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Serum Lipid, Growth and Haematological Parameters of Broilers Fed Garlic, Ginger and Their Mixtures

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Abstract: The study determined the effects of garlic, ginger and their mixtures on the growth, serum lipids, haematological indices, carcass and organs of broilers. Garlic and ginger were each added to broiler diets at 1, 1.5 and 2%. Four mixtures of garlic and ginger were also formulated. Control diet did not contain any test ingredient. The results showed that garlic, ginger and mixtures contained 7.41, 5.85 and 6.62% crude protein respectively. Dietary treatment significantly influenced the final liveweights (FLW) of broiler chicks ($P<0.001$) and chickens ($P<0.01$). The mixtures of garlic and ginger significantly ($P<0.001$) improved FLW and weight gain of the 28th day old chicks than those of control birds. Garlic at 1.5 and 2% ginger significantly ($P<0.01$) decreased the FLW of the chickens relative to the control. Dietary treatment significantly ($P<0.001$) affected the carcass parts and organs development of broiler chickens. However, dietary garlic, ginger and mixtures did not affect the red blood cells and haemoglobin concentration of the chickens. The mixtures of garlic and ginger exhibited better antilipidemic influence on the serum cholesterol, triacylglycerol and abdominal fat pad of the chickens than sole garlic and ginger. In conclusion, garlic and ginger could be used as antilipidemic agents in broiler diets to lower abdominal fat pad, serum cholesterol and triacylglycerol of broiler chickens with consequential reduced growth. However, the mixtures of garlic and ginger elicited similar and better hypolipidemic action without adverse effect on the growth of the chicks and chickens.

Key words: Serum lipid · Antilipidemic property · Mixtures of garlic and ginger · Broilers

INTRODUCTION

Nutritional strategies aimed at reducing cost of animal production have led to high accumulation of fat in broiler carcass. Feed additives such as chlortetracycline, tylosin, virginianmycin and *Lactobacillus acidophilus* in combination with zinc bacitracin have been reported to increase fat content of broiler carcass[1, 2]. Feeding low-protein diets to broilers resulted in consistent decreased nitrogen excretion with increase in abdominal and whole-body fat deposition [3].

Diets that have high cholesterol and saturated fats from animal products are known to contribute to unhealthy plasma lipid levels [4] leading to increased plasma total cholesterol and low density lipoprotein (LDL) cholesterol. Elevated blood cholesterol and triacylglycerol are associated with increased risk of cardiovascular disease [5]. Cardiovascular diseases affect all affluent societies in all countries of the world. Drugs used in the treatment of patients with cardiovascular diseases have achieved limited success with different side effects reported [6, 7]. Hence, an alternative means of correcting and preventing these diseases is very crucial in achieving a healthy society.

Medicinal herbs such as garlic and ginger have been reported to possess lipid lowering effects [8, 9]. Exploitation of lipid lowering agents of garlic and ginger in broiler diets may be used as a measure to reduce levels of serum cholesterol, triacylglycerol and abdominal fat pad of broiler chickens. The study therefore investigated the effects of garlic, ginger and their different mixtures on the growth, carcass, organs, serum lipid and haematological indices of broilers.

MATERIALS AND METHODS

Processing of Garlic and Ginger: The garlic bulbs were desegmented into cloves which were cut into chips.

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Table 1: Ingredient composition of broilers starter diets

Ingredients	Control	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10
Maize	49.51	49.21	49.06	48.86	49.21	49.06	48.86	49.14	48.99	49.06	48.91
Soya bean meal	29.69	29.39	29.24	29.04	29.39	29.24	29.04	29.31	29.16	29.24	29.09
Palm kernel cake	4.00	3.60	3.40	3.30	3.60	3.40	3.30	3.50	3.30	3.40	3.20
Fixed ingredients*	16.80	16.80	16.80	16.80	16.80	16.80	16.80	16.80	16.80	16.80	16.80
Garlic	-	1.00	1.50	2.00	-	-	-	1.00	1.50	1.00	1.50
Ginger	-	-	-	-	1.00	1.50	2.00	0.25	0.25	0.50	0.50
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Calculated calcium (%)	1.37	1.36	1.36	1.36	1.36	1.36	1.36	1.36	1.36	1.36	1.36
Calculated phosphorus (%)	0.65	0.64	0.64	0.63	0.64	0.64	0.63	0.64	0.63	0.64	0.63
Determined crude protein (%)	23.45	22.83	22.08	22.33	22.88	23.03	23.20	23.00	23.20	22.85	23.28
Calculated energy (Kcal ME/ Kg)	2938.60	2911.50	2907.15	2907.00	2911.50	2907.15	2907.00	2904.76	2891.21	2897.95	2884.45

*Fixed ingredients were groundnut cake, fish meal, bone meal, oyster shell, salt, vitamin premix+, methionine and lysine at inclusion rate of 10%, 3%, 2%, 1%, 0.25%, 0.25, 0.15% and 0.15% respectively in the diets.

+Broilers vitamin premix supplied the following vitamins and trace elements per Kg diet: Vit A 7812.50IU; Vit D_3 1562.50IU; Vit E 25mg; Vit K_3 1.25mg; Vit B_1 1.88mg; Vit B_2 3.44mg; Niacin 34.38mg; Calcium pantothenate 7.19mg; Vit B_6 3.13mg; Vit B_{12} 0.016mg; Choline chloride 312.50 mg: Folic acid 0.62 mg; Biotin 0.05; Mn 75mg; Fe 62.5mg: Zn 50mg; Cu 5.31 mg; Iodine 0.94 mg; Co 0.19 mg; Se 0.07mg and Antioxidant 75mg.

Table 2: Ingredient composition of broiler finisher diets

Ingredients	Control	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10
Maize	46.52	46.22	46.07	46.37	46.22	46.07	46.37	46.15	46.00	46.07	45.92
Soya bean meal	23.78	23.48	23.33	23.63	23.48	23.33	23.63	23.40	23.40	23.33	23.18
Wheat bran	15.00	14.60	14.40	13.30	14.60	14.40	13.30	14.50	14.15	14.40	14.20
Fixed ingredients*	14.70	14.70	14.70	14.70	14.70	14.70	14.70	14.70	14.70	14.70	14.70
Garlic	-	1.00	1.50	2.00	-	-	-	1.00	1.50	1.00	1.50
Ginger	-	-	-	-	1.00	1.50	2.00	0.25	0.25	0.50	0.50
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Calculated calcium (%)	1.30	1.30	1.30	1.30	1.30	1.30	1.30	1.30	1.30	1.30	1.30
Calculated phosphorus (%)	0.61	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60
Determined crude protein (%)	20.71	20.95	20.64	20.86	20.73	20.94	21.00	20.78	20.95	20.94	21.20
Calculated energy (Kcal ME/kg)	2800.91	2775.02	2762.08	2760.00	2775.02	2762.08	2760.00	2768.59	2763.75	2762.08	2749.14

Fixed ingredients were groundnut cake, palm kernel cake, fish meal, bone meal, oyster shell, salt, vitamin premix+, methionine and lysine at inclusion rate of 6%, 3%, 2%,2%, 1%, 0.25, 0.25%, 0.1% and 0.1% respectively in the diets.

+See foot note in Table 1

The chips were sun dried during the harmattan season at the environmental temperature of 39.83±1.77°C for a period of 2-3 weeks. Dried garlic chips were stored in an airtight container which were later pounded and incorporated in the diets.

Slices of dried ginger were pounded with pestle and mortar into powdery from, which was milled and stored. Powdered ginger was later mixed with diets.

Diets Formulation: Eleven experimental diets were formulated consisting of unsupplemented (control) and supplemented diets. Garlic, ginger and their mixtures were supplemented into diets. Garlic was included in diets T1, T2 and T3 at 1.0%, 1.5% and 2.0% respectively. Diets in T4, T5 and T6 contained 1.0%, 1.5% and 2.0% ginger respectively. Diets T7 and T8 contained 1.0% and 1.5% garlic respectively, while 0.25% ginger was added to both diets. Diets in T9 and T10 contained 1.0% and 1.5% garlic respectively as well as 0.5% ginger were added to both diets. Thus, treatments T1toT6 contained garlic and ginger as sole agent, while treatments T7 toT10 contained the mixtures of garlic and ginger.

Experimental Birds and Design: Three hundred and ninety six day old broiler chicks of Hubbard strain were randomly distributed into 11 dietary treatments, with 3 replicates in a treatment of 36 chicks. The birds were given non-pelleted diets and water *ad libitum* throughout the period of the study. Each phase of broiler growth consisted of 4 weeks each.

Data Collection: Data were collected on the parameters of growth performance such as initial and final liveweight of the birds. The growth phase of the experimental birds

consisted of four weeks each for broiler chicks and growers. Four blood samples were obtained from four 49-day old broiler chickens in a replicate into ethylene diamine-tetraacetic acid (EDTA) bottles for the assessment of haematological parameters of the birds. Another set of four blood samples from 4 broiler chickens per replicate were also collected into bottles without anticoagulant to determine parameters of serum lipid profile of the chickens at the 49th day of the study.

On the 56th day of the study, four broiler chickens from each replicate were separated and fasted for 18 hours. These separated birds were given water and slaughtered for measurement of carcass parts and organs of broiler chickens. The weights of organs and carcass parts of the chickens were expressed as percentage of the final live weight of the selected broiler chickens. The linear measurement of the intestinal portion and caeca were expressed as cm/kg of the final live weight of the selected chickens. The measurement of the length and weight of gastrointestinal tract involve the portion of the tract just immediately after the gizzard to the claoca.

Chemical Analysis: Haematological parameters of broiler chickens such as red and white blood cells were determined using haemocytometer method [10]. Packed cell volume (PCV) and haemogobin were analyzed by the methods of wintrobe microhaematocrit and cyanomethaemoglobin [10] respectively. Serum alanine and aspartate aminotransferases of broiler chickens were determined according to the methods of IFCC [11] and IFCC [12] respectively. Serum triacylglycerol, total –and high density lipoprotein (HDL)-cholesterol of the chickens were measured by appropriate methods [13-15]. Serum low density lipoprotein (LDL) cholesterol was calculated using Friedewald equation [16]. Proximate analyses of garlic, ginger and mixtures of the two spices and determination of crude protein of the diets were carried out according to A.O.A.C. [17].

RESULTS

The proximate composition of garlic, ginger and their mixtures were all comparable (Table3). The levels of crude protein(CP) in the three test ingredients were very low as garlic, ginger and the mixtures contained 7.41, 5.85 and 6.62% CP of respectively. The inclusion of these agents in broiler diets did not affect the concentration of the crude protein of the diets. Dietary treatment significantly ($P<0.01$) influenced final liveweight (FLW), weight gain (WG) and feed conversion ($P<0.01$) of the chicks (Table 4). Generally, garlic as a group did not affect any parameters of growth performance of the chicks, however, the inclusion of 2% garlic (T3) significantly ($P<0.001$) decreased FLW and WG of the chicks. Furthermore, 2% ginger (T6) caused 5% significant ($P<0.001$) increase in FLW and WG relative to control. All the mixtures of garlic and ginger significantly ($P<0.001$) promoted the FLW and WG of the chicks with increases of 16% and 17% respectively, when compared to the control.

Table 3: Determined proximate composition of garlic, ginger and their mixtures

Parameters	Garlic	Ginger	Mixtures
Crude protein	7.41	5.85	6.62
Ether extract	2.41	1.35	1.99
Ash	2.54	2.29	2.74
Crude fiber	1.83	2.93	2.30
Nitrogen free extract	85.81	87.58	86.36
Dry matter	85.25	87.39	89.13

During the finishing phase of growth of the chickens, 1.5% garlic and 2% ginger also caused significant ($P<0.01$) decreases in FLW and WG of the chickens (Table 5). The results of carcass parts of broiler chickens are shown in Table 6. Dietary treatment significantly ($P<0.001$) affected the carcass parts of the chickens such as breast, back, drumsticks, wings, shanks and abdominal fat pad. The higher the dietary concentration of garlic, ginger and their mixtures, the heavier the breast except those fed 2% ginger. However, the reverse was the weights of the back, drumsticks and abdominal fat pad of the chickens. Generally, the mixtures of garlic and ginger were the best in lowering the abdominal fat pad of the chickens.

The results of organs of broiler chickens are shown in Table 7. Dietary treatment significantly ($P<0.001$) influenced the development of organs of the chickens such as lungs, liver, crops, gizzard, gastrointestinal tract (GIT) and spleen ($P<0.01$). Generally, it seems the higher the concentration of garlic, ginger and mixtures in the diets, the lower the weights of these organs. The inclusion of garlic, ginger and their mixtures in broiler diets did not affect haematological parameters of the chickens except the white blood cells (Table 8). Ginger at 1.0% caused significant ($P<0.01$) decrease in the white blood cells of the chickens.

The results of serum lipid profile of broiler chickens are shown in Table 9. Dietary treatment significantly ($P<0.001$) reduced the concentration of serum triacylglycerol, total- and LDL-cholesterol of chickens. Garlic, ginger and mixtures caused significant ($P<0.001$) decreases of 21%, 19% and 23% respectively in serum

Table 4: Growth performance of broiler chicks fed garlic, ginger and their mixtures (g/bird)

Parameters	Control	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10	SEM	Sign	Gar	Gin	Mix
Final live weight	652.13^{c}	629.96^{cd}	646.95^{cd}	618.97^{d}	642.38^{cd}	632.43^{cd}	684.74^{a}	754.74^{a}	757.67^{a}	758.67^{a}	757.67^{a}	9.02	***	NS	***	***
Initial live weight	36.08	36.05	36.13	36.06	36.09	36.16	36.11	36.09	36.03	36.01	36.02	0.06	NS	NS	NS	NS
Weight gain	616.05^{c}	593.91^{cd}	610.83^{cd}	582.91^{d}	602.29^{cd}	596.27^{cd}	648.63^{b}	718.65^{a}	721.64^{a}	722.66^{a}	721.65^{a}	9.02	***	NS	***	***
Feed intake	1170.08	1172.09	1167.30	1158.17	1295.16	1193.25	1207.03	1082.56	1190.69	1232.64	1308.29	63.32	NS	NS	NS	NS
Feed conversion	1.90^{ab}	1.98^{ab}	1.91^{ab}	1.99^{ab}	2.14^{a}	2.00^{ab}	1.86^{abc}	1.51^{c}	1.65^{bc}	1.71^{bc}	1.81^{abc}	0.11	**	NS	NS	NS

Means in the same row with different superscripts are significantly different (**P<0.01,***P<0.001), NS- not significantly different.

Table 5: Growth performance of broiler chickens fed garlic, ginger and their mixtures (g/bird)

Parameters	Control	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10	SEM	Sign	Gar	Gin	Mix
Final liveweight	2000.00^{ab}	1914.52^{ab}	1855.79^{c}	1877.67^{ab}	1930.00^{bc}	1950.00^{abc}	1829.05^{c}	2008.62^{ab}	2067.67^{a}	1997.67^{ab}	1937.50^{abc}	39.65	**	NS	**	NS
Initial live weight	652.13^{c}	629.96^{cd}	646.95^{cd}	618.91^{d}	642.38^{cd}	632.43^{cd}	684.74^{d}	754.74^{a}	757.67^{a}	758.67^{a}	757.67^{a}	9.02	***	NS	***	***
Weight gain	1347.87^{a}	1284.56^{abc}	1208.84^{c}	1258.76^{abcd}	1287.62^{abc}	1317.57^{ab}	1144.31^{d}	1253.88^{abcd}	1310.00^{abc}	1239.00^{abcd}	1179.83^{cd}	39.84	**	NS	**	NS
Feed intake	3456.22	3528.39	3509.14	3536.17	3491.85	3516.05	3596.02	3549.49	3285.64	3521.59	3728.76	132.65	NS	NS	NS	NS
Feed Conversion	2.56^{b}	2.75^{ab}	2.90^{ab}	2.81^{ab}	2.71^{b}	2.67^{b}	3.14^{a}	2.84^{ab}	2.51^{b}	2.84^{ab}	3.16^{a}	0.13	**	NS	**	NS

Means in the same row with different superscripts are significantly different (**P<0.01,***P<0.001), NS- not significantly different.

Table6: Carcass parts of broiler chickens fed garlic, ginger and their mixtures (%)

Parameters	Control	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10	SEM	Sign	Gar	Gin	Mix
Head	3.08	3.09	3.03	3.09	3.02	2.96	2.99	3.07	3.15	3.05	3.04	0.06	NS	NS	NS	NS
Neck	4.71	4.88	4.89	4.73	4.72	4.84	4.57	4.58	4.75	4.92	4.65	0.10	NS	NS	NS	NS
Thighs	9.66	9.91	9.93	9.63	9.81	10.08	9.77	9.41	9.79	9.94	9.68	0.16	NS	NS	NS	NS
Breast	14.59^{ab}	13.16^{d}	14.69^{abc}	14.02^{ab}	15.30^{ab}	15.53^{ab}	12.86^{d}	14.10^{c}	15.33^{ab}	14.92^{abc}	15.58^{a}	0.30	***	***	***	**
Back	13.06^{ab}	13.31^{a}	13.01^{ab}	11.76^{d}	12.97^{ab}	13.27^{a}	12.23^{cd}	13.22^{a}	13.30^{a}	12.48^{bc}	13.29^{a}	0.21	***	***	***	**
Drumsticks	10.82^{a}	10.36^{a}	9.30^{ef}	9.69^{cd}	10.01^{c}	9.44^{de}	9.07^{f}	9.91^{c}	9.53^{de}	9.99^{c}	10.67^{a}	0.11	***	***	***	***
Wings	8.55^{de}	8.60^{de}	8.82^{bcb}	9.11^{ab}	9.21^{a}	9.00^{abc}	8.69^{cde}	8.44^{f}	8.15^{f}	8.49^{ef}	8.46^{ef}	0.11	***	***	***	NS
Shanks	4.90^{abc}	4.70^{bcde}	4.75^{bcd}	4.96^{ab}	4.77^{bcd}	4.48^{e}	4.57^{de}	4.65^{cde}	4.83^{bcd}	5.13^{a}	4.93^{ab}	0.09	***	NS	***	***
Abdominal fat pad	1.88^{a}	1.02^{b}	1.02^{b}	0.85^{c}	0.85^{c}	0.56^{d}	0.45^{de}	0.51^{de}	0.36^{e}	0.43^{de}	0.55^{d}	0.05	***	***	***	***

Means in the same row with different superscripts are significantly different (**P<0.01, ***P<0.001) NS-not significantly different.

Table 7: Organs of broiler chickens fed garlic, ginger and their mixtures (%)

Parameters	Control	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10	SEM	Sign	Gar	Gin	Mix
Lungs	0.59^{a}	0.54^{ab}	0.44^{cde}	0.46^{cd}	0.58^{a}	0.50^{bc}	0.38^{e}	0.42^{cde}	0.47^{bcd}	0.39^{de}	0.40^{de}	0.03	***	***	***	***
Liver	2.59^{ab}	2.74^{a}	2.13^{d}	2.39^{bc}	2.65^{a}	2.26^{cd}	2.13^{d}	2.21^{cd}	2.41^{bc}	2.22^{cd}	2.43^{bc}	0.07	***	***	***	**
Spleen	0.14^{abcd}	0.15^{ab}	0.12^{cd}	0.15^{abc}	0.14^{abcd}	0.14^{abcd}	0.13^{bcd}	0.12^{d}	0.14^{abcd}	0.15^{de}	0.13^{bcd}	0.78	**	*	NS	**
Crop	0.57^{bcd}	0.52^{bcd}	0.58^{abc}	0.58^{abc}	0.64^{a}	0.53^{cde}	0.53^{cde}	0.57^{bcd}	0.60^{ab}	0.51^{de}	0.50^{e}	0.02	***	NS	***	***
Gizzard	2.57^{abc}	2.46^{abcd}	2.57^{abc}	2.63^{ab}	2.66^{a}	2.42^{bcd}	2.46^{abcd}	2.31^{d}	2.63^{ab}	2.37^{cd}	2.37^{cd}	0.07	***	NS	NS	**
GIT	7.95^{bcd}	7.95^{bcd}	7.18^{cde}	8.19^{ab}	8.88^{a}	7.68^{bcde}	6.86^{e}	7.11^{de}	8.23^{ab}	8.01^{abc}	8.45^{ab}	0.28	***	NS	***	**
GIT (cm/kg)	15.04	14.90	14.47	14.31	15.42	14.87	14.51	14.65	15.41	14.55	14.31	0.33	NS	NS	NS	NS

Means in the same row with different superscripts are significantly different (*P<0.05,**P<0.01, ***P<0.001) NS – not significantly different. GIT- gastrointestinal tract.

Table 8: Haematological parameters of broiler chickens fed garlic, ginger and their mixtures

Parameters	Control	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10	SEM	SIGN	Gar	Gin	Mix
Packed cell volume (%)	25.41	26.49	26.74	26.74	26.41	25.57	27.07	26.32	25.74	25.41	25.16	0.55	NS	NS	NS	NS
Haemoglobin (g/dl)	8.46	8.82	8.96	8.91	8.79	8.50	9.01	8.76	8.58	8.45	8.46	0.19	NS	NS	NS	NS
Red Blood cells ($x10^{3}$/ mm^{3})	4291.67	4400.00	4475.00	4466.67	4416.67	4250.00	4550.00	4375.00	4291.67	4216.67	4122.22	97.95	NS	NS	NS	NS
White blood cells ($x10^{3}$/mm^{3})11.40	^{ab}11.75^{a}	11.93^{a}	11.83^{a}	11.05^{b}	11.86^{a}	11.90^{a}	11.90^{a}	11.83^{a}	11.94^{a}	11.34^{ab}	0.20	**	NS	**	NS	

Means in the same row with different superscripts are significantly different (**P<0.01) NS – not significantly different

Table 9: Serum lipid profile (mg/dl) and enzymes (IU/L) of broiler chickens fed garlic, ginger and their mixtures.

Parameters	Control	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10	SEM	Sign	Gar	Gin	Mix
Total cholesterol	143.20^{a}	120.61^{bc}	114.42^{d}	103.62^{e}	123.31^{b}	113.12^{d}	111.61^{d}	115.82^{d}	104.20^{e}	110.57^{d}	109.82^{d}	1.95	***	***	***	***
Triacylglycerol	207.21^{a}	164.76^{b}	120.42^{e}	126.34^{e}	150.67^{b}	125.00^{e}	134.63^{e}	120.37^{e}	100.01^{d}	94.38^{d}	102.98^{d}	5.11	***	***	***	***
HDL cholesterol	66.10^{c}	79.34^{ab}	76.54^{bc}	81.81^{a}	71.79^{ab}	79.19ab	73.12^{cd}	86.20^{a}	88.60^{a}	79.81^{a}	83.83^{a}	163	***	***	***	***
LDL cholesterol	86.95^{a}	53.21^{b}	52.62^{b}	22.00^{ef}	42.78^{c}	26.83^{d}	32.78^{d}	27.80^{de}	19.20^{ef}	16.39^{f}	18.80^{ef}	3.37	***	***	***	***
Aspartate amino transferase	181.42^{cde}	176.65^{e}	203.45^{ab}	192.84^{bc}	178.95^{de}	206.15^{a}	191.05^{bcd}	177.41^{e}	171.03^{e}	193.40^{bc}	178.43^{de}	4.27	***	***	***	***
Alanine aminotransferase	9.21^{ab}	10.18^{a}	7.20^{d}	7.20^{d}	6.20^{d}	9.27^{ab}	6.69^{d}	8.55^{bc}	7.47^{cd}	6.94^{d}	7.15^{d}	0.41	***	***	***	***

Means in the same row with different superscripts are significant (***P<0.001) NS-not significantly different.

total cholesterol when compared to the control. Corresponding decreases of 51%, 61% and 76% in serum LDL cholesterol. Garlic, ginger and their mixtures caused significant decreases of 34%, 34%and 50% respectively were observed in serum triacylglycerol of the chickens when compared to the control. The data showed that the mixtures of garlic and ginger were better in lowering serum total cholesterol, LDL cholesterol and triacylglycrol of the chickens than garlic and ginger as sole agent. Finally, dietary treatment significantly ($P<0.001$) affected the activities of serum alanine and aspartate aminotransferases.

DISCUSSION

Despite the fact that the nutrient levels of garlic, ginger and the mixtures of the two spices were very minute, they had strong impact on the growth and serum lipid of broilers.The mixtures of garlic and ginger significantly improved the growth of the chicks than garlic and ginger as sole agent in broiler diets. Garlic and ginger as sole agent demonstrated antilipidemic effects on serum cholesterol, triacylglycerol and abdominal fat pad of the chickens with consequential reduction on the growth rate of the birds. However, the mixtures of garlic and ginger exhibited similar influence on the serum lipids and abdominal fat pad without any adverse effect on the growth of the broiler chickens. This reveals that addition of the mixture of garlic and ginger in broiler diet could be more beneficial in lowering lipids in broiler chickens than sole addition of garlic and ginger. Furthermore, the results of hypolipidemic action of the supplements showed that they could be used to lower some of the risk factors associated with the development of cardiovascular diseases and cancer whether in animals or human beings. It has been reported that lowering blood levels of cholesterol and fats may help to prevent heart disease, angina, stokes and heart attacks [18]. Furthermore, it has been reported that increasing HDL and lowering LDL cholesterol and triacylglycerol levels by dietary or pharmacological means remain the most important goals to reach in dyslipidemic patients [19]. Therefore, the lowering of serum lipids and abdominal fat pad of the chickens by these supplements especially the mixtures of garlic and ginger may find useful application in improving the cardiovascular health of human beings. Low fat diets have been beneficial in correcting inherited disorder of lipoprotein metabolism [20] and hyperlipidemia in human beings.

The addition of garlic, ginger and their mixtures adversely affected the development of the reported organs. This implied that there is need for caution in adding these supplements to broiler diets probably lower concentration of the supplements may be appropriate. However, dietary addition of the supplements did not adversely affect the red blood cells and haemoglobin concentration of the chickens.

In conclusion, garlic, ginger showed hypolipidemic effects on the serum cholesterol, triacylglycerol and abdominal fat pad of the chickens with reduced growth rate of the birds. However, the mixtures of garlic and ginger promoted the growth of chicks and significantly lowered abdominal fat pad, serum triacylglycerol, total- and LDL- cholesterol of the chickens. These supplements adversely affected the development of the organs.

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