Original Research Article

Performance, haematology and serum biochemical status of two breeds of broiler chicken fed *Ficus thonningii* leaf powder and vitamin C supplemented diets

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ABSTRACT

Aims: To evaluate the effect of *Ficus thonningii* leaf powder (FTLP) and vitamin C supplemented diets on performance and haemato-biochemical status of two breeds of broiler chickens.

Methodology: Four hundred and eighty-one-day-old of Arbor acre (AB) and Cobb 500 (CO) broiler chicks were randomized to eight dietary treatments; diet 1 and 2 (Control), diets 3 and 4 (200mg/kg vitamin C inclusion), diets 5 and 6 (1% inclusion of FTLP) and (diets 7 and 8 (200mg/kg + 1% FTLP inclusions) for AB and CO breeds respectively.

Results: Result shows that feed intake, body weight gain and FCR were significant (P<0.05) at the starter phase. Interaction between breed and vitamin C were also significant (P<0.05) for body weight gain, FCR and feed intake. Vitamin C and FTLP supplementation significantly (P<0.05) improved the erythrocytes count while the MCV, MCH, WBC and lymphocytes of birds fed diets 2 and 6 were significantly (P<0.05) higher than the other diets. The breed effect showed that AB was significantly better (P<0.05) than CO in the erythrocytes count while the CO showed significant (P<0.05) improvement for the MCV and MCH. Vitamin C supplementation showed significant difference (P<0.05) for the RBC and the interaction of vitamin C and FTLP significantly (P<0.05) improved PCV, HB, MCV, MCH, WBC and lymphocytes. The interactive effect of vitamin C and FTLP significantly (P<0.05) improved the total protein and albumin while AST, cholesterol and creatinine were significantly (P<0.05) enhanced with the interaction of vitamin C and FTLP

Conclusion: As observed in this study, the inclusion of FTLP and vitamin C as a supplement in the diets of broiler chickens improved their performance, haematological indices and serum biochemical status of the tested birds.

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Comment [AAD6]: what do you mean here? Enhancement of cholesterol and creatinine implies negative result of the serum chemistry. Please be clearer. Give claerer result as indicated in the table

Keywords: Ficus thonningii, supplementation, performance, haematological, serum biochemical

1. INTRODUCTION

With the huge potential of poultry production to provide food and livelihood securities [1], broiler production is expected to meet the critical shortage in animal protein needed by Africa [2]. However, a major threat to achieving the full potential of broiler production has been the growing concerns of the impacts of climate change on livestock production [3] and it has been projected that there is an expected increase in average temperature by 2°C–6°C by the year 2100 [4] which portends serious challenge to sustainable broiler production. [5] reported that high ambient temperature adversely affects the performance of broiler chickens and a way to mitigate this is the supplementation of antioxidants in the diet to ameliorate the effects of thermal stress on the birds. The negative impacts of heat stress on poultry have been reported [6], [7]. The responses of birds to high ambient temperature includes high body temperature; lower feed intake, feed efficiency, live weight and growth and performance [8]. The inclusion of these phytogenic substances of plant origin in poultry diets has contributed to enhance the performance of animals, improving carcass traits and health status, ameliorating the negative impacts of oxidative stress and conferring positive effect on animal products [9], [10], [11]. The common wild fig, *Ficus thonningii* (odan) is one of the many fruit-bearing trees that have traditionally been used for treating diseases in Africa and beyond [12]. *Ficus thonningii* extracts also contain phytochemicals that mimic and/or enhance the action of regulatory peptides which increase the proliferation of parietal cells and exhibit tropic effects on the gut mucosa of rat [13]. In a previous study by [13], it was reported that *F. thonningii* leaf has 11.91% ash, 22.61% crude fibre, 8.51% crude fat, 7.63% crude protein, 70% DPPH, 8mg/g vitamin C, 81.55mg/g flavonoids, 51.42mg/g saponins, 59.50mg/g alkaloids, 12.51mg/g Ca and 6.63mg/g Fe. The inclusion of vitamin C in the diets of poultry birds has been reported to be a means of ameliorating the impact of heat stress due to its antioxidant properties, scavenging of free radicals [15], reduction of its biosynthesis during heat stress as well as poultry birds' ability to overcome infectious conditions [16]. Thus, two breeds of broiler chickens were examined in this study for their performance, haematological and serum chemistry status by being fed diets supplemented with vitamin C and *Ficus thonningii* leaf powder.

2. MATERIAL AND METHODS

2.1 Ethical approval; collection, processing, and analysis of phytogens

The Research and Ethics Committee of the Department of Animal Production and Health, The Federal University of Technology, Akure, Nigeria, accepted the experiment's requirements and criteria for animal and animal protocol. Osowe *et al* (2021) described the procedure for gathering and preparing *Ficus thonningii* leaf powder (FTLP) as well as investigated the proximate, phytochemical, antioxidant and mineral components of FTLP.

2.2 Vitamin C and ingredients for experimental feed

Local markets in Akure, Nigeria, were used to obtain vitamin C powder (Avondale Laboratories Limited, Banbury, England) and other feed ingredients.

2.3 Experimental diets, experimental design and the birds' living environment

To meet the nutritional needs of the birds, a broiler chicken's basal diet was compounded for the starter phase (0 to 21 days) and finisher phase (21-42 days) using the requirement of [17]. For each phase, the basal diet was divided into eight equal portions and named diets 1 to 8. Diet 1 and 2 were not supplemented (negative control), while diets 3 and 4 had vitamin C (200mg/Kg of basal diet) supplementation. Then diets 5 and 6, received 1g FTLP/Kg of basal diet supplementation each while diets 7 and 8 had 1g FTLP/kg of basal diet + 200mg of vitamin C. The feeding trial was undertaken at the Federal University of Technology's Teaching and Research Farm in Akure, Nigeria.
In a completely randomized design, 240 one-day-old chicks each of Cobb 500 and Arbor Acre breeds of broiler chicks weighing 37.40±0.45g were randomly assigned to all the eight experimental diets. The diets were replicated six times with ten birds (10 birds/replicate) and a total of 60 birds per treatment. Wood shavings were used as bedding for the floor of the experimental pen (2m x 1m) to a depth of 3cm. The temperature of the experimental house was kept at 31±2 degrees Celsius for the first week and then reduced by 2 degrees Celsius each week after that until the temperature reached 26±2 degrees Celsius. The lighting was turned on for 24 hours on the first day and 23 hours on consecutive days.

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2.4 Performance characteristics

The body weight (BW) and feed intake (FI) of the tested birds were measured and recorded weekly. The average body weight gain (BWG) was calculated as the difference between the initial and final weights of the birds. The feed conversion ratio (FCR) was calculated by dividing the feed consumed by the weight gained.

2.5 Collection and analysis of Blood samples

On the last day of the feeding trial, 18 birds per replicate were randomly selected for blood collection. Syringe and needle were used to draw blood from the wing vein. For the determination of the serum biochemicals indices (i. e. total protein, aspartate aminotransferase, creatinine, and cholesterol), 4ml of the blood sample was drawn into a plain bottle vial. The sample bottles were spun and the serum decanted into another plain bottle before freezing at -20^{0}C. The remainder (2ml) was dispensed into Ethylenediaminetetraacetic acid bottle for haematological indices determination [18]. The serum biochemical concentrations were measured using a Reflectron ®Plus 8C79 (Roche Diagnostic, GombH Mannheim, Germany) and kits.

2.6 Statistical data evaluation

The model: $Txy = \mu + bx + \beta xy$, was used in this experiment, where *Txy* any of the factors of response; x = the overall average; bx = the xth treatment's effect (*T*= diets 1, 2, 3, 4, 5, 6, 7 and 8); and *βxy* = random error due to the investigation. Using SPSS version 20, all of the data were subjected to one-way ANOVA. Duncan multiple range test of SPSS was used to detect the differences between the treatment means (*P<0.05*).

3. RESULTS AND DISCUSSION

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Table 2 shows the growth performance of different breeds of broiler chickens fed *Ficus thonningii* leaf powder (FTLP) and vitamin C supplemented diets. The body weight gain (BWG) at the starter phase (1 – 3 weeks) were not significantly different (P>0.05) for birds across all the diets except diet 6 and the feed intake (FI) for birds fed diets 1, 2, 3 and 4 were significantly (P<0.05) higher than the other diets. The FCR for birds fed diets 6 was significantly higher than the other tested diets. The breed and FTLP supplementation were significant (P<0.05) for BWG, FI and FCR at the starter phase. The interaction between BRD x VC were significant (P<0.05) for BWG and FCR; BRD x FTLP was significant (P<0.05) for FCR while VC x FTLP showed significance (P<0.05) for BWG and FI. The interactive effect of BRD x VC x FTLP were significant (P<0.05) for BWG and FCR at the starter phase. At the finisher phase (4-6 weeks), the BWG were significantly higher (P<0.01) in diets 2 and 4 though not significantly different (P>0.05) from diet 1; FI was not significantly different (P>0.05) except for diet 3 while the FCR was significantly higher (P<0.05) for diet 5 though not significantly different (P>0.05) from diet 6. The breed CO was significantly (P<0.05) higher than the AB for the BWG while FTLP inclusion showed significance (P<0.05) for BWG and FCR. The interaction between breed and vitamin C were significant (P<0.05) for the FI and FCR; VC x FTLP showed significance (P<0.05) for BWG while the interactive effect of breed, vitamin C and FCLP were significant (P<0.05) for BWG and FI at the finisher phase.

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At the overall phase (1-6 weeks), the BWG was significantly (P<0.05) higher for diets 2 and 4, though not significantly different from diet 1 while the FCR was significantly (P<0.05) higher for diets 5 and 6 but not significantly different (P>0.05) from diets 4, 7 and 8. The inclusion of FTLP at 1% showed significance (P<0.01) for BWG and FCR. The interaction between breed and vitamin C was significant (P<0.05) for FI; VC x FTLP was significant (P<0.05) for FCR and the interaction between breed, vitamin C and FCLP was significant (P<0.01) for FI.

Data on haematological indices of breeds of broiler chickens fed FTLP and vitamin C supplemented diets is presented in Table 3. The RBC of birds fed diet 7 was significantly (P<0.05) higher, though not significantly different (P>0.05) from birds fed diets 3 and 8. The MCV and MCH values of birds fed diets 2 and 6 were significantly (P<0.05) higher than the other diets while the WBC of birds fed diet 2 was significantly (P<0.05) higher, though not significantly (P>0.05) higher than birds fed diet 7. The LYM of birds fed diets 1, 3, 4, 5 and 6 were lower significantly (P>0.05) than those fed diets 2 and 7. The AB breed showed higher significance (P<0.05) than the CO breed in the value of RBC while the MCV and MCH were significantly (P<0.05) higher in the CO breed. The inclusion of 200mg/kg of vitamin C showed significance (P<0.05) for the RBC while the inclusion was significantly (P>0.05) lower for the MCV and MCH. The interaction between BRD x VC were significant (P<0.05) for the PCV, HB, MCV, MCH, WBC and LYM. BRD x FTLP were significantly (P<0.05) higher for WBC and LYM while there was no significant (P>0.05) interactive effect between BRD x VC x FTLP.

The result of serum chemistry indices of the two breeds of broiler chickens fed diets supplemented with FTLP and Vitamin C is presented in Table 4. The different dietary inclusion had a positive significant (P<0.05) influence on the Apsertate aminotransferase (AST), Creatine (CREA), Cholesterol (CHOL), Globulin (GLO) and Total Protein (TP). The AST performance of diets 1 and 2 for the breeds AB and CO were significantly (P<0.05) higher than those in diets 3 and 4 though, not significantly (P>0.05) different from diets 5 and 6. The serum creatinine level of the control diets (diets 1 and 2) for the breeds AB and CO were significantly (P<0.05) different from diets 3, 4, 5, 6, 7 and 8. The serum cholesterol level of diets 1, 2 were significantly (P<0.05) higher than those of the other tested diets. The TP of diets 7 and 8 were significantly (P<0.05) higher than those of diets 1 and 2 but not significantly (P>0.05) different from diets 3, 4, 5 and 6. The GLB performance of diets 5 and 6 (FTLP) and diets 7 and 8 (vitamin C + FTLP) were not significantly (P>0.05) different but they were significantly (P<0.05) higher than those of diets 1, 2, 3 and 4, Vitamin C inclusion also had significance (P<0.05) on the AST, CREA, CHOL, TP and ALB. The inclusion of FTLP has significant effect (P<0.06) on the serum creatinine, serum cholesterol, total protein and serum globulin. The interactive effect of vitamin C and FTLP on AST, CHOL and CREA levels of the birds were significant (P<0.05).

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Table 1: Composition of the experimental diets

Ingredients (g/kg)	Starter feed (%)	Finisher diet (%)
Maize	52.35	59.35
Rice bran	7	0
Maize bran	0	6
Soybean meal	30	24
Soy oil	3	3
Fish meal	3	3
Limestone	0.5	0.5

Bone meal	3	3
Salt	0.3	0.3
Premix	0.3	0.3
Methionine	0.3	0.3
Lysine	0.25	0.25
Nutrient composition (g/kg)	100	100
*Crude protein	22.18	20.03
Metabolizable energy (Kcal/kg)	3018	3108.1

Table 2 The growth performance response of different breeds of broiler chickens to *Ficus thonningii*, leaf powder and vitamin C dietary supplementations

Diet	BRD	VC mg/kg	FTLP %	IW g/b	BWG 1-3 wks	FI 1-3 wks	FCR 1-3 wks	BWG 4-6 wks	FI 4-6 wks	FCR 4-6 wks	BWG 1-6 wks	FI 1-6 wks	FCR 1-6 wks
1	AB	0	0	37.66	845.47^{a}	1022.48^{a}	1.21^{bc}	1777.11^{ab}	3262.23^{bc}	1.8^{bc}	2622.58^{ab}	4284.71	1.62^{ab}
2	CO	0	0	37.57	792.45^{a}	982.48^{a}	1.24^{b}	1883.76^{a}	2752.24^{bc}	1.4^{c}	2676.21^{a}	3734.71	1.40^{b}
3	AB	200	0	37.34	812.71^{a}	986.61^{a}	1.21^{bc}	1600.96^{bc}	2564.39^{c}	1.6^{bc}	2413.67^{bc}	3551.00	1.47^{b}
4	CO	200	0	37.56	807.12^{a}	1002.41^{a}	1.24^{b}	1911.59^{a}	3529.52^{a}	1.8^{bc}	2718.71^{a}	4531.93	1.67^{ab}
5	AB	0	1	37.61	820.06^{a}	856.95^{c}	1.04^{e}	1328.55^{d}	3193.86^{abc}	2.4^{a}	2148.61^{d}	4050.81	1.90^{a}
6	CO	0	1	37.52	648.59^{b}	876.55^{bc}	1.35^{a}	1543.93^{bcd}	3138.92^{abc}	2.0^{ab}	2192.52^{cd}	4015.47	1.84^{a}
7	AB	200	1	37.65	787.91^{a}	899.22^{bc}	1.14^{cd}	1624.30^{bc}	3071.24^{abc}	1.8^{bc}	2412.21^{bc}	3970.47	1.64^{ab}
8	CO	200	1	37.42	808.01^{a}	904.24^{b}	1.11^{de}	1533.00^{cd}	2921.14^{abc}	1.9^{bc}	2341.01^{cd}	3825.38	1.63^{ab}
SEM				0.04	13.67	13.07	0.01	44.04	81.28	0.07	47.79	83.93	0.04
P-value				0.60	0.01	0.01	0.01	0.01	0.05	0.01	0.01	0.06	0.02
	AB			37.56	816.54^{a}	941.32	1.15^{b}	1582.73^{b}	3022.93	1.93	2399.27	3964.25	1.66
	CO			37.52	764.04^{b}	941.42	1.23^{a}	1718.07^{a}	3085.45	1.82	2482.11	4026.87	1.63
	SEM			0.06	12.06	6.79	0.01	36.73	94.43	0.07	38.75	98.92	0.04
	P-value			0.60	0.01	0.99	0.01	0.01	0.64	0.25	0.15	0.66	0.69
		0		37.63	720.52	929.51	1.12	1552.83	3228.04	1.76	2385.60	4167.66	1.62
		200		37.49	807.56	953.32	1.17	1612.63	2817.81	1.87	2412.94	3760.73	1.65
		SEM		0.08	17.06	9.61	0.01	51.94	133.54	0.09	54.81	139.89	0.06
		P value		0.28	0.12	0.17	0.07	0.52	0.63	0.17	0.27	0.71	0.19
			0	37.50	829.09^{a}	1004.54^{a}	1.21^{a}	1689.03^{a}	2913.31	1.71^{b}	2518.13^{a}	3917.85	1.55^{b}
			1	37.63	803.99^{b}	878.09^{b}	1.09^{b}	1476.42^{b}	3132.55	2.16^{a}	2280.41^{b}	4010.64	1.77^{a}
			SEM	0.08	17.06	9.61	0.01	51.94	133.54	0.09	54.81	139.89	0.06
			P value	0.82	0.01	0.01	0.01	0.01	0.69	0.01	0.01	0.67	0.01
	Interactions *P-value*												
	BRD x VC			0.63	0.01	0.29	0.01	0.62	0.02	0.02	0.54	0.02	0.08
	BRD x FTLP			0.24	0.19	0.22	0.01	0.17	0.23	0.53	0.09	0.29	0.86
	VC x FTLP			0.44	0.04	0.04	0.06	0.05	0.44	0.48	0.01	0.55	0.03
	BRD x VC x FTLP			0.21	0.05	0.08	0.01	0.02	0.01	0.62	0.11	0.01	0.16

Means with a different superscript in the same column are significantly ($P<0.05$) different; BRD: Breeds; AB: Arbor acre; CO: Cobb 500; VC: Vitamin C; FTLP: *Ficus Thonningii*; IW: Initial weight; BWG: Body weight gain; FI: Feed intake; FCR: Feed conversion ratio; SEM: Standard error of the means.

Table 3 The haematological indices response of different breeds of broiler chickens to *Ficus thonningii* leaf powder and vitamin C dietary supplementations

Diet	BRD	VC mg/kg	FTLP %	PCV %	RBC x10^{6}/l	HB g/dl	MCHC g/dl	MCV Fl	MCH Pg/cell	WBC x10^{9}/l	GRA x10^{9}/l	LYM x10^{9}/l	MON x10^{9}/l
1	AB	0	0	30.50	2.26^{c}	10.16	33.56	135.90^{b}	45.30^{b}	2.86^{bc}	0.80	1.96^{bc}	0.06
2	CO	0	0	32.00	1.87^{c}	10.66	33.30	173.26^{a}	57.76^{a}	4.06^{a}	1.00	3.00^{a}	0.07
3	AB	200	0	31.5	3.26^{ab}	10.50	33.31	97.46^{c}	32.46^{c}	2.86^{bc}	0.80	2.10^{bc}	0.00
4	CO	200	0	30.00	2.86^{b}	10.00	33.30	105.33^{c}	35.10^{c}	2.66^{bc}	0.90	1.70^{bc}	0.06
5	AB	0	1	30.66	2.17^{c}	10.23	33.00	142.50^{b}	47.50^{b}	3.10^{abc}	1.00	2.10^{bc}	0.00
6	CO	0	1	30.67	2.07^{c}	11.23	33.13	164.50^{a}	54.83^{a}	2.90^{bc}	0.90	1.93^{bc}	0.06
7	AB	200	1	34.00	3.73^{a}	11.32	33.33	92.63^{c}	30.86^{c}	3.53^{ab}	0.90	2.56^{ab}	0.07
8	CO	200	1	29.33	3.20^{ab}	9.77	33.06	91.80^{c}	30.60^{c}	2.23^{c}	0.80	1.43^{c}	0.00
SEM				0.51	0.14	0.17	0.06	6.78	2.62	0.14	0.04	0.12	0.01
P-value				0.196	0.01	0.17	0.43	0.01	0.01	0.03	0.92	0.02	0.17
	A			31.67	2.85^{a}	10.55	33.30	117.13^{b}	39.03^{b}	3.09	0.87	2.18	0.33
	R			31.25	2.50^{b}	10.41	33.20	133.72^{a}	44.57^{a}	2.96	0.90	2.01	0.05
	SEM			0.65	0.09	0.22	0.08	3.65	1.22	0.16	0.07	0.14	0.01
	P-value			0.66	0.02	0.64	0.43	0.01	0.01	0.59	0.81	0.40	0.38
		0		31.71	2.09^{b}	10.57	33.25	154.04^{a}	51.35^{a}	3.23	0.92	2.25	0.05
		200		31.21	3.26^{a}	10.40	33.25	96.81^{b}	32.25^{b}	2.82	0.85	1.95	0.03
		SEM		0.65	0.09	0.22	0.08	3.65	1.22	0.16	0.07	0.14	0.01
		P value		0.59	0.01	1.00	1.00	0.01	0.01	0.09	0.46	0.14	0.38
			0	31.00	2.56	10.33	33.36	127.99	42.65	3.12	0.87	2.19	0.05
			1	31.91	2.79	10.64	33.13	122.85	40.95	2.94	0.90	2.01	0.03
			SEM	0.65	0.09	0.22	0.08	3.65	1.22	0.16	0.07	0.13	0.01
			P value	0.33	0.11	0.32	0.07	0.33	0.34	0.45	0.81	0.36	0.38
	Interactions *P-value*												
	BRD x VC			0.01	0.43	0.01	0.79	0.02	0.02	0.01	0.81	0.01	0.38
	BRD x FTLP			0.66	0.76	0.64	0.79	0.26	0.26	0.02	0.23	0.02	0.38
	VC x FTLP			1.00	0.21	0.97	0.29	0.45	0.44	0.22	0.81	0.16	0.38
	BRD x VC x FTLP			0.22	0.43	0.21	0.19	0.75	0.75	0.74	0.80	0.55	0.06

Means with a different superscript in the same column are significantly (P<0.05) different; BRD: Breeds; AB: Abore acre; CO: Cobb 500; VC: Vitamin C; FTLP: *Ficus Thonningii* leaf powder; PCV: Packed cell volume; RBC: Red blood cells; HB: Haemoglobin conc.; MCHC: Mean cell haemoglobin concentration; MCV: Mean cell volume; MCH: Mean cell haemoglobin; WBC: White blood cells; GRA: Granulocytes; LYM: Lymphocytes; MON: Monocytes; SEM: Standard error of the means.

Table 4: Serum biochemical profiles of different breeds of broiler chicken fed *Ficus thonningii* leaf powder and vitamin c supplemented diets

Diet	BRD	VC mg/kg	FTLP %	AST (IU/L)	ALT (IU/L)	CREA (µmol/L)	CHOL (mmol/L)	TP (g/L)	ALB (g/L)	GLB (g/L)	ALB/ GLO
1	AB	0	0	168.06^{a}	18.37	79.73^{a}	157.95^{a}	52.66^{b}	23.97	28.68^{b}	0.83^{b}
2	CO	0	0	171.28^{a}	17.54	81.20^{a}	155.53^{a}	53.65^{b}	23.88	29.77^{b}	0.80^{b}
3	AB	200	0	132.98^{bc}	16.55	65.18^{b}	134.96^{b}	63.47^{ab}	32.51	30.95^{b}	1.05^{ab}
4	CO	200	0	128.61^{c}	17.63	65.31^{b}	139.11^{b}	64.41^{ab}	35.17	29.24^{b}	1.19^{a}
5	AB	0	1	152.41^{ab}	16.28	67.75^{b}	129.78^{b}	61.93^{ab}	27.00	34.93^{a}	0.78^{b}
6	CO	0	1	152.39^{ab}	17.24	67.81^{b}	117.43^{c}	58.52^{ab}	25.30	33.22^{a}	0.75^{b}
7	AB	200	1	135.07^{bc}	16.91	63.93^{b}	119.09^{c}	66.79^{a}	32.35	34.44^{a}	0.94^{ab}
8	CO	200	1	132.22^{bc}	17.19	63.84^{b}	114.50^{c}	68.84^{a}	35.57	33.36^{a}	1.06^{ab}
SEM				3.77	0.57	1.62	3.42	1.56	1.39	0.52	0.04
P-value				0.01	0.99	0.01	0.01	0.05	0.10	0.01	0.05
	AB			147.13	17.02	69.15	135.44	61.21	28.96	32.25	0.90
	CO			146.12	17.40	69.54	131.64	61.35	29.95	31.40	0.95
	SEM			3.16	0.95	1.46	1.77	1.80	1.70	0.37	0.05
	P-value			0.82	0.78	0.85	0.14	0.95	0.68	0.13	0.46
		0		161.03	17.36	74.12^{a}	140.17^{a}	56.69^{b}	25.03^{b}	31.65	0.79^{b}
		200		132.22	17.07	64.57^{b}	126.91^{b}	65.87^{a}	33.88^{a}	31,99	1.06^{a}
		SEM		3.16	0.95	1.46	1.77	1.80	1.70	0.37	0.05
		P value		0.01	0.83	0.01	0.01	0.01	0.01	0.52	0.01
			0	150.23	17.52	72.86^{a}	146.89^{a}	58.55^{b}	28.88	29.66^{b}	0.97
			1	143.02	16.90	65.83^{b}	120.20^{b}	64.02^{a}	30.03	33.99^{a}	0.88
			SEM	3.16	0.95	1.46	1.77	1.80	1.70	0.37	0.05
			P value	0.12	0.65	0.01	0.01	0.04	0.64	0.01	0.24
	Interactions *P-value*										
	BRD x VC			0.56	0.82	0.85	0.17	0.60	0.44	0.32	0.25
	BRD x FTLP			0.92	0.85	0.84	0.08	0.75	0.90	0.33	0.94
	VC x FTLP			0.03	0.67	0.01	0.02	0.54	0.66	0.34	0.62
	BRD x VC x FTLP			0.79	0.63	0.88	0.90	0.59	0.83	0.13	0.94

Means with a different superscript in the same column are significantly (P<0.05) different; BRD: Breeds; AB: Arbor acre; CO: Cobb 500; VC: Vitamin C; FTLP: *Ficus thonningii leaf powder*; AST: Aspartate aminotransferase; ALT: Alanine aminotransferase; CREA: Creatine; CHOL: Cholesterol; TP: Total Protein; ALB: Albumin; GLB: Globulin; SEM: Standard error of the means.

4. Discussion

[19] reported that feed ingredients which are rich in antioxidant and polyphenols which are naturally abundant in them are getting attention, and [20] as well as [21] agreed that they could be used to boost performance in heat-stressed birds. The inclusion of phytogenic substances in feed have shown positive effects on the performance and biological health of broiler chickens [22]. Supplementation of broiler feed with plant extract containing secondary metabolites has been shown to promote growth performance and immune response in broiler chickens [23]. The interactive effects of breed, vitamin C and FTLP on BWG, FI and FCR in this study could be attributed to the nutritional composition of *Ficus thonningii* as reported by [14] Haematological markers are good indicators of an animal's physiological status, and changes in them are useful in determining how the animal responds to various physiological settings [24]. The protective properties of phytochemicals from plants against reactive oxygen species, as well as their antibacterial action are regarded to be one of their health-promoting impacts and the concentration of phenolic compounds and several vitamins in these medicinal plants may be related to their potential [25]. The PCV aids in determining whether supplemented diets have a negative impact on the health status of the broiler chickens. A high PCV value indicates the presence of toxic factors that may have an adverse effect on blood formation [26]. The values of PCV recorded in this study were within the range recorded by [27], who reported a range of 28 – 35% for broiler chicken aged 5 to 7 weeks. The significant effect of the supplementation of vitamin C and FTLP on the tested birds could be an indication that the interactive effect of vitamin C and FTLP combined could lead to increased feed intake which could lead to increase in the number of RBC. Accumulation of free radicals has been reported to promote oxidative stress which is linked to many chronic diseases and reduced performance of animals [28]. [29] reported that supplementation of diets with vitamin C can increase blood antioxidant levels by up to 30%, thus helping the body's natural defenses against inflammation. The vitamin C and Zinc present in *Ficus thonningii* as reported by [14] could be attributed to the performance of the birds in this regard. This is in agreement with the work of [30] who reported that the interaction of Zinc and ascorbic acid as supplements enhances production performance and immune status.

[25] has reported on the significance of the liver as the coordinating point for different metabolic, productive and digestive functions and it is prone to different levels of biological and chemical damages depending on the amount of specific serum enzymes which has their originating sources from the liver. These enzymes, depending on their levels may compromise many body functions, thereby resulting in poor immunity status and weak production performance. Aspartate aminotransferase (AST), alkaline phosphatase (ALP), and alanine aminotransferase (ALT) in the blood are key bioindicators of the extent of the function and damage in the liver [31]. A surge in the levels of these enzymes is usually associated with liver or muscle damage, resulting from the body's reaction to stress [32]. The reduction in AST due to inclusion of Vitamin C and FTLP can be deduced as an indication of better liver function due to the activities of the antioxidants and ascorbic acid which reduces oxidative stress induced by hepatotoxicity [33]. Creatine as a nitrogenous organic acid assist in the supply of energy to the cells, it is a by-product of muscle metabolism and it is excreted entirely by the kidney. Increased level of creatinine is an indication of decreased kidney function [34] and indication of a chronic kidney disease [35]. Inclusion of vitamin C and FTLP in this study showed reduced level of creatinine less than the value reported by [26], who reported 79.00 and 81.00% for AB and CO breeds respectively. Cholesterol, produced in the liver is a product of fat metabolism. Increase in the level of cholesterol is associated with hormonal and metabolic diseases, liver disease as well as kidney malfunctioning. [34]. The significantly lower values of cholesterol with the inclusion of FTLP in comparison to the control diets affirmed the believe that chickens fed with herbs have low levels of cholesterol as a result of decreased activity of lipogenic enzymes in the liver [36]. Serum proteins are

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essentially synthesized in the liver and they perform the function of maintaining blood volume through colloidal osmotic effect, regulate blood pH, transport hormones and drugs, participate in cell coagulation, catalyze chemical reactions, regulate the metabolism and participate in the body defense against foreign objects [37]. The main functions of albumin are the transport of several molecules and the maintenance of blood oncotic pressure [37]. The inclusion of FTLP in diets of tested birds shows a significant effect on the albumin level which could be attributed to the vitamin C content of *Ficus thonningii* as reported by [14]. This agrees with the work of [38] who reported that the inclusion of vitamin C in diets ameliorate the pathological changes in serum protein and body weight.

5. Conclusion

The result of this study revealed the potentials of *Ficus thonningii* leaf powder to enhance the performance and ameliorate the effect of heat stress of broiler chickens when used as organic supplement in feed. The antioxidants and phytochemical properties of FTLP resulted in increased feed intake and enhanced BWG as well as improving haematological and serum chemical profiles of the tested birds which is an indication that effect of heat and oxidative stress were mitigated.

Compliance with ethical standard

The study was carried out with the approval of the committee on ethics for care and use of animal for research of The Federal University of Technology, Akure, Nigeria.

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