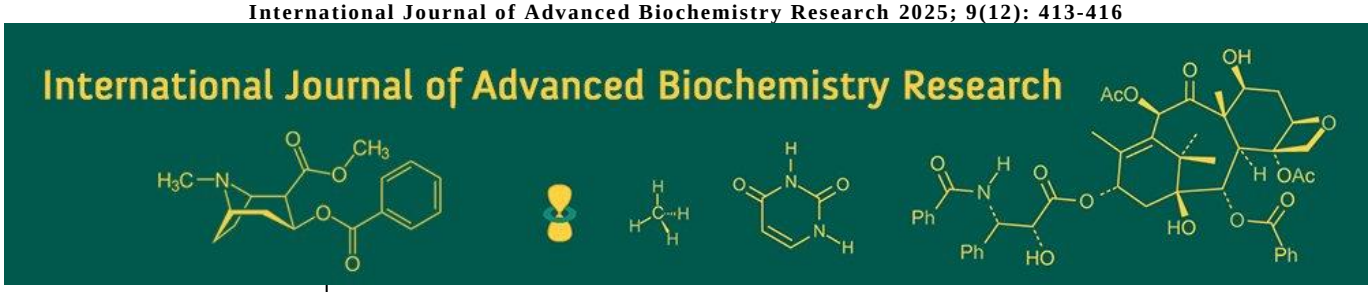

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Effect of aqueous ginger (*Zingiber officinale*) extract on carcass characteristics and haemato-biochemical profile of broiler chickens

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Abstract
A study was conducted to assess the effect of aqueous ginger (*Zingiber officinale*) extract on carcass characteristics and haemato-biochemical profile of broiler chickens. One hundred ninety-two broiler (Vencobb-430Y) chicks were uniformly divided into four treatment groups of 48 birds per treatment. The duration of experiment was of 42 days. The dietary treatments were T_1: Control diet; T_2: Control diet + 50 ml aqueous extract of ginger per 1000 ml of drinking water per day; T_3: Control diet + 100 ml aqueous extract of ginger per 1000 ml of drinking water per day; T_4: Control diet + 200 ml aqueous extract of ginger per 1000 ml of drinking water per day. The carcass characteristics, haematology and blood metabolites were studied at the end of the experiment. Results revealed that there was significant (p>0.05) improvement in dressing percentage in broiler chickens supplemented with aqueous extract of ginger. However, there was no impact (p>0.05) on organ weights of liver, heart, gizzard, kidney and spleen among the treatments. There was a significant increase (p<0.001) in the haemoglobin and haematocrit values in ginger supplemented group as compared to the control group. Moreover, mean serum cholesterol concentrations were lowest in the T_4 followed by T_3 and T_2 groups as compared to the T_1 group. It could be concluded that aqueous extract of ginger supplementation in drinking water improved dressing percentage, haematological parameters and reduction in serum concentration of cholesterol in broiler chickens.

Keywords: Broilers, haematology, blood metabolites, carcass traits, aqueous ginger extract

Introduction
Globally, poultry enterprise provides animal protein which is affordable, high quality, and for smallholders it acts as source of income (Attia *et al.*, 2022) [1]. The primary goal of the supplementation of feed additives in chickens is to improve growth performance, feed efficiency and health. Antibiotic growth promoters have been traditionally used in broiler production to prevent diseases and improve growth and feed efficiency. The use of in-feed antibiotics at sub-therapeutic doses for a longer duration favors the selection of resistance to multiple classes of antimicrobial resistance genes (Paul *et al.*, 2022) [2], and their spread among bacterial communities residing in the gut of animals and humans through the food chain or environmental pathways (Samtiya *et al.*, 2022) [3]. Considering the seriousness of the threat to human and animal health, some countries have banned the use of antibiotic growth promoters in feed of animals and poultry. Alternatively, phytogenic feed additives as a growth promoters have been tested in poultry and reported to have potential in augmenting their production performance and health.
Ginger, an age-old herb from the Zingiberaceae family, officially named *Zingiber officinale*, originates from south-eastern Asia. India is the largest producer and consumer of ginger contributing about 31% of total global production (Praveen Kumar *et al.*, 2025) [4]. The key phytochemicals present in ginger are gingerol, gingerdiol, and gingerdione, which enhance nutrient absorption by stimulating digestive enzymes, hinder the proliferation and activity of harmful microorganisms in the intestines, gut modulator for improving the performance of broiler birds, and have antioxidant characteristics (Edo *et al.*, 2025) [5]. Moreover, an effective way to minimize blood cholesterol, triacylglycerol, and abdominal fat content in broiler chickens is by adding extract of powdered ginger rhizome to their diets (Iheanacho *et*

al., 2024) [6]. A lot of research work has been carried out for the direct feeding of ginger powder in broiler birds, however, very scant work has been carried out on the extraction of active compounds and their supplementation in broilers in India and the world as a whole. Therefore, the present study was conducted to determine the effect of aqueous extract of ginger on carcass characteristics and haemato-biochemical profile of broiler chickens.

Materials and Methods

Animals and experimental design

The use of methodology in this experiment was approved (Approval No. VETCOLL/IAEC/2024/22/PROTOCOL-04) by the Institutional Animal Ethics Committee. One hundred ninety-two broiler (Vencobb-430Y) chicks were uniformly divided into four treatment groups of 48 birds per treatment. The duration of experiment was of 42 days. The treatments groups were as-T_1: Control diet (BIS, 2007) [7]; T_2: Control diet + 50 ml aqueous extract of ginger per 1000 ml of drinking water per day; T_3: Control diet + 100 ml aqueous extract of ginger per 1000 ml of drinking water per day; T_4: Control diet + 200 ml aqueous extract of ginger per 1000 ml of drinking water per day. At the end of experimental feeding (on 42nd day), eight birds from each treatment (2 birds from each replicate) were selected randomly and kept off feed for 12 hour and the live weight of birds as pre-slaughter weight were recorded. The birds were sacrificed by decapitation and feathers were carefully plucked after scalding. Eviscerated carcass along with giblet was weighed for calculating dressing percentage as described by Patel *et al.* (2024) [8]. The organs like liver, heart, spleen, kidney and gizzard were weighed separately using electronic balance. Also, on the same day (42nd day), the blood samples were collected from experimental birds. The haemato-biochemical parameters were estimated as described by Gosai *et al.* (2023) [9]. The blood samples were analyzed for haemoglobin and haematocrit. The serum samples were analyzed for glucose, total proteins, albumin, cholesterol, triglycerides, serum glutamic oxaloacetic transaminase (SGOT) and serum glutamic pyruvic transaminase (SGPT) levels using diagnostic kits.

Statistical Analysis

The obtained data were statistically analyzed using Analysis of Variance (ANOVA), applying the standard statistical methods (Snedecor and Cochran, 1994) [10]. The differences among the treatment means were assessed using Duncan's multiple range test (Duncan, 1955) [11]. The differences were considered significant at the level of $p<0.05$.

Results

Carcass characteristics

The effect of aqueous ginger (*Zingiber officinale*) extract on carcass characteristics of broiler chickens is presented in Table 1. The statistical analysis of values indicates no significant ($p<0.05$) difference among the various treatment groups for live weight (g) and dressed weight (g) of experimental birds. The dressing percentage in broiler chickens showed significant ($p<0.05$) differences among the treatments with higher dressing (%) in aqueous ginger extract supplemented groups as compared to the control. The mean liver, heart, gizzard, spleen and kidney weights (% of live BW) of broiler chickens were not affected ($p>0.05$) by the inclusion of aqueous ginger extract at different doses.

Table 1: Effect of aqueous ginger (*Zingiber officinale*) extract on carcass characteristics of broiler chickens

Particulars	T_1	T_2	T_3	T_4	SEM	P value
Pre-slaughter weight (g)	2317.13	2308.50	2311.00	2312.75	6.441	0.974
Dressed weight (g)	1626.00	1633.50	1648.25	1660.38	5.924	0.169
Dressing (%)	70.17^{a}	70.76^{b}	71.32^{c}	71.79^{d}	0.129	$p<0.001$
Liver (% of live BW)	1.80	1.80	1.78	1.83	0.019	0.842
Heart (% of live BW)	0.75	0.76	0.75	0.76	0.006	0.837
Gizzard (% of live BW)	2.95	2.95	2.96	2.96	0.017	0.990
Spleen (% of live BW)	0.09	0.09	0.09	0.09	0.001	0.278
Kidney (% of live BW)	0.36	0.37	0.38	0.38	0.004	0.345

^{abcd}Means in a row with different superscripts differed significantly ($p<0.001$).

SGPT: serum glutamic pyruvic transaminase; SGOT: serum glutamic oxaloacetic transaminase

T_1: Control diet; T_2: Control diet + 50 ml aqueous ginger extract in drinking water per day; T_3: Control diet + 100 ml aqueous ginger extract in drinking water per day; T_4: Control diet + 200 ml aqueous ginger extract in drinking water per day.

Haemato-biochemical parameters

The effect aqueous ginger (*Zingiber officinale*) extract on haematology and blood biochemical parameters of broiler chickens are presented in Table 2.

The statistical analysis of haemoglobin and haematocrit values showed significant differences amongst T_1 (control) and T_2, T3 and T_4 groups. There was a significant increase ($p<0.001$) in the haemoglobin and haematocrit values in ginger supplemented group as compared to the control group. The serum cholesterol concentration in broiler chickens showed that there were significant ($p<0.05$) differences among the treatments. The mean serum cholesterol concentrations were lowest in the T_4 followed by T_3 and T_2 groups as compared to the T_1 group. Supplementation of aqueous ginger extracts at different doses in drinking water had no effect ($p>0.05$) on serum concentrations of glucose, total protein, albumin, triglycerides, SGPT and SGOT in broiler chickens.

Table 2: Effect of aqueous ginger (*Zingiber officinale*) extract on haemato-biochemical parameters of broiler chickens

Age in weeks	Treatments¶					
	T_1	T_2	T_3	T_4	SEM	P value
Haemoglobin (g/dL)	9.85[a]	10.53[b]	11.27[c]	11.44[c]	0.141	$p<0.001$
Haematocrit (%)	22.56[a]	24.75[b]	26.05[c]	27.11[d]	0.331	$p<0.001$
Glucose (mg/dL)	234.88	237.75	236.38	235.13	2.776	0.978
Total protein (g/dL)	4.06	4.07	4.11	4.13	0.024	0.704
Albumin (g/dL)	1.43	1.46	1.45	1.48	0.016	0.747
Triglycerides (mg/dL)	60.19	59.19	58.34	57.44	0.414	0.104
Cholesterol (mg/dL)	183.13[a]	164.62[b]	148.73[c]	141.33[d]	3.051	$p<0.001$
SGPT (U/L)	10.52	10.36	10.63	10.53	0.105	0.840
SGOT (U/L)	309.79	300.45	301.46	306.70	4.300	0.865

[abcd]Means in a row with different superscripts differed significantly ($p<0.001$).

T_1: Control diet; T_2: Control diet + 50 ml aqueous ginger extract in drinking water per day; T_3: Control diet + 100 ml aqueous ginger extract in drinking water per day; T_4: Control diet + 200 ml aqueous ginger extract in drinking water per day.

Discussion

In the present study, the dressing percentage in broiler chickens was significantly ($p<0.05$) higher with the increasing dose rate of aqueous ginger extract addition in drinking water as compared to the control groups. The improvement in carcass traits like dressing percentage of broilers may be associated with the antioxidant effect of ginger which enhances protein and fat metabolism in body and ultimately the development of meat organs of body (Khan *et al.,* 2012) [12]. The results of present study are consistent with the observations recorded by earlier researchers like Oleforuh-Okoleh *et al.,* (2014) [13] and El-Kashef (2022) [14] indicating that carcass traits in broiler chickens were enhanced when fed varying amounts of ginger powder or aqueous extract from 1-42 days old. In contrast, Dieumou *et al.* (2009) [15] and Darwish *et al.* (2021) [16] reported that there was no significant difference in dressing percentage. The current research findings indicate that there is no significant ($p>0.05$) variation in organ weight due to aqueous ginger extract addition in drinking water. Our findings align with Ebrahimnezhad *et al.,* (2014) [17] who found that ginger powder had no significant impact of ginger supplementation on organ weight. Moreover, earlier researchers (Najafi and Taherpour, 2014 and Golshan *et al.,* 2015) [18, 19] also reported the comparable results.

The observed higher levels of haemoglobin in T_2, T_3, and T_4 groups could be a result of higher iron absorption triggered by herbal bio active compounds in ginger (Edo *et al.,* 2025) [5]. The vitamin C, polyphenols, flavonoids, and total tannins in ginger root powder improve haemoglobin levels in the blood by shielding erythrocytes from auto-oxidation (Iheanacho *et al.,* 2025) [6]. The rise in haemoglobin and haematocrit levels in the bloodstream of birds that consumed ginger powder suggests the enhanced ability of cells to transport oxygen, leading to improved nutrient delivery to the birds (Ewa *et al.,* 2023) [20].

The decrease in plasma cholesterol levels may be attributed to the high content of ginger from unsaturated fatty acids which may stimulate the cholesterol excretions into the intestine and the oxidation. Moreover, the decrease in cholesterol levels could be attributed to gingerol in ginger, which prevents lipid peroxidation. The potential cholesterol-lowering impact of ginger may be linked to various mechanisms, such as inhibiting cholesterol absorption in the gut, disrupting cholesterol production in the liver and the activation of the hepatic cholesterol-7-hydroxylase enzyme, which transforms cholesterol into bile acids, aiding in the excretion of biliary cholesterol (Fadhlina *et al.,* 2023; Salih *et al.,* 2023) [21, 22].

In the present study, there was no adverse effect of aqueous extract of ginger on serum glucose, total protein, albumin, triglycerides, SGPT and SGOT in broiler chickens. It indicates that aqueous extract of ginger supplementation in drinking water had no negative impact on protein metabolism and liver function of broiler chickens. These results were supported by the earlier studies (Malik *et al.,* 2023; Shoaibinobarian *et al.,* 2025) [23, 24].

Conclusion

Based on the results, it could be concluded that aqueous extract of ginger supplementation in drinking water improved dressing percentage, haematological parameters and reduction in serum concentration of cholesterol in broiler chickens.

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