

Effects of Dietary Ginger (*Zingiber officinale*) Powder Supplementation on Blood Biochemical Parameters in Broiler Chickens

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ABSTRACT

This study evaluated the effects of dietary ginger (*Zingiber officinale*) powder supplementation on serum glucose, total cholesterol and triglyceride concentrations in broiler chickens. A total 80 one-day-old Ross 308 broiler chicks of both sexes were randomly allocated to four dietary groups, with 20 birds per group. The control group received a basal diet without ginger powder, whereas groups T1, T2, and T3 received diets supplemented with 0.2%, 0.4%, and 0.6% ginger powder, respectively. Blood samples were collected on days 15 and 30 for biochemical analysis. On day 15, ginger supplementation significantly reduced serum total cholesterol concentrations in all treatment groups compared with the control group, while triglyceride concentration was significantly lower in T2 and T3 ($P < 0.05$). Serum glucose did not differ significantly among groups on day 15 ($P > 0.05$). On day 30, all ginger-supplemented groups had significantly lower cholesterol and triglyceride concentrations than control group ($P < 0.05$). A significant difference in glucose concentration was observed between T3 and the control group on day 30. These findings indicate that dietary ginger powder may beneficially modify the serum lipid profile of broiler chickens. Further studies are required to determine the optimal supplementation level and clarify its effects on glucose metabolism, productive performance and meat characteristics.

Keywords: Broiler Chickens; Ginger powder; *Zingiber officinale*; Serum glucose; Cholesterol; Triglycerides.

INTRODUCTION

Broiler chickens are meat-type birds that have been genetically selected for rapid growth, efficient feed conversion, and high carcass yield. Under modern commercial production systems, broilers commonly reach a market weight of approximately 2.0–2.5 kg within 35–42 days, although growth rate and slaughter age vary according to genotype, nutrition, management practices, and environmental conditions (FAO, 2013). Broilers are generally reared in intensive deep-litter systems, where appropriate nutrition, ventilation, stocking density, litter management, disease prevention, and biosecurity are essential for maintaining their health, welfare, and productive performance (Kpomassè et al., 2021). Feed additives have traditionally been incorporated into poultry diets to promote growth, improve feed utilization, and prevent

disease. However, concerns about antimicrobial resistance, drug residues, food safety, and consumer acceptance have increased interest in natural alternatives to antibiotic growth promoters. Consequently, medicinal plants and their bioactive constituents, commonly classified as phytogetic feed additives or phytobiotics, have received considerable attention in poultry nutrition. These additives may improve nutrient utilization, intestinal health, immune function, antioxidant status, and metabolic regulation in broiler chickens (Hashemi and Davoodi, 2011). Ginger (*Zingiber officinale* Roscoe) is a rhizomatous plant belonging to the family Zingiberaceae. It is widely used as a culinary spice and in traditional medicine because of its nutritional and pharmacological properties. Ginger contains numerous biologically active compounds, particularly gingerols, shogaols, paradols, and zingerone. These compounds

exhibit antioxidant, antimicrobial, anti-inflammatory, digestive-stimulatory, and lipid-modulating activities (Khan et al., 2012). The antioxidant effects of ginger are mainly associated with its ability to scavenge free radicals and support endogenous antioxidant defense systems. Its antimicrobial and anti-inflammatory properties may also contribute to improved intestinal conditions and nutrient utilization.

Dietary ginger supplementation may influence carbohydrate and lipid metabolism and consequently modify blood biochemical parameters in poultry (Khan et al., 2012). Blood glucose, total cholesterol, and triglyceride concentrations are commonly used as indicators of energy and lipid metabolism. Changes in these parameters may provide useful information about the physiological and metabolic responses of broiler chickens to dietary interventions. Previous studies have reported that ginger supplementation may reduce circulating cholesterol and triglyceride concentrations, possibly by affecting lipid absorption, hepatic lipid synthesis, bile acid secretion, and antioxidant activity. Nevertheless, the reported effects have not been entirely consistent because they may depend on the form and concentration of ginger, diet composition, bird strain, age, health status, and duration of supplementation.

Although ginger has considerable potential as a natural feed additive, additional research is required to establish effective dietary concentrations and clarify its effects on the metabolic status of broiler chickens. Therefore, the present study aimed to evaluate the effects of dietary ginger powder supplementation at different concentrations on blood glucose, total cholesterol, and triglyceride levels in broiler chickens. It was hypothesized that ginger powder supplementation would beneficially modify these biochemical parameters compared with an unsupplemented basal diet.

MATERIALS AND METHODS

Study Area

The experiment was conducted at the Poultry Research Farm of the Faculty of Veterinary

Science, Nangarhar University, Afghanistan, from 5 March 2022 to 4 April 2022.

Sample Size:

A total of 80 one-day-old Ross 308 broiler chicks of mixed sex were obtained from a commercial hatchery. The chicks were transported to the research farm in clean, well-ventilated chick boxes under appropriate conditions to minimize transportation stress. Upon arrival, the birds were individually examined for general health and housed under standard broiler management conditions.

Feed and clean drinking water were provided *ad libitum* throughout the experiment. Brooding temperature, lighting, ventilation, litter management, vaccination, and other husbandry practices were maintained according to the standard management recommendations for Ross 308 broilers.

Study Design:

The chicks were randomly allocated to four dietary treatment groups, with 20 birds in each group. The dietary treatments were as follows:

Group Dietary treatment

Control Basal diet without ginger powder

T1	Basal diet supplemented with 0.2% ginger powder/kg of feed
T2	Basal diet supplemented with 0.4% ginger powder/kg of feed
T3	Basal diet supplemented with 0.6% ginger powder/kg of feed

During the first three days, all chicks received the same basal starter diet. Ginger supplementation was initiated on day 4 and continued until the end of the experiment. The required amount of ginger powder was weighed accurately and thoroughly mixed with the basal diet to ensure uniform distribution. Ginger rhizomes were purchased from a local supermarket, cleaned, ground finely, and stored in an airtight glass container until use.

Samples Collection

At the end of the experimental period, 10 birds were randomly selected from each treatment group and subjected to a 12-hour feed withdrawal, with free access to drinking water. Blood samples were aseptically collected from the wing vein using sterile syringes and transferred into appropriately labelled plain tubes. The samples were allowed to clot at room temperature and then centrifuged at 3,000 rpm for 10 minutes to separate the serum. The serum was transferred into sterile labelled tubes and stored at -20°C until biochemical analysis. Serum glucose, total cholesterol, and triglyceride concentrations were measured using commercial diagnostic kit according to the manufacturer's instructions.

Statistical Analysis

The data were analyzed using IBM SPSS Statistics version 26. Differences among treatment groups were evaluated using one-way analysis of variance (ANOVA), followed by Tukey's post hoc test when significant differences were detected. Results were expressed as mean $\pm$ standard deviation, and differences were considered statistically significant at $P < 0.05$.

RESULTS

Dietary ginger supplementation significantly influenced the measured blood biochemical parameters, although the effects varied according to supplementation level and sampling day. On day 15, serum glucose concentrations did not differ significantly among the groups ($P > 0.05$). Serum cholesterol was significantly higher in the control group than in all ginger-supplemented groups ($P < 0.05$), while no significant differences were observed among T1, T2, and T3. Serum triglyceride concentrations were lower in T2 and T3 than in the control and T1 groups ($P < 0.05$), whereas the control and T1 groups did not differ significantly (Figure 1).

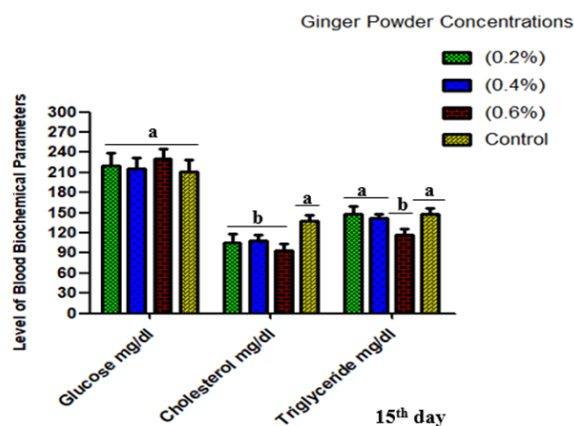


Figure 1. Effects of dietary ginger powder supplementation on serum glucose, total cholesterol, and triglyceride concentrations in broiler chickens on day 15. Bars represent mean $\pm$ SD. Within each biochemical parameter, bars carrying different letters differ significantly at $P < 0.05$.

On day 30, serum glucose was significantly higher in T3 than in the control group ($P < 0.05$). However, T1 showed an intermediate value and did not differ significantly from either group. Serum cholesterol was significantly lower in all ginger-supplemented groups than in the control group ($P < 0.05$), with the lowest concentration recorded in T3. Serum triglyceride concentrations were also significantly lower in all ginger-supplemented groups than in the

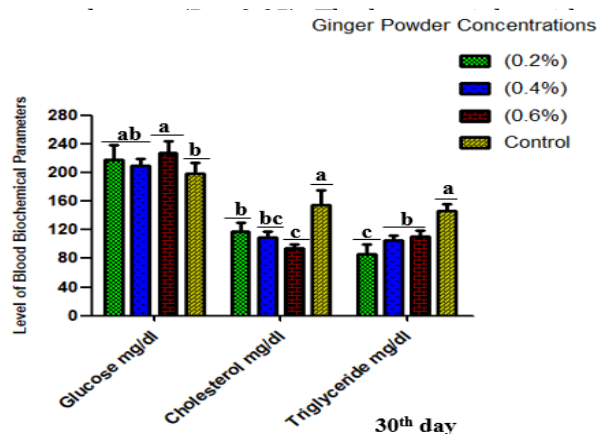


Figure 2. Effects of dietary ginger powder supplementation on serum glucose, total cholesterol, and triglyceride concentrations in broiler chickens on day 30. Bars represent mean $\pm$ SD. Within each biochemical parameter,

bars carrying different letters differ significantly at $P < 0.05$.

DISCUSSION

The present study demonstrated that dietary ginger powder supplementation significantly influenced the serum lipid profile of broiler chickens. On day 15, all ginger-supplemented groups showed significantly lower serum total cholesterol concentrations than the control group, whereas triglyceride concentrations were significantly lower in the T2 and T3 groups. On day 30, serum cholesterol and triglyceride concentrations were significantly lower in the ginger-supplemented groups than in the control group. These findings suggest that ginger powder may exert hypolipidemic effects in broiler chickens. However, the response was not consistently dose-dependent because the highest supplementation level did not produce the lowest triglyceride concentration at every sampling time.

The observed lipid-lowering effects may be associated with the bioactive constituents of ginger, particularly gingerols, shogaols, paradols, and zingerone. These compounds possess antioxidant and lipid-modulating properties and may influence hepatic lipid metabolism. Ginger may reduce circulating cholesterol by inhibiting hepatic cholesterol synthesis, enhancing its conversion into bile acids, or increasing the fecal excretion of cholesterol and bile acids (Kairalla et al., 2022; Shewita and Taha, 2018). Its antioxidant compounds may also limit lipid peroxidation and support the physiological regulation of circulating lipids (Zhang et al., 2009). Nevertheless, these potential mechanisms were not directly investigated in the present study.

The findings of the present study are consistent with those of Oleforuh-Okoleh et al. (2015), who evaluated aqueous ginger and garlic extracts in 80 Marshall broiler chickens during a 56-day experiment. They found that ginger supplementation reduced serum cholesterol concentrations. However, direct comparisons

should be made cautiously because the extracts were administered through drinking water, whereas the present study incorporated ginger powder into the feed. Differences in broiler strain, supplementation method, experimental duration, and administered concentration could also affect the biochemical responses.

Ebegbulem (2018) evaluated broiler diets containing 0%, 2%, 4%, 6%, and 8% ginger and reported evidence supporting the hypocholesterolemic effects of ginger. Therefore, the findings of that study generally support, rather than contradict, the cholesterol results of the present investigation. However, the ginger concentrations used by Ebegbulem (2018) were substantially higher than those used in the present study. Differences in dietary concentration, basal diet composition, ginger processing, bird age, and management conditions may explain variations in the magnitude of the reported responses.

Similarly, Aikpitanyi and Egweh (2020) reported that diets containing ginger and black pepper significantly modified the biochemical profile of broiler chickens. Their results showed lower serum total cholesterol, triglyceride, low-density lipoprotein, and very-low-density lipoprotein concentrations in supplemented birds. These findings support the potential use of ginger as a phytogenic feed additive for improving the serum lipid profile. Nevertheless, because ginger and black pepper were used together in some treatments, the observed effects cannot be attributed exclusively to ginger.

Shewita and Taha (2018) found that dietary ginger supplementation at 2, 4, and 6 g/kg reduced serum cholesterol, triglyceride, and very-low-density lipoprotein concentrations in broiler chickens. They suggested that ginger may exert hypolipidemic effects and reduce abdominal fat deposition. Kairalla et al. (2022) similarly reported improved serum lipid profiles in broilers receiving diets supplemented with 0.2%, 0.4%, and 0.6% ginger powder. In their study, supplementation with 0.6% ginger

powder significantly reduced serum triglyceride, total cholesterol, and very-low-density lipoprotein concentrations compared with the control diet. These findings closely support the cholesterol and triglyceride responses observed in the present investigation.

The present results are also consistent with those of Zhang et al. (2009), who reported that dietary ginger root influenced the antioxidant status and serum metabolites of broiler chickens. Similarly, Ademola et al. (2009) observed lower serum cholesterol and triglyceride concentrations in broilers receiving ginger, garlic, or their mixtures. Collectively, these studies support the hypothesis that ginger and its bioactive compounds can beneficially influence lipid metabolism in broiler chickens.

Serum glucose concentrations did not differ significantly among treatments on day 15. On day 30, however, a significant difference was observed between the T3 and control groups, while T1 showed an intermediate response. Therefore, it would be inaccurate to conclude that ginger had no effect on glucose throughout the experimental period. Differences in serum glucose may be associated with the effects of ginger on carbohydrate metabolism, but they could also reflect feed intake, feed withdrawal, physiological stress, or blood-sampling conditions. Because these factors were not separately evaluated, the glucose findings should be interpreted cautiously.

CONCLUSION

Dietary ginger powder supplementation was associated with lower serum cholesterol and triglyceride concentrations in broiler chickens, supporting its potential use as a natural lipid-modulating feed additive. Nevertheless, the relatively small sample size, short experimental duration, limited biochemical measurements, and lack of clearly reported replication at the pen level restrict the generalizability of the results. Further studies should employ adequately replicated experimental designs and evaluate additional parameters, including HDL, LDL, VLDL, liver enzymes, oxidative stress indicators, growth performance, carcass characteristics, and meat lipid composition.

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