted in (Figure 3). Figure indicates significant ($p<0.05$) difference in crude fiber digestibility of group A with B, C and D, while non-significant ($p>0.05$) difference between groups (B and C). Further, figure shows that maximum crude fiber

digestibility (33.83%) was observed in group C (where the birds were supplemented with 15g/L of *Camellia sinensis*) and minimum (30.33%) was recorded in group-A (where the birds were supplemented with 5g/L of *Camellia sinensis*). **[22]** reported results are in support to the current study. Similarly, **[23]** also reported that relevant kinds of findings when studied the *Camellia sinensis* supplementation in broiler diet.

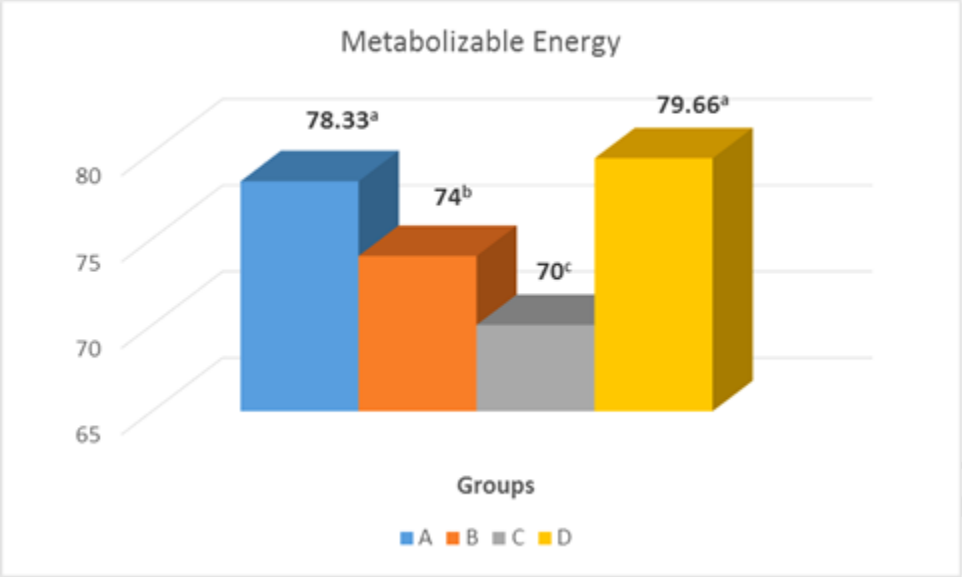
Metabolizable energy

Figure 4 shows the digestibility of metabolizable energy influenced by different levels of *Camellia sinensis* supplementation. It is depicted in the figure that maximum metabolizable energy digestbility (79.66%) was recorded in group D (Control) and minimum (70%) was seen in group C (where the birds were supplemented with 15g/L of *Camellia sinensis*). Statistically there was significant ($p<0.05$) difference in digestibility metabolizable energy for group A with B and C, while non-significant ($p>0.05$) difference between the groups A and D. In contrast to present findings, **[24]** much similar results. They also found that the *Camellia sinensis* do not significantly improve the digestibility of metabolizable energy compared to control group. **[25]** also reported supportive results for the current study. Their finding strongly relates with our results for the digestibility of metabolizable energy.



SE± = 0.5886, LSD at 0.05 = 1.4403, P-value = 0.0033, Remarks = Significant

Figure 3. Influence of *Camellia sinensis* supplementation on digestibility of crude fiber



SE± = 1.0453, LSD at 0.05 = 2.5577, P-value = 0.0004, Remarks = Significant

Figure 4. Influence of *Camellia sinensis* supplementation on digestibility of metabolizable energy

Conclusion

Present study concludes that the maximum digestibility of crude protein was observed in birds who were supplemented with 5g/L of *Camellia sinensis*, but the digestibility of ether extract and metabolizable energy was recorded higher in birds whose diet was free from *Camellia sinensis*. However, the birds though were supplemented with 15g/L of *Camellia sinensis* showed maximum digestibility of crude fiber.

Authors' contributions

Conceived and designed the experiments: MAAMK Solangi & AA Khaskheli, Performed the experiments: MAAMK Solangi, Analyzed the data: GA Mughal, QA Memon & NA Rajput, Contributed reagents /materials/ analysis tools: IH Leghari, MN Rajput, TA Kaurejo & MA Kumbhar, Wrote the paper: AA Khaskheli.

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