POTENTIALS OF *Psidium guajava* SUPPLEMENTED MEAL ON GROWTH PERFORMANCE AND SOME ORGANS FUNCTION PARAMETERS OF *Clarias gariepinus* JUVENILE

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ABSTRACT

This study evaluates the effects of Psidium guajava (guava) leaf extract supplementation on the growth performance and organ function parameters of Clarias gariepinus (African catfish) juveniles. Four dietary treatments were formulated: a control group (T1) and three experimental groups supplemented with varying concentrations of guava leaf extract (T2: 5g, T3: 10g, T4: 15g in 100ml of water). Fish were fed twice daily for eight weeks, and growth performance indicators such as weight gain and length gain were recorded. Additionally, liver and renal function parameters, including ALT, AST, ALP, total protein, urea, and creatinine levels, were analyzed. Results showed that T2 (5g guava supplementation) significantly enhanced weight gain (108g) and protein synthesis, while liver function remained stable. However, higher guava concentrations (T4) induced elevated ALT and AST levels, indicating potential liver stress. Renal function parameters showed improved nitrogen metabolism with lower urea and creatinine levels in the guava-supplemented groups. The study concludes that moderate supplementation with Psidium guajava (5g per 100ml water) can enhance growth and improve organ function in Clarias gariepinus juveniles, while higher concentrations may cause liver stress. This suggests that Psidium guajava leaf extract has potential as a cost-effective dietary supplement in aquaculture, with appropriate dosage management.

Keywords: Fish juveniles; Plant extract supplementation; Performance indices; liver function

INTRODUCTION

The *Clarias gariepinus* (African catfish) is a highly valued species in aquaculture due to its fast growth rate, hardiness, and high adaptability to diverse environmental conditions. Sustainable fish farming, however, faces challenges in meeting the nutritional demands of these fish species, particularly due to the rising cost of conventional feed ingredients. In recent years, there has been an increasing interest in alternative plant-based feed supplements to improve growth performance and reduce feed costs (Kong *et al*., 2020). One such potential plant-based supplement is *Psidium guajava* (guava), a tropical fruit widely recognized for its rich content of vitamins, minerals, antioxidants, and phytochemicals (Kareem and kadhim, 2024). *Psidium guajava* has been extensively studied for its medicinal properties, including anti-inflammatory, antimicrobial, and antioxidant effects, which have shown potential in improving animal health when used as a dietary supplement (Sharma *et al*., 2017). In fish nutrition, plant-based supplements such as guava may offer the dual benefit of providing essential nutrients while promoting overall health through the bioactive compounds present in the plant (Khosravi *et al*., 2015). However, there is limited information on the efficacy of *Psidium guajava*-based supplements in aquaculture, particularly with respect to their impact on the growth performance and physiological function of farmed fish species like *Clarias gariepinus*.

Understanding the role of plant-based supplements in aquaculture is crucial for optimizing fish growth, enhancing feed efficiency, and maintaining the health of cultured species (Akpator *et al*., 2024). This study aims to evaluate the potential of *Psidium guajava*-supplemented feed on the growth performance and certain organ function parameters, such as liver and kidney function, of *Clarias gariepinus* juveniles. The findings from this current study could provide insights into the viability of guava (*Psidium guajava*) as an affordable and health-promoting dietary supplement in catfish farming.

MATERIAL AND METHODS

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 5% of the body weight daily. The diet was introduced twice daily, morning and evening. The amounts of feed were adjusted weekly based on the actual body weight changes.

Experimental Fish

A group of *C. gariepinus* juvenile were obtained from 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 45% and lipid 12%) at a rate of the fish body weight, 2 times daily. The experimental treatments were tested at three tanks (replicates) for each.

T_1 = control.

T_2 = 5g of *Psidium guajava* in 100ml of water (H_2O).

T_3 = 10g of *Psidium guajava* in 100ml of H_2O.

T_4 = 15g of *Psidium guajava* in 100ml of H_2O.

Preparation of Guava Leaf Extract (GLE)

The guava leaves were gotten from the school environment and then weighed it. The weighed leaves was rinsed in clean water, after rinsing, the leaves was blended with a blending machine. 100ml of water was added to the blended leaves which form 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.

Experimental Diet

Blended dried leafs 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.

Growth Performance Parameters

The growth performance and feed utilization parameters were calculated according to the following equations:

Initial weight – Measured using a weighing balance

Final weight – Measured using a meter rule

Average weight gain (AWG, g/fish) = Average final weight (g) - Average initial weight (g).

Initial length – Measured using a meter rule

Final length – Measured using a meter rule

Length gain – Final length – initial length

Feed Conversion Ratio (FCR) - Feed given/wt gain

Determination of Liver function parameters

Alanine aminotransferase (ALT),

Aspartate aminotransferase (AST),

Alkaline phosphatase (ALP),

Total bilirubin, and

Total protein

Alanine Aminotransferase (ALT)

This was determined using Randox commercial kits and following the principles and procedures outlined by the commercial kit producer, Randox Laboratories Limited, UK. Two test tubes were set up in a test tube rack and labeled "Blank: and test. 0.1ml of the sample (test serum) was introduced into the test tube while 0.1ml of distilled water was pipetted into the blank test tube. 0.5ml of ALT reagent R_1 was then be pipette into each of the tubes and mixed. The mixture was incubated for 30 minutes at 37^0C before the addition of 0.5ml of reagent R_2 to each of the tubes and also incubated at 20-25^0C for 20 minutes. 5ml of Sodium Hydroxide was then added to each tube and allowed to stand for 5 minutes before absorbance was read against the reagent blank on a spectrophotometer (722 N, CHINA) at 546nm. ALT activity in the serum was then obtained by tracing the equivalent absorbance of the sample on the ALT absorbance chart and finding its corresponding ALT activity value in U/I.

Aspartate aminotransferase (AST)

This was estimated using AST commercial kits and following standard procedures prescribed by the producer, Randox Laboratories Limited, U.K. A blank test tube was set up into which 0.1ml of distilled water was being pippetted. 0.1ml of the test serum was also pipetted into a second test tube labelled "test". AST reagentR_1 (0.5ml) was added to each test tube, mixed and incubated at 37^0C for 30 minutes. After the incubation, 0.5ml of AST reagentR_2 was added to each test tube and allowed to stand for 20 minutes at 20-25^0C before 5.0ml of 0.4mol/liter Sodium Hydroxide was added to each allowed to stand for 5 minutes before reading absorbance against the reagent blank on a spectrophotometer (722N, CHINA) at wavelength 546nm. AST activity in the serum was then obtained by finding an equivalent value of absorbance on the standard chart and obtaining its corresponding activity value in U/I.

Alkaline phosphatase (ALP) activity

This was determined using the ALP commercial kits and following standard procedures as outlined by the produce Teco diagnostic, U.S.A. Three test tubes were set up and labeled test, control and standard respectively into which 0.5ml of Alkaline phosphatase substrate was added. 0.05ml (50µl) of the standard, control and sample (test serum) were added to the corresponding test tubes while distilled water was used for the control. The test tubes were incubated for 10 minutes at 37^0C before adding 2.5ml of Alkaline Phosphate Colour Developed at timed intervals. The mixtures were properly mixed before reading absorbance on a spectrophotometer at 590nm after zeroing with the reagent blank.

ALP value in IU/Liter was calculated using the formular

$$\frac{\text{Absorbance of Sample}}{\text{Absorbance of standard}} \times 50$$

Where: 50 is the standard ALP value

Statistical Analysis

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

RESULTS

The result from Table 1 reveals the growth parameters of *Clarias gariepinus* (African catfish) fed with varying concentrations of *Psidium guajava* supplemented diets. The control group (T1) had a weight gain of 103 g, which is comparable to T3 (104 g) and T4 (105 g). However, T2 (108 g) exhibited the highest weight gain which was statistically significant ($p<0.05$), while FCR was lowest in T2 (4.63) suggesting that the 5g of *P. guajava* may enhance weight gain in *C. gariepinus* when incorporated into their diet. The length gain was significantly highest in T3 (7.7 cm) compared to T1 (7.1 cm), T2 (7.2 cm), and T4 (7.5 cm). This suggests that the concentration of *P. guajava* can influence the length increase of *C. gariepinus*. Table 2 revealed the liver function parameters of *Clarias gariepinus* fed with varying concentrations of *Psidium guajava* supplemented diets. The total protein levels varied among the treatments, with the highest observed in T2 (5g of *P. guajava* in 100ml H2O) at 5.10±0.10 mg/dl, and the lowest in T3 (10g of *P. guajava* in 100ml H2O) at 4.79±0.50 mg/dl. This trend suggests that lower supplementation of *P. guajava* may promote better protein synthesis or retention in *C. gariepinus*. The activities of aspartate aminotransferase (AST) and alanine aminotransferase (ALT) are critical indicators of liver function. In this study, the AST activity was significantly higher in T4 (5g of *P. guajava* in 100ml H2O) at 36.33±0.10 u/, while ALT peaked in the same treatment at 26.00±0.20 u/. Alkaline phosphatase (ALP) levels showed no significant differences across treatments, suggesting that *P. guajava* supplementation did not markedly affect bile duct function or liver health. Bilirubin levels ranged from 0.45±0.30 mg/dl in T2 to 0.54±0.30 mg/dl in T4, with T2 demonstrating the lowest levels. Albumin levels were highest in T3 (10g of *P. guajava* in 100ml H2O) at 0.54±0.20 g/dl, suggesting that this treatment may enhance the protein synthesis capacity of the fish. Conversely, globulin levels varied significantly, with T3 showing the lowest at 1.75±0.10 g/dl. Table 3 presents the renal function parameters of *Clarias gariepinus* (African catfish) fed diets supplemented with different concentrations of *Psidium guajava* (guava). The urea concentrations in the control group (T1) were significantly higher (11.10 ± 0.10 mg/dL) compared to the experimental groups, with T3 (10.09 ± 0.02 mg/dL) and T4 (10.09 ± 0.02 mg/dL) showing the lowest levels. Creatinine levels were lowest in T4 (0.73 ± 0.10 mg/dL) and showed a significant decrease compared to the control group. Sodium levels significantly increased from the control (98.30 ± 0.01 mEq/L) to T3 (106.13 ± 0.30 mEq/L), while potassium and chloride levels showed a mixed pattern of change. Bicarbonate concentrations showed relative stability across treatments, with T4 showing the highest level (18.90 ± 0.20 mEq/L).

Table 1: Some growth parameters of *C. gariepinus* fed with varying concentrations of *P. guajava* supplemented diet

Treatments	Initial Wt(g)	Final Wt(g)	Wt. gain(g)	Initial length(cm)	Final length(cm)	Length gain(cm)	FCR
T_1	$38.5±0.2^a$	$141.5±2^a$	$103±1.8^a$	$10.2±0.2^b$	$17.3±0.2^a$	$7.1±0.1^a$	$4.8±0.05^a$
T_2	$38.2±0.2^a$	$146.2±3^b$	$108±2.7^b$	$10.2±0.1^b$	$17.4±0.1^a$	$7.2±0.2^a$	$4.6±0.01^a$
T_3	$38.4±0.1^a$	$142.4±2^a$	$104±1.8^a$	$10.1±0.2^b$	$17.8±0.2^a$	$7.7±0.4^b$	$4.81±0.08^a$
T_4	$38.3±0.2^a$	$143.3±3^a$	$105±2.8^a$	$10.4±0.2^b$	$17.9±0.3^a$	$7.5±0.5^b$	$4.76±0.12^a$

Mean with the same superscript down the column are not significantly different at $p>0.05$

T_1 - control

T_2 - 5g of *Psidium guajava* in 100ml of water (H_2O)

T_3 - 10g of *Psidium guajava* in 100ml of H_2O

T_4 - 15g of *Psidium guajava* in 100ml of H_2O

Wt – Weight

Table 2: Liver function parameters of *C. gariepinus* fed with varying concentrations of *P. guajava* supplemented diet

Trts	Total protein (mg/dl)	AST (u/)	ALT (u/)	ALP(u/)	Bilirubin	Albumin (g/dl)	Globulin (g/dl)
T_1	$5.10±0.10^a$	$34.33±0.10^c$	$22.67±0.20^d$	$65.83±0.20^a$	$0.45±0.30^b$	$3.03±0.10^a$	$2.07±0.20^a$
T_2	$4.79±0.50^d$	$33.33±0.50^d$	$24.30±0.30^{bc}$	$63.13±0.10^c$	$0.49±0.10^{ab}$	$3.04±0.10^a$	$1.75±0.10^d$
T_3	$4.89±0.30^c$	$35.00±0.20^b$	$24.33±0.40^b$	$63.16±0.10^c$	$0.54±0.30^a$	$3.01±0.20^{ab}$	$1.88±0.03^c$
T_4	$4.98±0.40^b$	$36.33±0.10^a$	$26.00±0.20^a$	$64.70±0.10^b$	$0.54±0.20^a$	$2.94±0.10^c$	$2.01±0.02^b$

Mean with the same superscript down the column are not significantly different at $p>0.05$

Trts - Treatments
T_1 – control;
T_2 - 5g of *Psidium guajava* in 100ml of water (H_2O);
T_3 - 10g of *Psidium guajava* in 100ml of H_2O
T_4 - 15g of *Psidium guajava* in 100ml of H_2O

Table 3: Renal function parameters of *C. gariepinus* fed with varying concentrations of *P. guajava* supplemented diet

Trts	Urea (mg/dl)	Creatinine (mg/dl)	Na^+ (mEq/L)	K^+ (mEq/L)	Cl^- (mEq/L)	$HC03^-$ (mEq/L)
T1	11.10±0.10^a	0.81±0.40^a	98.30±0.01^d	4.42±0.01^c	78.90±0.02^c	18.70±0.10^b
T2	10.80±0.10^b	0.77±0.20^{ab}	102.00±0.20^c	4.47±0.02^{bc}	79.47±0.10^a	18.70±0.10^b
T3	10.09±0.02^c	0.77±0.10^{ab}	106.13±0.30^a	4.51±0.10^b	78.27±0.30^d	18.40±0.30^c
T4	10.09±0.02^c	0.73±0.10^b	105.33±0.20^b	4.64±0.10^a	79.17±0.20^b	18.90±0.20^a

Mean with the same superscript down the column are not significantly different at $p > 0.05$
Trts - Treatments
T_1 - control
T_2 - 5g of *Psidium guajava* in 100ml of water (H_2O)
T_3 - 10g of *Psidium guajava* in 100ml of H_2O
T_4 - 15g of *Psidium guajava* in 100ml of H_2O

DISCUSSION

The weight gain in this study showed an improvement in the *P. guajava* supplemented diet. This agrees with previous studies which indicated that the incorporation of plant-based supplements can improve growth performance in fish, as they provide essential nutrients that may stimulate growth (Olusola and Olaifa, 2018). According to Ishaku *et al*., (2023), fish fed diets with higher plant content often demonstrate enhanced growth metrics, likely due to improved digestibility and nutrient absorption. The means with the same superscript down the column indicate that there are no significant differences (p > 0.05) between the treatments for weight gain and initial length. This suggests that while there are variations in growth parameters, the differences may not be statistically significant at the specified level. This finding is consistent with the observations of Babalola *et al*. (2017), who noted that variations in plant-based diets can lead to similar growth outcomes, depending on the species and dietary formulations. Overall, while *C. gariepinus* showed enhanced growth in response to the supplementation of *P. guajava*, particularly at the 5 g dosage, the control group also performed well, indicating that the standard diet may be sufficient for maintaining growth. However, the enhanced performance observed in T2 suggests a potential for optimizing growth further through diet modification leading to a more robust fish compared to other *P.guajava* supplemented diets. The liver function result shows that lower concentrations of *P. guajava* enhances protein synthesis which is supported by the findings of other studies indicating that protein levels are influenced by dietary components (Bennett *et al*., 2016).

The elevated levels of AST and ALT in T4 suggest potential liver stress or damage, as higher enzyme levels are often indicative of hepatic injury (Javed *et al*., 2020). Elevated bilirubin can signal liver dysfunction; however, the variations in this study indicate that supplementation of *P. guajava* might not significantly disrupt bilirubin metabolism (Oni *et al*., 2021). The balance between albumin and globulin is critical for maintaining osmotic pressure and immune responses; thus, the results indicate a potential influence of *P. guajava* on protein profiles that merit further investigation (He *et al*., 2024). This suggests that guava supplementation may enhance nitrogen metabolism and reduce urea accumulation in the fish, potentially indicating improved renal function (Setufe *et al*., 2018). Creatinine levels were lowest in T4 and showed a significant decrease compared to the control group. The reduction in creatinine levels across guava-supplemented diets suggests a potential protective effect on kidney function, consistent with findings by Adebayo *et al*. (2015), who noted that dietary antioxidants could enhance renal function in fish. The increased sodium levels in T3 may indicate an improved ion balance, which can enhance osmoregulation in fish (Moraes *et al*., 2019). Conversely, potassium levels decreased in T3 and T4 compared to the control, suggesting that guava supplementation may influence electrolyte homeostasis, which is critical for cellular functions and metabolic processes (Al-Mamun *et al*., 2021). Bicarbonate concentrations were relatively stable across treatments, with T4 showing the highest level. This consistency indicates that guava supplementation does not adversely affect acid-base balance, which is vital for maintaining physiological pH and overall health in fish (Adineh *et al*., 2020).

CONCLUSION

The findings indicate that incorporating *Psidium guajava* (guava) into the fish diet has both positive and varied effects on growth and physiological functions. The results suggest that moderate *Psidium guajava* supplementation (around 5g per 100ml of water in feed) improves growth performance, FCR, protein synthesis, and organ function, particularly for liver and renal. Higher concentrations of guava (15g) may induce liver stress, as indicated by elevated ALT and AST levels, suggesting that the dosage of plant-based supplements like *Psidium guajava* should be carefully optimized to avoid potential negative effects.

The *Psidium guajava* supplementation shows potential as a cost-effective and beneficial dietary additive in aquaculture, particularly for enhancing the growth and health of *Clarias gariepinus* juveniles. However, proper dosage is essential to maximize benefits and avoid adverse effects on organ function.

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AUTHORS CONTRIBUTIONS

IJC and OCE designed this work. JO and GUE experimented and collected data. OCE monitored data collection while IJC and ODA analyzed, and wrote the draft copy

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