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Phytochemical and Proximate Analysis of Sweet Potato (*Ipomea batatas)* Leaves Aqueous Extract and Its Prophylatic Effects on *Pseudomonas aeruginosa* Infected Catfish (*Clarias gariepinus)*

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Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

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ABSTRACT

The phytochemical and proximate analysis of sweet potato (*Ipomea batatas)* leaves were carried out to ascertain its bio-active compounds and proximate composition, and their importance in aquaculture. Subsequently, four different feeds were produced from a thirty-five (35) percent crude protein feed using *I. batatas* aqueous leaves extracts as follows: Do (Oml/kg); D1 (50ml/kg); D2 (100ml/kg) and D3 (150ml/kg). One hundred and fifty (150) sub-adult *Clarias gariepinus* were distributed to five groups in triplicate and designated as: D^{+ve} (positive control); D^{-ve} (negative

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control); D1; D2 and D3. While D^{+ve} and D^{-ve} were fed Do, D1 – D3 were fed 50ml/kg – 150ml/kg respectively. After eight weeks of feeding ten (10) fish from D^{-ve}, D1 – D3 were infected intraperitoneal, with 1.5ml of 15 x 10^{10}cfu/ml over night grown *Pseudomonas aeruginosa* and the fish in D^{+ve} was not infected. After one week post infection period, the prophylactic effects of the *I. batatas* leaves extract were evaluated on the experimental fish following assessments on survival rate, disease resistance, condition factor and physicochemical parameters of the experimental waters. The results indicates as follows: proximate composition of *I. batatas* leaves contains fat, crude protein, crude fibre, ash and carbohydrate at different percentages, but they were higher in content in the dried leaves, but reverse was the case for moisture content. Phytochemical content of *I. batatas* leaves contains high percentage of alkaloids, phenols, flavonoids and Saponins with noticeable quantities of tannins, anthraquinones and coumarins; the survival rate and disease resistance indicates that D^{-ve} recorded 46.66$\pm$11.54% and 0$\pm$0.00% respectively, while D^{+ve} and D1 – D3 had 100+0.00% in both parameters; there were no significant difference in the dissolve oxygen, temperature and pH D^{+ve}, D^{-ve} and D1 – D3 but the value in D^{-v} were lower compared to the rest. The values for conductivity and total dissolve solids (TDS) were significantly higher in D1-D3 compared to D^{+ve} and D^{-ve}, but the value of TDS was significantly lower in D^{+ve}.

Keywords: Potato leaves; catfish; aquaculture; fish diseases, phytochemicals and proximate analysis.

1. INTRODUCTION

There is global demand for fish and fish products as a result of increase in human population. The effect of this high demand is the dwindling in the natural catch and increase in aquaculture products, making aquaculture one of the fastest growing sectors in agriculture and a major business in most countries in the world [1,2]. Aquaculture have been developed to provide highly nutritious protein especially from fish which is expected to make up about seventy percent (70%) of the required protein by the year 2030 [3,4].

Clarias gariepinus is a species of catfish with commendable potential in aquaculture as a result of its fast growth rate, high survival rate, disease resistance, good nutritional profile and good flesh quality. Some of the bottle necks in the aquaculture industry includes non-availability of quality fry, lack of feed and feed materials and poor quality of the aquatic environment [5,6,7]. The above bottle necks exposes catfish to bacterial infections such as *Aeromonas hiphoplila* and *Pseudomonas aeruginosa* which has resulted to several diseases leading to high mortality and sever economic loses [8,9,10].

Pseudomonas aeruginosa is specific pathogen that attack fish and exposes it to stress, causing disease such loss of appitite, ulcerations, poor flesh quality among others [10,11] leading to death of fish.

Chemotherapy have often been used as a therapeutic or prophylactic agent against fish bacteria such a *Pseudomonas aeruginosa* but it is associated with disadvantages such as chemical residue on the fish flesh, high cost, development of bacterial strains that are resistant to the chemical and pollution of the environment [12,13]. The use of chemotherapy in aquaculture is seriously kicked against and is rapidly replaced by used of plants and plant products. Plants and plant products are not immunospecific, are cost effective, does not deposit on fish flesh, does not develop resistance strain and are eco-friendly [13,14,15]. Several studies have shown that plants and plant products are encouraging therapeutics and prophylatics in aquaculture especially in fish farming. Plants are used as immunostimulants and antiestress [10,16], antioxidant and antimicrobial agents [17,18,19]. Plants and plant products have been reported as antioxidants, immunostimulators, antimicrobrals, appitide enhancers, among others [10,20,21]. So many plants parts have been used to enhance productivity in aquaculture. *Persea Americana* powdered leave enhanced appitide in *Clarias gariepinus* [22], *Solamum trilobatum* and *Psoreleacorylifolia* demonstrate survival, growth and antibacterial activities on *Penaeus monodon* post larvae [21]; *Zea mays* husk extracts demonstrated therapeutic tendencies against *Pseudomonas aeruginosa* in *Clarias gariepinus* [23]; *syzgium malaccence* leaves extract demonstrated prophylactic affects against *P. aeruginosa* in *Clarias gariepinus* [24] and [25] reported the immostimulatory effects of *Zingiba officinale* and *Currcuma longa* on *Cirrhinus mrigala* exposed to *Pseudomonas aeruginosa.*

Sweet potato (*Ipomoa batatas)* leaves have been reported for its medicinal properties as a result of

its nutritional and phytochemical content [26,27]. This research work was aimed at evaluating the effect of various forms of *Ipomoa batatas* leaves extracts in the culture of *Clarias gariepinus* and its effects in the physico-chemical parameters of the experimental waters.

2. MATERIALS AND METHODS

2.1 Study Location

The project work was carried out in the laboratory of the Fisheries and Aquatic Environment Department, Faculty of Agriculture, Rivers State University, Nkpolu-Orowukwo, Port Harcourt.

2.2 Experimental Fish and Acclimation

One hundred and fifty (150) healthy *C. gariepinus* of mean weight 150-200kg were purchased from Idi-Onyana farms along Abua-Ahoada Road in Abua/Odual Local Government Area, Rivers State. The fish was taken to the project site, acclimatization and observation were carried out on the fish for a period of two (2) weeks to access disease present or bruises. During this period the fish were fed to satisfaction with commercial feed.

2.3 Preparation of Experimental Herb

Ipoemoea batatas leaves were harvested within Port Harcourt, Rivers State, Nigeria. The leaves were prepared using the method of Ukwe and Jamabo [28] *Ipoemoea batatas* leaves were harvested, washed clean, pounded to paste, soak in tap water (100^{o}C) at the concentration of five hundred grams/liter (500g/L) for 12 hours. It was filtered and the filtrate was used immediately.

2.4 Experimental Diet

35% CP (crude protein) diet was formulated using the following ingredient: wheat-bran, corn, soya beans, fish meal, lysine, methionine, palm oil, starch and vitamin C. Four (4) different diets were produced from the formulated diet using the *Ipoemoea batatas* aqueous extracts at 0ml/kg, 50ml/kg, 100m/kg and 150ml/kg and labeled as Do, D1, D2 and D3, respectively.

2.5 Quantitative Screening of Sweet Potato, *Ipoemoea batatas* Leaves

The quantitative screening of the sweet potato leaves (*I. batatas*) was conducted in the Department of Chemistry, Faculty of Science, Rivers State University in accordance with International Organization for Standardization (ISO) 179245 using UV 250 visible.

2.6 Proximate Composition of Sweet Potato (*Ipoemoea batatas*) Leaves

The proximate composition of wet and dry sweet potato leaves (*I. batatas*) was carried out in the Department of Food Science, Faculty of Agriculture, Rivers State University using the method described by the Association of Official Analytical Chemist [29,30].

2.7 Experimental Design

A complete randomized method (CRD) was used. There were five treatments in triplicates and a total of fifteen experimental tanks were used.

2.8 Experimental Procedure

150 sub-adult *C. gariepinus* were distributed into five groups in triplicates using 25 liters plastic tanks and acclimatized for 2 (two) weeks. Two groups were fed Do and labelled D^{-ve} (negative control) and Do $^{+ve}$ (positive control), while the remaining three (3) groups were fed diets D1-D3 and labelled D1, D2 and D3 respectively. After eight (8) weeks feeding period, the fish labelled D^{-ve}, D1, D2, and D3 were infected intraperitoneally with 1.5ml of 1.5 x 10^{10} *cfu*/ml overnight grown *Pseudomonas aeruginosa,* while the fish labelled D^{+ve} was not infected. The weight and length of the fish from D^{+ve}, D^{-ve} , D1, D2and D3 were taken before and after the seven days infection period to determine the condition factor of the experimental fish.

2.9 Physico-Chemical Parameters

Temperature: This was determine using mercury-in-glass thermometer calibrated in degree centigrade (0-100^{o}C). The thermometer was immersed in the water column of the fish tank for two minutes, and reading taken immediately. The process was repeated three times and the average reading was taken as the temperature.

pH (Hydrogen ion concentration): This was determine using pH meter, model 780 made in Japan. It was dipped into the water of the fish tanks, stirred gently and reading was taken off the meter. The process was repeated thrice and the average was taken as the pH of the water.

Dissolve oxygen (D.O): This was determine using a 9-series multi-parameter water quality meter (BANTE 980 PRECISION D.O METER) version: 20090-70200 manufactured by BANTE INSTRUMENTS CO. LTD, China. The membrane of the probe was removed, and the probe was washed under running water. The membrane cup was filled with the experimental water and screwed into the probe as the excess water was drained out, with cathode of the probe contacting the membrane cap. The D.O. was read on the screen of the D.O. meter.

Conductivity and total dissolve solids (TDS): This was determined using a La motte Agriculture kit model AQ-4, CODE 3635-04, Manufactured by la motte company Chestown, USA.

Length: The total length of the fish was determine before and after seven days post infection period using a millimeter calibrated ruler.

Weight: The weight of the fish was determined before and after the seven days post infection period using Super Camry Peterson weighing balance with product certificate No. r-1509/02328, manufacture by Want Balance Instrument Co. Ltd in China.

Condition factor (K): The condition factor was determine using the formula:

$$K = \frac{W}{L^3} \times 100\% \text{ [31]}$$

Where: K= Condition factor; L= Length (cm); W=Weight (g)

2.10 Disease Resistance (DR)

The ability of the experimental diets to resist the *P. aeruginosa* attack was determined using the formula:

$$DR = I\frac{\%\ Survival\ in the\ treated\ group}{\%\ Survival\ in the\ control\ group} \times 100 \text{ [32]}$$

2.11 Survival Rate %

The survival rate was determined using the formula:

$$\%\ SUR = \frac{No\ of\ fish\ survived}{No\ of\ Infected\ fish} \times 100 \text{ [32]}$$

2.12 Data Analysis

The obtained data were subjected to the statistical package for social sciences (SPSS) for inferential and differential statistics and probability level of $P<0.05$.

3. RESULTS

3.1 Physiochemical Parameters of Water in the Tanks During the Experimental Period

The physiochemical parameters of water in the tank during the experimental period are presented in Table 1. The results revealed that there were no significant differences in the values of Dissolved Oxygen (DO), Temperature and pH across all treatment groups D^{+ve}, D^{-ve} and D1 – D3. The values of conductivity were within the same range for D1 – D3 (445.00 $\pm$ 33.41 – 470.66 $\pm$ 15.37), but significantly lower in D^{+ve} (278.67 $\pm$ 78.36) and D^{-ve} (260.67 $\pm$ 25.66). There were fluctuations in the values of Total Dissolved Solids (TDS). TDS value for D1-D3 were significantly the same ($P>0.05$) but significantly lower in D^{-ve} (120.00 $\pm$ 14.79). However, the lowest value of TSD was recorded in the D^{+ve} (90.67 $\pm$ 2.08).

3.2 Quantitative Screening for Phytochemical Components of Sweet Potato Leaves

Table 2 shows the quantitative screening for phytochemical components of sweet potato laves. The results indicated the following components and values: Flavonoid (23.00 $\pm$ 0.01), Coumarone (0.57 $\pm$ 0.00) Saponins (25.0 $\pm$ 0.02), Tannins (11.70 $\pm$ 0.01), Anthraquinones (9.00 $\pm$ 0.01), Alkaloids (73.00 $\pm$ 0.00), Terpeniods (o), Glycosides (o), Phenol (50.00 $\pm$ 0.00).

3.3 Survival Rate (%) Diseases Resistance and Condition Factor of the Experimental Fish after Seven Days Post Infection Period

The survival rate (%), Diseases Resistance (DR) and condition Factor (before infection CF – BI and after infection CF – AI) of the experimental fish after seven days post infection are presented in Table 3. The results indicated that the values of % were exactly the same range for D^{+ve} and D1 = D3 (100.00 $\pm$ 0.00), but significantly lower

in the D^{-ve} (46.66 ± 11.54). The values of DR were also exactly the same for D^{+ve} and D1 – D3 (100.00 ± 0.00) but significantly lower in D^{-ve} (0 ± 0.00). The values of CF – BI were significantly the same across all treatment groups while values /CF-AI were within the same range for the D^{+ve} and D1 – D3 (1.03 ± 0.5 - 1.09 ± 0.15)) but significantly lower in D^{-ve} (0.75 ± 0.07).

Table 1. Physicochemical parameters of water in the tanks during the experimental period (Mean ±SD)

Treatments	Parameters				
	DO (mg/L)	Temperature(^{0}C)	pH	Conductivity (µ/cm)	TDS (ppm)
$D+_{Ve}$	4.67±0.15^a	26.00±1.00^a	7.20±0.43^a	278.67±78.36^a	90.67±2.08^a
D-ve	3.87±0.25^a	27.66±0.40^a	6.07±0.21^a	260.67±25.66^a	120.00±14.79^b
D_1	4.06±0.04^a	28.47±1.16^a	6.04±0.27^a	445.00±33.41^b	222.67±23.63^c
D_2	4.17±0.15^a	28.36±0.51^a	6.03±0.07^a	470.66±15.37^b	244.33±7.63^c
D_3	3.83±0.25^a	28.40±1.10^a	6.04±0.08^a	469.00±15.62^b	245.33±8.62^c

Means within the same column with different superscripts are significantly different (P<0.05)
Key: Do-Dissolved Oxygen; TDS-Total Dissolved Solids; D^{+v}; Positive control, D^{-ve}: Negative Control

Table 2. Quantitative screening for phytochemical components sweet potato leaves

S/N	Components	Quantity
1	Flavonoid	23.00±0.01
2	Coumarins	0.57±0.00
3	Saponins	25.0±0.02
4	Tannins	11.70±0.01
5	Anthraquinones	9.00±0.01
6	Alkaloids	73.00±0.00
7	Terpeniods	-
8	Glycosides	-
9	Phenol	50.00±0.00
10	Terpenes	-

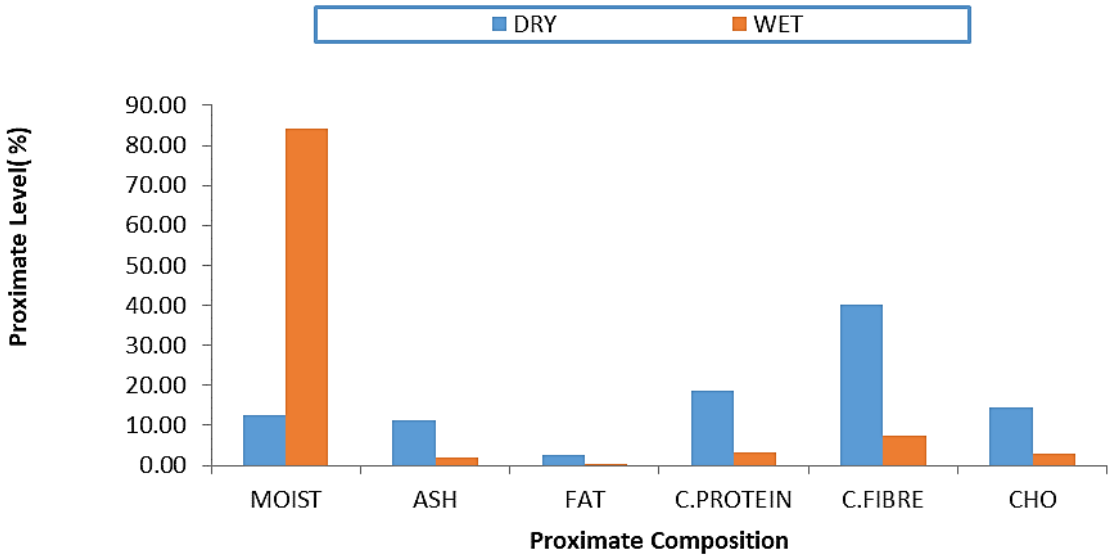

Fig. 1. Comparative values of proximate composition of dry and wet *Ipomea batatas* leaves

Table 3. Survival rate (%), diseases resistance and condition factor of the experimental fish after seven days post infection period

Treatments	Parameters			
	% SUR	DR	CF-BI	CF – AI
D^{+ve} Control	100.00±0.00[b]	100.00±0.00[b]	1.05±0.009[a]	1.03±0.05 [b]
D^{-ve} Control	46.66±11.54 [a]	0±0.00[a]	1.04±0.03[a]	0.75±0.07 [a]
D_1	100±0.00[b]	100±0.00[b]	1.16±0.03[a]	1.04±0.05 [b]
D_2	100±0.00[b]	100±0.00[b]	1.23±0.05[a]	1.07±0.11 [b]
D_3	100±0.00[b]	100±0.00[b]	1.29±0.19[a]	1.09±0.15 [b]

Key: SUR: DR: Diseases Resistance; CF-B1: Condition factor before infection; CF-AI: Condition factor after infection, D^{+ve}: Positive control D^{-ve}: Negative control.

3.4 Proximate Composition of Dry and Wet *Ipomoea batatas* Leave

The value of the proximate composition of dry and wet *Ipomoea batatas* leaves are presented in Fig. 1. The results obtained indicated that moisture (%) and was higher in the wet leaves when compared to the dried leaves. Whereas, the value of Fat (%), crude protein (%), crude fibre (%), Ask (%) and carbohydrate were (%) higher in the dry leaves compared to the wet leaves.

4. DISCUSSION

4.1 Physic-Chemical Parameter

The physcio-chemical properties of any aquatic environment greatly affects the productivity of the organisms there-in and to a great extent determines the health, survival and reproduction of the organisms such as fish [33,34]. In this research work, the physico-chemical parameters such as temperature, dissolve oxygen and pH were within the acceptable range for aquaculture practice [35.36], despite the differences in the experimental diets This may be due to the regular change of water in the experimental tanks. The conductivity is a measure of how turbid the experimental water is, with respect to the presence of total dissolved solid including salts/mineral content [37], and conductivity and total dissolved solids (TDS) increase in water as a result of the presence of minerals such as calcium, magnesium, sodium, and potassium, as well as inorganic matters in water [38]. The conductivity and TDS were high in all the treatments, but were significantly higher in treatments D1, D2 and D3 (Table 2), and the values were almost twice that of the conductivity in all the treatments.

The relationship between TDS and conductivity in this work agrees with the position of Stone and [39] also observed the values of conductivity almost twice that of TDs when *Oreochronus niloticus* was exposed to chemically dispersed Bonny light crude oil. The increase in conductivity and TDS in the experimental waters could be as a result of the above mentioned minerals in the leaves of *Ipomea batatas* [40,41]. Though the fish in treatments D^{+ve} and D^{-ve} were fed the control diets, the conductivity and TDS were higher in treatment D-ve, this could be as result of feed deposits due to the lost of appetite in the first three days of exposure to *P. aeruginosa.* Similar lost of appetite was observed in Ukwe et al. [23] when *C. gariepinus* was exposed to *P. aeruginosa* and treated with corn husk extracts. Interactions of these minerals with harmful microbes in the experimental water may lead to sever lost of appetite and diseases if not properly checked [42]. This position is supported by Ukwe et al. [5], who stated that particles from uneaten feed enhance proliferation of microbes in experimental tanks.

4.2 Survival Rate, Diseases Resistant and Condition Factor

The culture of *Clarias gariepinus* have been threatened by the presence of microbial infections including *P. aeruginosa* [8] and this has led to economic losses and endangering the lives of consumers. Protecting our farms from microbial invasions comes with challenges such as antibiotic resistance, pollution of the environment and deposition of the drugs in the fish flesh as a result of the use of synthetic drugs. For this reason, series of work has been done assessing the efficacy of plants and plants products in the treatment or protection of farms from microbial invasion such as *P. aeruginosa* attack [43,24,28].

There were 100% survival in the fish fed D1 – D3 and D^{+ve}, while the fish fed D^{-ve} had 53.33% survival. The fish fed D1-D3, and D^{+ve} had 100%

diseases resistance (DR) while the fish fed D^{-ve} had 0.0% [44] also reported 0% disease resistance (DR) in the control fish (fish fed non-herb inclusion diet) when *C. gariepinus* were fed dietary medicinal plant and exposed to *P. aeruginosa.* The ability of the diets D1 – D3 to resist the *P. aeruginosa* could be as a result of the bioactive compounds such as phenol, alkaloids, flavonoids etc that are seen in high quantities in the quantitative screening of *Ipomoea batatas* leaves extract in this research work, and these bioactive compounds enhanced the immune system of the *C. gariepinus* and increase resistance against *P. aeruginosa.* This work is in agreement with the work of Rahman et al. [45] when stinging catfish were fed dietary natural spirulina and exposed *Aeromonas hydroplula,* the author and further stated that natural spirulina strengthened the defence mechanism of the fish and made it more resistant to the tested pathogen. Other authors who had similar results includes: [25] when *cirrhinus mrigala* were fed dietary *Zingiber officinale* and *Curcum longa* and were exposed to *P.aeruginosa;* [46] when rainbow trout were fed dietary garlic and exposed to *A. hydrophila;* [47] when *C. gariepinus* injected with *S. aureus* was exposed to *Chromolenea odorata* leaves extracts*;* [10] when *C. gariepinus* infected with *P. aeruginosa* were exposed to *Carica papaya, roots* extract.

The condition factor of fish expresses the wellness of the fish with respect to the nutritive quality of the environment [48] and it is influence by factors such as sex, age fish type food availability, season and life stage [49,50]. However, Ukwe et al (2023a) stated that the condition factor of a fish in a confined environment such as experimental tanks is determined by whatever is administered to the fish, when all other conditions remains the same across the experimental tanks. The condition factor of the fish in this study (after seven days post infection period) was slightly above one (1) in the pre and post infection values of the fish in D1 – D3 and D^{+ve} (positive control) while the condition factor for fish in D^{-ve} (negative control) was less than one (0.75 ± 0.07) in its post infection value. Ujjania et al. [49] stated that condition factors $\geq$ 1 (greater or equal to one) shows good feeding habit in fish and conducive environment. The significantly lower condition factor of the fish in D^{-ve} is due to lost of weight as a result of loss of appetite experience by the fish due to the infection of *P. aeruginosa.* Similar result was recorded by Ukwe et al. [23], when *C. gariepinus* was infected with *P. aeruginosa* and treated with corn husk extract. The condition factor of the fish in D^{+}ve and the fish fed D1 – D3 had unaltered condition factor after the post infection period because the fish maintained increase in weight, since the lost of appetite was in less than twenty four (24) hours after infection, compared to five (5) days lost of appitide in the negative control fish (D^{-}ve). The fish in D1 – D3 were able to sustain their condition factor because the bioactive compounds in *Ipomoea batatas* were bactereostic or bactereocidal to *P. aeruginosa*. Similar result was obtained by Kumar et al. [51]. in the length – weight relationship of *lebeo rohuta* and *lebeo gonius.*

4.3 Proximate Composition and Phytochemical Analysis of Sweet Potatoe Leaves

The proximate composition of the wet and dry sweet potatoes leaves reveals the presence of the following components in percentage (%), depending on its wet or dry weight: Moisture (12.5 – 84.1); Ash (1.93 – 11.8); Fat (0.47 – 2.79); Crude protein (3.38 – 18.81); Crude fibre (7.16 – 40.87) and carbohydrate (2.63 – 15.59). But in all the components except the moisture content, the highest values were recorded in the dry weight while the wet weight had the least valves (Fig. 1). The phytochemical analysis reveals the presence of the following phytochemicals in noticeable quantities (Table 1): alkaloids, phenols, flavonoids, saponinus, tannins, anthroquinones and coumarins. The above results as shown in (Fig. 1) is informative to the fact that higher concentration of wet leave extracts will be needed to have more of these components.

Other authors have reported similar observations in the proximate and phytochemical analysis of sweet potatoe leaves, with little variations as a result of mode of extract, solvent used, age of leaves, place of harvest among others [27,52,53,54]. The above properties of sweet potatoe leaves can be linked to the various benefits derived from plants or plants parts in aquaculture, when they are used by the organisms as a single or combined bioactive compounds. Some of the benefits of the bioactive compounds revealed in this study includes: growth promoting and fish flesh quality; immunostimulants, anti-stress agents; anti-microbial among others.

Growth and flesh quality in fish depends mostly on the protein content of the consumed diet and

the quantity utilized by the fish. Torti [54] reported reduction in the protein content of fish diets, but the fish flesh recorded improved protein content when Tilapia Zill fingerlings were fed dietary sweet potato leave meal. However [55] reported no significant difference in the protein content of diets, but significant increase in weight gain when *Oreochronis niloticus* were fed hot water extracts of sweet potatoe leave meal. Interactions between the feed ingredients in formulated diets remains a factor, but the digestibility of these ingredients determines the usage of the diet by the fish. This assertion is supported by Sorensen [56]. The nutritional value of a diet and its effect on absorption is a reflection of its digestibility [57] and sweet potato leave meal have been reported to have high digestibility for protein [58], as a result of the bioactive compounds contained in sweet potato leaves [59]. Other authors that have reported improved growth as a result of these bioactive compounds includes: [60] – tannins; [61] – Saponins; and [62] – Alkaloids.

The immune system consists of substances found in the extra cellular fluids of an organism which fights against harmful substances or pathogens invading the body [63]. Immnostimulants are susbstances that enhance the immunostimulation of an organism before the invasion of pathogen or other extraneous substances. Phytochemicals such as the ones seen in this work have been revealed to be good immunostimulants and considered safe for fish, fish consumers and the environment [13,17]. Baleta et al. [55] reported improve immunostimulant when *Oreochronis niloticus* was fed dietary sweet potato shoots in Hepa nets, and attributed it to the presence of the phytochemicals in the sweet potato leaves. Safari et al. [60] reported the immunostimulatory effects of tannins when beluga sturgeon (*Huso huso*) was fed dietary polyphenols, while [62] reported the immunostimulatory potentials of alkaloids when *Megalobrama amblycephala* was fed Gelsemium elegans alkaloids.

Some aquacultural activities such as transportation of fish, water quality, handling, contaminations etc exposes fish to stress [33,64,65]. Amachree and Ukwe [64] describe stress as a situation were the reactive oxygen species and other free radicals exceeds the anti-oxidant content of the body. Stress in fish instigates series of physiological response such as weak immunity, loss of appetite, behavioural changes, protein synthesis among others [54,64]. Phytochemicals have exhibited good anti stress activities in fish by supporting the antioxidant system of the fish or by directly adding to the anti-oxidant content of the fish. Amachree and Ukwe [64] reported the enhancement of the antioxidant levels in *Clarias gariepinus* after feeding with dietary *Persea americana* powdered leaves and *Persea americana* powdered leaves have been reported to contain phytochemicals such as phenols, tannins, saponins, flavonoids [17], and these phytochemicals are seen in this report. Safari et al. [60] attributed the improve superoxide dismutase (SOD) and Catalase (CAT) in *Huso huso* to the presence of tannins in the administered diet.

The antimicrobial activities of sweet potato leaves extracts have been reported against some bacteria. Adsul et al. [65] reported the antimicrobial activities of sweet potato leaves against *Salmonella typhimurium* and *Pseudomonas aeruginosa; and* [53] also reported the antimicrobial activity of extracts of sweet potato leave. Both authors attributed the antimicrobial activities of sweet potato leaves to the presence of phytochemicals such as flavonoids, saponins, anthraquinone, phenols, alkaloids and tannins. *Persea amaericana* that was earlier reported to contain these phytochemicals was antimicrobial against *Klebsiella preumone* [17].

5. CONCLUSION

The proximate analysis shows that the dry *Ipomoea batatas* leaves have higher percentage composition in protein, fat, carbohydrate, fibre and ash compared to the wet leaves, and can be used in smaller quantities to achieve desired results. Also the phytochemical analysis reveals the presence of aquacultural valuable bioactive compounds that enhanced the immune system of *Clarias gariepinus* against *P. aeruginosa* with no harmful effect on the physico-chemical parameters of the culture water. *Ipomoea batatas* aqueous leaves extracts can therefore be used as a prophylactic in aquaculture especially in the culture of *Clarias gariepinus, but regular monitoring of the water is necessary to maintain good water quality.*

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of manuscripts.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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