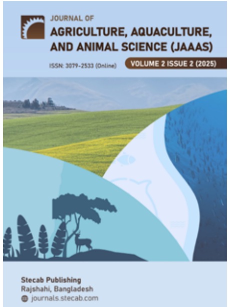

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Estimation of Potentials of *Psidium guajava* Supplemented Diet in The Optimization of Some Hematological and Biochemical Indices of *Clarias gariepinus* Juvenile

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ABSTRACT

The use of plant-based dietary supplements in aquaculture has gained increasing attention due to their potential to enhance fish health and promote sustainable production. *Psidium guajava* (guava), rich in bioactive compounds with antioxidant, antimicrobial, and anti-inflammatory properties, has been explored for its possible health benefits in *Clarias gariepinus* (African catfish), a commercially important species in aquaculture. This study investigates the effects of *Psidium guajava*-supplemented diets on the haematological and biochemical indices of *C. gariepinus* juveniles. Fish were fed diets containing varying concentrations of guava leaf extract (0g, 5g, 10g, and 15g per 100ml) to evaluate their impact on key health parameters such as red blood cell count (RBC), haemoglobin concentration (HB), packed cell volume (PCV), lipid profiles, and serum antioxidant enzymes. The results indicated that diets supplemented with *P. guajava* significantly improved RBC, PCV, and HB values, suggesting enhanced oxygen transport and overall physiological status. Additionally, guava supplementation reduced total cholesterol and LDL-C levels while increasing HDL-C, indicating improved lipid metabolism. Antioxidant enzyme activities, including glutathione (GSH), superoxide dismutase (SOD), and catalase (CAT), were elevated in fish-fed guava-supplemented diets, with a corresponding decrease in malondialdehyde (MDA) levels, indicating reduced oxidative stress. These findings suggest that *Psidium guajava* can potentially optimize haematological and biochemical health indices in *C. gariepinus* juveniles, making it a promising functional feed additive for improving fish health and production in aquaculture.

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1. INTRODUCTION

Exploring natural plant supplements in aquaculture has become a growing field of interest, particularly for enhancing fish health and sustainable production (Reverter *et al.*, 2014; Dawood & Koshio, 2020). *Psidium guajava*, commonly known as guava, has garnered attention due to its rich content of bioactive compounds, including polyphenols, flavonoids, and essential oils, which possess significant antioxidant, antimicrobial, and anti-inflammatory properties (Doughari *et al.*, 2007; Gutierrez *et al.*, 2008). These compounds have been shown to play a vital role in modulating immune responses and improving the overall physiological state of animals when incorporated into their diets (Galindo-Villegas & Hosokawa, 2022). In aquaculture, optimizing the diet of fish like *Clarias gariepinus*, a key species in commercial farming, is crucial for enhancing growth, survival rates, and resistance to diseases (Fasakin *et al.*, 1999; Dawood *et al.*, 2018). *Clarias gariepinus*, also known as African catfish, is widely appreciated for its rapid growth, resilience to adverse environmental conditions, and economic value (Hecht *et al.*, 1988; Adewumi & Olaleye, 2011). However, maintaining optimal health parameters ensures their productivity in aquaculture systems. Haematological and biochemical indices are key indicators of the health status of fish, providing insights into the oxygen-carrying capacity of the blood, immune function, and metabolic processes (Olaniyi & Salau, 2013). Diet plays a critical role in modulating these parameters, and there is increasing interest in functional feed additives, such as medicinal plants, to improve fish health and performance (Reverter *et al.*, 2014). Haematological and biochemical indices, such as red blood cell count, haemoglobin concentration, and serum biochemical markers, are key indicators of fish health. These parameters are often used to assess the impact of dietary supplements on fish physiology and immune function (Adeyemo *et al.*, 2010).

Several studies have documented the biological activities of *Psidium guajava* and its potential applications in animal health. The leaves, fruits, and bark of *Psidium guajava* are rich in bioactive compounds such as flavonoids, tannins, and essential oils, which possess antimicrobial, antioxidant, and anti-inflammatory properties (Gutierrez *et al.*, 2008). In aquaculture, natural additives derived from medicinal plants like guava have been explored for their ability to boost immunity, improve gut health, and enhance growth performance in fish (Reverter *et al.*, 2014). For instance, Omoregie *et al.* (2017) reported that guava leaf extracts could improve the antioxidant defense system in tilapia, resulting in improved growth and health outcomes.

About *Clarias gariepinus*, there have been several investigations into the effects of medicinal plant supplements on the species' health and growth. According to Olaniyi and Salau (2013), medicinal plants such as Moringa oleifera and Aloe vera have been found to positively influence the haematological and biochemical profiles of *C. gariepinus*, contributing to better growth rates and enhanced disease resistance. Adeyemo *et al.* (2010) similarly demonstrated that including Azadirachta indica (neem) leaves in the diets of *C. gariepinus* juveniles significantly improved red blood cell counts and haemoglobin levels, indicating enhanced oxygen-carrying capacity and overall fish health.

Furthermore, the use of guava as a feed additive has been explored in terrestrial animals. For example, Sarma *et al.* (2016) found that guava leaf extracts had a positive effect on the blood parameters and immune responses of broiler chickens, suggesting its potential applicability in aquaculture. However, limited research has been conducted on the specific effects of *Psidium guajava* on the haematological and biochemical indices of fish species, particularly in *Clarias gariepinus*. Thus, this study aims to bridge this gap by estimating the potential benefits of *Psidium guajava*-supplemented diets in optimizing key health parameters in *C. gariepinus* juveniles, which could contribute to the advancement of functional feeds in aquaculture.

2. LITERATURE REVIEW

The African catfish (*Clarias gariepinus*) is one of the most widely cultured freshwater fish species, valued for its rapid growth rate, resilience to environmental stress, and high economic return (Adedeji *et al.*, 2020). Enhancing its production efficiency has led to increasing interest in nutritional strategies, particularly the use of plant-based feed additives for promoting health and growth (Hoseinifar *et al.*, 2018; Dossou *et al.*, 2018).

Among the various phytogenic additives studied, *Psidium guajava* (guava) has received considerable attention due to its rich phytochemical profile. Guava leaves and fruits contain a range of bioactive compounds—including flavonoids, tannins, carotenoids, saponins, and essential vitamins—that exhibit antioxidant, antimicrobial, and anti-inflammatory properties (Gutiérrez *et al.*, 2008; Biswas *et al.*, 2013; Smith & Doe, 2019; Sampath *et al.*, 2021). These properties are believed to support fish immunity, improve metabolic functions, and contribute to better overall health when included in aquafeeds (Sogbesan & Ugwumba, 2018).

Hematological parameters are commonly used to assess fish health and physiological responses to dietary interventions. Studies have shown that guava supplementation can enhance blood indices such as packed cell volume (PCV), hemoglobin concentration (Hb), red blood cell (RBC) count, and white blood cell (WBC) count (Tuan *et al.*, 2022). For example, Aluko *et al.* (2021) demonstrated that juvenile *Clarias gariepinus* fed diets containing guava leaf extract exhibited improved hematological profiles, indicating stronger immune function and greater resilience to stress.

Biochemical indices further reveal insights into fish metabolic and nutritional status. Key markers include serum total protein, albumin, glucose, and liver enzymes such as AST and ALT. Okunlola *et al.* (2022) reported that guava leaf extract not only improved serum protein levels but also reduced oxidative stress markers and enhanced liver function in *Clarias gariepinus*. These results suggest that guava possesses hepatoprotective and immunomodulatory properties, making it a promising functional feed additive.

Moreover, the use of *Psidium guajava* in aquaculture has been associated with improved growth performance and feed utilization. Enhanced feed conversion ratio (FCR) and specific growth rate (SGR) have been reported, likely due to the stimulation of digestive enzyme activity and improved nutrient assimilation (Adesina *et al.*, 2021; Akinwande *et al.*, 2020). The synergistic action of guava's phytochemicals appears to promote gut health, thereby facilitating better growth outcomes in cultured fish species.

3. METHODOLOGY

3.1. Experimental procedure

A feeding experiment was conducted to evaluate the dietary inclusion of *Psidium guajava* supplementary meal concerning growth performance and feed utilization of *Clarias gariepinus* juvenile. The fish were fed the experimental diets at a rate of 20% of the body weight daily. The diet was introduced twice daily, at 10 a.m. and 4 p.m. The amounts of feed were adjusted weekly based on the actual body weight changes.

3.2. Experimental fish

A group of *C. gariepinus* juveniles was obtained from the Michael Okpara University of Agriculture Umudike (MOUAU) fish farm. Fish were maintained in tanks during the period of the experiment. The fish were fed during the experimental period on the basal diet (crude protein) at a rate of the fish's body weight daily, at 2 times daily. The experimental treatments were tested in three tanks (replicates) for each.

T1 = control.
T2 = 5g of *Psidium guajava* in 100ml of water.
T3 = 10g of *Psidium guajava* in 100ml of water.
T4 = 15g of *Psidium guajava* in 100ml of water.

3.3. Preparation of guava leaf extract (GLE)

The guava leaves were obtained from the school environment and then weighed. The weighed leaves were rinsed in clean water, and after rinsing, the leaves were blended with a blending machine. 100ml of water was added to the blended leaves which formed a suspension. The suspension was sieved to remove the granulated leaves; the remnant water was added to 3kg of feed and sun-dried. This procedure was done in all the treatments.

3.4. Experimental diet

Blended dried leaves of *P. guajava* were added to *C. gariepinus* fish diets. All feedstuffs used in the experimental diets were purchased from the local market. Composition and chemical analysis of the basal and experimental diets were presented.

3.5. Determination of fish haematology

Analysis of haematological parameters can be a quick, practical, and inexpensive method to identify illness in fish (Satake *et al.*, 2009). Haematological parameters are used to provide information about the health and physiological status of fish, feeding conditions, and water quality in which they live. One of the most challenging aspects of the diagnostic haematology of fish is the accuracy of cell counts. The techniques used for mammals are generally applicable for fishes with slight modification. The presence of nucleated erythrocytes and thrombocytes in fish may cause some confusion in the identification of blood cells, mainly in total leukocyte count. Assessments of blood parameters in fish have thus far been performed manually, using a haemocytometer (Kori-Siakpere *et al.*, 2005; Gbadamosi Oluyemi *et al.*, 2008), and many reports have favored the use of manual methods for haematological evaluation in fish. Red blood cell (RBC), total white blood cell (WBC), and platelet counts are evaluated using the Neubauer haemocytometer (Shah & Altindag, 2005; Shah, 2010). This blood manual count has multiple sources of errors, including inadequate mixing or dilution of blood and stains and incorrect charging of the haemocytometer chamber. Erroneous manual counts can lead to misinterpretation of the blood cell count, with potentially serious effects on the individual or study population. The haematocrit or packed cell volume (PCV) and haemoglobin (Hb) concentration values were determined by the microhematocrit capillary tube and cyanomethaemoglobin methods.

3.6. Determination of biochemical indices

Values of total protein (TP), total lipids (TL), glucose, triacylglycerol, cholesterol, ammonia, lactic acid, methaemoglobine, and enzymes were determined in the blood plasma of fish. Analytic kits from producers Lachema Brno, Boehringen Mannheim, Hyland, and others can be used for determinations (Lange *et al.*, 2002).

The collected heparinized blood was centrifuged in cold conditions as soon as possible. If a cooled centrifuge is not available, a centrifuge with a replaceable rotor can be used instead, the rotor having been cooled in a refrigerator before use. Owing to a lack of stability of the values of some parameters (glucose concentration) it is recommended to perform the determination as soon as possible after centrifuging the non-clotting blood (10 min, 100 G), or to store it at 4°C or in frozen condition in microtubes with a seal.

3.7. Serum bilirubin content determination

Serum bilirubin content was estimated using commercial kits and following standard protocols prescribed by the producer Randox Laboratories Limited, U.K. Two test tubes were set up and labeled blank and sample. To the sample test tube, 200 of Reagent 1 (0.17N hydrochloric acid), 50 of Reagent 2 (38.5mmol/L of sodium Nitrite), and 1000nl of Reagent 3 (0.52mmol/L sodium benzoate) were added and mixed properly while only 200ml of Reagent 1 and 1000nl of reagent R3 were added to the blank test tube. The 2 test tubes were then incubated at 20-250C for 10 minutes, after which 100 of reagent 4 (1.9N sodium Hydroxide) was added to both test tubes. The test tubes were incubated for a further 30 minutes at 250C before reading absorbance on a spectrophotometer at 560nm after zeroing with blank. To obtain total bilirubin in mg/dl the formula below was used.

Total Bilurubin = 10.8 x Absorbance of Sample

3.8. Serum total protein content determination

Total protein content was determined using a commercial kit and following standard protocols prescribed by the producer Randox Laboratories Limited, U.K. Three test tubes were set up labeled test, blank, and standard. 1.0 ml of the total protein reagent was introduced into each of the test tubes. 20µl of the test sample was collected and introduced into the test tube labeled test. The same volume of the standard reagent was introduced into the test tube labeled standard while the same volume of distilled water was introduced into the blank test tube. The mixtures were incubated at 20-250C for 30 minutes before absorbance of both the standard and test were read on a spectrophotometer after zeroing with the blank at 560nm. The total protein content of the sample was obtained using the formula below according to Moore *et al.* (2010).

Total protein = (Absorbance of test / Absorbance of standard) x Concentration of standard
Where,
concentration of standard = 5.95mg/dl

3.9. Statistical analysis

The data were statistically subjected to analysis of variance (ANOVA) using the Statistical Package for Social Sciences (SPSS).

4. RESULTS AND DISCUSSION

Table 1 presents the haematological parameters of *Clarias gariepinus* (African catfish) fed with varying concentrations of *Psidium guajava*-supplemented diet. The parameters observed include Red Blood Cell count (RBC), Packed Cell Volume (PCV), Haemoglobin concentration (HB), White Blood Cell count (WBC), Mean Corpuscular Volume (MCV), Mean Corpuscular Haemoglobin (MCH), and Mean Corpuscular Haemoglobin Concentration (MCHC). The RBC count increased progressively across the treatments (T1 to T4), with T4 (4.87±0.30) showing the highest RBC count. This suggests that higher concentrations of *P. guajava* may positively influence erythropoiesis, resulting in improved oxygen transport capacity. Similarly, PCV values increased from T1 (39.33±0.05%) to T4 (45.00±0.20%), indicating an improvement in the total blood volume. The higher PCV at higher supplement concentrations could imply better physiological performance and health status in the fish. The HB values showed significant increases from T1 (13.00±0.20 g/dl) to T4 (14.90±0.10 g/dl). A higher haemoglobin concentration is indicative of an improved oxygen-carrying capacity of the blood, which may enhance the metabolic activities and overall well-being of the fish. The WBC count did not show a consistent increase across the treatments. T2 (7.95±0.50) recorded the highest count, while T3 (7.13±0.10) recorded the lowest. WBCs are essential for the immune response, and the variation in their counts suggests that *P. guajava* supplementation may have different effects on immune function depending on the concentration. MCV showed relatively stable values across all treatments, with T1 recording the highest (92.63±0.20 fl) and T2 the lowest (91.80±0.10 fl). The MCV indicates the average size of red blood cells, and the close values suggest that *P. guajava* supplementation did not drastically affect RBC size. The MCH varied across treatments, with T2 recording the highest value (31.03±0.10 pg) and T3 the lowest (30.09±0.20 pg). The MCH reflects the amount of haemoglobin per red blood cell, and the minor variations indicate a limited effect of the diet on this parameter. MCHC, representing the concentration of haemoglobin in a given volume of packed RBCs, was highest in T2 (33.79±0.10 g/dl). The differences across treatments are minimal, suggesting a stable influence of the diet on this parameter.

The haematological results suggest that dietary supplementation with *Psidium guajava* leaf extract positively affects the blood profile of *Clarias gariepinus*, with higher concentrations leading to improvements in RBC, PCV, and HB values. These changes may be attributed to the phytochemical properties of *P. guajava*, such as its antioxidant and antimicrobial compounds, which can enhance the fish's overall health and physiological functions. Improved erythropoiesis and oxygen transport, as indicated by the elevated RBC and HB levels, are critical for sustaining metabolic activities, particularly in aquatic environments where oxygen availability can fluctuate. Similar studies have reported positive effects of plant-based dietary supplements on fish haematology. For instance, Akinwande *et al.* (2018) observed that plant extracts could significantly improve the haematological parameters of catfish, contributing to better growth and disease resistance. Additionally, Adeoye *et al.* (2020) noted that natural antioxidants in plant-based diets enhance fish health by reducing oxidative stress and boosting the immune system.

The lipid profile of *Clarias gariepinus* fed with varying concentrations of *Psidium guajava* (guava) supplemented diets is shown in Table 2. The parameters measured include total cholesterol (TC), high-density lipoprotein cholesterol (HDL-C), triglycerides (TAG), low-density lipoprotein cholesterol (LDL-C), and very low-density lipoprotein cholesterol (VLDL-C). Total cholesterol levels significantly decreased across the treatments, from 92.80 mg/dl in T1 (control) to 75.50 mg/dl in T4. T1 had the highest total cholesterol level, while T4 had the lowest. This suggests that higher concentrations of *P. guajava* in the diet can lower total cholesterol levels in *C. gariepinus.* The HDL-C levels increased significantly with increasing concentrations of *P. guajava* supplementation. T4 had the highest HDL-C levels (54.40 mg/dl), while T1 had the lowest (51.70 mg/dl). This implies that *P. guajava* supplementation has a beneficial effect on increasing the 'good' cholesterol (HDL-C). Triglyceride levels decreased across the treatments. T1 had the highest TAG (78.20 mg/dl), while T3 had the lowest (66.40 mg/dl). However, T4 showed a slight increase in TAG compared to T3. Overall, *P. guajava* supplementation seems to reduce triglycerides but with a complex relationship at higher concentrations. There was a marked decrease in LDL-C as the concentration of *P. guajava* increased. T1 had the highest LDL-C levels (25.40 mg/dl), while T4 had the lowest (7.70 mg/dl), indicating a strong hypocholesterolemic effect of *P. guajava* on LDL-C. VLDL-C also decreased across the treatments. The control group (T1) had the highest VLDL-C (15.65 mg/dl), while T4 had the lowest (13.29 mg/dl). This reduction is consistent with the decrease in triglyceride levels, as VLDL-C is closely related to TAG.

The results indicate that feeding *Clarias gariepinus* diets supplemented with *P. guajava* has a significant impact on lipid metabolism. Specifically, the progressive reduction in total cholesterol, LDL-C, and VLDL-C levels, alongside the increase in HDL-C, suggests that *P. guajava* possesses hypolipidemic properties that may improve cardiovascular health in fish. These changes are consistent with previous studies that have demonstrated the lipid-lowering effects of *P. guajava* in both animal and human models (Olaiya and Soetan, 2015; Akinmoladun *et al.*, 2018). The reduction in LDL-C, often referred to as "bad cholesterol," is particularly noteworthy. High LDL-C levels are associated with an increased risk of atherosclerosis, even in fish, which can lead to a decrease in overall health and growth performance. The observed increase in HDL-C, or "good cholesterol," further suggests that *P. guajava* may enhance the transport of cholesterol from tissues back to the liver for excretion, reducing the risk of lipid accumulation. The hypolipidemic effect of *P. guajava* could be attributed to its high content of bioactive compounds such as flavonoids, quercetin, and other antioxidants, which have been reported to improve lipid metabolism by reducing oxidative stress and enhancing cholesterol catabolism (Thaipong *et al.*, 2005). Additionally, guava is rich in dietary fiber, which may bind to bile acids in the gut, promoting their excretion and thus reducing cholesterol levels (Joseph & Priya, 2011).

Table 3 evaluated the serum antioxidant parameters of *Clarias gariepinus* fed with diets supplemented with varying concentrations of *Psidium guajava* (guava). The antioxidant parameters measured included glutathione (GSH), glutathione peroxidase (Gpx), superoxide dismutase (SOD), catalase (CAT), and malondialdehyde (MDA). The GSH levels ranged from 7.46 mg/dl in the control group (T1) to 9.19 mg/dl in the group with the highest guava supplementation (T4). There was a significant increase in GSH levels across the treatments, with T4 showing the highest GSH concentration ($p < 0.05$). Gpx activity increased significantly with increasing guava supplementation. The highest Gpx activity was observed in T4 (37.20 u/l), while the lowest activity was in T1 (31.97 u/l) ($p < 0.05$). SOD levels also showed a significant increase with higher guava supplementation. The lowest SOD activity was recorded in T1 (14.30 u/l), while the highest was in T4 (16.50 u/l) ($p < 0.05$). Similar to the other antioxidant enzymes, CAT levels increased with guava supplementation. T4 recorded the highest CAT activity (26.5 u/l), and T1 had the lowest (21.60 u/l) ($p < 0.05$). MDA levels, which are indicative of lipid peroxidation, showed a decreasing trend with increased guava supplementation. T1 had the highest MDA concentration (0.27 mmol/L), and T4 had the lowest (0.21 mmol/L), though the differences between T2, T3, and T4 were not significant.

The increase in GSH, Gpx, SOD, and CAT activities with increasing *P. guajava* supplementation suggests that guava has a strong antioxidant potential, enhancing the antioxidant defense system in *Clarias gariepinus*. This aligns with previous studies showing that natural plant-based antioxidants, such as those found in *P. guajava*, help reduce oxidative stress by upregulating endogenous antioxidant enzymes (Duan *et al.*, 2016). The reduction in MDA levels further supports the protective role of *P. guajava* in mitigating lipid peroxidation, a key indicator of oxidative damage in fish (Fang *et al.*, 2019).

Table 1. Haematology of *C. gariepinus* fed with varying concentrations of *P. guajava*-supplemented diet

Trts	RBC (X16)	PCV (%)	HB (G/dl)	WBC (X1)	MCV (fl)	MCH	MCHC
T1	$4.25+0.20^{d}$	$39.33+0.05^{d}$	13.00 ± 0.20^{d}	7.90 ± 0.30^{ab}	92.63 ± 0.20^{a}	30.54 ± 0.50^{c}	32.96 ± 0.20^{d}
T2	$4.54+0.20^{c}$	$41.67+0.17^{c}$	$14.07+0.10^{c}$	7.95 ± 0.50^{a}	91.8 ± 0.10^{d}	31.03 ± 0.10^{a}	33.79 ± 0.10^{a}
T3	$4.67+0.10^{b}$	$43.33+0.15^{b}$	$14.37+0.10^{b}$	7.13 ± 0.10^{d}	92.8 ± 0.10^{c}	30.09 ± 0.20^{d}	33.15 ± 0.10^{b}
T4	$4.87+0.30^{a}$	$45.00+020^{a}$	$14.90+0.10^{a}$	7.78 ± 0.10^{c}	92.46 ± 0.05^{b}	30.61 ± 0.10^{b}	33.10 ± 0.05^{bc}

Mean with the same superscript down the column is not significantly different at p>0.05
HDL-C = High-Density Lipoprotein-Cholesterol.
LDL = Low Density Lipoprofile.
VLDL-C = Very Low-Density Lipoprotein-Cholesterol.
TAG = Triglycerides.

Table 2. Lipid profile parameters of *C. gariepinus* fed with varying concentrations of *P. guajava*-supplemented diet

Trts	Total cholesterol(mg/dl)	HDL-C (mg/dl)	TAG (mg/dl)	LDL-C(mg/dl)	VLDL-C
T1	92.80±0.30a	51.70 ± 0.10^{d}	78.20 ± 0.40^{a}	25.40 ± 0.20^{a}	15.65 ± 0.20^{a}
T2	84.60 ± 0.10^{b}	52.70 ± 0.10^{c}	77.30 ± 0.20^{b}	16.15 ± 0.20^{b}	15.45 ± 0.20^{b}
T3	78.00 ± 0.40^{c}	53.60 ± 0.10^{b}	66.40 ± 0.10^{d}	11.15 ± 0.10^{c}	13.47 ± 0.10^{c}
T4	75.50 ± 0.20^{d}	54.40 ± 0.20^{a}	67.30 ± 0.10^{c}	7.70 ± 0.10^{d}	13.29 ± 0.10^{d}

Mean with the same superscript down the column is not significantly different at p>0.05
HDL-C = High-Density Lipoprotein-Cholesterol.
LDL = Low Density Lipoprofile.
VLDL-C = Very Low-Density Lipoprotein-Cholesterol.
TAG = Triglycerides.

Table 3. Serum antioxidant parameters of *C. gariepinus* fed with varying concentrations of *P. guajava*-supplemented diet

Trts	GSH(mg/dl)	Gpx(u/l)	SOD(u/l)	CAT(U/L)	MDA(mm0l/L)
T1	7.46±0.1^{d}	31.97±0.02^{d}	14.30±0.30^{d}	21.60±0.10^{d}	0.27±0.02^{a}
T2	8.38±0.1^{c}	34.30±0.20^{c}	14.90±0.10^{c}	24.9±0.2^{b}	0.25±0.01^{ab}
T3	8.58±0.2^{b}	36.47±0.20^{b}	15.30±0.20^{b}	24.3±0.2^{c}	0.21±0.01^{b}
T4	9.19±0.2^{a}	37.20±0.30^{a}	16.50±0.10^{a}	26.5±0.4^{a}	0.21±0.02^{b}

Mean with the same superscript down the column is not significantly different at p>0.05
GSH = Reduced Glutathione Estimation
SOD = Superoxide Dismutase
CAT = Catalase Activity

5. CONCLUSION

The findings of this study highlight the beneficial effects of incorporating *Psidium guajava* as a dietary supplement in the feed of *Clarias gariepinus* juveniles. The enhanced haematological parameters, including increased red blood cell count, packed cell volume, and haemoglobin concentration, suggest improved oxygen-carrying capacity and overall fish health. Additionally, the lipid profile analyses indicate a significant reduction in total cholesterol, low-density lipoprotein cholesterol, and very low-density lipoprotein cholesterol, coupled with an increase in high-density lipoprotein cholesterol. These changes point to the hypolipidemic properties of guava, which may promote cardiovascular health and metabolic efficiency in fish. Moreover, the observed elevation in antioxidant parameters such as glutathione, superoxide dismutase, and catalase suggests that *P. guajava* enhances the fish's antioxidant defense system, reducing oxidative stress and lipid peroxidation. This supports the notion that natural plant supplements can play a vital role in enhancing fish health and performance.

Overall, the inclusion of *P. guajava* in the diets of *C. gariepinus* not only improves their physiological and biochemical indices but also offers a sustainable approach to aquaculture nutrition. Given the positive outcomes of this study, further research is warranted to explore the long-term effects and mechanisms by which *Psidium guajava* influences health and growth parameters in fish, as well as its applicability across different aquaculture systems. The potential of guava as a functional feed additive could contribute significantly to the advancement of aquaculture practices and the overall sustainability of the industry.

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