Effects of *Teifairiaoccidentalis* and *Vernonia amygdalina* inclusion levels on growth performance of *Clariasgariepinus* fingerlings

ABSTRACT

Thisstudyexaminedthegrowthenhancingpotentialof*Telfairaoccidentalis*and*Vernoniaamygdalina*leafpowderin*Clariasgariepinus*culture. The experiment was conducted at TiddofishfarmMakurdi. Onethousandjuvenilecatfishwere obtained from the farms hatcheryand allocatedtofivetreatmentgroupsidentifiedasControl (0% supplement inclusion),T1(10%flutedpumpkinleafpowder inclusion),T2(20%flutedpumpkinleaf powderinclusion),T3(10%bitterleafpowderinclusion)andT4(20%bitterleafpowderinclusion). Thefishwerefedthricedailyfor8 weeksandwaterchangeddaily.Resultsobtainedshowedthatafterthetreatmentperiod,MeanWeightgainandSpecificGrowthRatewasnotsignificantlydifferent(p>0.05).However,FeedConversionRatioandPercentageSurvivalratewassignificantlydifferent(p<0.05).Waterqualityparameterssuchas pH,DissolveOxygenandTemperaturewaswithintherecommendedrangeandnotsignificantlyaffected. Bothplantspeciesfeed inclusions were utilized by fish, which was observed to facilitate thegrowthandsurvivalofthefishspecies, with high percentage survival.

Keywords:*Substances, Treatment,Feed Inclusion, Feed utilization, Growth*

INTRODUCTION

Vernoniaamygdalina(family*asteraceae*)isavaluablemedicinalplantthatiswidespread inEast and West Africa (Atawodi, 2008). It is known as bitter leaf andmay be used as an active anti-cancer, anti-bacteria, anti-malarial, and anti-parasitic agent(Braide,2012).Thisplantcontainscomplexactivecomponentsthatarepharmacologically useful and are used in the treatment of fever,hiccups,kidneyproblems,andstomachdiscomfort.Traditionalmedicalpractitioners, herbalists, and local healers in West Africa recommend aqueous *V.amygdalina*for their patients. The beneficial use of *V. amygdalina*in animal nutritioninNigeriahasbeenwelldocumented. However, the unrefinednature of the herbal preparations, coupled with the apparent lack of specificity orprecision in the application of the plant in traditional medicine could lead to overdosage of the herbal medicine, which can result in accumulation of essential andnon-essential plant ingredients in the human system. The accumulation can reach atoxiclevel,especiallyinthesystemsofpeoplewhorelyheavilyonunrefinedproducts,withsevereconsequencesontheir biochemical and geneticsystem.

Fluted Pumpkin (*Telfairiaoccidentalis*) is a tropical vine grown in West Africa as aleaf vegetable and for its edible seeds. *T. occidentalis*is a member of the family Cucurbitaceae and isindigenous to southern Nigerian (Fagbemi, 2007). The fluted gourd grows in manynations of West Africa, but is mainly cultivated in Southern eastern Nigeria and it isusedprimarilyinsoupsandherbalmedicines(Alada,2000).*Telfairiaoccidentalis*Isan important staple vegetable grown in Nigeria. Theplant produces luxuriant ediblegreen leaves, which are rich in iron and vitamins. Stems of the plants have branching,long twisting tendrils and the leaves are divided into three to five leaflets with theterminal leaflets up to 15 cm long, while the male plant is grown principally for leavesandseeds,whichareimportantsoupcondition.Recentstudieshaveshownthat*Telfairiaoccidentalis*leafisrichinminerals(suchasiron,potassium,sodium,phosphorus,calciumandmagnesium), antioxidants,vitamins(suchasthiamine,riboflavin, nicotinamide and ascorbic acid, phyto-

chemicals such as phenols.Theleafextractis usefulinthemanagementofcholesterolemia, liver problems and impaired defense immune systems (Eseyi*et al*., 2005).Theaminoacidprofileof*T.occidentalis*hadalsobeenshowntobeveryrichandincludesalanine,aspartate,glycine,glutamine,histidine,lysine,methionine,tryptophan,cystine,leucine,arginine, serine,threonine,phenylalanine,valine,tyrosine and isoleucine (Fasuyu, 2006). Emeka and Obidoa (2009) revealed that thelongtermfeedingof*T.occidentalis*supplemented dietcausedasignificant increaseinweight of animals which may be due to its content of rich nutrients.The high proteincontent in leaves of plants such as *Telfairiaoccidentalis*could have supplementaryeffect for the daily protein requirement of the body. The symptoms of protein energymalnutritionsuchasKwashiorkorandMarasmuswererarelyobservedamongdwellers in region where adequate amount of protein is obtained from fruits/seeds andleavesofplantsrichinproteinssuchas*T.occidentalis*(Dike,2010).Manyresearchers especially in the field of medical sciences have observedfree radicalscavenging ability andantioxidant property in*Telfairiaoccidentalis*.The darkishgreen leafy vegetable leaves of *Telfairiaoccidentalis*and extracts (such as aqueousand ethanol extracts) from the leaves have been found to suppress or prevent theproduction of free radical and scavenge already produced free radial, lower lipidpreoxidation status and elevates antioxidant enzymes both in vitro and *in vivo* (Oboh,2007). *Clariasgariepinu*s fish is a perishable commodity which spoils immediatelyafter capture. It is generally accepted that some tropical fish species can keep forlonger periods in comparison to fish from temperate or colder water (Jimoh,*et al*., 2013).This can be attributed to differences in the bacteria growth rates in tropical fish storedinice.

StatementofResearch

*Clariasgariepinus*isanimportantaquaculturefishinAfrica,but its culture is being hampered and becoming unattractive due to the highcostoffeed, high cost of production andscarcity,thisisbecausemostfishfeedmanufacturedinthecountryrelyon imported feed ingredients. Plant based supplement included in fish feed may proveeffective in supporting the growth and development of fish, thereby cutting the cost offishfarming.

Study Justification

Aquaculture productionseemstobe respondingtothe increasedfishdemand andhaveexclusively increased the world fish production by 20 million tons. Irrespectiveof the achievement of aquaculture, the high cost and scarcity of desirable feeds foraquaculture enterprises in Africa has become a serious constraint in the successfuloperation of intensive aquaculture enterprise. Fish meal and soybean meal which arethe major sources of protein are used as food, by human, it is in high demand byindustries for the production of human, animal and fish feeds and this makes theproductsandfeedsexpensive.Theneedtoreducethiscostisimperativeintheaquaculture business. An inexpensive source of fish feeds will make fish farmingattractivedueto its profitability.The studydetermines the response of *Clariasgariepinius*(Catfish) to various feed inclusionratio of *Vemoniaamygdalina*(Bitter leaf) and *Telfairiaoccidentalis*(Pumpkin leaf)supplement.

Objectivesof Study

1. Todeterminetheutilizationandgrowthrateof*C.gariepinus*tovaryingpercentagesof*Vernon*

*iaamygdalina*dietaryinclusion

2. Todeterminetheutilizationandgrowthrate*C.gariepinus*tovaryingpercentagesof*Telfairia occidentalis*dietaryinclusion
3. To determine the Feed Conversion Ratio and Survival Rate of *Clariasgariepinus*fed with varying percentages of dietary inclusions of *V. amygdalina*and *T.occidentalis.*

NullHypothesis

Powderedinclusionof*Vernoniaamygdalina*leafhasnoeffect on *Clariasgariepinus*juveniles.
Powderedformof*Telfairiaoccidentalis*leafhasnoeffecton*Clariasgariepinus*juveniles*C.gariepinus*didnotfeedorsurviveonthevaryingdietaryinclusionsof*V.amygdalina*and *T. occidentalis*

MATERIALS AND METHODS

StudyArea

This experiment was conducted at TiddofishfarmMakurdi, Benue State,situated inthe Guinea Savannahagro-ecologicalzoneand in theNorth Central geo-politicalzoneof Nigeria.

CollectionoftheExperimentalFish

The juveniles of *C. gariepinus*was bought from the university farm and transferred to five 1000
litresplasticbowlsatthefishfarmandwereallowedtostabilizefor48hoursbeforecommencement of experiment. The fish were randomly distributed in the 5 treatments atstocking density of 200 fish per tank. The fish were fed thrice daily, in the morning,afternoon and Evening (8:00am, 2:00pm and 6:00pm respectively), and they wereweighed once a week for 8 weeks, at daily feeding rate of 3% of thetotalbodyweight, adjusted inlike manner as documented by Agarwal (2003).

Source and preparation of *Telfairiaoccidentalis and Vernoniaamygdalinapowder*

*Telfairiaoccidentalis*and *Vemoniaamygdalina*leaves were purchased from Wadatamarket. The leaves were washed with clean water to remove the dust and dirt. Theywere subsequently air dried under room temperature and devoid of sunlight for twoweeks. Upon drying and when the leaves became bristle to touch, they were blendedintopowderedformandsievedusinga1mmmeshsizesieveas documented by Ayinla,(2007).

FeedFormulationandPelletPreparation

Alldietary ingredientsweregroundandmixedwithvitamin-mineralpremixandwater was added gradually until a desirable paste-like consistency was obtained afterwhich the mixture was pelletized through 2mm disc and sun-dried. The pelletizedfeeds were then stored in air tight polythene bags, until required. Diet samples weresubjected to proximate analysis feed formulation (Olurin, 2006). Diet (1) was thecontrolwithnoinclusionof*Telfariaoccidentalis*(fluted pumpkin leaf) or *Vernoniaamygdalina*(bitterleaf)used during formulation, Diet (2) contained 10% inclusion of *Telferiaoccidentalis*(fluted pumpkin leaf) referred to as T1, Diet (3) contained 20% inclusion of *Telfariaoccidentalis*(fluted pumpkin leaf)referred to as T2,Diets(4)contained10%inclusionof*Vernoniaamygdalina*(bitter leaf) referred to as T3, while Diets (5) contained 20% inclusion of *Vernoniaamygdalina*(bitter leaf)referred to as T4. All

these inclusion at different levels was added todeterminedifferent growth rate and wellness, viatheinclusions.

ExperimentalSetUp

Water was pumped from the College farm borehole into over-head tanks tosettleafterwhichwaterwasreleasedintotheexperimentalunits.The 5bowlswerefilledwith300 liters water uniformly, and 200 *Clariasgariepinus*juvenile were randomly stockedin each treatment bowl. The experiment lasted 8 weeks (56 days). The design of the experiment was completely randomizeddesignprior tothe introductionof thecompositiondiet.Introductionoftreatmentdiets containing different concentration of *TelfairiaOccidentalis*(Fluted pumpkinleaves) and *Vernoniaamygdalina*(Bitter leaves) was carried out from the 1st to the 4thtreatmentbowlwhilethefirstbowlwasleftasthecontrolwithnoinclusionof*Telfairiaoccidentalis*(Fluted pumpkin leaves) or *Vernoniaamygdalina*(Bitter leaves).

GrossComposition ofExperimentalDiet

Table1below, showsthecomposition ofthevarious inclusion levelsof*V.amygdalina* and *T.occidentalis*treatments.

Table1:GrossCompositionofExperimentalDiet

Ingredients	Diet 1	Diet 2	Diet 3	Diet 4	Diet 5
Soya Beans	32	32	32	32	32
Fishmeal	10	10	10	10	10
GNC	36	36	36	36	36
Maize	7.5	7.5	7.5	7.5	7.5
Lysine	0.5	0.5	0.5	0.5	0.5
Methionine	0.5	0.5	0.5	0.5	0.5
Vitamin	0.5	0.5	0.5	0.5	0.5
Salt	0.5	0.5	0.5	0.5	0.5
Cassava Flour	5	8	8	8	8
BloodMeal	7	7	7	7	7
BoneMeal	0.5	0.5	0.5	0.5	0.5
Feed Inclusion	0%	10%	20%	10%	20%
Total	**100**	**100**	**100**	**100**	**100**

Mean Water Parameters

Mean Water Physico-chemical parameters of water used for the experiment across the treatments (Mean ±SD**)** was taken during the experimental period and presented in Table 2 below.

Table2: Mean water Quality Parameters

Parameter	Control	T1 (PL 10%)	T2 (PL 20%)	T3 (BL10%)	T4 (BL20%)	Normal Range
Temperature(^{0}C)	27.20± 0.10	27.00 ± 0.00	26.80 ± 0.12	27.40 ± 0.03	27.60 ± 0.14	25-31
pH	7.0 ± 0.00	7.4 ± 0.03	7.6 ± 0.04	8.0 ± 0.10	7.4 ± 0.10	6.5-8.5
D.O(mg/l)	5.82 ± 0.20	5.6 ± 0.10	6.22 ± 0.11	5.7 ± 0.30	6.7 ± 0.10	5.00

DeterminationofGrowthPerformance

Data on the following performance indices were collected on a weekly basis. Initialmean weight of the fish was determined using sensitive weighing balance after whichregular sampling for mean weight changes were taken at two weeks intervals for 8weeks.Thedatacollectedwasprocessedforgrowthassessmentandnutrientutilizationusingthefollowingformulaebyjobling(1983), asdescribed below.

MeanWeightGain(MWG)
The weight gain of fish in each treatment group were taken. All fish per treatmentwere individually weighed on a sensitive weighing balance and the respective meanswererecorded.

$MWG=Wf-Wi$

Where:
Wf= final mean weight
Wi=initialmeanweight

PercentageMeanWeightGain(PMWG)

$PMWG=\frac{Wf-Wi}{Wf} x100$

Where:

Wf= final mean weight
Wi=initialmeanweight

SpecificGrowthRate:
The SGR was calculated using the formula below:

$SGR = \frac{\ln [Wf - Wi] \times 100}{T}$

Where:
Wf= final mean weight
Wi=initialmeanweightT=cultureperiod (day)

FeedConversionRatio (FCR)
Thisistheamountofunitweightoffoodthatthefishwereabletoconvertintounitmuscle.

$$FCR = \frac{Feed Intake}{Total\ Weight\ Gain}$$

SurvivalRate(SR)

$$Survival Rat(\%) = \frac{No.of\ Fish\ at the\ end of Experiment}{Initial No.of Fish\ Stocked} x100$$

Data Analysis

All data collected during experimental period was subjected to two-way analysis ofvariance (Two-Way ANOVA) using SPSS version 26. Duncan's Multiple Range Testwasemployedto revealsignificantdifferencesamongthetreatmentmeans.

RESULTS
PercentageMeanWeight Gain,SpecificGrowth Rate,Food Conversion Rate, and Percentage Survival Rate of*Clariasgariepinus*fedwith*TelfairiaOccidentalis*and*VernoniaAmygdalina*leaf Powder was determined from data obtained, recorded, and computed.

The Specific Growth Rate (SGR) was highest (7.9) in T2 (20% Pumpkin powder) and T3 (10% Bitter Leaf Powder*)* and lowest (7.3) in T0 (Control) with significant difference ($p<0.05$).

The Percentage Mean Weight Gain (PMWG) was significantly different across treatments,and highest (96%) in T3 (10% Bitter Leaf Powder*)* and lowest (65%) in T0(Control). There was no significant difference ($p<0.05$) between T2 and T3.

The Feed Conversion Ratio showed that *Clariasgariepinus*utilized feed fed across the treatmentsfed with a significant difference($p<0.005$)(Table2). T0 at 1.4, and T1 to T4 at 1.0.

Thehighestsurvivalraterecordedwas100%fortreatment3(10%bitterleaf),95%fortreatment1(10

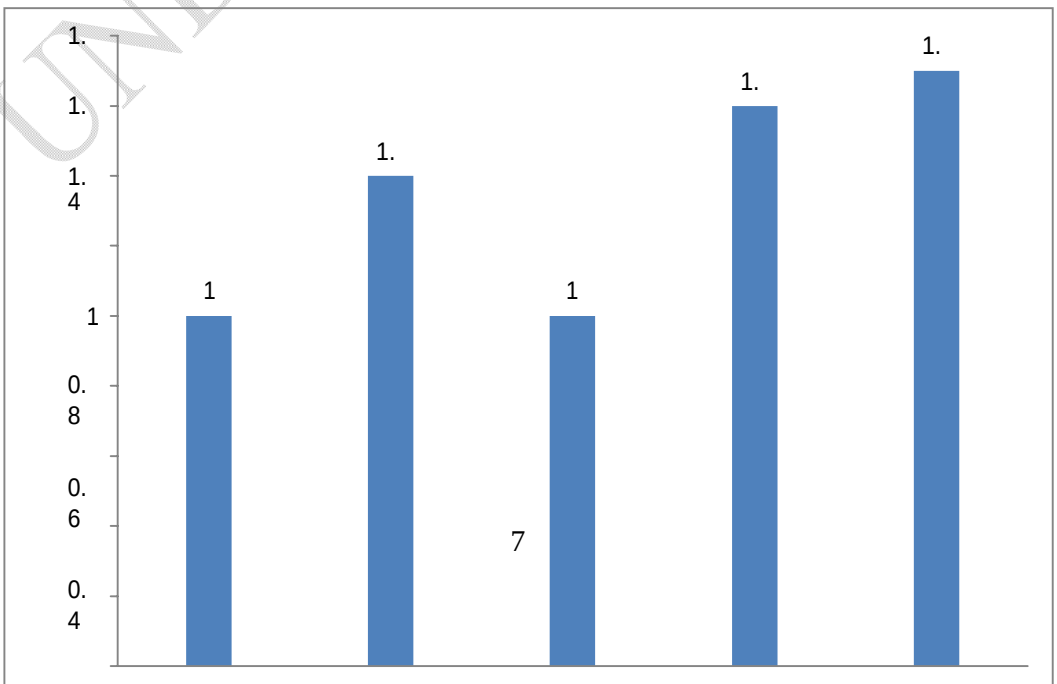
%pumpkinleaf),90%forbothtreatment2(20%pumpkinleaf)andtreatment4(20%bitterleaf)and85%fortreatment1(control).

Table 3:Feed Utilization and Survival of *Clarias fingerlings* in Relation to Varying Percentages of *V.amygdalina*and *T.occidentalis*leaf powder inclusions

Parameters	Control	T1 (10% Pumpkin leaf)	T2 (20% Pumpkin leaf)	T3 (10% Bitter Leaf)	T4 (20% Bitter Leaf)
No.of fish Stocked	200.0	200.0	200.0	200.0	200.0
Mean Initial Weight (g)	4.0	3.9	3.9	3.9	3.9
Mean Initial Length (cm)	5.0	5.3	4.9	5.2	5.3
Mean Final Weight (g)	65.0^{b}	80.0^{a}	87.0^{a}	91.0^{a}	80.0^{a}
Mean Final Length (cm)	27.3^{c}	30.2^{a}	26.8^{b}	30.4^{a}	26.8^{b}
SGR	7.3^{c}	7.7^{b}	7.9^{a}	7.9^{a}	7.7^{b}
PMWG (%)	93.8^{c}	95.1^{b}	95.5^{a}	95.7^{a}	95.1^{b}
FCR	1.4^{a}	1.0^{b}	1.0^{b}	1.0^{b}	1.0^{b}
PSR (%)	90.0^{c}	95.0^{b}	90.0^{c}	100.0^{a}	85.0^{d}

*MWG: Mean Weight Gain,SGR: Specific Growth Rate, PMWG: Percentage Mean Weight Gain, FCR: Feed Conversion Ratio, and PSR: Percentage Survival Rate
*Mean Values with the same superscript along rows are not significantly different (p>0.005)
*Mean Values with Different superscripts along rows are significantly different (P>0.005)

Figure1: Mean Weight Gain



T0= Control
T1 = 10% fluted pumpkin leaf
T2 = 20% fluted pumpkin leaf
T3=10%bitterleaf
T4=20%bitterleaf

DISCUSSION, CONCLUSION AND RECOMMENDATIONS

GrowthPerformanceof*Clariasgariepinus*juvenilesinRelationtoTreatmentswith Pumpkinleaf andBitterleaf Powder

There was general growth and improvement in weight of fish across the treatments. Mean Initial Weight was 3.92grams and Mean Final Weight was 7.92grams at the end of the experiment. Mean Initial Length was 5.14 cm and Mean Final Length was 9.74 cm at the end of the experiment.When fish are fed consistently, fish utilizes feed and grows.Growth can be isometric or allometric however. Thegrowth of fish at all stages in its life history is largely regulated by a numberof factors, such as food type, food intake, feeding rate, feeding frequencyand its ability to absorb nutrients(Gelineau*et al.*, 1998; Akbulut*et al.*, 2013).There was no weight loss across the treatments from the weight of fish from start of experiment till the final weight of fish at the end of the experiment.

The Percentage Mean Weight Gain (PMWG) was significantly different across treatments, and highest (96%) in T2 and T3 (20% *T. occidentalis* and 10% Bitter Leaf Powder*)* and lowest (65%) in T0 (Control). There was no significant difference ($p<0.05$) between T2 and T3. 20% *T. occidentalis*leaf powder inclusion and 10% *V. amygdalina*leaf inclusion had a better result ($p<0.05$) as compared with the other treatments. This indicates that the higher the percentage inclusion of*T. Occidentalis*supplements, the better the feed assimilation by the fish.*T. occidentalis* is not as toxic as *V.amygdalina*leafin water. However, *V. amygdalina*has anti-bacterial and anti-parasitic properties (Tadesse*et al.*, 1993 and Gboladе*et al.*, 2003); has an anti-oxidant (Erasto *et al.*, 2006) and as a growth promoter enhancing the gastro intestinal enzymes thus increasing feed conversion efficiency (Huffman *et al.*,and ,Opata*et al.*, 2006). The more the percentage inclusion of *V. amygdalina* in feed, the faster the pond water gets toxic. At 10% Pumpkin and 10% Bitter leaf (T1 and T3 respectively), Pumpkin leaf showed only a slight percentage difference (95.1% and 95.7% respectively). This indicates that both supplements (especially Pumpkin leaves) can enhance growth rates, this agrees with Yin *et al.*, (2006) that said the use of plant based additives in aquaculture is one of the methods used to improve weight gain, feed efficiency, and/or disease resistance. According to Fasuyi and Nonyerem (2007), *T. occidentalis*leaf contains ingredients such as bioflavonoid, an active chemical, plant promoter, which promotes growth in birds, and may have similar effects in fish. Aqueous *T. occidentalis* is also reported to increase haematological parameters (Alada, 2000). The result from this experiment had T2 (10% *T. occidentalis)* and T3 20% *V. amigdalina)*with highest PMWG at 96%. This agrees with the findings of Adekunle (2016) that showed better growth rate and weight gain with treatment with *T. occidentalis*inclusions in feed.However, the higher the concentration, the higher the tendency of leading to

accumulation of toxins in fish and acute water toxicity (most liable to Bitterleaf toxin accummulation). The unrefined nature of the herbal preparations, coupled with the apparent lack of specificity or precision in the application of the plant in traditional medicine could lead to over dosage of the herbal medicine, which can result in accumulation of essential and non-essential plant ingredients in the human system. The accumulation can reach a toxic level, especially in the systems of people who rely heavily on unrefined herbal products, with severe consequences on their biochemical and genetic systems (Okwuzu, 2017).

The Specific Growth Rate (SGR) was highest (7.9) in T2 (20% Pumpkin powder) and T3 (10% Bitter Leaf Powder) and lowest (7.3) in T0 (Control) with significant difference ($p<0.05$). Most treatments with the leaf powder inclusions had a higher SGR than the Control treatment (T0). T2 at 20% *T. occidentalis*leaf powder inclusionshad better SGR as well as 10% *V. amigdalina*. This is a pointer to the fact from recent studies that have shown that *T. occidentalis*leaf powder is rich in minerals, antioxidants, vitamins as compared to *V. amygdalina*that has more of antibiotic, antiparasitic and disease management tendencies (Ekeocha 2011). Hence, *T.occidentalis* possesses a higher tendency to utilize feed and growth, while *V. amygdalina* inclusion had a higher disease resistant rate tendencies.

Results obtained show a significant difference in the Feed Conversion Ratio of *Clariasgariepinus*juvenile fedwith bitterleaf and pumpkin leafpowder ($p>0.05$).The Feed Conversion Ratio showed that *Clariasgariepinus*utilized feed fed across the treatments fed, with a significantdifference ($p<0.005$) across treatments T0 at 1.4, and T1 to T4 at 1.0.All treatments (T1 to T4) with the feed inclusions had a better FCR as compared to the Control (T0), with a significant difference ($p>0.05$ and this agrees with the findings of Adekunle (2017) that showed better FCR for treatments of feed with additive inclusions as compared with the control treatment.

Survival rate recorded showed minimal or inconsequential loss to *Clariasgariepinus*population across the treatments, and this indicates that the fish species can survive well when fed with calculated amounts of both*Vernoniaamygdalina*and *Telfairiaoccidentalis*inclusions.The highest percentage survival rate recorded was 100% for treatment 3 (10% bitter leaf), and lowest (85%) for T4.

During the period of the experiment, TemperatureandpHof experimental water fallwithinthenormalrangeforaquaculture, however the data collected for Dissolved Oxygen was slightly above thenormal range. This could be a factor that enhanced the survival rate of the fish asDissolvedOxygen isavital component requiredfor their survival. The physico chemical parameters of the experimental water across treatments was within tolerable range for fish culture, as described by Onyia*et al*., (2015).

Conclusion

*V. amygdalina*and *T. occidentalis*powder supplements showed support for fish growth. Based on this research, both plant supplements can be used forgrowth development as they contain a healthy amount of vitamins and minerals and arenot of harm to thefish species as shown bytheir survival rate.

Recommendation

Further research on these plant species used can be conducted to ascertain theactual amount of mineral components present. In addition, after growing to table size,proximate analysis of the fish species should be done for the control as well as thevarious treatment groups.

A tastesurvey analysis of the table size fish can be doneonrandomlyselectedindividualstoascertainifthereisadifferenceintastebetweenthe control and the treatment groups of the fish samples. Histological analysis can bedone on the fish species to determine the effect of the supplement on the internalorgansof thefish.

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