HAEMATOLOGICAL AND SERUM BIOCHEMICAL RESPONSE OF BROILER CHICKS FED DIETS CONTAINING GINGER (*Zingiber Officinale*) FROM DIFFERENT PROCESSING METHODS

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ABSTRACT

An experiment was conducted with 300 one day old (arbor acre) broilers to assess their haematological and serum biochemical response when fed *ad-libitum* varying levels of dietary ginger from different processing methods. Ten dietary treatments were formulated such that diet 1 was the basal diet (BD) without ginger, diets 2, 3 and 4 were BD+ sundried ginger at 1, 1.5, 2% inclusion levels respectively, diets 5, 6 and 7 were BD+ air-dried ginger at 1, 1.5 and 2% inclusion levels respectively, diets 8, 9 and 10 were BD+ oven-dried ginger at 1, 1.5 and 2% inclusion level respectively. On day 52 of the experiment, blood samples were collected from the wing vein of the birds for haematological and serum biochemical evaluation.

Dietary treatments had no significant differences on haematological parameters, except for the packed cell volume (PCV) and monocytes which were significantly $P<0.05$ influenced by the dietary treatment. Broilers fed with diet containing sun-dried ginger at 1.5% inclusion level had the highest PCV value and monocyte value.

The serum biochemical indices were not significantly $P>0.05$ affected by the dietary treatments. However, the total cholesterol was reduced across the diets that contained ginger when compared with the control.

Keywords: Haematological, Ginger, Processing methods and Serum biochemical

INTRODUCTION

Ginger (*Zingiber officinale*) rhizome has become a very popular spice which is widely used in Indonesian cuisine as well as in other countries. It is valued due to its volatile components especially the aromatic compounds which give a spicy, pungent and pleasant smell. Barley and Jacobs, (2000) noted that these aroma compounds only partially contribute to the flavor of fresh ginger rhizome and the oleoresin content plays an important role for its pungency. Beside fresh ginger rhizome, it is quite common to find dried sliced ginger rhizome or in its powdered form. Menon *et al.* (2007) had studied the effect of processing on the flavor compounds of Indian fresh ginger (*Zingiber officinale* Roscoe). They found that gerental (24.2%) and zingerone (14.2%) were the major components in the original aroma of fresh ginger and during processing it will be decreased. Furthermore they also reported that the hydrocarbon content of the oil increased and the oxygenated compounds decreased in the dry and oil products. Puengphian and Sirichote, (2007) studied the effect of drying ginger rhizome on its (6)-gingerol content and found that as drying time increased the amount of this compound decreased.

Ginger (*Zingiber officinale*) is a spice which is used for cooking and also consumed as a whole delicacy or medicine. Akhtar *et al.* (1984) reported that ginger possess useful pharmacological potent chemical substances use in poultry, this is due to its antioxidants, antibacterial, anti-inflammatory, antiseptic, anti-parasitic and immune-modulatory properties. Positive effect of ginger on blood circulation, gastric secretion, and enterokinesia were reported by Ali *et al.* (2008); Incharoen and Yamauchi (2009). In addition, ginger has been found to enhance digestive enzyme activities (Platel and Srinivasan, 1996, 2000). All of these have favorable effects on animal productivity. So, using ginger as natural feed additives in broiler nutrition may be of great benefit and value.

Haematological traits are essential parameters for evaluating the health and physiological status of farm animals. Haematological constituents reflect the physiological responsiveness of an animal to its internal environment which include feed and feeding. Haemoglobin in the blood carries oxygen from the respiratory organs (lungs or gills) to the rest of the body (i.e. at the tissues) where it releases the oxygen to burn nutrients to provide energy to power the functions of the organism, and collects the resultant carbon dioxide to bring it back to the respiratory organs to be dispensed from the organisms. In mammals, the protein makes up about 97% of the red blood cell's dry content (by weight), and around 35% of the total content (including water) (Weed et al., 1963).

According to Daramola *et al.* (2005), haematological values could serve as baseline information for comparison in conditions of nutrient deficiency, physiology and health status of farm animals especially those kept under native husbandry system in Nigeria. The examination of blood provides the opportunity to clinically

investigate the presence of several metabolites and other constituents in the body of animals and it plays a vital role in the physiological, nutritional and pathological status of an organism (Aderemi, 2004; Doyle, 2006). It also helps in distinguishing normal state from state of stress, which can be nutritional, environmental or physical (Aderemi, 2004).

Serum biochemistry constituents have clinical importance in assessing an animal's growth, health, nutritional status and also for diagnosis and prognosis of diseases Kalitha and Mahapatra, 1998). AST are normally found in the red blood cell, liver, heart, kidney and pancreas. High levels of AST are found in the blood when tissue or organ such as heart or liver is diseased or damaged during which additional AST is released into the blood stream.

MATERIALS AND METHODS

Ginger root was purchased from a local market in Ibadan, Nigeria. The ginger used was observed for any physical defect, it was surface cleaned and washed in running tap water to remove adhering debris after which the samples was divided into three portions. The first portion was oven dried at 60^{0}C for 72 hours; the second and third portions were sundried and air-dried at an average temperature of 32.4^{0}C and 30.9^{0}C respectively. After drying, the dried ginger was grinded into powder using commercial blender. The powdered ginger samples were stored in an airtight container until needed for use. The samples were analysed for chemical composition according to official analyst chemist AOAC at the University of Ibadan, Nigeria.

Table 1: Proximate composition of processed ginger

Parameters	Sundried ginger	Air dried ginger	Oven dried ginger
Crude protein	11.53	13.33	11.01
Crude fibre	15.35	9.88	14.87
Ether extract	4.12	4.46	3.97
Dry matter	88.90	89.36	92.42
Ash	6.80	7.20	6.51
Gross energy	3.38	3.39	3.38

Diets formulation

Ten experimental diets were formulated such that diet 1 which served as the control diet contained no ginger. Sun dried ginger was included in diets 2, 3 and 4 at 1.0%, 1.5% and 2.0% respectively. Diets in 5, 6 and 7 contained 1.0%, 1.5% and 2.0% air dried ginger respectively. Diets 8, 9 and 10 contained 1.0%, 1.5% and 2% oven dried ginger respectively. The composition of the experimental diets is shown in Table 3.

Blood collection

Blood collection was carried out at the 52nd day of the experiment. Three birds per treatments were randomly selected and bled via wing veins, using sterile needles and syringes. About 5ml of blood was collected into two sets of three sterile glass tubes, for each treatment.

The samples collected for haematological parameters determination were in bottle tubes containing ethylene diaminetetra-acetic Acid (EDTA). Blood samples for serum biochemical studies were collected into plain bottles (i.e. without anticoagulant) for serum separation.

Serum was obtained by centrifugation and the serum samples were stored in a deep freezer at (-10^{0}C) until analyzed. Packed cell volume (PCV) was determined by microhaematocrit method (Igene and Iboh, 2004). Haemoglobin (Hb) concentration was measured spectro-photometrically using SP6-500 UV spectrophotometer. The red blood cells (RBC) and white blood cell (WBC) counts were estimated using haemocytometer. Serum indices were analyzed using sigma kits as reported by (Igene and Iboh, 2004).

Experimental design and statistical analysis

The experimental design was 3 x 3 factorial arrangements in a completely randomized design (CRD) and the data obtained were subjected to analysis of variance (ANOVA) using SAS (1999) and difference among treatments means were separated using SAS macro (1998).

Table 2: Gross composition of experimental basal diets

INGREDIENTS	STARTER (kg/100kg)	FINISHER (kg/100kg)
Maize	55.00	56.50
Soybean	33.00	---
Wheat Offal	---	10.00
Fish meal (72 %)	0.50	0.30
GNC	4.60	9.50
FF soya	3.00	20.00
Oyster shell	0.50	1.00
L-lysine	0.15	0.10
Dl-methionine	0.25	0.15
B.Premix	0.25	0.25
Salt	0.25	0.25
DCP	2.50	1.95
Total	**100.00**	**100.00**
Calculated nutrients		
Crude protein (%)	23.11	19.72
Metabolizable Energy (Kcal/kg)	3005.31	3000.39
Crude fibre (%)	3.82	3.79
Ether extracts (%)	3.86	5.51
Calcium (%)	1.02	1.12
Available phosphorus (%)	0.55	0.45

GNC - Groundnut Cake; FF Soya- Full Fat Soya; DCP- Dicalcium Phosphate
B. Premix- Broiler Premix

Table 3: Haematological parameters of broiler chicks fed differently processed ginger

PARAMETERS		METHODS			SEM
	CONTROL	SUNDRIED	AIRDRIED	OVENDRIED	
PCV (%)	28.33^{b}	30.78^{a}	30.11^{ab}	30.89^{a}	1.15
HEMOGLOBIN(g/dl)	9.60	10.20	10.05	10.38	0.48
RED BLOOD CELL (10^6/ mm^3)	3.34	3.50	3.48	3.39	0.10
WHITE BLOOD CELL (10^3/ mm^3)	17.03	17.01	20.11	20.76	19.63
LYMPHOCYTE (%)	61.00	59.56	64.00	63.33	3.84
HETEROPHIL (%)	35.33	34.56	30.67	31.44	3.93
MONOCYTE (%)	3.33	2.67	2.56	2.56	0.48
EOSINOPHIL (%)	3.00	3.11	2.44	2.44	0.65
BASOPHIL (%)	0.00	0.11	0.22	0.22	0.24

Means with different superscript are significantly different from each other (P<0.05)

Table 4: Effect of graded inclusion levels of ginger on haematological indices of broiler chicks

PARAMETERS	INCLUSION LEVEL				
	0%	1%	1.5%	2%	SEM
PCV (%)	28.33^{b}	30.22^{ab}	30.89^{a}	30.67^{ab}	1.15
HAEMOGLOBIN (g/dl)	9.60	10.07	10.27	10.29	0.48
RED BLOOD CELL (10^6/ mm^3)	3.34	3.41	3.47	3.50	0.10
WHITE BLOOD CELL(10^3/ mm^3)	17.03	20.15	19.26	18.47	19.63
LYMPHOCYTE (%)	61.00	60.11	63.89	62.89	3.84
HETEROPHIL (%)	35.33	34.56	30.67	31.44	3.93
MONOCYTE (%)	3.33^{a}	2.33^{ab}	3.22^{ab}	2.22^{b}	0.48
EOSINOPHIL (%)	3.00	2.89	1.89	3.22	0.65
BASOPHIL (%)	0.00	0.11	0.22	0.22	0.24

Means with the same superscript are not significantly different from each other. (P>0.05)
Means with different superscript are significantly different from each other (P<0.05)

RESULTS

The result of the effect of the different processing methods of ginger on the haematological indices of broilers fed dietary treatment as shown in table 9, showed that the different processing methods of ginger had no significant (P>0.05) effect on the haematological indices of broilers fed dietary treatment, except PCV which was significantly (P< 0.05) influenced by the different processing methods. Birds fed with diet containing oven-dried ginger had the highest value (30.89), while birds fed with

diet without ginger had the lowest value of (28.33).

There were no significant (P>0.05) differences observed across the various graded inclusion levels for all the haematological indices measured except for PCV and Monocytes. The highest value of PCV (30.89) was obtained from birds fed diet that contained ginger at 1.5% level of inclusion while the lowest value was obtained from birds fed with diet without ginger. The values of the basophils increased as the inclusion levels of ginger increases from (0.00) for birds fed diet without ginger to (0.22) for birds fed diet containing ginger at 1.5% and 2% inclusion level.

Significant interaction (P<0.05) was observed for birds fed with diet containing sun-dried ginger at 1.5% inclusion level which had the highest value (32.33). On the other hand PCV of birds fed diet without ginger (28.33) had no significant (P>0.05) difference when compared with birds fed with Sun-dried ginger at 1.5% inclusion level (32.33).

The effect of the different processing methods and inclusion levels of ginger had significant (P<0.05) interaction on the monocyte of the broiler chicks. Birds fed diet containing sun-dried ginger at 1.5% inclusion level had the highest mean (4.00) which significantly (P<0.05) differs from those fed Sundried ginger at 1% (2.00) and 2% (2.00) inclusion levels, Air-dried ginger at 1.5% inclusion level (2.00), and Oven-dried ginger at 1% inclusion level (2.00) which had the lowest mean.

No significant interaction was observed for the other haematological indices. The numerical values showed that highest haemoblobin value (10.73) was observed in birds fed sundried ginger at 1.5% level of inclusion and lowest on birds fed diet without ginger (9.60), the highest red blood cell count value (3.67) was obtained in birds fed sundried ginger at 2% level of inclusion and the lowest value obtained in birds fed sundried ginger at 1% inclusion level. The highest White blood cell count was observed in birds fed oven dried ginger at 2% inclusion level (23.23), while the lowest value (15.93) was observed in birds fed sundried ginger at 2% inclusion level. Highest lymphocyte value (68.00) was observed in birds fed diet containing air-dried at 1.5% inclusion level, while the lowest numerical value (58.00) was observed in birds fed diet containing air-dried ginger at 1% inclusion level.

Table 5: Interaction effect of different processing methods and dietary inclusion levels of ginger on haematological indices of broiler chicks

PARAMETERS	CONTROL		METHODS SUNDRIED			AIR-DRIED			OVEN-DRIED		
INCLUSION LEVEL	0%	1%	1.5%	2%	1%	1.5%	2%	1%	1.50%	2%	SEM
PCV (%)	28.33^{b}	30.00^{ab}	32.33^{a}	30.00^{ab}	29.00^{ab}	31.00^{ab}	30.33^{ab}	31.67^{ab}	29.33^{ab}	31.67^{ab}	1.15
HAEMOGLOBIN (g/dl)	9.60	10.06	10.73	9.80	9.80	10.10	10.27	10.33	10.00	10.80	0.48
RED BLOOD CELL (10^{6}/ mm^{3})	3.34	3.27	3.57	3.67	3.67	3.42	3.36	3.29	3.41	3.46	0.10
WHITE BLOOD CELL (10^{3}/ mm^{3})	17.03	18.17	16.93	15.93	21.08	23.00	16.23	21.20	17.85	23.23	19.63
LYMPHOCYTE (%)	61.00	58.33	59.33	61.00	58.00	68.00	66.00	64.00	64.33	61.67	3.84
HETEROPHIL (%)	35.33	36.33	33.33	34.00	36.00	28.00	28.00	31.33	30.67	32.33	3.93
MONOCYTE (%)	3.33^{ab}	2.00^{b}	4.00^{a}	2.00^{b}	3.00^{ab}	2.00^{b}	2.67^{ab}	2.00^{b}	3.67^{a}	2.00^{b}	0.48
EOSINOPHIL (%)	3.00	3.33	3.00	3.00	3.00	1.33	3.00	2.33	1.33	3.67	0.65
BASOPHIL (%)	0.00	0.00	0.33	0.00	0.00	0.33	0.33	0.33	0.00	0.33	0.24

Table 6: Effect of different processing methods of ginger on serum biochemical parameters of broiler chicks

PARAMETERS	METHODS				
	CONTROL	SUNDRIED	AIRDRIED	OVENDRIED	SEM
AST (UI/L)	187.33^{b}	234.33^{a}	223.11^{a}	213.67^{ab}	15.54
ALT (UI/L)	32.00	28.33	33.44	33.56	4.49
T.CHOL (mg/dl)	205.00	199.78	197.00	190.44	20.12
TRIG(mg/dl)	178.00	176.33	197.78	184.33	21.37
HDL (mg/dl)	171.33	181.22	166.78	168.00	19.65
LDL (mg/dl)	37.93	27.69	50.53	36.24	17.44

Means with different superscript are significantly different from each other (P<0.05)
AST: Aspertate Transaminase, ALT: Alanine Amino Trasaminase, HDL: High-Density Lipoproteins, LDL: Low- Density Lipoproteins, TRIG: Triglycerides, TCHL: Total Cholesterol

The different methods of processing ginger had no significant (P>0.05) influence on the serum biochemical indices except for Aspartate Transaminase (AST). There was variation (P<0.05) in the AST values of the birds fed diet containing ginger from different processing methods. The highest value of AST was obtained in birds fed diet containing sun-dried ginger (234.33), while the birds fed basal diet without ginger had the lowest mean value (187.33).

There was no significant difference in other serum biochemical indices. However, the numerical values showed that Alanine Amino Transaminase (ALT) had the highest value (33.56) obtained from birds fed diet containing oven dried ginger while the lowest value(28.33) was obtained from birds fed diet containing air-dried ginger. The values obtained for total cholesterol showed a reduction from the value obtained from birds fed diet without ginger (205.00) which had the highest value, to the lowest value (190.44) which was obtained in birds fed with diet containing oven-dried ginger. Triglyceride highest value (197.78) was obtained from birds fed diet containing air-dried ginger, while the lowest value (173.33) was obtained from birds fed diet containing sundried ginger. High density lipoprotein obtained the highest numerical value (181.22) on bird fed diet containing sun-dried ginger, while birds fed with diet containing air-dried ginger had the lowest value (166.78). The highest numerical value (50.53) for Low density lipoprotein was obtained from birds fed diet containing air-dried ginger and lowest value (27.69) obtained from birds fed diet that contained sun-dried ginger.

Table 7: Effect of graded inclusion level of ginger on serum biochemical indices of broiler chicks fed dietary treatments

PARAMETERS	INCLUSION LEVELS				
	0%	1%	1.5%	2%	SEM
AST (UI/L)	187.33^{b}	215.67^{ab}	239.11^{a}	216.33^{ab}	15.54
ALT (UI/L)	32.00	31.78	31.56	32.00	4.49
T.CHOL (mg/dl)	205.00	212.44	189.89	184.89	20.12
TRIG (mg/dl)	178.00	203.22	177.56	177.67	21.37
HDL (mg/dl)	171.33	174.44	169.11	172.44	19.65
LDL (mg/dl)	37.93	31.36	36.73	46.38	17.44

Means with different superscript are significantly different from each other (P<0.05)
AST: Aspertate Transaminase, ALT: Alanine Amino Trasaminase, HDL: High-Density Lipoproteins, LDL: Low- Density Lipoproteins, TRIG: Triglycerides, TCHL: Total Cholesterol

The varying level of ginger had no significant (P>0.05) influence on the serum biochemical indices of the birds across except for AST. There were no variation (P>0.05) in the AST of the birds across the varying levels of ginger. However, birds fed with ginger at 1.5% inclusion level recorded the highest mean value (239.11) which was significantly (P<0.05) higher when compared with the mean values of the birds across the other inclusion levels, control (187.33), 1% (215.67) and 2% (216.33).

There was no significant difference in other serum biochemical indices. However, the numerical values showed that Alanine Amino Transaminase (ALT) had the highest value (32.00) obtained from birds fed diet containing 0% and 2% inclusion levels of ginger while the lowest value(31.56) was obtained from birds fed diet containing 1.5% inclusion level of ginger . The values obtained for total cholesterol showed a reduction from the value obtained from birds fed diet without ginger (205.00) which had the highest value, to the lowest value (184.89) which was obtained in birds fed with diet containing 2% ginger. Triglyceride highest value (203.22) was obtained from birds fed diet containing 1% ginger, while the lowest value (177.56) was obtained from birds fed diet containing 1.5% ginger.

High density lipoprotein obtained the highest numerical value (174.44) on bird fed diet containing 1% ginger, while birds fed with diet containing 1.5% ginger had the lowest value (169.11). The highest numerical value (46.38) for Low density lipoprotein was obtained from birds fed diet containing 2% ginger and lowest value (31.36) obtained from birds fed diet that contained 1% ginger.

Table 8: Interaction effect of processing methods and dietary inclusion levels of ginger on serum biochemical parameters of broiler chickens

	METHODS										
PARAMETERS	CONTROL	SUNDRIED			AIR-DRIED			OVEN-DRIED			
INCLUSION LEVEL	0%	1%	1.5%	2%	1%	1.5%	2%	1%	1.5%	2%	SEM
AST(UI/L)	187.33	225.33	243.00	234.67	192.00	246.00	231.33	229.67	228.33	183.00	15.54
ALT(UI/L)	32.00	23.33	26.67	35.00	39.00	32.00	29.33	33.00	36.00	31.67	4.49
TCHOL(mg/dl)	205.00	205.00	196.67	197.67	224.00	183.33	183.33	208.33	189.67	173.33	20.12
TRIG(mg/dl)	178.00	189.00	173.00	167.00	215.33	177.67	200.33	205.33	182.00	165.67	21.37
HDL(mg/dl)	171.33	177.00	178.33	188.33	139.33	197.67	163.33	207.00	131.33	165.67	19.65
LDL(mg/dl)	37.93	12.73	19.47	50.87	41.60	49.87	60.13	39.73	40.87	28.13	17.44

Means with different superscript are significantly different from each other (P<0.05)

AST: Aspertate Transaminase, ALT: Alanine Amino Trasaminase, HDL: High-Density Lipoproteins, LDL: Low- Density Lipoproteins, TRIG: Triglycerides, TCHL: Total Cholesterol

The result of the interaction of the different processing methods and inclusion levels of ginger on the serum biochemical indices of the broiler chicks are shown in table 14. Although, there was no significant (P>0.05) difference across the values obtained for the interaction effect on AST. Birds fed with oven-dried ginger at 2% inclusion level recorded a lower value (183.00) when compared with the control diet (187.33). The highest numerical value of AST was obtained in birds fed diet containing air-dried ginger at 1.5% inclusion level while bird fed oven-dried ginger at 2% inclusion level had the lowest AST value (183.00)

No significant difference in all serum biochemical indices examined. However, the numerical values showed that Alanine Amino Transaminase (ALT) had the highest value (39.00) obtained from birds fed diet air-dried-ginger at 1% inclusion level while the lowest value(23.33) was obtained from birds fed diet containing sun-dried ginger at 1% inclusion level. The value (224.00) obtained for total cholesterol was highest on birds fed diet that contained air-dried ginger at 1% inclusion, while the lowest value (173.33) which was obtained on birds fed with diet containing oven-dried ginger at 2% inclusion level. Triglyceride highest value (215.33) was obtained from birds fed diet containing air-dried ginger at 1% inclusion level, while the lowest value (173.33) was obtained from birds fed diet containing oven-dried ginger at 2% inclusion level. High density lipoprotein obtained the highest numerical value (207.00) on bird fed diet containing oven-dried ginger at 1% inclusion level, while birds fed with diet containing air-dried ginger had the lowest value (131.33). The highest numerical value (60.13) for Low density lipoprotein was obtained from birds fed diet containing sun-dried ginger at 2% inclusion level and lowest value (12.73) obtained from birds fed diet that contained sun-dried ginger at 1% inclusion level.

DISCUSSION

Haematological parameters

The results of the present study were consistent with the results of Al- Kassie, (2009), who found that the group fed with cinnamon and thyme oils had significantly higher RBC and hematocrit (PCV) counts compared with the control group.

The values obtained under the different processing methods and inclusion levels for HB, RBC, WBC, Lymphocytes and eosinophils fall within the recommended range by Mitruka and Rawnsley, (1977) for healthy birds.

It can be inferred that the haematological indices were within safety limits for broilers in this experiment. The normal Packed Cell Volume, Haemoglobin and other haematological values portray normal nutritional status of the broiler chicken and thus indicating adequate nourishment of the birds (Church *et al.,* 1984). This also implies that the immune system of the birds was normal. The numerical differences observed in the PCV of birds fed diet containing ginger from different processing methods suggest that the diets were better utilized and assimilated into the blood stream for use by the birds.

Serum biochemistry

The supplementation of ginger has been observed to reduce cholesterol levels in blood serum because of its antioxidative action (Jang *et al.*, 2007). Results from this present study showed that total cholesterol recorded the highest value from birds fed basal diet without ginger, when compared with the other values recorded by ginger from the different processing methods. This suggests that inclusion of ginger in broiler diet reduce the total cholesterol level of broiler chickens. It was also observed that 1.5% and 2% inclusion level of processed ginger was lower compared to that of 0% inclusion level, while that of 1% inclusion level was higher than that of 0% inclusion level. This also suggests that increment in the inclusion level of ginger above 1% lowers the total cholesterol level. This is in agreement with Barazesh, *et al.* (2013) who reported that other blood parameters did not differ significantly between the control group and the treatment plant. But cholesterol and triglyceride levels in treatments 1% and 1.5% of powdered ginger in numerical compared to the control group demonstrated a numerical decrease that was not significant and also in agreement with Bhandari *et al.* (2005) who reported that ethanolic extract of ginger produced significant decrease in serum total cholesterol and triglycerides levels and increased HDL-cholesterol level as compared to rats and the extract exhibit a significant lipid lowering activity and protect the tissues from lipid peroxidation. This observations were also comparable with the findings of Ciftci *et al.,* (2010) that hypertriglyceridemia effects in chickens fed with herbs are due to active ingredients in herbs leading to a decrease in the activity of lipogenic enzymes; thereby reduce re-synthesis (de novo) of fatty acids in the liver. Also, with the conclusion of Ciftci *et al.* (2010) that high crude fiber content

in herbs increase the excretion of bile and thereby resulting in decreased blood cholesterol and triglyceride.

CONCLUSION

The different processing methods and inclusion levels as well as their interaction did not have any adverse effect on the blood constituent of the broiler chickens. Ginger supplementation in broiler diets, irrespective of the processing method at 1.5% and 2% inclusion level resulted in a decrease in serum total cholesterol of the broiler chicken.

REFERENCES

Aderemi, F.A., 2004. Effects of replacement of wheat bran with cassava root sieviate supplemented or unsupplemented with enzyme on the haematology and serum biolochemistry of pullet chicks. Trop. J. Anim. Sci., 7: 147-153.

Akhtar, M.S., Afzal, H., Chaudry, F. 1984: Preliminary *in vitro* antibacterial screening of Bakain, and Zarisk against Salmonella. Medicose, 9, 6-7.

Al-Kassie, G. A. M. 2009. Influence of two plant extracts derived from thyme and cinnamon on broiler performance. Pakistan Vet. J., 29(4): 169-173.

Ali, B.H., Blunden, G., Tanira, M.O. and Nemmar, A. 2008. Some phytochemical, pharmacological and toxicological properties of ginger (*Zingiber officinale Roscoe*): A review of recent research. Food Chemistry and Toxicology 46: 409-420.

AOAC, 1990. Official methods of analysis, 15th Edition, Association of Official Analytical Chemists, Washington DC.

Barazesh, H., Pour, M.B., Salari, S and Abadi, T.M. (2013). The effect of ginger powder on performance, carcass characteristics and blood parameters of broilers. *International journal of Advanced Biological and Biomedical Research*, Volume 1, Issue 12: 1645-1651

Bartley, J. P. and Jacobs, A. L. 2000. Effects of Drying on Flavour Compounds in Australian-grown Ginger *(Zingiber officinale)*. Journal of the Science of Food and Agriculture 80: 209-215.

Church, J. P., Judd, J. T., Yomg, C. W., Kebay T. L., Kim W.W. 1984. Relationship among dietary constituents and specific serum clinical components of subjects eating self selecting diets. America Journal Clinical Nutrition, 40, 1338-1344.

Ciftci, M., Simsek, U.G., Yuce, A., Yilmaz O. and Dalkilic, B. 2010. Effects of dietary antibiotic and cinnamon oil supplementation on antioxidant enzyme activities, cholesterol levels and fatty acid compositions of serum and meat in broiler chickens. *Acta Veterinaria Brno* 79, 33-40.

Daramola, J. O., Adeloye, A. A., Fatoba, T. A. and Soladoye, A. O. 2005. Haematological and serum biochemical parameters of West African Dwarf (WAD) goats. Livestock Research for Rural Development, 17(8). Available at: http://www.irrd.org/irrd17/8/dara17095.htm

Doyle, M.E. 2003. Alternatives to antibiotic use growth promotion in Animal Husbandry Food Research Institute. University of Wisconsin

Igene, F. U. and Iboh, S. O. 2004. Growth performance and haematological responses of cockerel chicks fed diets containing different levels of rice offals as replacement for wheat offals. Pages 20 – 22. In: OGUNJI et al. Proceedings of the 9th Annual Conference of Animal Science Association of Nigeria.

Incharoen, T. and Yamauchi, K. 2009. Production performance, egg quality and intestinal histology in laying hens fed dietary dried fermented ginger. *International Journal of Poultry Science* 8: 1078-1085.

Jang, I.S., Ko, Y.H., Kang, S.Y and Lee, C.Y. 2007. Effect of commercial essential oil on growth performance, digestive enzyme activity and intestinal microflora population in broiler chickens. *Animal Feed Science and Technology* 134, 304-315.

Kalita D.J. and Mahapatra M. 1998. Serum constituents and serum enzyme activities of Black Bengal Indian Journal of Animal Research 32 (1) 38-40

Menon, A. N., Padmakumari, K. P., Kutty, B. S.,Sumathikutty, M. A., Sreekumar and Arumugham, C. 2007. Effects of Processing on the Flavor Compounds of Indian Fresh Ginger (*Zingiber officinale Rosc.*). *Journal of Essential Oil Research* 19 (2): 105-110.

Mitruka, B.M., Rawnsley, H.M. 1977. Clinical Biochemical and Haematological Reference Values in Normal Experimental Animals. Masson Pub. USA Inc., N.Y. pp. 21-84.

Platel, K. and Srinivasan, K. 2000. Influence of dietary spices and their active principles on pancreatic digestive enzymes in albino rats. *Food/Nahrung* 44, 42-46.

Platel, K. and Srinivasan, K. 1996. Influence of dietary spices or their active principles on digestive enzymes of small intestinal mucosa in rats. *International Journal of Food Sciences and Nutrition* 47, 55-59.

Puengphian, C. and Sirichote, A. 2007. [6]-gingerol content and bioactive properties of ginger

(*Zingiber officinale* Roscoe) extracts from supercritical CO2 extraction *Asian Journal of Food and Agro-Industry* ISSN 1905-

SAS Macro Language: 1998. Reference, SAS Online Doc ®9.2, SAS Institute Inc., Cary, NC, USA

SAS 1999. SAS / STAT User's Guide. Version 8 for windows. SAS Institute Inc., SAS Campus Drive, Cary, North Carolina, USA.

Saxton, A.M.1998. A macro for converting mean separation output to letter groupings in Proc. Mixed.in proc. 23rd SAS users group intl., SAS institute carry, NC,PP,243-1246.

Weed, R. I., Reed, C. F. and Berge, G. 1963. Is haemoglobin an essential structural component of human erythrocyte membranes? *J. Clin. Invest.* 42(4): 581-588.