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Comparative assessment of ampicillin antibiotic and ginger (*Zingiber officinale)* effects on growth, haematology and biochemical enzymes of *Clarias gariepinus* juvenile

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Abstract
A 12-week study was carried out to comparatively investigate effects of ampicillin and powdered ginger, applied as bath treatment on growth performance, haematology and serum enzymes of *Clarias gariepinus*. Phytochemical constituents of ginger were investigated. A total of 210 *Clarias gariepinus* juveniles (26.01±0.05 g and 15.31±0.10 cm) were assigned to seven treatments with three replicates each. Treatment groups had different concentrations of ampicillin and powdered ginger (250, 750 and 1000 mg/35 litres respectively) added to the culture water. Control group had neither of the substances. Fish were fed twice daily with commercial feed at 5% body weight for 12 weeks. Result for growth revealed that there was significant difference (p<0.05). Result for haematology studies revealed that there was significant difference (p<0.05) between ampicillin and ginger treatments. There was no significant difference (p>0.05) in aspartate amino transferase (AST) and alkaline phosphatase (ALP) between treatment groups. However, significant decrease in alanine-amino-transferase (ALT) was seen in 250 mg and 1000mg ampicillin treatment groups. Ginger can conveniently be used in place of ampicillin.

Keywords: Ampicillin, ginger, growth, haematology, enzymes, *Clarias gariepinus*

1. Introduction
Over decades, aquaculture has contributed greatly to the world protein and food production. Aquaculture production in 2014 only, amounted to73.8 million metric tonnes [1]. However, disease which is caused by pathogenic bacteria is a major setback that has affected aquaculture production [2]. Physiological changes due to stress, deteriorated water quality and overcrowding have been reported to undermine fish health [3, 4]. In order to find alternative solution to this ugly situation, antimicrobial compounds have been recommended for use in aquaculture to prevent and treat diseases [3]. Antimicrobials are synthetic compounds that are capable of destroying or inhibiting the growth of pathogens. The use of antibiotics in aquaculture becomes necessary in order to prevent or treat fish diseases, thus promote fish growth and health [2]. The use of ampicillin antibiotic in aquaculture for the prevention of diseases has been reported [5], [6]. Reported that antimicrobials are added regularly as additives in fish diet or as bath treatment and injections. However, critical issues have been raised on the use of antibiotics in aquaculture as per its negative or side effects on aquaculture species and aquatic ecosystems [7]. A study by [2] revealed that a greater percentage of antibiotics administered to fish were actually metabolized after administration, but found to be excreted through urine or faeces without complete decomposition [8]. Opined that residual antibiotic in an aquatic ecosystem has negative effects which include environmental pollution, degradation of aquatic ecosystems and pathogen resistance to drugs.
Attention has being shifted to medicinal plant as a viable alternative to antibiotics and chemotherapeutics [7]. Herbal plants provide a better and cheaper source of treatment than antibiotics [9]. Several authors have reported the efficacy of herbal plants in terms of immune system stimulation, growth promotion, anti-stress and anti-pathogenic actions [10, 11, 4]. Herbal plants have been reported to be ecosystem friendly with minimal side effect and are available all year round for utilization [7, 4].
Ginger (*Zingiber officinalis*) has been reported to be a suitable and safe herbal plant [12], [13]. Reported that ginger has the faculty to increase resistance to pathogenic infections and stimulate the immune system against diseases resulting from poor management practices and

poor water quality in cultured fish. Ginger has also been reported to be very effective immune-stimulatory agent in fish and animals and has helped in reducing mortality in aquaculture [14, 15, 16]. The effectiveness of ginger as an anti-microbial agent is based on the fact that it contains active aromatic compounds such as gingerol, shogaols and zingerone which are antioxidants [17].

Although ginger has been reported to be effective in handling stress incurred by the fish during transportation, sorting and grading [13], there is need to investigate its effect in the blood system and biochemistry of the fish. Therefore, the current study aims at ascertaining the effects of varying concentration of ampicillin and powdered ginger on growth performance, haematology and serum enzyme activities of *Clarias gariepinus.*

2. Materials and Methods

This research was carried out at the wet laboratory of the Department of Fisheries and Aquaculture, Federal University Ndufu Alike Ikwo Ebonyi State, Nigeria. Ebonyi State is located between latitudes 6.24 ^{0}N and 6.28 ^{0}N and longitudes 7.00 ^{0}E and 7.06 ^{0}E on the South-Eastern part of Nigeria. Two hundred and ten experimental fish (*Clarias gariepinus)* (mean weight 26.01±05 g and mean length 15.31±10 cm) were procured from the Department of Fisheries and Aquaculture complex farm and were transported to the wet laboratory. Fish were acclimated for two weeks in a tarpaulin tank (10 x8x3m) prior to the start of the experiment and were fed with commercial feed (coppens).

2.1 Proximate Analysis of the Feed

Proximate analysis of the commercial feed (coppens) was performed to ascertain the proximate composition of diet fed to the fish [18].

2.1.2 Preparation of Ampicilin and Powdered Ginger

Ampicillin used in the study was purchased from a pharmaceutical store (batch no. AC.5116, Me cure industries Ltd.). Six hundred capsules (250 mg) of ampicillin were decapsulated and stored in an airtight container. Fresh rhizomes of ginger (*Zingiber officinale*) were purchased from an open market. The fresh ginger rhizomes were dried under shade for one week. The dried rhizomes were crushed into powdered form, homogenized and sieved using a hand sieve and stored in an airtight container. Phytochemical analysis of powdered ginger was done at the international Institute of Tropical Agriculture (IITA) Ibadan [19].

2.1.3 Experimental Design

Completely randomized design (CRD) was used for the experiment. A total of twenty one experimental plastic tanks (65x40x50 cm) were used for the experiment. The water level was maintained at volume of 35 litres throughout the study period. Experimental fish were randomly assigned to seven treatment tanks. Each triplicate treatment tank contained ten fish. The fish were divided into two treatment groups namely, group A and B. Group A received Ginger treatment at different concentrations (250,750 and 1000 mg/35 litres of water) while group B received Ampicillin treatment at different concentrations (250,750 and 1000 mg/35 litres of water) respectively. The control tank contained neither of the substances. Water in each tank was replaced every three days throughout the period to prevent fouling resulting from feed remnants [20]. Ampicillin and powdered ginger were reintroduced in the culture water at the same varying concentrations along side. The mean temperature, dissolved oxygen and pH were recorded 25.10±0.21°C, 5.19±0.08 mg/l, 5.95±0.5 respectively. The fish were fed with commercial feed twice daily (8.00am and 17.00pm) at three percent (5%) body weight for 12 weeks [20].

2.1.4 Growth Parameters

At the end of the experiment, the weights of the fish were determined using an electronic weighing balance (S. Mettler 0.01-500 g weighing capacity). A plastic meter rule was used to measure fish length. Growth parameters were calculated [21]

Weight Gain (WG) = final weight – initial weight.

Specific growth rate, [SGR (%/day)] =100 (log *W2*- log *W1*) / (T2-T1),

Where; *W1* is the weight at time *T*1 and *W*2 is the weight at time at T2.

$$\text{Survival rate (\%)} = \frac{\text{Nf x 100}}{\text{Ni}}$$

Nf = Number of cultured fish alive at the end of the experiment

Ni = Number of cultured fish stocked at the beginning of the experiment

Length increase (cm) = Final length – Initial length

Mean daily weight gain (g) = $(Wf – Wi)/t^{-1}$. Wf= Final weight at harvest, Wi= Initial weight at stocking and t^{-1}= time in days.

Condition factor = $K = 100W/ L^3$ [22].

Where by K = condition factor

W = the weight of the fish in gram (g)

L = the total length of the fish in centimeters (cm)

2.1.5 Haematology and Biochemical Analysis

Six fish per treatment were sampled for blood collection at the end of the experiment for haematological and blood serum analysis [20]. Haematology and blood serum analysis were carried out at the Central Research Laboratory of the Faculty of Agriculture, University of Calabar, Nigeria. Haematology for red blood cells, white blood cells, lymphocytes, hemoglobin, hematocrit and granulocytes were analyzed using an automated haematology analyzer (Abacus-360).

Red cell indices such as mean cell hemoglobin concentration (MCHC), mean cell hemoglobin (MCH) and mean cell volume (MCV) were calculated using the total red blood cell count (RBC), hemoglobin concentration (Hb), and hematocrit (Hct) [23].

The following serum enzymes: Aspartate amino transferase (AST), alkaline phosphatase (ALP) and Alanine amino transferase (ALT) were analyzed [24].

2.1.6 Statistical analysis

Values obtained from each parameter after the experiment were subjected to one-way analysis of variance (ANOVA), using SPSS (Statistical package for Social Science 2006, version 22). Duncan multiple range test (DMRT) was used to compare the differences between means at (p<0.05). Data were presented as mean ± SE.

3. Result

Phytochemical constituents of ginger are presented in Table 1. They include mineral elements (calcium, magnesium, potassium, sodium, phosphorous, iron and zinc), vitamins (vit.A, vit. C, vit. D, vit. B_1, B_2, B_3, B_5, B_6 and B_9) and phytochemical compounds (tannin, saponin, alkaloid and

flavonoid) with their respective values (Table 1). Proximate composition of fish diet (commercial feed) is presented in Table 2. Result on proximate composition of diet revealed that crude protein has the highest percentage (43.75±0.00), followed by crude lipid (11.93±0.13) and ash (9.44±0.12). Result of growth performance of *Clarias gariepinus* cultured under varying concentrations of ampicillin and ginger are presented in Table 3. The control group had the highest values in terms of final weight (137.59±3.69), weight gain (111.73±4.01), mean daily weight gain (1.33±0.48) and specific growth rate (2.25±1.18). This was followed by fish group that received 750mg ginger treatment FW (133.05±2.81), WG (106.70±2.67), MDWG (1.27±0.03) and SGR (2.23±2.0.92). The lowest values for the same growth parameters were observed in fish group that received 750 mg ampicillin treatment (113.32±5.23, 88.86±5.19, 1.06±0.06 and 2.15±2.01) respectively.

Result presented on Table 4 shows the haematological values of *Clarias gariepinus* juveniles cultured under varying concentrations of powdered ginger and ampicillin. Highest values for RBC, Hb, LYM and HCT was observed in fish group that received 1000 mg ginger treatment group (2.28±0.67, 15.97±0.49, 49.16±9.91 and 36.47±1.08) when compared to other treatments and the control. Changes in serum activities in the plasma are shown in Table 5. There was no significant difference (p<0.05) in ALP and AST activity between fish groups that received different treatments of ginger and ampicillin when compared to the control group. However, ALT activity decreased significantly in fish groups that received 250mg (19.00±1.16) and 1000mg (19.67±0.33) ampicillin concentration.

Table 1: Phytochemical constituents of powdered ginger (mg/100g)

Minerals	Values	Vitamins	Values	Phytochemical compounds	Values
Calcium	1.50	Vitamin A (Retinol)	3.15	Tannin	0.013
Magnesium	0.47	Vitamin C (Ascorbic acid)	12.86	Saponin	0.027
Potassium	1.98	Vitamin D (Cholecalciferol)	18.47	Alkaloid	0.528
Sodium	1.24	Vitamin B1(Thiamin)	0.38	Flavonoid	0.008
Phosphorus	0.27	Vitamin B2 (Riboflavin)	0.14		
Iron	45.01	Vitamin B3 (Niacin)	2.46		
Zinc	5.55	Vitamin B5 (Pantothenic acid)	0.66		
		Vitamin B6 (pyridoxine)	3.87		
		Vitamin B9 (Folic acid)	2.14		

Table 2: Proximate composition (%) of diet (commercial feed)

Parameter	Composition (%)
Moisture	8.10±0.27
Ash	9.44±0.12
Crude protein	43.75±0.00
Crude lipid	11.93±0.13
Crude fiber	7.42±0.62
NFE	34.88±0.08
GE	21.35±0.00

NFE (Nitrogen free extract) = (100 – (%crude protein+% crude lipid +% ash), GE = (Gross energy) (CP = 23.9 kj/g, CF = 39.8 kj/g, NFE= 17.6 kj/g) (Schulz *et al.,* 2005)

Table 3: Mean values of growth performance of *Clarias gariepinus* juveniles cultured under different concentrations of ginger and ampicillin for 12 weeks

				Concentrations (mg)			
		Ginger				***Ampicillin***	
Parameter	**0.00**	**250**	**750**	**1000**	**250**	**750**	**1000**
Initial weight (g)	26.19±0.86 ^{a}	25.72±0.21 ^{a}	26.35±0.29 ^{a}	26.32±0.52 ^{a}	25.62±0.52 ^{a}	26.13±0.82 ^{a}	25.74±0.56 ^{a}
Final weight (g)	137.59±3.69^{a}	120.22±0.26^{cde}	133.05±2.81 ^{ab}	125.33±1.17^{bcd}	118.04±1.99 ^{de}	113.32±5.23^{e}	115.95±0.86 ^{e}
Weight gain (g)	111.73±4.01 ^{a}	95.16±0.12 ^{cde}	106.70±2.67 ^{ab}	99.01±0.73 ^{bcd}	93.75±2.27 ^{cde}	88.86±5.19 ^{e}	90.88±0.79 ^{de}
Mean daily weight gain (g)	1.33±0.48 ^{a}	1.13±0.00 ^{cde}	1.27±0.03 ^{ab}	1.18+0.01 ^{bcd}	1.12±0.27^{cde}	1.06±0.06 ^{e}	1.08±0.01^{de}
Specific growth rate (g/%day)	2.25±1.18^{a}	2.18±0.0.94^{cde}	2.23±2.0.92^{ab}	2.21±0.40^{bcd}	2.17±0.73^{de}	2.15±2.01^{e}	2.16±0.32^{e}
Initial length (cm)	15.97±0.37 ^{a}	15.37±0.11 ^{a}	15.12±0.63 ^{a}	15.42±0.12 ^{a}	15.03±0.27 ^{a}	15.25±0.28 ^{a}	15.23±0.22 ^{a}
Final length (cm)	27.05±0.39 ^{a}	25.35±0.15 ^{c}	26.09±0.50 ^{bc}	25.49±0.25^{c}	25.71±0.12 ^{bc}	25.33±0.41 ^{c}	25.30±0.12^{c}
Length increase (cm)	10.99±0.26^{ab}	10.37±0.41^{b}	10.97±0.40 ^{ab}	10.08±0.16^{b}	11.20±0.24^{ab}	10.66±0.44 ^{ab}	11.05±0.74 ^{ab}
Survival rate (%)	100.00+0.00 ^{a}	86.67±3.33^{abc}	96.67±3.33 ^{ab}	100.00±0.00 ^{a}	76.67±12.02 ^{bc}	76.67±8.82 ^{bc}	73.33±8.82 ^{c}
Condition factor (K)	0.70+0.02^{a}	0.74+0.01^{a}	0.75+0.03^{a}	0.76+0.02^{a}	0.70+0.02^{a}	0.70+0.01^{a}	0.72+0.02^{a}

Means(±SE) with the same alphabet superscript in the same row are not significantly different (p>0.05) while means (±SE) with different alphabet are significantly different (p<0.05)

Table 4: Mean values of haematological parameters of *Clarias gariepinus* juvenile Specimens cultured under different concentrations of ginger and ampicillin for 12 weeks

				Concentrations(mg)			
		Ginger					***Ampicillin***
Parameter	**0.00**	**250**	**750**	**1000**	**250**	**750**	**1000**
RBC x $10^{12/L}$	2.14±0.65^{ab}	1.91±0.16^{b}	2.05±0.73^{a}	2.28±0.67^{a}	1.99±0.21^{b}	2.09±0.18^{ab}	2.19±0.02^{a}
Hb (gm%)	13.63±0.32^{ab}	12.33±0.9^{ab}	10.33±4.62^{b}	15.97±0.49^{a}	12.50±1.20^{ab}	10.03±4.32^{b}	13.57±0.32^{ab}
WBC x $10^{9/L}$	69.76±8.63^{a}	59.40±2.24^{b}	60.72±28.38^{b}	69.22±10.42^{a}	61.30±13.43^{b}	54.24±16.96^{c}	56.63±1.74^{bc}
HCT (%)	33.69±0.69^{ab}	30.39±2.34^{ab}	25.51±11.77^{b}	36.47±1.08^{a}	32.57±2.90^{ab}	36.58±1.45^{a}	36.04±0.56^{a}
LYM x $10^{9/L}$	46.82±11.54^{a}	35.07±4.60^{ab}	36.69±16.72^{ab}	49.16±9.91^{a}	41.41±13.05^{a}	29.67±11.59^{b}	43.18±1.65^{a}
LYM (%)	65.27±7.62^{a}	64.00±5.65^{a}	68.93±9.31^{a}	70.20±6.29^{a}	65.03±5.79^{a}	75.57±8.58^{a}	76.20±0.60^{a}
GRA x $10^{9/L}$	8.76±0.89^{a}	7.79±0.78^{a}	7.82±4.38^{a}	8.09±1.88^{a}	7.86±2.17^{a}	7.65±1.68^{a}	7.64±0.39^{a}
MCV (FI)	158.00±2.08^{a}	159.00±4.51^{a}	155.00±4.51^{a}	158.00±0.58^{a}	163.67±2.40^{a}	149.00±14.19^{a}	164.00±2.00^{a}
MCH (Pg)	63.93±0.50^{a}	64.60±0.55^{a}	62.63±21.32^{a}	64.17±0.68^{a}	62.57±0.63^{a}	63.10±19.11^{a}	61.77±0.85^{a}
MCHC (%)	40.50±0.27^{a}	40.70±1.22^{a}	39.67±13.34^{a}	40.53±0.38^{a}	38.27±0.29^{a}	36.80±11.44^{a}	37.63±0.64^{a}

Means (±SE) with the same alphabet in the same row are not significantly different (p>0.05)

Key * Red blood cell = RBC, Hemoglobin content= Hb, White blood cell= WBC, Hematocrit= HCT, Lymphocytes count= LYM, Granulocytes= GRA, Mean cell volume=MCV, Mean cell hemoglobin=MCH, Mean cell hemoglobin content=MCHC

Table 5: Mean values of blood serum of *Clarias gariepinus* juvenile specimens cultured under varying concentrations of ampicillin and ginger for 12 weeks.

Concentrations (mg)							
		Ginger					***Ampicillin***
Parameter	**0.00**	**250**	**750**	**1000**	**250**	**750**	**1000**
ALP(IU/I)	35.52±9.93^{a}	36.11±0.40^{a}	35.63±2.63^{a}	35.79±9.45^{a}	34.86±0.44^{a}	36.93±16.37^{a}	35.54±1.91^{a}
AST(IU/I)	28.00±10.59^{a}	27.00±7.51^{a}	28.67±12.33^{a}	27.86±20.22^{a}	27.67±7.21^{a}	28.33±31.69^{a}	27.00±5.13^{a}
ALT(IU/I)	23.00±7.10^{ab}	22.30±2.08^{ab}	23.67±5.36^{ab}	21.33±6.36^{ab}	19.00±1.16^{b}	30.67±17.74^{a}	19.67±0.33^{b}

Means (±SE) with the same alphabet in the same row are not significantly different at (p>0.05) while means (±SE) with different alphabet are significantly different (p<0.05)

Key: Alkaline phosphatase= ALP, Aspartate amino transferase= AST, Alanine aminotransferase=ALT

4. Discussion

Plant extracts have been reported to favor various activities like antistress, growth promotion, appetite stimulation, enhancement of tonicity and immune stimulation, maturation of culture species and antipathogen properties in fish and shrimp aquaculture [4]. This may be due to the active phytochemicals such as alkaloids, terpenoids, tannins, saponins, glycosides, flavonoids, phenolics, steroids or essential oils [25, 2]. The values for mineral elements such as phosphorous (0.27 mg), sodium (1.24 mg), potassium (1.98 mg) and calcium (1.50 mg) reported in the study were found to have lower values compared with the values (phosphorous (25.70mg), sodium (40.96 mg), potassium (37.34mg), calcium (35.66mg) reported by [26] and [27] (phosphorous (12.56 mg), sodium (5.00 mg), potassium (21.00 mg), and calcium (25.76%)). Vitamins are good antioxidants, thus involved in cellular metabolism and intermediary transfer of electrons in metabolic oxidation-reduction reactions [28, 29, 30, 31]. The values for vitamin C (12.86mg) obtained from the study is found to be higher than that of [32] and [33] who reported lower values for the same vitamins (9.33mg and 0.7mg) respectively. The values for the vitamin B_1, B_2 and B_6 (0.38, 0.14 and 3.87 mg/kg respectively) obtained from the present study were higher than the values reported by [33] (0.025, 0.034 and 0.16mg/kg).

Phytochemical compounds found in ginger contain antioxidant, antibacterial, antifungal and anti-inflammatory properties [32, 34]. The values for phytochemical compounds obtained from the study (tannin (0.013 mg), saponin (0.027 mg), alkaloid (0.528 mg) and flavonoid (0.008 mg) were lower compared to the values reported by [27] (11.21 mg alkaloid, 3.54 mg tannin, 0.80 mg saponin and 5.56 mg flavonoid) (Table 1). [26, 32] reported higher values for tannin and flavonoid (0.26 mg, 1.51 mg and 2.98 mg) respectively. The variation in composition may be due the type, variety, agronomic conditions, curing methods, drying and storage conditions [35, 36].

Antibiotics and phytobiotics are largely used in aquaculture for the purpose of preventing and treating diseases in aquaculture [37, 4]. They are also used as growth promoters when added to fish food [11, 38]. Herbal plants have been found to be of economic importance and are beneficial to both human/animal health and nutrition [39]. Opined that the use of medicinal plants could improve health conditions, reduce costs of treatment and most importantly be less toxic to the environment as they tend to be more biodegradable than chemotherapeutics. Ginger known as herbal plant has been used to improve animals diets [40].

With reference to the control this study observed higher values of final weight, weight gain, specific growth rate and mean daily weight gain for fish in powdered ginger treatments than the ampicillin group treatments (Table 3). The treatment with 750 mg ginger performed best [41]. Reported that ginger is beneficial to the growth and immune systems of aquatic animals [42]. Observed higher weight gain and specific growth rates when *Penaeus monodon* post larvae received ginger treatment.

Haematological parameters are important health indicators whose study reveals the health conditions of fish regarding diseases and immune system conditions before and after an experiment [20]. The study revealed that there was significant difference (p<0.05) among treatment groups (Table 4). Highest values for RBC, Hb, HcT and LYM were seen in fish group that received 1000 mg ginger treatment when compared to other treatments and the control (Table 4) [43]. Opined that an increase in haematological indices shows immune system stimulation and function of organs related to blood cell formation such as thymus, spleen and bone marrow. Adding powdered ginger to the culture water in this study did not undermine fish hematology, rather it stimulated the immune

system of the fish. This is reflected in the increase of some blood parameters above the control [44]. Reported that ginger enhanced the immunity of fish when cultured in water with 20 mg/l of ginger for 15 days [45]. Observed an increase in pack cell volume, hemoglobin and erythrocyte count when ginger supplemented diet and other phytobiotics were fed to *Oreochromis niloticus.* [11] reported that fish fed with the supplement of powdered ginger rhizome showed significant immune-stimulatory effect and increased RBC, HcT and WBC values when compared to the control ($p<0.05$).

Red cell indices (MCV, MCH and MCHC) are important for the diagnosis of anemia in most animals including fish [46, 47]. Significant increase or decrease in red cell indices may indicate macrocytic or microcytic anemia [46]. The application of powdered ginger and ampicillin at varying concentration in this study did not alter red cell indices ($p>0.05$) (Table 4) [48]. Reported no significant difference ($p>0.05$) in MCV and MCH when ginger supplemented diet levels (0.5, 1.0 and 1.5%) were fed to broiler chicks.

Blood serum enzymes are enzymes found in liver, bones, and kidney [49]. These enzymes have been reported to promote gluconeogenesis from amino acid and aminotransferase activities in the liver [50]. Blood serum enzyme studies helps to ascertain the function of the liver and other organs [51], [52]. Reported that enzymes activities might be altered by a variety of chemical, biological and physiological factors or by a disturbance in the Kreb's cycle [53]. Reported that an increase in serum amino transferase activity indicates liver damage which may be induced by free radicals generated after radiation exposure. An increase or decrease in the activity of liver enzymes and kidney function parameters might indicate occurrence of liver and kidney injuries [54].

The findings of this study for AST and ALP revealed that there were no significant differences ($p>0.05$) between ampicillin and ginger treatment groups compared to the control (Table 5). Unlike with ginger, a significant decrease in ALT was observed in fish groups cultured under 250mg and 1000mg ampicillin groups [5]. Reported a reduced AST in serum of catfish after ampicillin administration [44]. Reported that ginger when administered as bath treatment significantly decreased both ALT and creatinine levels in serum of *Clarias gariepinus* infested with gill monogenia. The decrease observed in ALT activities might be attributed to stress induced during fish sampling for blood collection [20]. Reported a similar reduction in serum enzyme activity which was attributed to stress encountered during sampling, capture and handling procedure. It implies that ampicillin and ginger applied at different concentrations had no adverse effect on serum enzymes of the fish [55]. Reported no significant difference ($p>0.05$) in AST, ALP and ALT values of laying hens fed with supplemented diets of powdered ginger and turmeric rhizomes compared to the control.

In conclusion, the findings of this study revealed that ginger had an immune stimulatory effect on the immune system of the fish. The inclusion level of 1000 mg/35L powdered ginger increased haematology in relation to the control and application of ampicillin. However, ginger application did not undermine fish growth and serum enzyme activities. The use of ginger in aquaculture as phytobiotics is encouraged. More work on the study is advised.

5. Acknowledgment

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