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ORIGINAL ARTICLE

The effects of ginger root (*zingiber officiale*) processed to different levels on growth performance, carcass characteristics and blood biochemistry parameters in broiler chickens

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ABSTRACT
This experiment was conducted to the effects of ginger (*Z. officiale*) processed to different levels on growth performance, carcass characteristics and blood biochemistry parameters in broiler chickens. A total of 360 one–day–old broilers (Cobb × Cobb 500) were allotted to 6 experimental equal groups in a complete randomized design, according to the added ginger content (0, 5, 10, 15, 20, and 25 g/kg of diet) for 42 days. Growth performance (body weight gain, feed intake and feed conversion ratio) were determined on day 10 (end of the starting period), on day 22 (end of the growing period) and on day 42 (end of the finishing period). Carcass traits (relative weights of carcass, liver, abdominal fat, fat around gizzard and intestinal) and blood biochemistry parameters were assessed on day 42. Growth performance was significantly improved in the ginger treated broilers compared to the not supplemented controls. In addition, carcass characteristics and blood biochemistry parameters were not significantly altered except relative weight of eviscerated carcass and blood LDL. These data suggest that the ginger may improve growth performance in broiler chickens.
Key-words: ginger, performance, carcass, blood biochemistry, broiler

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INTRODUCTION

Antibiotics are microbial metabolites produced by fungi and algae which have low molecular weight and can inhibit the growth of other microorganisms even in low concentrations [1]. While antibiotics have prevalently been used as growth promoters in animal nutrition, European Community has prohibited the use of antibiotics in animal nutrition as growth promoters from January 1, 2006 [2]. The use of antimicrobials in poultry industry for growth promotion and treatment of infections for many years have caused microbiological and clinical evidence of resistant bacteria that might be passed from animals to humans resulting in infections that are more difficult to treat [3]. Consequently, studies on natural products such as plant extracts have recently gained a great attention [4]. It is stated that the plant extracts can continuously be used in rations without any need for their removal and that they do not induce any resistance to antibiotics [5].

Ginger is an underground rhizome of plant Zingiber Officinale belonging to the family Zingibeaceae and now; it is considered a common constituent of diet worldwide [6]. It was reported that ginger has medicinal properties against digestive disorders, rheumatism and diabetes [7]. Ginger extract possesses antioxidative characteristic, since it can scavenge superoxide anion and hydroxyl radicals [8]. Bhandari *et al.* [9] found that, the ethanolic extract of ginger significantly reduced serum total cholesterol and triglycerides and increased the HDL-cholesterol levels; also, the extract can protect tissues from lipid peroxidation and exhibit a significant lipid lowering activity in diabetic rats. In addition, Fuhrman *et al.* [10] reported that ginger decreased LDL-cholesterol, VLDL-cholesterol and triglycerides levels in apolipoprotein-E deficient mice.

Zingiber officinale is a perennial plant, commonly known as ginger. Ginger may act as a pro-nutrient because of the vast active ingredients it has been reported to contain [11]. Herbs Hands Healing [12] reported that

ginger contains volatile oils like borneol, camphene, citral, eucalyptol, linalool, phenllandrene, zingiberine, zingiberol (gingerol, zingirone and shogaol) and resin. Some gingers' medicinal properties are contained in the chemicals responsible for the taste, the most noteworthy being gingerol and shogaol. The stem of this plant is used as a popular cooking spice throughout the world. This study was conducted to explore the effects of different levels of ginger (Zingiber officinale) root powder in broiler nutrition as a natural growth promotion to determine their effects on the performance, carcass characteristics and some blood chemichal parameters.

MATERIALS AND METHODS

Birds and Protocol design

A total of Three hundred and sixty one day old male broiler chickens (Cobb 500) were used in the present study. Broilers were weighted and randomly divided six equal groups (each group was constituted by 4 replicates of 15 birds per replicate) according to the ginger contents incorporated in the diets (0, 5, 15, 20, 25 g/kg of diet). Birds were kept in pens for 42 days at a temperature which was gradually decreased from 36°C to 24°C. The diet was formulated to meet the requirements of broiler as recommended by the Catalog of Cobb 500 broilers. The ingredient and nutrient composition of the experiment broiler starter, grower and finisher diet, are presented in table 1. Broilers had access to feed and water *ad libium*. All animal experimentation was conducted in accordance with the regulations of Islamic Azad University, Animal Ethics Committee.

Data Collection

In each pen, total bird body weight, bird numbers and the weight of unconsumed and added feed were recorded on days 0, 10, 22 and 42. Mean body weight gains, feed intake and feed conversion ratios were calculated for each pen between 0-10, 11-22, 23-42 and 0-42 days. For each time period, body weight gain was calculated and expressed as grams per bird. Feed intake (g of feed intake/bird) over the entire grow-out period was calculated by totaling feed consumption in each time interval between each bird sampling. Feed conversion ratio (g of food intake/g of body weight gain) was calculated by dividing total feed intake by total weight gain in each pen.

Carcass traits and blood samples

At the end of study, two bird selected from each replicate were randomly selected for organ weights and blood samples. Birds were weighted and slaughtered by cervical dislocation then the abdominal cavity was opened. The weight of eviscerated carcass, liver, abdominal fat, fat around gizzard and intestinal were recorded and the corresponding percentages (% of live body weight) were calculated.

Blood samples were collected in non-heparinised blood sterile by cardiac puncture. Then, the serum total protein, glucose, triglyceride, globulin, cholesterol, albumin, LDL and HDL concentrations were measured using colorimetric commercial kit.

Table 1: Composition of the basal diets used in the periods of the experiment.

Ingredients (%)	Starter (1-10 day)	Grower (11-22 day)	Finisher (23-42 day)
Yellow corn	58.82	63.00	64.08
Soybean meal (44% protein)	35.00	29.99	27.5
Fat1	1.73	2.62	4.08
Limestone	1.03	0.98	0.95
DCF	2.12	2.09	2.03
Salt	0.13	0.20	0.20
Soda	0.33	0.24	0.24
Vitamin premix2	0.25	0.25	0.25
Mineral premix3	0.25	0.25	0.25
DL-Methionine	0.24	0.24	0.25
Lysine	0.05	0.09	0.12
Anti cocsidiate4	0.05	0.05	0.05
Total	100	100	100
Calculated chemical analyses			
ME (kcal/kg)	2900	3000	3100
Crude protein (%)	20.4	18.55	17.547
Calcium (%)	0.97	0.93	0.90
Avail. Pho. (%)	0.48	0.465	0.45
Methionine + Cystien (%)	0.89	0.84	0.82
Lysine (%)	1.2	1.1	1.05

1. Soybean oil

2. Per 2.5 kilogram vitamin supplementary: vitamin A, 9/000/000 IU; vitamin D3, 2/000/000 IU; vitamin E, 18/000 mg; vitamin E, 18/000 mg; vitamin K3, 2/000 mg; vitamin B1, 1800 mg; vitamin B9, 1000 mg; vitamin B2, 6/600 mg; vitamin B3, 10/000 mg; vitamin B5, 30/000 mg; vitamin B6, 3/000 mg; vitamin B12, 15 mg; choline, 500/000 mg and vitamin H2, 100 mg;
3. Per 2.5 kilogram Mineral supplementary: Mn, 100/000 mg; Fe, 50/000 mg; Zn, 100/000 mg; Cu, 10/000 mg; I, 10/000 mg and Se, 200 mg;
4. Salinomycin

Preparation of Ginger Powder

Fresh matured ginger roots were kindly provided by a local farm (Laiwu Farming Bureau, Shandong, China) and were processed into dry ginger powders using the method described by Zhao *et al.* [13]. The collected ginger powder was mixed into diets.

Experimental design and statistical evaluation

All data were analyzed using the CRD (Completely Randomized Design) of the program (SAS Intitute, 1998)[14]. Duncan's multiple range tests were used to compare differences among the treatments [15].

RESULTS AND DISCUSSION

The effects of dietary ginger supplementation during the breeding period on the feed intake, body weight gain and feed conversion ratio are given in table 2. Weight gains were significantly increased in broilers supplemented with ginger compared to the control broilers during the starting (day 0 to day 10) and the finisher (day 23 to day 42) periods.

Feed intake was also noted that significantly decreased in treated broilers compared to the not supplemented broilers during the grower period (day 11 to day 22) and whole trial (day 0 to day 42), although the differences were not statistically significant during the starting (day 0 to day 10) and finisher (day 23 to day 42) periods. Consequently, feed conversion ratio was significantly improved in ginger supplemented broilers for the starter, finisher and whole periods. The results of the present study were consistent with the results of Tekeli *et al.* [16] showed that broilers fed with ginger (*Z. Officinal*) at the rate of 120, 240 and 340 ppm, improved body weight gain. Also, Herawati [17] reported that the use of 2% red ginger in the ration of broilers improved the body weight gain. Onu [18] stated that the dietary ginger addition (25%) increased body weight in broilers. According to Kamel [19], these additives inhibit the growth of harmful bacteria including E. coli in the intestinal tract due to antimicrobial activity. Thus, when the number of harmful bacteria in the intestinal is low, promotes the nutrient assimilation and sustains performance in broilers. In the other hand, most of the researchers attributed the better performance of the broiler birds fed ginger to an improvement in palatability and the quick digestive effect of this natural product. These results are in agreement with the results of Kausar *et al.* [20] who, demonstrate that the addition of ginger at the dose rate of 2 and 4 ml/l of drinking water increased body weight in 35 days old broilers. By contrast, Zhang *et al.* [21] reported no significant effects of dietary ginger supplementation (5g/kg) on weight gains of broilers.

In the study of Nasiroleslami and Torki [22] reported that the dietary essential oil of ginger did not affect feed intake in laying hens. In agreement, Zhang *et al.* [21] did not find any significant difference in daily feed intake by feeding ginger although numerically the feed intake was higher than the control. Besides, Onu [18] reported that the addition of ginger (0.25 %) in diet of broiler resulted in improved feed conversion ratio. Also, the improved feed conversion ratio observed in birds fed ginger supplemented diets suggests that the antimicrobial action of ginger may be sufficient to inhibit microbial fermentation [23]. As also reported by Tekeli *et al.* [24, 25], the additives of antibiotic, Z. officinale and propolis extracts affect the weights and/or lengths of the digestive system. The improvement in such parameters of the digestive system is attributed to the stimulatory and promotive effects of these extracts on the gastric juices and the digestive system and consequently to greater performance in broilers.

Table 2: Performance parameters of broilers (0-42 days) of age on various levels of supplemental ginger inclusions.

Parameters[1]		T1 (Control)	T2	T3	T4	T5	T6	SEM	P
Body weight gain (g)	0-10 days	200.38^{b}	231.77^{a}	215.06^{ab}	229.50^{a}	224.69^{a}	231.71^{a}	5.36	0.0035
	11-22 days	727.28^{a}	699.09^{a}	614.31^{b}	635.00^{b}	677.13^{ab}	672.94^{ab}	19.53	0.0102
	23-42 days	1628.24^{b}	1791.21^{a}	1824.61^{a}	1640.76^{b}	1778.68^{a}	1714.71^{ab}	38.04	0.0119
	0-42 days	2535.92^{ab}	2640.78^{a}	2619.36^{a}	2466.59^{b}	2631.50^{a}	2576.19^{ab}	40.98	0.0503
Feed consumption (g/bird)	0-10 days	278.93	270.61	274.23	270.45	273.83	264.92	4.40	0.3746
	11-22 days	980.70^{a}	940.04^{b}	986.13^{a}	933.57^{b}	942.70^{b}	921.32^{b}	12.71	0.0155
	23-42 days	3569.80	3588.40	3841.30	3459.20	3666.00	3554.10	82.76	0.1132
	0-42 days	4770.30^{ab}	4537.10^{b}	5015.00^{a}	4557.90^{b}	4749.70^{ab}	4664.30^{b}	89.63	0.0157

Feed conversion efficiency	0-10 days	1.39[a]	1.17[c]	1.28[b]	1.18[c]	1.22[bc]	1.15[c]	0.03	0.0001
	11-22 days	1.35[b]	1.34[b]	1.61[a]	1.48[ab]	1.40[b]	1.38[b]	0.05	0.0152
	23-42 days	2.19[a]	2.00[c]	2.10[ab]	2.11[ab]	2.06[bc]	2.07[bc]	0.03	0.0140
	0-42days	1.88[a]	1.72[c]	1.91[a]	1.85[a]	1.80[ab]	1.81[b]	0.02	0.0002

[a-c] Means within same column having different letters are significantly different (P<0.05).
[1]T2, T3, T4, T5 and T6 represents ginger root (Zingiber officinale) processed was the rate 5, 10, 15, 20 and 25 g/kg respectively.

As shown in table 3, the relative weights of the abdominal fat, liver, fat around gizzard and intestinal did not show significantly differences between the treatment groups in 42 days old broilers fed with ginger supplemented diets compared to the controls whereas eviscerated carcass weight was significantly altered in the treated broilers. Minimal eviscerated carcass weight was recorded in broilers supplemented with 10 mg ginger.
Similar to our results, Moorthy *et al.* [26] showed that, no effect of ginger supplementation on relative weights of abdominal fat and liver in broilers. Besides, El- Deek *et al.* [27] reported that, the carcass weight didn't differ between control and ginger treated broilers up to 6th week of age. Oun [18] demonstrate that the addition of ginger (Z. Officinale) in the diet of broilers did not result in significant differences in carcass traits. Also, this was similar to the findings of Erener *et al.* [28] and Cabuk *et al.* [29], who observed that there was no significant effect on carcass characteristics of broilers fed with different levels of ginger powder and extract of ginger respectively up to six weeks of age. This was contrary to the findings of Avci [30] mentioning that plant extracts of thyme, fennel, ginger, rosemary, nigella and their combination did not have any effect on carcass yield.

Table 3: Effects of dietary supplemental plant extracts on carcass characteristics of broiler chicks.

Parameters1 (Percent)	T1 (Control)	T2	T3	T4	T5	T6	SEM	P
Eviscerated carcass weight	62.56[a]	62.59[a]	59.19[b]	62.59[a]	62.03[a]	62.70[a]	0.39	0.0001
Liver weight	2.49	2.22	2.27	2.30	2.52	2.47	0.15	0.6367
Abdominal fat weigh	2.69	2.43	2.67	2.88	2.95	3.18	0.20	0.2137
Fat around gizzard weight	0.72	0.71	0.70	0.84	0.91	0.86	0.06	0.1193
Intestinal weight	1.94	2.05	2.10	2.31	2.53	2.92	0.24	0.0895

[a-c] Means within same column having different letters are significantly different (P<0.05).
[1]T2, T3, T4, T5 and T6 represents ginger root (Zingiber officinale) processed was the rate 5, 10, 15, 20 and 25 g/kg respectively.

In addition, total protein, glucose, triglyceride, globulin, cholestrol, albumin and HDL of serum metabolites did not show significantly differences between the treatment groups in 42 days old broilers fed with ginger supplemented diets compared to the controls but, the LDL were significantly altered (Table 4). This was similar to the findings of Farinu *et al.* [31], Al-Homidan [32] and Jamel *et al.* [33] reporting that supplementation of ginger did not affect TP, albumin and Globulin in the serum of broilers. Also, Tekeli *et al.* [34] reported that supplementation of ginger did not affect Cholesterol in the serum of broilers. This was contrary to the findings of Bhandari *et al.* [9], Ademola *et al.* [35] and Jamel *et al.* [33] reporting that supplementation of ginger and ginger extracts did affect Cholesterol and Triglyceride in the serum of broilers.

Table 4: Effect of Ginger to blood biochemistry parameters of broiler.

Parameters[1]	T1 (Control)	T2	T3	T4	T5	T6	SEM	P
Total protein (g/dl)	2.89	2.69	3.17	2.50	2.43	2.29	0.25	0.1878
Glucose(mg/dl)	282.00	269.25	288.63	284.44	288.69	239.25	12.49	0.0846
Triglyceride (mg/dl)	112.56	109.06	126.94	123.25	118.56	103.50	20.52	0.9637
Globulin (g/dl)	0.70	0.87	0.99	0.62	0.56	0.47	0.13	0.0833
Cholesterol (mg/dl)	134.63	127.50	141.38	136.25	128.50	102.88	9.56	0.1251

Albumin(g/dl)	2.19	1.81	2.19	1.88	1.88	1.81	0.18	0.4711
LDL(mg/dl)	35.25[a]	37.19[a]	38.25[a]	34.12[a]	34.44[a]	24.94[b]	1.92	0.0018
HDL(mg/dl)	82.19	79.56	82.62	75.94	77.69	71.19	5.79	0.7382

[a-b] Means within same column having different letters are significantly different (P<0.05).
[1]T2, T3, T4, T5 and T6 represents ginger root (Zingiber officinale) processed was the rate 5, 10, 15, 20 and 25 g/kg respectively.

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