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MS Bayon
Sierra Leone Agricultural Research Institute, Tower Hills P.O. Box 1313, Freetown, Sierra Leone

MD Kpundeh
Department of Aquaculture and Fisheries Management, School of Natural Resources Management, Njala University, Sierra Leone

NB Ikenweiwe
Department of Aquaculture and Fisheries Management, College of Environmental Resources Management, Federal University of Agriculture, Abeokuta (FUNAAB), Ogun, Nigeria

PM Ngegba
Sierra Leone Agricultural Research Institute, Tower Hills P.O. Box 1313, Freetown, Sierra Leone

EJ Ndoko
Sierra Leone Agricultural Research Institute, Tower Hills P.O. Box 1313, Freetown, Sierra Leone

Correspondence
MS Bayon
Sierra Leone Agricultural Research Institute, Tower Hills P.O. Box 1313, Freetown, Sierra Leone

Effects of *Adansonia digitata* (Baobab) bark meal additive on growth performance and haematological parameters of *Clarias gariepinus* (Burchell, 1822) fingerlings

MS Bayon, MD Kpundeh, NB Ikenweiwe, PM Ngegba and EJ Ndoko

Abstract
Adansonia digitata (Baobab) bark meal was incorporated at varying levels (0.00, 0.20, 0.40, 0.60, 0.80, and 1.00%) into 40% crude protein diet (D_1- D_6) of *Clarias gariepinus* fingerlings to assess its effects on growth performance and haematological parameters of the fish. A total of 180 fingerlings (3.09 ± 0.21 g) were raised and fed to satiation for 12 weeks in transparent plastic tanks using completely randomized design and data subjected to statistical analysis. *A. digitata* bark has oxalate, alkaloid, tannin, flavonoid, saponin steroid, anthraquinone, terpenoid, glycoside and phenol. Fish fed D_3 had the highest in percentage weight gain (1398.2 ± 38.50%), daily growth weight (0.50 ± 0.02 g/day) and apparent net protein utilization. White blood cell count was lowest (4.30 x 10^3/L) while 12.90 x 10^3/L was highest for D_6. *A. digitata* bark meal promotes growth and boost immunity of catfish when incorporated at 0.40% in fish diet.

Keywords: *Adansonia digitata* bark meal, *Clarias gariepinus* fingerlings, growth performance

1. Introduction
In the rummage around for better ways of promoting fish growth at less expensive cost of feeding in fish farming, many researches have been carried out on the use of plant as additive to promote growth with maximum survival rate. None the less, nutrition in fish farming though critical but still remain a challenge because feed represents 30 to 70 percent of the production cost depending on the type of culture system and intensity of feeding. Aquaculture requires high quality feeds which should contain not only necessary nutrients but also complementary feed additives that would keep fish healthy and ensure faster growth rate in a friendly environment [1]. A large number of feed additives are available to improve growth performance and health of fish and some of these additives are used in feed mill industries but are chemical products that are mostly synthetic hormones and antibiotics which may cause unfavourable side effects on fish and consumers [2]. Growth promoters in form of synthetic hormones, antibiotics and repartitioning agents had been popular in livestock husbandry. However, the impact of these on human health and the environment had failed a reduction and in some cases cessation of its use, but the trend of research efforts in recent time has been on substituting synthetic growth promoters with natural ones. Medicinal plants and probiotics have recently been reported as potential alternatives to antibiotics in aquaculture diets [3]. Studies have proposed that these plant products are useful and can promote various activities like anti stress, boost antimicrobial, growth promotion, appetite stimulation and immune-stimulation in cultured fish. The use of medicinal herbs and plants to substitute and minimize the use of chemical for a global trend to continue in its nature [3]. There are a lot of indicators such as blood parameters to measure the health status of farm fish when plants are used as addictive in the feed. Blood samples serves as good indictor to determine the health status and as well as pathological reflector of an organism's whole body [4]; hence haematological parameters are important in diagnosing the functional status of fish exposed to bioactive substances and toxicant.

Adansonia digitata (Baobab) is a plant which is widespread throughout the hot, drier regions of tropical Africa [5, 6]. The tree is a massive deciduous, and grows up to 25 m above ground and may live for hundreds of years [7]. The leaves, bark and fruits are used as food and for medicinal purposes in many parts of Africa. The baobab seed meal has been incorporated into fish feed to replace soybean meal in the diet of *C. gariepinus* fingerlings in Nigeria [8]. Fruit-pulp extract of African Baobab (*A. digitata*) have being used as feed for evaluation of safety, growth promoting and immuno-potentiating activities in commercial broilers [9]. There is dearth of information on the use of *Adansonia digitata* (Baobab) bark to promote growth and health of fish compared to its extensive usage in the diet of West African dwarf rams and in sex control for the bathing of male babies to enhance growth. This study was therefore carried out to evaluate the possible effects of *A. digitata* (baobab) bark meal additive as one such probable alternative feed resource. However, there is limited literature on its potential use in aquaculture or fish farming, hence the preceding work looks at how baobab bark meal have featured as a non-synthetic additive source in fish diets for growth performance, nutrient utilization, body composition and survival of *C. gariepinus* fingerlings, thus, practicing healthy aquaculture development in a friendly environment.

2. Materials and Methods

2.1 Experimental Fish

One hundred and eighty (180) catfish (*C. gariepinus*) fingerlings (3.09±0.21g) were obtained from Motherhood Freshwater Fish Farms, Obantoko Abeokuta Ogun State, Nigeria. The fingerlings were allowed to acclimatize to the experimental environment for two weeks while being maintained on commercial diet, Copence® (35% Crude Protein). Thereafter, the fish were batch weighed with a sensitive electronic balance (S. METTLER TO, PB602) and randomly distributed into experimental tanks in a completely randomized design with ten (10) fish per tank per replicate.

2.2 Experimental Diets

A. digitata bark (ADB) was peeled from Baobab stand of University cashew plantation opposite FUNAAB Venture. The peels were taken to the Herbarium laboratory of Forestry Department in Federal University of Agriculture, Abeokuta for confirmation and genuineness. Pieces of bark from the baobab stand sliced with machete, weighed with a sensitive electronic balance (S. METTLER TO, PB602) and oven dried at 75°C for 24 hours using a laboratory oven (Model No. DHG-9101.ISA) in Aquaculture and Fisheries Management (AQFM) Department of FUNAAB. The dried *A. digitata* bark was milled into powder with an electric blender (Saisho S-1851) in AQFM fish Laboratory 2. Six iso-nitrogenous diets (40% crude protein) were formulated and the powdered bark weighed and included as additives at 0.00, 0.20, 0.40, 0.60, 0.80, and 1.00% inclusion levels and tagged as $D_1 - D_6$ respectively as shown in Table 1. A fabricated pelletizing machine with 2 mm die was used to pellet the compounded feed separately by treatment. The pelleted feeds were sundried, allowed to cool and then packed in nylon bags according to treatments and stored in a cool and dry place at room temperature.

2.3 Phytochemical Analyses of the Test Plants

Phytochemical analyses of *Adansonia digitata* bark (ADB) was done to determine the presence and quantity of important phytochemical constituents such as alkaloid, flavonoid, terpenoid, anthraquinon, tannins, oxalate, saponin, cardiac glycosides, steroid and phenoid using modified laboratory methods of [10].

2.4 Proximate Composition of experimental diet

The proximate composition of the formulated feed was analyzed for moisture, crude protein, ash, crude fibre, and fats according to the method of Association of Officials Analytical Chemist [11]. The value of Nitrogen free extract was obtained by subtracting the total values of aforementioned constituents of proximate composition from 100.

2.5 Experimental Set-up and procedure

The experiment was carried out in the Fish Hatchery Unit of the Federal University of Agriculture Abeokuta (FUNAAB), Ogun State, Nigeria, using eighteen rectangular transparent plastic tanks, 58L each and filled with bore-hole freshwater up to the 48L mark. The feeding trial was conducted in eighteen experimental plastic tanks. Each tank (180 liters) was filled to 3/5 of its volume with water supplied from the farm's borehole, introduced after storage for 24 hours. Fish were fed to satiation twice daily at 07:30-08:30 and 16:00-17:00 h for twelve (12) weeks. The system was siphoned daily before feeding in the morning to 1/3 of its volume and replaced with freshwater. Total cleaning of the system was done on a weekly basis. Fish were batched weighed fortnightly with a sensitive electronic weighing scale (S. METTLER TO, PB602). The physical and chemical water quality parameters such as pH, temperature, dissolved oxygen, conductivity, total dissolved solids (TDS), ammonia, and nitrite were monitored weekly throughout the period of the experiment. Water temperature, pH, total dissolved solids and electrical conductivity were determined using portable Hanna instrument (model HI 98129) while dissolved oxygen meter (model JPB-607) portable analyzer was for dissolved oxygen. Standard methods were used to determine ammonia and nitrite in the laboratory.

2.6 Growth Performance and Nutrient Utilization

Growth performance and nutrient utilization parameters were computed using the following as thus below:

i. Mean weight gain (MWG)

$$\text{MWG (g)} = \frac{W_F - W_I}{N} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots [12]$$

Where: W_F = Final body weight in grams,
W_i = Initial body weight in grams, N = Number of fish

ii. Final mean weight (FMW)

$$\text{FMW (g)} = \frac{W_F}{N} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots [12]$$

Where: W_F = Final body weight in grams,
N = Number of fish that survived

iii. Percentage weight gain (PWG)

$$\text{PWG} = \frac{\text{MWG}}{\text{IMW}} \times 100 \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots [13]$$

Where: MWG = Mean Weight Gain
IMG = Initial mean weight

iv. Percentage weight gain (PWG)

$$PWG = \frac{MWG}{IMW} \times 100 \quad \text{.....} [13]$$

Where: MWG = Mean weight gain
IMG = Initial mean weight

v. Feed conversion ratio (FCR)

This is used to estimate the nutrient utilization efficiency on the experimental fish.

$$FCR = \frac{FI}{MWG} \quad \text{.....} [12]$$

Where: FI = Feed Intake,
MWG = Mean Weight Gain

vi. Protein efficiency ratio (PER)

$$PER = \frac{\text{Mean Weight Gain}}{\text{Mean Crude Protein Fed}} \quad \text{.....} [14]$$

Where mean crude protein fed
= feed supplied x percentage protein of diet

vii. Daily growth rate (DGR)

$$DGR = \frac{\text{Mean Weight Gain}}{\text{Mean Crude Protein Fed}} \quad \text{.....} [13]$$

viii. Apparent net protein utilization (ANPU)

$$ANPU = \frac{\text{Protein Gained in the Body}}{\text{Protein Fed}} \quad \text{.....} [14]$$

$$\text{Where Protein fed (g)} = \frac{\text{Percentage Protein in Feed x Total Weight of diet Consumed}}{100}$$

ix. Survival Rate (SR)

$$SR = \frac{\text{Initial number of fish stocked} - \text{mortality}}{\text{Initial number of fish stocked}} \times 100 \quad \text{.....} [13]$$

2.7 Hematological Analyses

The following parameters were used to assess the effects of dietary treatments on the haematological profile of *C. gariepinus* at the end of the feeding trials. Blood samples were collected from the fish with a fine syringe (1ml) into EDTA bottles and taken to College of Veterinary medicine, Federal University of Agriculture Abeokuta, Ogun state, Nigeria and analyzed

2.7.1 Packed cell volume (PCV)

A haemocrite tube was ¾ filled with blood and the ends filled with cristaseal, the tube was then centrifuged for five minutes in a haemocrite centrifuge. The PVC was read by a microhaematocrit reader and expressed as a volume of erythrocyte per 100cm³ [15].

2.7.2 Haemoglobin (Hb)

Haemoglobin concentration (Hb) was obtained by measuring the amount of oxygen which can combine with haemoglobin, using Van Slyke apparatus and applying Hufner's factor (1.36ml oxygen per 1g of Hb) for its calculation.

2.7.3 Erythrocyte count (Red Blood Cell)

Fish blood was diluted in an improved Neubauer pipette with formal citrate fluid at 1: 200. The diluted blood was introduced into a Neubauer counter/counting chamber and red blood cells counted under the microscope [15].

2.7.4 Leucocytes count (White Blood Cell)

Total White blood cell count (WBC), was done by visual counting method. 0.1ml of the anticoagulated blood was mixed with 1.9ml of 2% glacial acetic acid as diluents tinged with gentian violet. Total WBC count was estimated accordingly using Neubauer count chamber. The white blood cell differential count: a drop of blood was spread on a clean glass slide and allowed to air dried, fixed with methanol and stained with Giemsa solution for 15 minutes. Differentials of blood white cells were analyzed in percentage into Neutrophil, Lymphocyte, Eosinophil, Monocyte and Basophil.

i. Mean corpuscular volume (MCV)

The mean volume of blood cell was estimated using the relationship:

$$MCV = \frac{\text{Pack Cell Volume x 100}}{\text{Erythrocyte Count}} \quad \text{.....} [16]$$

ii. Mean corpuscular haemoglobin concentration (MCHC)

The mean corpuscular haemoglobin concentration was calculated using the relationship:

$$MCHC = \frac{\text{Haemoglobin Concentration (g/100 ml) x 100}}{\text{Pack Cell Volume}} \quad \text{.....} [16]$$

iii. Mean corpuscular haemoglobin, MCH

The mean corpuscular haemoglobin content of a single RBC was calculated as:

$$MCH = \frac{\text{Haemoglobin}}{\text{Erythrocyte Count}} \quad \text{.....} [16]$$

3. Results

Table 1 showed the gross composition of experimental diets. As depicted in Table 2, phytochemical screening revealed that *A. digitata bark* contained 6.71% of tannin%; 2.65% of saponin; 0.46% of terpenoid; oxalate content of 10.42%; Flavonoid content of 5.42%; alkaloid content of 8.44%; steroid content of 1.21%; anthraquinone content of 0.96%; phenol and cardiac glycoside contents were 0.01% and 0.02% respectively. Table 3 presents the proximate composition of experimental diets which did not show any significant difference. Growth performance and nutrient utilization of Clarias gariepinus fingerlings fed varying inclusion levels of *A. digitata bark* meal is shown in Table 4, there was no significant ($p>0.05$) difference in the initial mean weight (IMW) of *C. gariepinus* fingerlings and values ranged between 2.99 to 3.09g. There were significant ($p<0.05$) differences among the treatments for final mean weight (FMW), mean weight gain (MWG), and percentage weight gain (PWG). Fish fed D_3 (0.40% inclusion level of ADBM) recorded the highest ($p<0.05$) mean values for FMW, MWG and PWG (44.76g, 41.77g, and 1398.2 % respectively). Mean feed intake (MFI) was highest ($p<0.05$) in fish fed D_5 (0.80% inclusion level) and similar value was recorded for fish fed with D_6 (1.00% inclusion level). Significant ($P>0.05$) difference observed in feed conversion ratio (FCR) was best

(1.17) in fish fed with 0.40% (D_3) inclusion level of ADBM with similar values (1.26, 1.30, and 1.32) recorded in fish fed D_2, D_1 and D_4 inclusion levels. The haematological Parameters of *C. gariepinus* fed *A. digitata* bark meal based diets as presented in Table 5, the packed cell volume (PCV), red blood cell count (RBC), hemoglobin (HB), monocytes (MON) and basophil observed in this study had no significant difference ($p>0.05$). Meanwhile, there were significant differences ($P<0.05$) in the mean corpuscular volume (MCV) and mean corpuscular haemoglobin (MCH) observed. The values decrease in fish fed D_3 to D_6 and were relatively higher in fish reared on D_2 but however, lower in those fed on the control diet. There was a significant difference ($P<0.05$) in the value of mean corpuscular haemoglobin concentration (MCHC) but the values decrease as the level of ADBM increased in the diets. The white blood cell (WBC) values in this work showed variations amongst the treatments with highest value (12.90 $x10^3$ /L) been observed in fish fed with D_6 while D_2 have the least value (3.30 x 10^3 /L). An alternating increase and decrease pattern was observed across the treatments with no statistical difference ($p>0.05$) in fish fed with diet D_3, D_4 and the control diet, however, there exist a significant difference ($p<0.05$) in those fish among other treatments.

4. Discussion

The presence of phytochemical in Baobab bark and the varying percentages recorded during this studies conformed to the work of Abiona *et al.* [17] as cited by Bayon *et al.* [18] who reported the presence of tannins, terpenoid, flavonoids, saponin, reducing sugar, alkaloids, anthraquinones, steroids, resins, cardiac-active glycoside, and phenols in baobab (*A. digitata*) leaves. The presence of these bioactive constituents in the root of baobab tree in considerable amount was reported by Gbadamosi and others [19]. Thus, the relatively high quantity of these bioactive chemicals in the bark of *A. digitata* could possibly be due to the phenomenon that various parts (roots, stems, leaves, etc) of plant will exhibit different capability of retaining mineral content and other substances for its utilization. Generally, higher levels of anti-nutrients are retained on the skin of plant parts like stem, leaves and seed coats [18]. The crude protein content in ADBM appeared to be sufficient in the compounded ration of fish feed to promote growth as expressed in group of fish fed D_3 when compared with those fed control diet. Flavonoid is an appetite stimulating chemical in *A. digitata* bark. The flavonoid content in D_3 might be regarded as the optimal amount given those fish fed D_3 thus, recording the best FCR and manifesting good nutrient utilization. It is an indication that the fish were able to covert the consumed feed into tissue growth more efficiently than those in the other treatments. Growth performance was believed to have been influenced due to the presence and roles of saponin, tannins, phenol and oxalate played as the level of *A. digitata* bark milled was increased in the diets. These bioactive chemical are known to act by interfering with feed intake, palatability and absorption of nutrient in the body when consumed in excess [18] as expressed by lower growth in group of fish fed inclusion levels in excess of 0.40%. These anti-nutritional factors could act singly or in combination to produce this effect, and notably, reduced growth performance could be related to tannin which as condensed tannin (CT) is known to bind with protein to form an irreversible and reversible complexes that is consequent of a number of phenolic-hydroxyl groups [20]. Blood parameters are routinely used for the evaluation of physiological environment and husbandry stressors in fishes [21]. Changes in blood parameters of *C. gariepinus* exposed to environmental pollutants, diseases or pathogens especially in captured fisheries is have been captured in many studies and is a growing concern to fisheries scientists [22, 23, 24]. Result of this research conformed to others studies that one way of monitoring feed toxicity particularly when plants are use as additive is through haematological constituents of the blood. The haematological parameters computed in this study were within the recommended physiological ranges reported for *C. gariepinus.* The decreasing trend in the PCV from fish fed control diet to those fed D_6 could be due to the presence of some anti-metabolites such as saponin and tannin in the feed as cited by Bayon *et al.* in a study on important anti-nutritional substances and inherent toxicants of feeds [25]. Similar finding has been reported in a study on growth performance and haematogical responses of *C. gariepinus* fed dietary levels of *Moringa oleifera* leaf meal [26].

The higher values of haemoglobin concentration recorded in this study can be associated with large anaerobic metabolism capacity of *C. gariepinus*. The increase in the level of haemoglobin as *A. digitata* bark powdered increased in the diet could imply that diets having higher *A. digitata* bark meal have positive effect on the blood. However, this investigation has underscored that further inclusion of *A. digitata* bark in the fish diet interferes with tissue oxygen supply and thus provoke adaptive responses like increased red cell mass which is otherwise known as erythrocytosis. This increase in the erythropoietin production account for the elevation in hematocrit values and is best explain as a compensatory response to tissue metabolic hypoxia Hb (e.g., increased blood volume, Hb, hematocrit, and erythrocyte count and volume). Increase in haemoglobin concentration, as well as haematocrit ratio, is a well-documented response to hypoxia that serves to increase the oxygen carrying capacity of the blood. Changes in haematocrit ratio of fish fed with plant additives could possibly render them vulnerable to toxic and there by exposing and not only affecting the oxygen carrying capacity of the blood, but affect blood flow as well [27]. Therefore, when haematocrit ratios increase much above normal, oxygen delivery to the tissues may be reduced, because the resultant decrease in blood flow can more than offset the increased oxygen carrying capacity of the blood [28]. Differences in the range recorded in this study could be due to certain factors such as the size of the fish, the culture facility and the level of anti-nutritional factors of the test ingredient. The decreasing trend in the RBC as the level of *A. digitata* bark meal increase in the diet could possibly lead to anemic condition of fish which may however be due to its protein inadequacy to meet the fish nutrient requirements, and thus might have inhibited erythrocyte production or increase rate of destruction. Slight fluctuations were recorded in the MCH, MCHC and MCV which can be attributed to the insignificant reduction in cellular blood iron, resulting in reduced oxygen carrying capacity of blood and thus stimulate erythropoiesis. In addition, the observed decrease in MCHC level could be attributed to release of young RBCs containing lower Hb into the circulation. In this study, the increase value in MCV in fish could be a factor for high survival rate; and this might have the tendency to manifest high immunity or resistance to disease [29]. With a reducing trend in MCV as the level of *A. digitata* bark powder in the diet increases, is an indication of possible reduction in the immune system of the fish which

might lead to less resistance to some vulnerable illness or disease. White blood cells in fish respond to various stressors including infections and chemical irritants [30] and thus fluctuations in number of white blood cells count (WBC) are normal reaction on exposure to toxicants [31]. The increase in white blood cell count and LYM in some of the treatments may have resulted from the excitation of defense mechanism of the fish to counter the effect of the toxicant that may have been introduced by the bioactive compounds present in *A. digitata* bark. This variance could be probably due to the culture medium, the size of fish and the level of toxicity of the test ingredient. The high values of WBC and LYM recorded in this study at higher inclusion level of *A. digitata bark* can be correlated with increase in anti-body production which aids in survival, growth and recovery of fish that may come in contact with pathogens. Hence the ability of animal to fight infection from outside or within could depend on the amount of WBC and LYM which has implication in immune responses.

Table 1: Gross composition of experimental diets

	Experimental Diets					
Ingredient	**D_1**	**D_2**	**D_3**	**D_4**	**D_5**	**D_6**
Fish meal	26.74	26.76	26.77	26.80	26.82	26.84
Soybean meal (SBM)	26.74	26.76	26.77	26.80	26.82	26.84
Groundnut cake	13.37.	13.38	13.39	13.40	13.41	13.42
Maize	26.88	26.65	26.42	26.15	25.92	25.65
Milled *A. digitata* bark	0.00	0.20	0.40	0.60	0.80	1.00
Vitamin. Premix	0.5	0.5	0.5	0.5	0.5	0.5
Salt	0.25	0.25	0.25	0.25	0.25	0.25
Vegetable oil	4	4	4	4	4	4
Lysine	0.5	0.5	0.5	0.5	0.5	0.5
Methionine	0.5	0.5	0.5	0.5	0.5	0.5
DCP	0.5	0.5	0.5	0.5	0.5	0.5
Total (%)	100	100	100	100	100	100

Table 2: Phytochemical analysis of *Adansonia digitata* bark

Parameter	**Quantity (%)**
Tannin	6.71
Saponin	2.65
Terpenoid	0.46
Oxalate	10.42
Flavonoid	5.42
Alkaloid	8.44
Steroid	1.21
Anthraquinon	0.96
Phenol	0.01
Glycoside	0.02

Table 3: Proximate Composition (%) of Experimental diets

	Experimental Diets					
Parameter	**D_1**	**D_2**	**D_3**	**D_4**	**D_5**	**D_6**
Moisture (%)	9.32	9,11	9.46	9.78	8.91	9.67
Ash (%)	11.50	11.00	10.55	10.90	10.65	10.50
Crude fibre (%)	2.98	3.01	3.05	3.09	3.14	3.20
Fats (%)	4.31	4.26	5.01	4.56	5.64	4.34
Crude Protein (%)	40.00	40.01	39.99	39.98	39.99	40.01
Nitrogen Free Extract (%)	31.89	32.61	31.94	31.69	31.67	32.28

D_1= control diet; D_2= Diet containing 0.20% of ADBM; D_3= Diet containing 0.40% of ADBM; D_4= Diet containing 0.60% of ADBM; D_5= Diet containing 0.80% of ADBM; D_6= Diet containing 1.00% of ADBM; ADBM= *Adansonia digitata* bark

Table 4: Growth Performance and nutrient utilization of *Clarias gariepinus fingerlings* fed varying inclusion levels of *Adansonia digitata* bark meal

	TREATMENTS					
Parameters	**T_1 (CTR)**	**T_2 (0.20 %)**	**T_3 (0.40 %)**	**T_4 (0.60 %)**	**T_5 (0.80 %)**	**T_6 (1.00 %)**
IMW (g)	3.08±0.11	3.09±0.21	2.99±0.49	3.04±0.06	3.04±0.24	3.00±0.01
FMW (g)	$37.13±2.32^{bc}$	$39.62±4.28^{b}$	$44.76±1.88^{a}$	$36.42±1.42^{bc}$	$34.31±2.25^{c}$	$35.25±2.47^{bc}$
MWG (g)	$34.06±2.25^{bc}$	$36.52±4.25^{b}$	$41.77±1.88^{a}$	$33.38±1.48^{bc}$	$31.27±2.48^{c}$	$32.24±2.46^{bc}$
PWG (%)	$1106.8±59.13^{b}$	$1183.4±145.20^{b}$	$1398.2±38.50^{a}$	$1097.5±68.17^{b}$	$1035.9±161.94^{b}$	$1072.1±80.06^{b}$
FI (g)	$44.40±4.59^{b}$	$46.05±4.20^{b}$	$48.72±2.90^{b}$	$43.93±3.65^{b}$	$47.33±0.94^{b}$	$55.54±3.82^{a}$
FCR	$1.30±0.06^{c}$	$1.26±0.03^{c}$	$1.17±0.29^{c}$	$1.32±0.13^{c}$	$1.52±0.15^{b}$	$1.72±0.08^{a}$
ANPU (%)	$64.69±12.11^{ab}$	$72.24±12.65^{ab}$	$76.73±3.98^{a}$	$65.27±4.14^{ab}$	$58.53±1.31^{bc}$	$49.84±4.23^{bc}$
PER	$1.91±0.76^{b}$	$1.98±0.05^{ab}$	$2.15±0.04^{a}$	$1.91±0.20^{b}$	$1.66±0.17^{c}$	$1.45±0.07^{d}$

DGR	0.41±0.03^{bc}	0.43±0.05^{b}	0.50±0.02^{a}	0.40±0.02^{bc}	0.37±0.03^{c}	0.38±0.03^{bc}
SR (%)	93.33±5.77	100.00±0.00	100.00±0.00	96.67±5.77	100.00±0.00	93.33±577

Means in each row with different superscript are significantly different (p <0.05). IMW= Initial mean weight, FMW= Final mean weight, MWG= Mean weight gain, PWG= Percentage weight gain, MFI= Mean final intake, FCR= Feed conversion ratio, ANPU= Apparent net protein utilization, PER= Protein efficiency ratio, DGR= Daily growth rate, SR= Survival rate, T_1= fish fed control diet; T_2= fish fed D_2; T_3= fish fed D_3; T_4= fish fed D_4; T_5= fish fed D_5; T_6= fish fed D_6

Table 5: Blood Parameters of *Clarias gariepinus* fingerlings fed varying levels of *Adansonia digitata* bark meal based diets

	DIETS					
Parameterr	**D_1**	**D_2**	**D_3**	**D_4**	**D_5**	**D_6**
PCV (%)	30.00±0.00	28.67±0.58	29.67±1.53	29.00±5.00	29.00±2.00	25.67±0.58
HB (g/dl)	10.00±0.00	9.47±0.25	9.80±0.50	9.67±1.65	9.67±0.65	8.50±0.20
RBC (x 10^{12}/L)	2.80±0.05	2.72±0.01	2.74±0.18	2.72±0.52	2.72±0.19	2.41±0.05
MCH (pg)	35.73±0.64^{ab}	34.74±0.79^{b}	35.87±0.47^{a}	35.68±0.69^{ab}	35.61±0.23^{ab}	35.34±0.17^{ab}
MCHC (g/dL)	33.33±0.00^{b}	33.16±0.30^{b}	34.78±1.55^{a}	33.29±0.05^{b}	33.28±0.05^{b}	33.33±0.13^{b}
MCV (fl)	10.72±0.19^{ab}	10.48±0.15^{b}	10.80±0.15^{a}	10.72±0.19^{ab}	10.66±0.01^{ab}	10.60±0.01^{ab}
WBC (x 10^{3}/L)	9.80±3.40^{ab}	4.30±0.20^{c}	6.17±0.06^{bc}	11.27±4.95^{ab}	6.47±3.25^{bc}	12.90±0.00^{a}
NEUT (%)	50.67±3.51^{a}	37.67±2.08^{c}	53.00±0.00^{a}	51.00±6.00^{a}	45.67±7.51^{ab}	42.00±1.00^{bc}
LYM (%)	46.00±4.00^{c}	58.67±1.53^{a}	43.67±0.58^{c}	46.00±5.00^{c}	51.00±7.00^{bc}	55.00±1.00^{ab}
EOS (%)	3.00±0.00^{ab}	3.00±0.00^{ab}	3.67±0.58^{a}	2.67±0.58^{b}	3.00±0.00^{ab}	2.67±0.58^{b}
MON (%)	0.67±0.58	0.00±0.00	0.00±0.00	0.67±0.58	0.67±0.58	0.67±0.58
BAS (%)	0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00

Means in each row with different superscript are significantly different (p <0.05). PCV= Pack Cell Volume, HB= Haemoglobin, RBC= Red Blood Cell, MCH= Mean Corpuscular Haemoglobin, MCHC= Mean Corpuscular Haemoglobin Concentration, MCV= Mean Corpuscular Volume, WBC= White Blood Cell, NEUT= Neutrophil LYM= Lymphocyte, EOS=Eosinophil, MON= Monophils, BAS= Basophil

5. Conclusion

Adansonia digitata bark contains high amount of useful antibiotic agents (oxalate, alkaloid, tannin, flavonoid and saponin and low quantity of steroid, anthraquinone, terpenoid, glycoside and phenol). The inclusion level of *A. digitata* bark meal at 0.40% in the diet would not negatively affect the growth of *C. gariepinus.* Haematological parameters of *C. gariepinus* were not affected negatively by the inclusion *of A. digitata* bark meal in the diet of *C. gariepinus.* The study further revealed that *A. digitata* bark meal is a good immunity booster which is evidenced in the white blood cells count. Thus the amount of WBC and LYM in the fish will influence the ability of the animal to boost the immune responses and fight infection from outside or within the culture environment.

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