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Growth response and some haematological parameters of African catfish (*Clarias gariepinus*) juveniles fed guava (*Psidium guajava*) leaf extract diets

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Abstract
This study evaluated the growth response, haematological indices of African Catfish (*Clarias gariepinus*) juveniles fed guava (*Psidium guajava*) leaf extracts, completely randomized block design was adopted for this study, one hundred and twenty (120) juveniles were put in four treatments; 0 (Control) 5, 10 and 15 ml guava leaf extracts for three (3) months. The diets formulated contained approximately 38% crude protein. It was observed that all the parameters (i.e. TW (g), AW (g), AL (cm)) were significantly different at (P<0.05) across treatments, the highest significant (P<0.05) average weight (AW in grams) was recorded in treatment 4 (37.48±1.82), and the lowest value in treatment 2 (29.73±1.77), Specific growth rate (SGR), daily weight gain (DWG), Survival rate (SR), feed conversion ratio (FCR) and feed conversion efficiency (FCE) were significantly different at (P<0.05) across treatments. The PCV, HB, ESR, TWBC, MCHC, Neut and Lymp tested in the study were also significantly different (P<0.05). It reported the highest growth rate in treatment four (4) treated with 15 ml of guava leaf extracts, hence, the inclusion of 15 ml guava leaf in the diet of African Catfish (*Clarias gariepinus*) would enhance it growth and wellbeing.

Keywords: Growth response, catfish, haematology, guava leaf extracts

1. Introduction
1.1 Background of the Study
Fish constitutes the fastest growing source of animal protein in the developing world as well as the major and cheapest source of protein for the teeming population of the world, being a commodity with no social taboo3 [23]. The role of aquaculture in ensuring a constant supply of fish for human consumption cannot be overstated and medically, health benefits of frequently consumed fish is bounteous [19]. Hence, good nutrition in fish production system is essential to economically produce a healthy and high quality fish product. Fish nutrition has advanced in recent years in the production of varied balanced commercial feeds, which promote optimal growth and sound health in cultured fishes [14]. In Aquaculture, feeding of culture fish is one of the most important factors that must be considered [22]. Nutrition plays an important role in the maintenance of health and marketable product. Therefore, uses of functional feed are novel to the aquaculture industry [5]. Fish like other animals have a requirement for essential nutrients in order to grow properly [22]. Fish depend on protein and minerals supplied through feed and pond environment for fast and healthy growth. Feed formulations accounts for more than 50% of the total production costs in modern intensive aquaculture [5]. Increasing feed efficiency, especially by improving the metabolic assimilation of dietary nutrients, is of high priority in contemporary animal production [5].
In Nigeria, African catfish (*Clarias gariepinus*) are widely cultured due to their hardiness to stress, high resistance to diseases, spawning ability, fast growth rate and acceptability to consumers' taste. Wide range of feed additives are available to improve fish growth and health status, some of these additives, which include hormones and antibiotics are chemical products and may cause deleterious effects on fish (Bello *et al*., 2012) [5-6]. The use of plant immuno-stimulants seems to be attractive alternative to enhance growth and control disease infection.

Immuno-stimulants are more widely and successfully applied to improve fish welfare, health and production, it facilitates function of phagocytic cells, increase their bactericidal activities and stimulate natural killer cells, complement system, lysozyme activity and antibody response in fish and shellfish which confer enhanced protection from infectious diseases [6].

Guava (*Psidium guajava*) is a fast growing evergreen shrub or small tree that can grow to a height of 3-10 m. It has a shallow root system. Guava produces low drooping branches from the base and suckers from the roots. The trunk is slender, 20 cm in diameter, covered with a smooth green to red brown bark that peels off in thin flakes. Young twigs are pubescent. The leaves grow in pairs, opposite each other. The leaf blade is elliptic to oblong in shape, 5-15 cm long x 3-7 cm broad, finely pubescent and veined on the lower face, glabrous on the upper face. Guava may have originated either from tropical America or from Asia, and is now widespread throughout the tropics and subtropics. It is naturalized in the Old World Tropics and in the West Indies. Guava can grow under a wide range of environmental conditions. It is reported as an invasive weed in many countries (mainly in the Pacific Islands and along the Pacific Rim) [8]. Guava can be found in open areas, such as savannah/shrub transitional zones, or in frequently disturbed areas (Orwa *et al*., 2009) [40]. In some places, it can form dense thickets with more than 100 trees per ha, and it can cause pasture abandonment and land degradation [8]. Guava leaves have a poor to moderate protein content (10-14% DM) and a high fibre content (ADF 27-39% DM). The leaves have been reported to contain high levels of tannins, calcium oxalates. Guava waste tested in Nile tilapia had a relatively good DE value of 15.1 MJ/kg DM, twice that of copra meal. However, the determination of acceptable inclusion rates requires further research (Santos *et al*., 2009) [28].

2. Materials and Methods

2.1 Experimental Site

This study was carried out at the Department of Fisheries and Aquaculture teaching and research farm Federal University Wukari, Taraba State. The site is located along 7.8^{0}N latitude and 9.0^{0}E longitude of the southern guinea savanna zone of Nigeria. It is situated at elevation 189 meters above the sea level. (Blench, and Moore, 2008). It has maximum rainfall intensity and duration. The temperature varies from 25 ^{0}C to 28 ^{0}C with optimum relative humidity.

2.2 Experimental Procedure

2.2.1 Source and Collection of Guava (*Psidium guajava*) leaves

Guava (*Psidium guajava*) leaves were collected from Federal University Wukari environs and taken to the Department of Forestry and Wildlife, Federal University Wukari, for identification.

2.2.2 Processing of Leaves and Alcoholic Extraction

The leaves were thoroughly rinsed with clean water to remove dirt and evenly spread on a mosquito net mesh size to air dry under shade and was pulverized to fine powdered using a petrol grinding machine [18]. The ethanol extract of dried guava (*Psidium guajava*) leaves were made in fresh ethanol. About 5 grams of guava (*Psidium guajava*) leaves powder was taken and mixed in 50 ml of ethanol. The mixture was taken into 250 ml sterile conical flasks, plugged with sterile cotton and kept in Shaking Incubator (Kottermann, Germany) with the 200 rpm for 24 hours. The solution was filtered through muslin cloth, this process was repeated three times after which a clear alcoholic extract of the leaf was obtained (Zamin *et al*., 2014) [29].

2.2.3 Phyto Chemical Analysis

The proximate composition of guava (*Psidium guajava*) leaves were determined using the standard procedure described by AOAC (2001). Nitrogen free extract (NFE) were computed using the formula:

NFE = 100–(% Moisture + CP + CF + EE + ASH)

Where
CP = crude protein
CF = crude fibre
EE = ether extract

Metabolizable energy (ME) was calculated using to the formula of Pauzenga (1985) [37] express as

ME (kcal/kg) = 37 × % CP + 81 × % EE + 35.5 × % NFE.

Energy values obtained were converted to mega joules per kilogram. Amino acid profile was determined using the High Power Liquid Chromatography (HPLC) Buck Scientific BLC 10/11 model

2.2.5 Diet Formulation

The feeds ingredients (Maize, Groundnut cake, Fishmeal, Soybean meal, lysine, methionine vitamins and mineral premixes oil) were purchased from Gboko main market. The ingredients were milled using hammer milling, and were accurately measured and mixed to a homogenized dough with hot water. Four (4) experimental diets were formulated at varying levels of inclusion of guava (*Psidium guajava*) leaf extracts: Dt 1 (Control, 0 ml plant extract), Dt 2 (5 ml GL extract), Dt 3(10 ml GL extract), and Dt4 (15 ml GL extract) which were pelleted through a 2 mm die hand pelletizer and sun-dried for eight hours, after which the feed were packed in well labeled polyethylene bags to prevent mycotoxin contamination and stored for usage.

Table 1: Nutrient Composition of Experimental Diets

Ingredients	Diet1 (Control)	Diet2 (5 ml GL)	Diet3 (10 ml GL)	Diet4 (15 ml GL)
Fishmeal	550	550	550	550
Groundnut cake	280	280	280	280
Soybean meal	420	420	420	420
Maize	480	480	480	480
Blood meal	140	140	140	140
Lysine	10	10	10	10
Methionine	10	10	10	10
Vitamin premixes	10	10	10	10

Oil	20	20	20	20
Salt	20	20	20	20
Bone meal	30	30	30	30
Cassava flour	40	40	40	40
Guava leaf extracts	-	5 ml	10 ml	15 ml
Total (g)	2000	2000	2000	2000
Calculated CP (%)	40	40	40	40

2.2.6 Procurement, Acclimatization of Experimental Fish

One hundred and thirty (130) *Clarias gariepinus* juveniles were purchased from Owecho Fish Farms, Makurdi and transported to Federal University Wukari Fisheries and Aquaculture Teaching and Research farm in half filled fifty liters Jerrycan early morning between the hours of 6:00am – 7:00am. The fish were acclimatized for 14 days in reinforced fibre tanks (52.5 x 33.5 x 21 cm3) and fed 2 mm Skretting feed under standard condition; temperature (27.5-29.5 oC), dissolved oxygen (5.5-6.0 mg/l) and pH (6.5-7.0) during the experimental period.

2.2.7 Experimental Design and Feeding Trial

The experiment was carried out in Fisheries and Aquaculture Teaching and Research Farm, Federal University Wukari. Completely randomized design with four (4) treatments and treatment consist of three replicates making Twelve (12) plastic bowls (50 liters) were used, Fish were weighed, and randomly stocked into the plastic bowls at the rate of 10 fish per tank (average weight 12.9±0.44 g) and the experiment was carried out in triplicates. The fish were starved overnight before the commencement of the feeding trials to empty their stomachs. Fish were fed experimental diets to satiation by hand, twice daily (9.00 and 16.00 h) for a period six weeks. The weight of the experimental fish was measured using a digital balance (Camry EK 5055) at the beginning of the experiment and at the end of every week to determine the average weight gain while the quantity of the feed fed for each week were also be recorded. The water of the tanks was changed regularly after three (3) days to maintain good water quality while fish mortality was monitored daily. The fish were bulk weighed on weekly basis after which the mean body weight and mean feed intake was determined accordingly. The feeding trial lasted for twelve (12) weeks from December 2021 to March 2022.

2.2.8 Fish Growth and Nutrient Utilization Parameters

Mean weight gain (MW G), percent weight gain (PW G), mean length increase (MLI), specific growth rate (SGR), condition factor (CF), percentage survival and feed conversion ratio (FCR) were computed as described by Okoye *et al*. (2001) [30], Adikwu (2003) [2], Alatise and Otubusin (2006) [31] and Orisamuko (2006) [32]. The protein efficiency ratio (PER) was computed as described by Zeitoun *et al*. (1974) [33].

The following calculations were made:

Specific Growth Rate (SGR % day-1) = [(ln FW − ln IW)/T] × 100

And

Daily Weight Gain (DWG) = (FW − IW) / T,

Where FW and IW refer to the mean final weight and the mean initial weight, respectively, and T is the feeding trial period in days.

Survival Rate (SR %) = [(Nf / Ni) × 100],

Where the Nf is final total number of fish and Ni is initial total number of fish.

Protein Intake (PI) per fish = [total feed intake (g) × protein in the diet (%)] / Nf.

Feed Conversion Ratio (FCR) = [total feed intake (g)/total weight gain (g)].

Food conversion efficiency = [total weight gain (g)/protein intake].

2.2.9 Collection of Fish Blood for Haematological Analyses

Blood samples were collected from the caudal peduncle of randomly picked fish from each treatment in a 2ml syringe and transferred to ethylene-diamine-tetra-acetic acid (EDTA) bottles and to sterile plain sample bottles. The specimens were taken to Federal Medical Center, Jalingo, and Taraba State for analysis. Haematological parameters examined were white blood cell (WBC), packed cell volume (PCV), haemoglobin (Hb), erythrocyte sedimentation rate (ESR), neutrophil (Neut), leukocytes (Leuk) counts and Mean corpuscular haemoglobin concentration(MCHC) as described by standard method (Joshi *et al*., 2002) [16].

2.3 Data Analysis

Data obtained during the experimental period was subjected to one-way analysis of variance (ANOVA) and comparisons among treatments means were carried out by Duncan multiple range test (Duncan, 1955) [11] at a significance level of (P<0.05). The computations were carried out using the statistical package SPSS 16.0 (SPSS Inc., Chicago, IL, USA).

3. Results

3.1 Result for Proximate Composition of Experimental Diets

The results for proximate analysis is presented in table 2, the results showed the Crude (%) ranged from protein of the feeds to be 38.25 to 38.89, it was higher in Dt4 but not significantly different across treatments, the ash content (%) ranged from 2.5 in Dt3 to 10 in Dt4, there was no significance difference between Dt 4, 2 and 1 but they were significantly difference from Dt3, the fat content (%), % fibre, dry matter and % moisture recorded in this study was not significantly different across treatments, though a significance difference was observed nitrogen free extract (NFE) content (%) across treatments.

Table 2: Results for Proximate Composition of Experimental Diets

Parameter	Dt1	Dt2	Dt3	Dt4
% CP	38.25	38.87	38.81	38.89
% Ash	9.5	9.0	2.5	10.0
% Lipid	13.0	14.3	14.0	11.5
% Fibre	5.3	4.5	6.2	4.7
% Moisture	3.0	3.5	4.0	3.5
% NFE	35.9	32.8	40.4	31.9
% DM	97.0	96.5	96.0	96.5

Key: NFE = Nitrogen Free Extract, DM = Dry matter, CP = Crude protein

3.2 Result on Growth and Nutrient Utilization Parameters

The results of growth performance and nutrients utilization parameters are summarized in Table 3. From the results obtained, it was observed that all the parameters (i.e. TW (g), AW (g), AL (cm) and 3% BW) were significant at 5%. The result showed that for the TW (g), the results showed that the treatments had mean values of 283.33±6.39, 278.41±16.24, 279.38±14.65 and 342.31±17.06 for treatments 1, 2, 3 and 4 respectively. The first treatment with mean value of was significantly different from treatment 4 (with treatment 4 having the largest mean value) but not significantly different from treatment 2 and 3. Treatment 2 and treatment 3 were significantly different from treatment 4 but not significantly different from each other.

The highest significant (p<0.05) average weight (AW in grams) was recorded in treatment 4 (37.48±1.82 g), and the lowest value in treatment 2 (29.73±1.77g). The treatments 1, 2 and three were not significantly different from each other but significantly different from treatment 4. The increase in weight recorded from the treatment showed that the fish fed with treatment 4 had the average weight best performance compared with other experimental treatments.

The average length AL (cm) of the fishes has mean values of 16.11±0.35, 16.25±0.37, 16.60±0.36 and 17.70±0.20 for treatment 1, 2, 3 and 4 respectively. The results further indicated that treatment 4 has a mean that is significantly different from that of treatment 1, 2 and 3. The first, second and third treatments had means that were not significantly different.

The specific growth rate for treatments 1, 2, 3 and 4 have mean values of 0.90±0.03, 1.12±0.06, 1.00±0.06 and 1.38±0.02 respectively. The treatment's mean were significant at 5% level. From the results, the meant of treatment 1 was significantly different from that in treatment 3 and 4 but not significantly different from the mean of treatment 2. The mean of treatment 4 was significantly larger than all of the mean observed in all the treatments.

The daily weight gain shows mean values of 2.40±0.09, 3.28±0.29, 2.66±0.34 and 4.36±0.35 across the four treatments respectively. However, it was discovered that the mean of treatment 4 was significantly larger than that of treatment 1, 2 and 3. But those of treatments 1, 2 and 3 were not significantly different.

The survival rate shows mean values of 86.67±3.33, 96.67±3.33, 83.33±8.82 and 96.67±3.33 across the four treatments. However, it was discovered that the mean of all the treatment (1, 2, 3 and 4) were not significantly different from each other.

The food conversion ratio (FCR) for treatment 1, 2, 3 and 4 have mean values of 0.37±0.01, 0.33±0.01, 0.35±0.01 and 0.29±0.00 respectively. The treatment means were significant at 5% level. From the results, the mean of treatment 1 was significantly different from that in treatment 2 and 4 but not significantly different from that of treatment 3. The mean value in treatment 2 was significantly different from that observed in treatment 4 was not significantly different from that in treatment 3.

The protein intake per fish (PIPF) shows mean values of 8.15±0.00, 8.09±0.00, 8.03±0.00 and 8.16±0.00 across the four treatments. However, it was discovered that the mean of all the treatment (1, 2, 3 and 4) were not significantly different from each other.

The food conversion efficiency (FCE) of the fishes has mean values of 131.24±2.23, 148.30±4.92, 138.57±5.45 and 165.69±1.33 for treatment 1, 2, 3 and 4 respectively. The results further indicated that treatment 4 has a mean that is significantly larger than mean values observed in treatment 1, 2 and 3. That of treatment 3 was not significantly different from the mean in treatment 1 and 2, while the mean of treatment 2 was significantly larger than that in treatment 1.

Table 3: Result on Growth and Nutrient Utilization Parameters

Treatment	TW (g)	AW (g)	AL (cm)	SGR	DWG	SR	FCR	PIPF	FCE
1	283.33 ± 6.39^{ab}	30.56 ± 1.87^{b}	16.11 ± 0.35^{b}	0.90 ± 0.03^{c}	2.40 ± 0.09^{b}	86.67 ± 3.33^{a}	0.37 ± 0.01^{a}	8.15 ± 0.00^{a}	131.24 ± 2.23^{c}
2	278.41 ± 16.24^{b}	29.73 ± 1.77^{b}	16.25 ± 0.37^{b}	1.12 ± 0.06^{bc}	3.28 ± 0.29^{b}	96.67 ± 3.33^{a}	0.33 ± 0.01^{b}	8.09 ± 0.00^{a}	148.30 ± 4.92^{b}
3	279.38 ± 14.65^{b}	30.40 ± 1.77^{b}	16.60 ± 0.36^{b}	1.00 ± 0.06^{b}	2.66 ± 0.34^{b}	83.33 ± 8.82^{a}	0.35 ± 0.01^{ab}	8.03 ± 0.00^{a}	138.57 ± 5.45^{bc}
4	342.31 ± 17.06^{a}	37.48 ± 1.82^{a}	17.70 ± 0.20^{a}	1.38 ± 0.02^{a}	4.36 ± 0.35^{a}	96.67 ± 3.33^{a}	0.29 ± 0.00^{c}	8.16 ± 0.00^{a}	165.69 ± 1.33^{a}
P-Values	0.013	0.008	0.003	0.01	0.06	0.244	0.03	0.310	0,01
Remark	S	S	S	S	S	NS		NS	S

3.3 Result on Chemical Composition of Guava (*Psidium guajava*) Leaf Extracts

The result of phytochemical analysis (table 4 and 5) showed the presence of tannins, saponnins, glycoside and oxalate. Saponnins, glycoside and oxalate were present in moderate concentration in *P. guajava* leaves extracts while tannins was present in high concentration. The quantity of phytochemicals per 0.5 g recorded was 2.3 mg for saponnins, 3.7 mg tannins, 2.8 mg for glycoside, and 2.7 mg for oxalate, the percentage availability of the phytochemicals recorded in this study was 0.46%, 0.74%, 0.56%, and 0.54% for Saponnins, tannins, glycoside and oxalate respectively. The crude protein analyzed from this study was 13.2%, fat content was 2.8%, moisture content was 2.3%, fibre content was 2.5%, ash content was 6.8%, Nitrogen free extracts was 18.0%, and dry matter was 22.4%.

3.4 Result on Haematological profiles of C. *gariepinus*

juveniles fed different levels of Guava (*Psidium guajava*) Leaf Extracts

The haematological parameters considered in this study include PCV, HB, ESR, TWBC, MCHC, Neut and Lymph and the results obtained from the examination are recorded in Table 6. However, the highest values for haemoglobin was 13 g/dl (for treatment 2 & 4), the largest packed cell volume (PCV), were recorded for the treatment 4 with value of 40%, while their lowest values (32%) was recorded for treatment 4. Also, the TWBC count was highest (1780.0×10^9/L) in treatment 1 and lowest (1184.0×10^9/L) in treatment 4.

The highest value (0.34% and 85%) for neutrophil and leukocytes were recorded for treatment 3 and 4 respectively while, the least values (15% and 70%) for these parameters were recorded in treatment 4 and 3, respectively. Furthermore, for ESR parameter, all the treatments had unit values and for MCHC, the largest value was observed in treatment 3 while all the remaining treatments (1 g/dl, 2 g/dl and 4 g/dl) had the same value (0.33 g/dl).

Table 4: Phytochemical composition of guava (*Psidium guajava*) Leaf Extract

Phytochemicals	Observation	Quantity per 0.5g	Percentage (%)
Saponnin	++	2.3 mg	0.46
Tannins	+++	3.7 mg	0.74
Glycoside	++	2.8mg	0.56
Anthraquinone	-	-	-
Steroid	-	-	-
Flavonoid	-	-	-
Oxalate	++	2.7	0.54

Key: + = present, ++ = moderate, +++ = high present - = absent

Table 6: Result for Haematological profile of *Clarias gariepinus* fed guava (*Psidium guajava*) leaf extracts

	T_1C	T_2C	T_3C	T_4C
PCV (%)	36	39	32	40
HB (g/dl)	12	13	11	13
ESR (mm/hr)	1	1	1	1
TWBC (/L)	1780.0×10^9	1683.0×10^9	1203.0×10^9	1184.0×10^9
MCHC (g/dl)	0.33	0.33	0.34	0.33
Neut (%)	25	20	30	15
Lymph (%)	75	80	70	85

4. Discussion

4.1.1 Results of Proximate Composition of Experimental Diets

The results proximate composition of the experimental diets revealed that the crude protein values recorded in the this study were in agreement with the values (40.20% and 40.04%) reported by [5, 9], who reported that the protein required for the growth of *Clarias gariepinus* juveniles was about 40%. The proximate composition of the experimental diets used in this study support the growth of *Clarias gariepinus* juvenile as reported by [21, 5] that for maximum growth, fry, fingerlings and juveniles must be fed a diet in which nearly half of the digestible ingredients consist of balanced proteins.

4.1.2 Results of Growth and Nutrients Utilization of *Clarias gariepinus*

The results of growth performance and nutrients utilization parameters are shown in Table 2. The highest significant (P<0.05) mean weight gain was recorded in fish fed diet 4 (37.48±1.82 g), and the lowest value in fish fed diet 2 (29.73±1.77 g). The increase in weight recorded from each treatment showed that the fish fed with P. *guajava* (15 ml) had the best growth performance compared with other experimental diets. This result was corroborated by the study of [15] who reported that *P. monodon* survived and grew better in *T. catappa* leaf extract, this is also in agreement with [20] who reported that *Clarias gariepinus* juveniles grew better when fed *Moringa oleifera* leaves extracts. This could be as result of the presence of growth stimulants or constituents in the *P. guajava* leaves as reported by [3, 17]. These phytochemical properties could contribute to improving the digestion and nutrient absorption with a subsequent increase in the fish-weight. This result is in agreement with the report of [5] who obtained high growth performance in *Clarias gariepinus* with 1.5% walnut leaves and onion bulb extracts as well as that of [26], who obtained the highest growth performance in O. *niloticus* with 30g/kg garlic diet.

The highest specific growth rate value of 1.38±0.02 was recorded in treatment 4, followed by treatment 2 (1.12±0.06), and treatment 3 (1.00±0.06) both of which had better growth rate than the control (0.90±0.03) treatment 1, there is significant difference (p>0.05) between treatments 2 and 4 but no significance difference between treatment 3. This result agrees with the work of [26] who reported better growth rate in treated groups than the control. Feed conversion ratio (FCR) is used to assess feed utilization and absorption. FCR was highest in treatment 1 (0.37±0.01) and the lowest (0.29±0.00) in treatment 4. The result obtained showed *Psidium guajava* leaves extracts supplemented diets were less utilized by the *Clarias gariepinus* than the control diets. There were significant differences in feed conversion ratio (p>0.05) between the treatments 2 and 4, but not significantly difference from treatment 3. The daily weight gain recorded in this study ranged from 2.40 to 4.36, the highest value was recorded in treatment 4 which has a 15 ml inclusion of *Psidium guajava* leaf extracts and least value was recorded in the control, This result agrees with the work of [26] who reported better daily weight gain in treated groups than the control. The survival rate recorded in this study ranged 83.33 to 96.67, highest values were recorded in treatments 4, and 2 and least value was recorded in treatment 3, this results is in agreement with Hamid *et al*. (2018) [39] who reported higher survival rate of fish in treated diets and also the control. The protein intake per fish (PIPE) obtained in this results ranged from 8.03 to 8.16 with the highest value in treatment 4 treated with 15 ml *Psidium guajava* leaf extracts followed by the control and least values in treatment 3 treated with 10 ml *Psidium guajava* leaf extracts, this may be due to higher inclusion level of the leaf extracts this is in line with the report of [20] who reported higher PIPE value in treated diets with *Monringa oleifera.*

4.1.3 Results of Haematological Response of *Clarias gariepinus*

Blood is an active transport medium in higher animals, especially in the vertebrates and it is explained to be a medium that constantly bathes all the organs and tissues of the body, enabling exchange of materials between the internal and external environment of the organs and tissues [25]. All the haematological parameters measured in this study were within the recommended physiological ranges reported for *Clarias gariepinus* according to the previous studies carried out by some workers [1, 4]. Reported that red blood cell counts and packed cell volume (PVC) are mostly affected by dietary treatment. PCV ranging from 32% to 40% observed in this study were within the range of 20 to 50% reported for African

Catfish. The value of 11±0.23 to 13.0±0.29 g/dl recorded for Hb concentrations were within the normal range reported by some researchers [23] for African Catfish. PCV and Hb are major and reliable indicators of various sources of stress (Rainza-Paiva *et al*., 2000) [34]. White blood cells (WBC) and lymphocytes are reported to be the defense cells of the body and [10] demonstrated that the amount present in the body of the animal has implication in immune responses and the ability of the animal to fight infection. High WBC count is usually associated with microbial infection or the presence of foreign body or antigen in the circulating system (Oyawoye and Ogunkunle, 1998) [35]. TWBC recorded in this study range from 1184.0×10^9 to 1780.0×10^9 the treated groups were lower than the control, and treatment 1 was significantly different from treatments 2, 3 and 4. The haematological parameters in the present investigation such as white blood count (WBC), erythrocyte sedimentation rate (ESR), neutrophil, leukocytes counts, haemoglobin and the value of MCHC recorded a significant differences when groups of fish fed with leaves extracts were compared with control group. This were similar to Peruzzi *et al*., (2005) [36] findings.

4.1.4 Results of Phytochemical Screening of Guava (*Psidium guajava*) Leaves

The phytochemical screening of guava (*Psidium guajava*) leaves obtained in this work was similar to the results obtained by [3, 17] who reported the presence of phytochemical (tannins, saponins, glycoside and oxalate) in *Psidium guajava* leaves Also, the report of Azubuogu (2012) [37] confirmed the presence of these phytochemical.

4.2 Conclusion

This study showed that *Clarias gariepinus* juveniles diets with *Psidium guajava* leaves extracts had nutritional properties that enhance growth. These leaves are found in abundance, and thus can be obtained at little or no cost. This makes it relatively cheap natural nutritional product that can be used in aquaculture industry as feed supplement to enhance productivity. The use of *Psidium guajava* leaves are safe because they are biodegradable and has little or no side effect as the excess will serve as food and nourishment in the body unlike the synthetic or chemical supplement used in fish feed. Therefore, inclusion of 15 ml *Psidium guajava* leaves extracts in the diet of African Catfish (*Clarias gariepinus*) will enhance the growth and productivity in fish farming.

4.3 Recommendation

Based on the results of this study, the following recommendations are made

- Feeds for African Catfish (*Clarias gariepinus*) should be fortified with 15 ml *Psidium guajava* leaves extract, for optimum growth and maximal productivity.
- The variation in growth and nutrients utilization parameters obtained in this study emphasizes the need of more study on large number of fish population at different seasons and different age, sex and environmental conditions to confirm these findings of African Catfish (*Clarias gariepinus*).

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