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Exploration of Tropical Pond, Hybrid Fish Production, Under Probiotic Condition in Badagry, Southwest, Nigeria.

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Abstract
Background:*The significance of improvedproduction of fish through intense aquaculture methods, include deterioration in water quality which often leads to stress, disease and cannibalism. Bio-depollutingby probiotics, is a prominentmethod to evade these problems. The efficiency of using Pondtoss (a probiotic)toincrease earthen pond water valuethroughbreeding ofhybrid 'Heteroclarias' catfish fingerlings were assessed from September to November 2019.*
Materials and Methods:*For this study, hybrid of♂Heterobranchus bidorsalisX♀Clarias gariepinusknown in Africa as'Heteroclarias'frys were stocked in two earthen ponds. Pond A was treated with probiotic(Pondtoss) and pond B was used as control. Water qualityfactors:pH, Temperature, Dissolved oxygen(DO),Ammonia (NH_3), Alkalinity, water hardness and salinity were recorded.Plankton diversity, length weight relationship andfish yield were studied.Shannon diversity index, Evenness of distribution, Margalef Richness Index, Menhinicks Richness Index, Fisher Alpha Index, Berger-Parker Dominance Indexwere evaluated.*
Results:*A total of Forty-eight planktonic organisms were identified, comprising of 39 phytoplanktersand 9 zooplankters. Shannon diversity was 2.903 in pond A and 1.615 in pond B. Other diversity indices also showed better thriving conditions for plankton in pond A. Correlation was highbetween total plankton and pH= 0.808;and total plankton and temperature =0.906, in September. Pond A, had a higher mean fingerling length (5.71±0.16 cm) and weight(2.08±0.21gm) than pond B with a mean fingerling length of 4.43±0.12 cm and meanfingerling weight of 1.02±0.16 gm.Regressionplotsrevealedthat the growth exponent "b" for Heterolalias fingerlings in pond A was higher (2.946, 3.223 and 2.795) in September, October and November respectively.*
Conclusion:*The probiotic-treated pond, evinced a better condition factor 'K' =1.05 ± 0.19 in the fingerlings.In entirety, resultsshowed that probioticsimproved water quality, increased plankton density, diversity and ultimately, a comparatively betterHeteroclariasfingerlings yield.*
Keywords: *Fingerlings, Plankton Diversity,Probiotic, Water Quality, Yield.*

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I. Introduction

Aquaculture ranks as one of the fastest growing sector of protein source in the world and provides agrowing percentage of the total production of fish and shellfish for human ingestion. It is graduallyintensifying both in terms of total world production and the diversity of cultured species. In 2010, global production of farmed food fish was 59.9 million tons, up by 7.5 percent from 55.7 million tons in 2009 and estimated at US$119.4 billion[1].The request for fish in Nigeria generallyexceeds the limited production. Nigeria is the leading fish consumer in Africa and among the biggest fish consumers in the world with over 1.5 million tons of fish consumed annually. The development in fish production is due to improved activities of aquaculture, and the necessity for aquaculture arose from the decline in supply from Ocean Fisheries as a result of over-fishing, habitat destruction piracy and pollution. perennially, the demand for fish has been on the rise with supply still pursuing demand. However,the major concern of Fisheries and Aquaculture isreducing the broadeningcrack between fish demand and supply and attaining the crucialobjective of self-sufficiency in fish production.

The strengthening of aquaculture is attained by swelling inputs and improving organization of the production methods to enhance productivity per unit area and/or volume of the system. These inputs may include better stocking density, use of better-quality breeds, and increased use of artificial feed, health

management and improved management or manipulation of the culture environment (e.g. management of water exchange, aeration, wastes, water temperature, nutrients, and ecological composition). Probiotics is thought to have capacity to enhance intensive fish production. Recently, there has been a great interest in the use of probiotic bacteria in aquaculture to improve water quality, inhibit pathogens and promote the growth of farmed fish[2].

Pondtoss is said to be a blend of Lymnozymeplusone more trade secrete product WSR.The probiotic share is from Lymnozymeand the water conditioning bacteria from WSR. Pondtoss is said to be a freeze-dried biological formula of natural microbes, enzymes, micronutrients and amino acids on a special carrier designed to improve microbial growth rates. When introduced, Pondtoss is advertised to create improved water quality beneficial to health, growth and reducing mortality; it is known to produceminor peptides that have a positiveinfluence on fish, enhancing survival and development ratesbuilding a natural, favorable Bio-Floc, while decreasing ammonia, nitrite and nitrate in addition to the capacity todigest organic solids and bottom sludge.

Water quality is asignificantpointer in assessing the eutrophic situation, primary production and fish yield potential. The production of plankton is directly related with fish production and several processes of the pond ecosystem. In fresh water fish ponds plankton are main fish food sources.The correlation between the physico-chemical factors and plankton production of pond water and their relation with cyclic fluctuation of zooplankton are of great significance and crucial in fish culture. The success of any fish production system depends on suitable water quality, which is any characteristics of water that affects the survival, reproduction, growth, production or management of fish in any way [3].Water quality largelyembraces all physical, chemical and biological features of water.Consequently, observing the optimal physio-chemical conditions like temperature, pH, alkalinity, dissolved oxygen, transparency and conductivity, enhances optimum fish growth and development.

The plankton communityincludes primary producers (phytoplankton) plus secondary producers (zooplankton). The micro-phytes represent the natural wealth of a water body, constituting a dynamic link in the food chain. While the zooplankton forms the main source of food for fish fry within the water body [4]. Plankton-fish coupling is an important component in the cycle of organic matter and inorganic nutrient in aquatic ecosystem.They may affect each other positively or negatively depending on the nutrient condition and consequent trophic status of their environment. Although zooplankton is present in aquatic habitats, their supply as food supplement to fish canbe augmented through external supply from cultures or by blooming of existing algae through fertilization[5].

II. Materials And Method

a. **Source of Fish Species Used:** Brood stocks (male: *Heterobranchus bidorsalis*, female: C*larias gariepinus*) were selected from a commercial fish farm (Omageyu fish farm) in Ijotun, nearBadagry town.

b. **Hormone Induced Reproduction in Concrete Tanks:**Six Brooding ♀ *Clarias gariepinus*and two ♂ *Heterobrnchus bidorsalis*were selected from the brood stock ponds and transferred to different holding tanks within the hatchery. Thefemale brood stocks were injected intramuscularly above the lateral line with Ovaprim at the rate of 0.5ml per kilogram (kg) body weight of female fish[6](Kerduchuen and Legendre, 1994).At about 10p.m. they were left for 8 hours for ovulation to take place andat7a.m. the female brood stocks were stripped and the eggs collected. The males were dissected to obtain the milt. The male gonad was then sliced into two and the milt sprinkled on top of the eggs with the addition of saline water.The egg and milt mixture (three ♀ and one ♂, for each nursery tank)was spread on a net inside the nursery tank in the hatchery,after hatching they were allowed to absorb the yolk in 3 days, and then transferred to earthen ponds.

c. **Pond Preparation:**Two Ponds (Pond A and Pond B), each with a 24m wide and 32m long dimensions, were drained completely and leftover fish were removed, de-mudding and netting of ponds was done and water was introduced from borehole to a depth of 1 meter in the ponds after one week of drying out. The hatchlings were fed commercial feed(Artemia for three days and Coppens thereafter) until they became fingerlings on the 4th week. This was replicated three times. Pond A had probiotic introduced at the rate of 250g per week for thefour (4)weeks fingerling production period. As the water soluble bags dissolved, Pondtossdispersed throughout the water column and across the pond bottom while the control pond B had noprobiotics (Pondtoss).

d. **Water Quality Analysis:** Physical and Chemicalwater quality parameters were analyzed, weekly, using standard methods in the two ponds, to ascertain if the introduction of Pondtoss had any effect on the generally accepted range for all water parameters examined. The water quality parameters assessed include:Transparency, Dissolved oxygen content (mg/L), Temperature (°C),pH, Salinity (ppm), Ammonia (mg/L), Alkalinity (ppm) and water hardness (mg/L). The YSI Pro 1020 meter was used to measure dissolved oxygen, pH and temperature. Salinity was measured using the (model New 3 – 100) Refractometer. Transparency was measured in the ponds using aSecchi disc[7] (APHA, 1980) while, Ammonia (mg/L), Alkalinity (ppm) and water hardness (mg/L) were analyzed using standard methods[8] (Boyd, 1979).

e. PlanktonSamplingand Analysis:A 55µm mesh size, standard phytoplankton net, was dragged for five minutes, in each pond, just below the water surface to collect plankton which were concentrated and collected in the detachable glass jar at the rear end of the equipment.

The plankton samples were fixed and preserved in a 20% aqueous solution of formaldehyde, acidified with glacial acetic acid.

The plankton were identified under a phase contrast light microscope (Olympus Tokyo Model No. 602980) at 10x40 magnification, using taxonomic keys[9](Edmonton,1959),[10] (Prescott, 1970) and [11](Sharma, 1986). Counting of the plankton was done using a Sedgwick Rafter Counting Chamber.

The total number of organisms of the concentrated sample was calculatedper millimeter using the formula below:

$$\text{Number of plankters per ml} = (T)\ \frac{1{,}000}{AN} \times \frac{\text{Volume of concentrate in ml.}}{\text{Volume of sample in ml.}}$$

Where, T= total number of plankters counted.

A= area of grids in mm^2

N= number of grids employed

1,000= area of counting chamber (mm^2)

Source: [12](GEMS Water Operational Guide, 1977).

The indicesapplied to estimate **measures of plankton diversity**for each pond within the period of studywere:

e. i. **Margalef's Richness Index** $(D = (S-1) / \text{Log } N)$

Where S = Total Number of Different Species (Number of taxa)

N = Total Number of Individuals and

Ln = Natural logarithm

e. ii. **Menhinicks Richness IndexS**$=1 / \ln(n)$

where S = Number of Taxa and

n = Number of Individuals

e. iii. **Equitability or Evenness of distributionE**$= H/\log_2 S$

where H = Shannon's diversity index,

S = Species Richness

e. iv. **Berger-Parker Dominance index (BPDI) d**= Nmax/Nwt),

e. v. **Simpson Diversity IndexD** $= 1 - \sum (Pi^2$

e. vi. **Shannon Weiner Diversity index'H'**$= (-\sum_{i=1}^{s} pi \ln pi)$,

where H = Shannon Diversity Index

S = Number of Species = species Richness and

Pi = Proportion of Total Sample of Species i.

Divide number of individuals of species 'i' by total number of samples

Source: [13](Shannon and Weiner, 1963)

e. vii. **Fisher Alpha Index S**$= a*\ln(1+n/a)$

where S = Number of Taxa and

n = Number of Individuals

a = Fisher's alpha

f. **Measures of fish Growth:** Length and weight measurements were taken at the end of a four weeks standard fingerling growth when they are no longer fragile. A subsample of thirty (30) fingerlings were harvested from each pond using a piece of fine mesh net and softly placed on paper towels to absorb most of the adhering water according to the methods of [14](Anderson and Gutreuter, 1985). The total length (cm) was measured using a ruler on a measuring board while the body weight was determined using a Mettler electronic compact scale (Model PM 400). The harvested *Heteroclarias* fingerlings were weighed to the nearest 0.1gm and total lengths determined to the nearest 1mm.

g. **Condition Factor (K)** $= 100W/ L$

where W = Weight of fish in grams and

L = Total Length of fish in centimeters

h. **The length-weight relationships (LWR)** was estimated using the equation $W= aL^b$

Where W = Weight (gm)

L = Total length (cm)

a = Constant and

b = Growth exponent

i. **Length-weight regressions** were compared to 3 using Student's t-test according to[15]Sokal and Rohlf, 1987, to determine whether the *Heteroclarias* fingerlings grew isometrically.

j. **Fingerlings Yield:** was derived as total number of fingerlings harvested from each pond.

III. Results

Physical and Chemical Parameters

The average mean dissolved oxygen (DO) concentration was **8.49 ± 0.59**(mg/L) for Pond A and 7.19 ± 0.55(mg/L) for Pond B within the period of study. Other significant average mean water quality parameters, recorded for Pond A and Pond B respectively were pH (**7.25 ± 0.09),**6.88±0.06;Transparency (**0.57 ± 0.03),** 0.55 ± 0.06; Temperature ^{0}C(**28.78 ± 0.30),** 26.96 ± 0.29; Salinity (ppm) **(0.65 ± 0.11),** 0.57 ± 0.11; Ammonia (mg/L) (**0.09 ± 0.01),** 0.26 ± 0.02; Alkalinity (mg/L) (**30.58 ± 2.48),** 28.67 ± 2.23 and Water hardness (mg/L) (**76.26 ± 6.45),** 62.70 ± 6.12; within the period of study (Table 1).

Table 1: Mean and Average Mean Physico-Chemical Water Quality Parameters of Treated Pond (A) And ControlPond (B)Within The Period of Study.

PARAMETERS	SEPTEMBER		OCTOBER		NOVEMBER		AVERAGE MEAN	
	POND A	POND B	POND A	POND B	POND A	POND B	POND A	POND B
Dissolved oxygen (mg/l)	**8.63 ± 0.26**	7.48 ± 0.41	**8.08 ± 0.78**	6.6 ± 0.65	**8.78 ± 0.73**	7.75 ± 0.58	**8.49 ± 0.59**	7.19 ± 0.55
Salinity (ppm)	**0.72 ± 0.12**	0.45 ± 0.05	0.55 ± 0.07	**0.71 ± 0.20**	**0.67 ± 0.14**	0.57 ± 0.07	**0.65 ± 0.11**	0.57 ± 0.11
Alkalinity (mg/l)	**32 ± 3.63**	26.25 ± 1.75	**29.75 ± 1.25**	29.0 ± 2.55	30.00 ± 2.55	**30.75 ± 2.39**	**30.58±2.48**	28.67 ± 2.23
Water hardness (mg/l)	**76.84 ± 8.39**	45.16 ± 12.83	**71.27 ± 6.69**	71.02 ± 1.05	**80.68 ± 4.26**	71.91 ± 4.47	**76.26± 6.45**	62.70±6.12
pH	**7.25 ± 0.15**	6.86 ± 0.06	**7.23 ± 0.07**	6.89 ± 0.06	**7.27 ± 0.05**	6.88 ± 0.06	**7.25±0.09**	6.88±0.06
Transparency	**0.56 ± 0.04**	0.55 ± **0.05**	**0.58 ± 0.02**	0.54 ± **0.07**	**0.57± 0.04**	0.55± 0.06	**0.57±0.03**	0.55±0.06
Temperature ^{0}C	**29.15 ± 0.23**	27.95 ± 0.16	**28.15 ± 0.47**	26.55 ± 0.25	**29.03 ± 0.27**	26.38 ± 0.47	**28.78±0.30**	26.96±0.29
Ammonia (mg/l)	**0.06 ± 0.01**	**0.18 ± 0.02**	0.10 ± 0.01	**0.26 ± 0.02**	0.11 ± 0.01	**0.33 ± 0.02**	**0.09±0.01**	0.26±0.02

Plankton Density and Diversity

A total of Forty-eight planktonic organisms were identified in both the treated and control ponds, including 12 groups comprising of 39 phytoplankters and 9 zooplankters. In pond A, phytoplankton was mainly represented by 7 groups, Bacillariophyta (Diatoms) (6), Chlorophyta (13), Cyanophyta (5), Chrysophyta (2), Euglenophyta (3 species), Pyrrophyta (2) and Rhodophyta (2). Zooplankton was mainly represented by 5 groups, Cladocera (2), Copepoda (1), Mollusca (1), Protozoa (2) and Rotifera (1). In pond B, phytoplankton was mainly represented by 6 groups, Bacillariophyta (Diatoms) (2 species), Chlorophyta (10 species), Cyanophyta (3 species), Chrysophyta (2 species), Pyrrophyta (1 specie) and Rhodophyta (2 species). Zooplankton was mainly represented by 2 groups, Copepoda (1 specie) and Rotifera (1 specie).

In pond A, the percentage abundance decreased in the order of the class Chlorophyta (43%) Cyanophyta (15%), Bacillariophyta (13%), Rhodophyta (9%), Chrysophyta (7.01%), Pyrrophyta (4%), Euglenophyta (3%), Cladocera (2%), Copepoda (2%), Mollusca (1%) and others which were less than one percentincluding the Protozoa were collapsed (figure 1). In pond B, the plankton also showed a polymitic distribution. Chlorophyta had the highest percentage abundance (41.92%) followed by Cyanophyta (16%) Rhodophyta (14%), Bacillariophyta (13%), Chrysophyta (11%) then Pyrrophyta (2%) and Copepoda (1%). (Figure 2)

Indices of diversity which included Menhinicks richness index, Margalef species richness index, Evenness of Distribution, Shannon Weiner index, Fisher Alpha index and Berger-Parker Dominance Index were allhigher andbetter for Pond 'A' than Pond 'B' (figure 3).

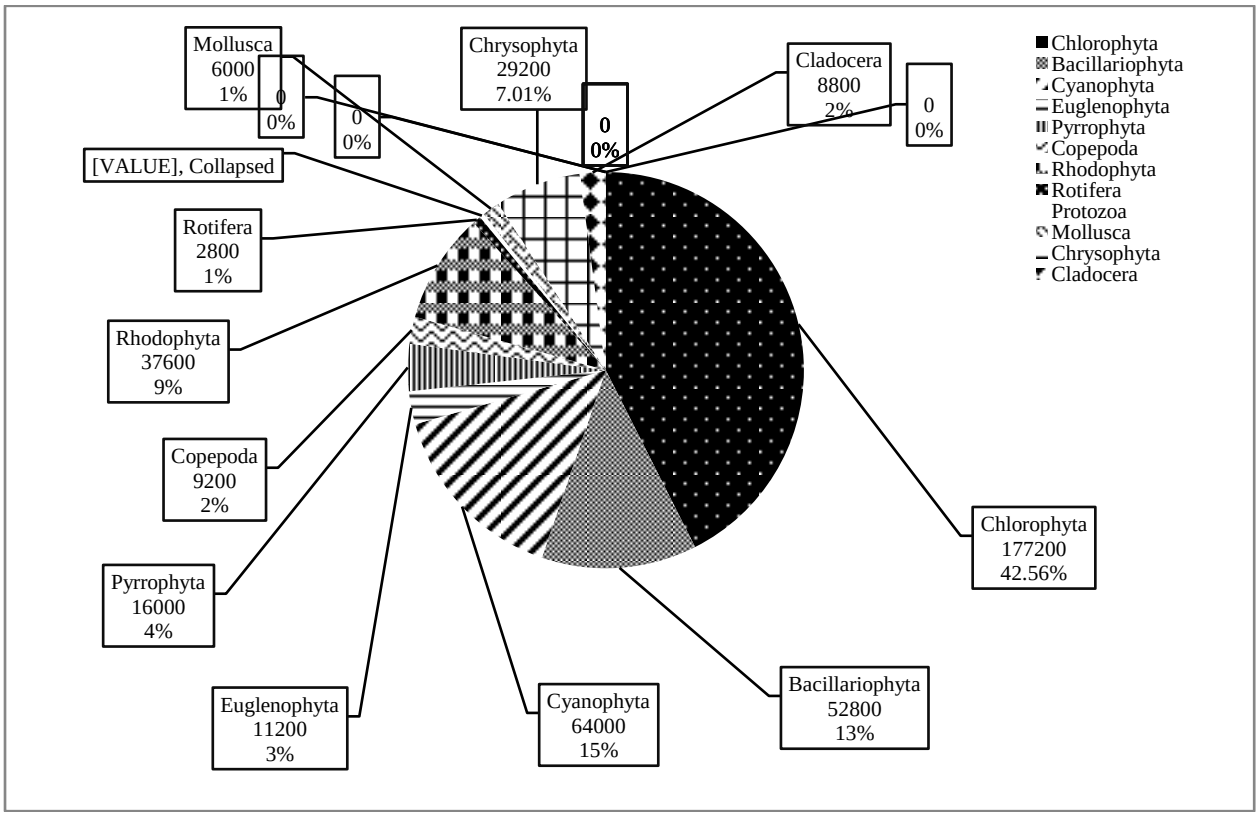

Figure 1: Relative abundance of planktonic groups in pond A within the period of study.

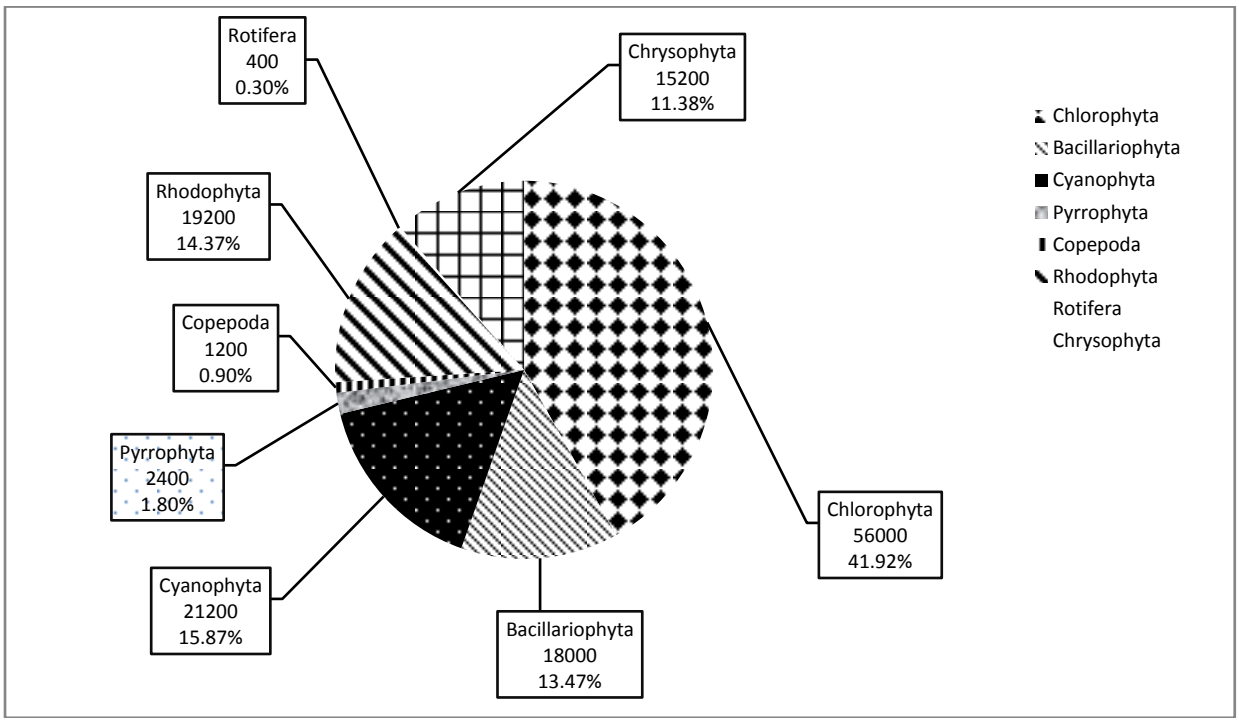

Figure 2: Relative abundance of planktonic groups in pond B within the period of study.

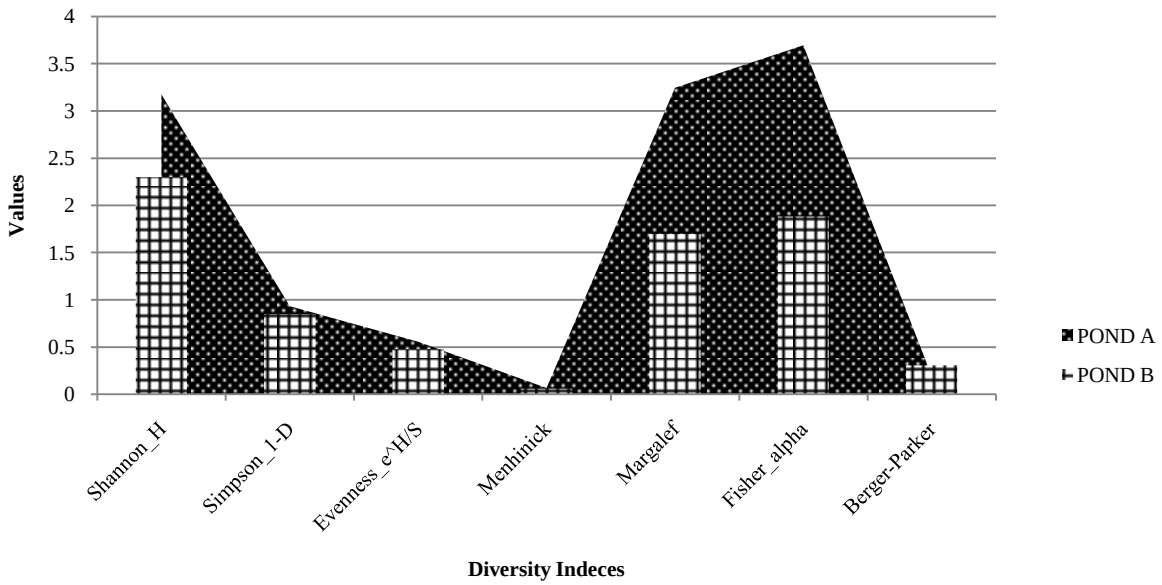

Figure 3: Diversity Indices for Pond A and Pond B Measured within the Period of Study.

The correlation between total plankton and physicochemical parametersshowed that the total plankton best correlated withpH, transparency and temperaturein pond A than in pond B. The dissolved oxygen concentration also had a positive correlation with phytoplankton population density and increased correspondingly with an increase in population of the phytoplankton (Table 2).

Table 2: Showing The Correlation Between Total Plankton and Physicochemical Parameters.

TOTAL PLANKTON / PHYSICOCHEMICAL PARAMETERS	SEPTEMBER Pearson's 'r' value		OCTOBER Pearson's 'r' value		NOVEMBER Pearson's 'r' value	
	POND A	POND B	POND A	POND B	POND A	POND B
Total Plankton / pH	**0.808***	0.272	**0.917***	-0.505	**0.882***	0.784**
Total Plankton / Transparency	**0.905***	0.808*	**0.968***	0.874*	**0.988***	0.908*
Total Plankton / Temperature	**0.906***	0.765	**0.787****	-0.929****	**0.786****	-0.314***
Total Plankton / Dissolved Oxygen	0.561	0.626	**0.884***	-0.401	**0.978***	**0.899***
Total Plankton /Salinity	-0.128***	0.773	0.745	-0.887***	0.020	-0.994****
Total Plankton / Alkalinity	-0.218***	**0.841***	0.098	-0.941***	**0.956***	0.771**
Total Plankton / Hardness	-0.347***	0.288	0.670	-0.460	**0.822***	-0.381***
Total Plankton / Ammonia	0.127	**0.778**	**0.747**	-0.376***	-0.314***	**0.903***

*High Positive Correlation***High Negative Correlation
** Low Positive Correlation ****Low Negative Correlation

Condition Factor (K) of *Heteroclarias* Fingerlings

For pond A in September, the mean condition factor was 1.08, with the minimum and maximum being 0.69 and 2.25, while in pond B the mean condition factor was 1.02, with the minimum and maximum values being 0.71 and 1.81 respectively. Pond A in October had a mean condition factor of 1.01 with the minimum and maximum values as 0.68 and 1.30, whereas, in pond B, the mean was 1.0 with a range between 0.71 and 1.25. In November, pond A had a mean condition factor of 1.06 with a range of 0.71 – 1.60 while in pond B, the mean was 1.03 with the range of 0.59 - 1.93. (Table 3)

Table 3: Mean Length, Weight and Condition Factor of *Heteroclarias* Fingerlingsin Pond 'A' (With Probiotic) and Pond 'B' (Without Probiotic) Within The Period of Study.

MONTH	**POND A**			**POND B**		
	MEAN LENGTH (cm)	MEAN WEIGHT (gm)	MEAN CONDITION FACTOR(K)	MEAN LENGTH	MEAN WEIGHT	MEAN CONDITION FACTOR (K)

SEPTEMBER	5.72±0.16	2.02±0.20	**1.08±0.06**	4.53±0.14	0.86±0.09	**1.02±0.04**
OCTOBER	5.67±0.16	2.05±0.21	**1.01±0.03**	4.43±0.10	0.85±0.03	**1.00±0.02**
NOVEMBER	5.75±0.17	2.17±0.21	**1.06±0.48**	4.33±0.11	0.76±0.07	**1.03±0.41**
Average / Mean of Means	5.71 ± 0.16	2.08 ± 0.21	**1.05 ± 0.19**	4.43 ± 0.12	0.82 ± 0.05	**1.02 ± 0.16**

Length-Weight Relationship

There was a high positive correlation of the body length and body weight in the *Heteroclarias* fingerlings in September, with a significant correlation coefficient of r= 0.907 in pond A and r=0.892 in pond B,In October, the correlation was higher in pond A with coefficient of r= 0.953 while in pond B it deepened and became lower with r = 0.843. In November, pond A had a reduced correlation of r = 0.882 which was still higher than that of pond B with a correlationof r=0.869.

The regression graphs of length-weight relationships of farmed *Heteroclarias* fingerlings, within the period of study are presented in figures 4-9 below. In the probiotic pond A, for September (Figure 4), the determinant coefficient (R^2 = 0.825)showed a strong correlation with the negative isometric growth trend (2.946) of the *Heteroclarias* fingerlings while in pond B, (Figure 5) for the same period exhibited a weaker correlation (R^2 = 0.798) and negative allometric growth trend (2.850).

In October, there was an all-time high correlation coefficient (R^2 = 0.907) and a strong positive isometric growth trend (3.223) in the *Heteroclarias* fingerlings of the Pondtoss pond A (Figure 6). Whereas, in pond B (Figure 7), the regression coefficient (R^2 = 0.739) showed a weak negative allometric growth trend (1.932).There was a weak negative allometric growth trend (2.795) for *Heteroclarias* of pond A in November (Figure 8) when the regression R^2 = 0.775 while the fish in pond B (Figure 9), also exhibited a weak negative allometric growth trend (b = 2.686)

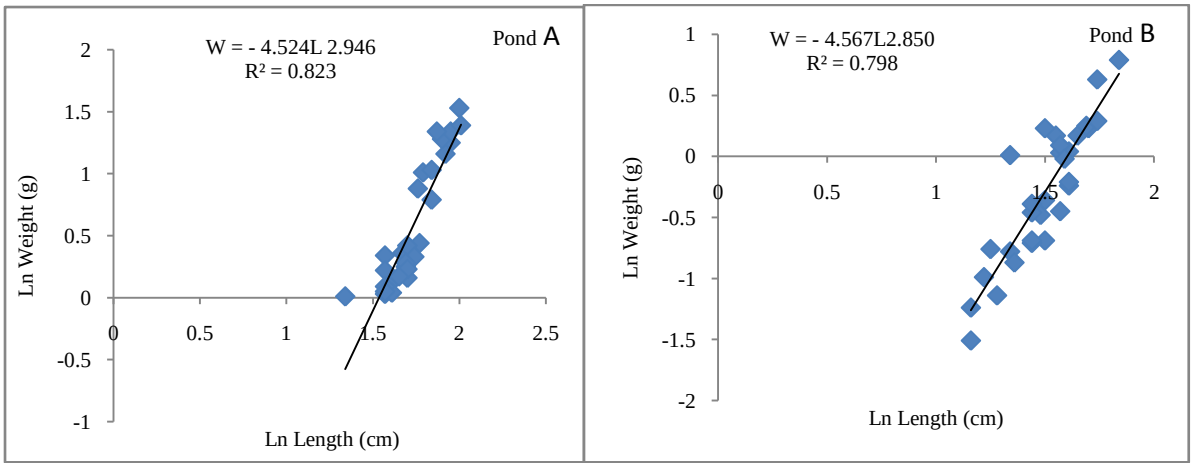

Figure4 and Figure 5: Length-Weight relationship of *Heteroclarias*fingerlingsin pond A (with pondtoss) and pond B (without pondtoss) in September.

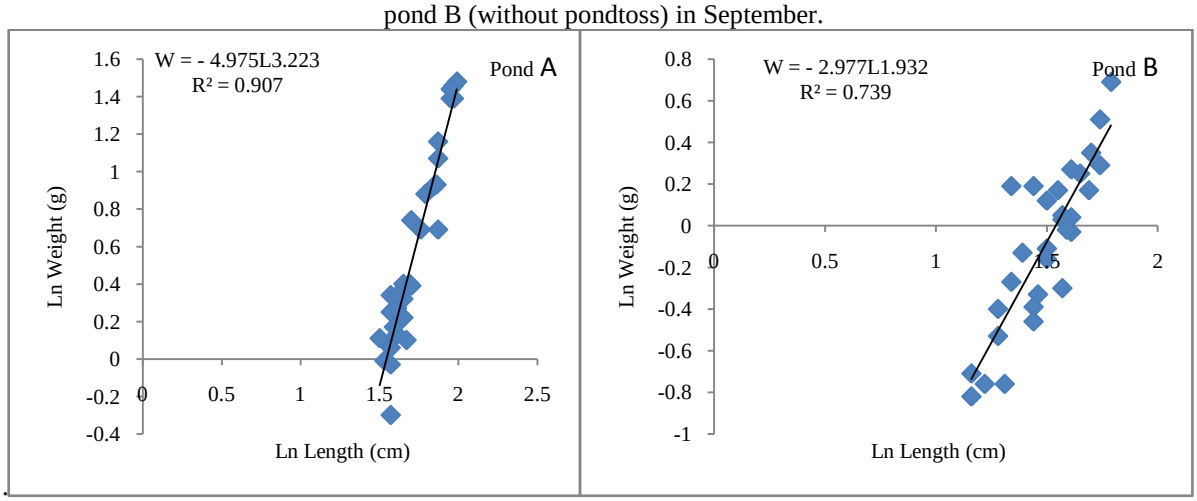

Figure 6 and Figure 7: Length-Weight relationship of *Heteroclarias* fingerlingsin pond A and pond B in October.

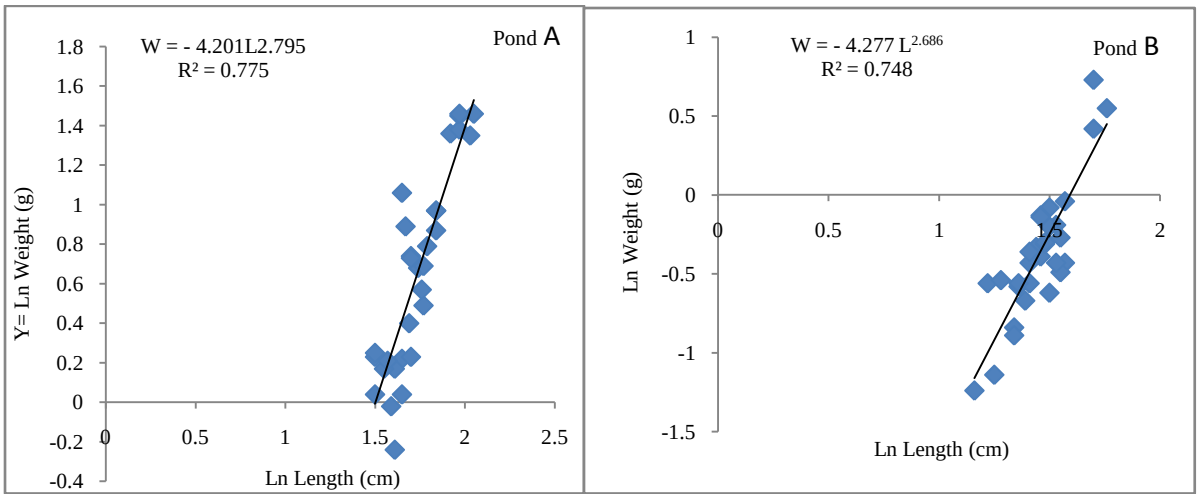

Figure 8 and Figure 9: Length-Weight relationship of *Heteroclarias*fingerlingsin ponds A and Bin November.

IV. Discussion

Water quality is avitalgauge in assessing the eutrophic situation, primary production and potential fish yield. of Fish pond waterqualityis subject to the nature of soil, source of water besides the location of ponds[16] (Boyd, 1981). The physico-chemical parametersexamined were in good range according to works done by various authors on appropriate water quality for Fish survival. Physico-chemical parameters of the pond treated with probiotics were observed to be of better conditions,probably due to therole played by pondtosstoregulate the water quality to fall within optimum range needed for algalbloom, which subsequently increased Dissolved Oxygen released by photosynthesis and used in fish respiration. Beneficial bacteria in Pondtoss is knownto reduce sludge in ponds by consuming organic waste and uneaten food that lead to sludge build up, converting them into bacterial biomass, water and carbon dioxide. This bacterial biomass is eaten by fish and improves the food conversion ratio (FCR). In this study, the difference in water temperature was very narrow which is a known characteristic of tropical waters [17](Ahmed, Wahab, Miah and Azim,2000). In September, Water temperature had a positive significant relationship with total plankton abundance in pond A (r=0.906), pond B (r=0.765) while in October, pond A (r=0.787) and pond B (r=-0.929) whereas in November, pond A (r=-0.314) and Pond B (r=0.786). This positive relationship could be attributed to the increase in plankton activity in the decomposition of organic matter with the increase in temperature. [18]Roberts, Kawamura and Nicholson(1997),affirmed thatprime temperature ranges for aquatic biota is considered to be between 20^0C-33^0C and the temperature range recorded for the duration of this experiment was 25.0^0C-29.5^0C which indicated that the range was suitable for the fingerlings. Pondtoss improved water quality by consuming organic waste and uneaten food before they begin to decay. This preventedbuildup of harmful ammonia and nitrite which can become lethal, cause health problems and are also difficult to eliminate. The beneficial bacteria added to the water outcompetes harmful bacteria and consumes the excess nutrients and sludge. By reducing the negative elements, survivability and water quality improved.

Dissolved Oxygen (DO) is the principal factor for the survival and growth of fish. [19]Erondu (1991)opined that dissolved oxygen greater than 5mg/l is needed for the subsistence of fish and any aquatic organism. This was backed up by[20] Akinwole and Faturoti,(2006) who suggested that if DO falls below 4.5mg/l then the fish may probably die. The DO in this work, ranged between 5.0- 10.2mg/land was within the suitable range for earthen fish ponds. Total plankton showed positive correlation with DO in pond A (r=0.561) and pond B (r=0.626) in Septemberindicating a corresponding increase in DOwith an increase in plankton abundance whereas, in October, the total plankton had a negative correlation with DO in pond B (r=-0.401) which implies that there is a corresponding decline in dissolved oxygen concentration with a reduction in the total population of plankton. Conversely,the total plankton in pond A, had a strong positive correlation with DO (r=0.884) showing a concurrent rise in dissolved oxygen concentrationwith an increase in plankton population. The negative correlation of all water quality parameters in Pond B showed a corresponding decline inthe total plankton abundance in October.[21]Rahman, Chowdhury, Hague and Haq (1982),stated that dissolved oxygen concentration of a productive pond should be 5.0mg/L or more. [22]Wahab, Ahmed, Aminul-Islam, Haq and Rahmatullah (1995),also observed similar dissolved oxygen values that ranged from 3.18 to 7.58mg/l. However, in this study, dissolve oxygen ranged between 6.2-10.2mg/l in pond A and 5.0-9.1mg/l in pond B. Optimum levels of dissolved oxygen sustained in pond A might be aresult of the favorableconsequence of probiotics (pondtoss) which was a facilitator to good water quality and plankton bloom.According to[23](Gaunder, 2005), the pH range for *Clarias gariepinus* is 6.5-8.0, affirming that the pH suitable for fish farming depends on the

species cultured and that for all aquatic organisms, a pH range of 7-9 is tolerable. The pH recorded within the duration of thisstudy was in the range 6.75-7.42, which according to[23](Gaunder, 2005) is tolerable. ThepHshowed variation throughout the study period most probably as a consequence of respiration and photosynthetic activities of the pond water biota. The pHranged from 6.80-7.42 in pond A and 6.75-7.0 in pond B. The pH wasobserved to have a positive relationship with total plankton in September, in pond A (r=0.808) and in pond B (r=0.272).In October, a negative correlation was observed in pond B (r=-0.505) and a robustprogressiveassociation in pond A (r=0.917) while,for November, in pond A (r=0.822) and in pond B (r=0.784). Due to strong photosynthetic actionby algae, the carbon dioxide in the environment declined. This work agrees with[24](Seenayya, 1971) and[25](Rao, 1972) thatoxygenas a byproduct of photosyntheticactivity,improved the dissolved oxygen content in water. It was observed that the higher pH values overlapped with the period of better photosynthetic activity of phytoplankton as a consequence of the relationship between primary productivity, dissolved oxygen concentration and pH.

In September, water hardness in pond A presented a negative relationship with total plankton in pond A(r=-0.347) and pond B(r=0.288) whereas in October (r=0.670) in pond A and (r=-0.460) in pond B,while in November, water hardness showed a strong positive correlation with total plankton in pond A (r=0.822) and a negative correlation in pond B (r=-0.381). According to[26](Boyd, 1982), water hardness is typically related to alkalinity as the cation of hardness and anions of alkalinity are generallyresultant from the solution of carbonate minerals. The concentrations of ammonia in pond B (control pond) were higher than pond A and this is as a result of the use of nitrifying bacteria in the form of probiotics, as these bacteria are known to change ammonia to nitrite and then to nitrate, the low level of ammonia recorded in pond A compared to pond B is supported.The plankton community is made up of primary producers (phytoplankton) and secondary producers (zooplankton). The phytoplankton population represents the biological wealth of a water body, creating a vital link in the food chain. The zooplankton forms the principal source of food for fish within the water body[4](Prasad *and* Singh, 2003). A total of 48 species were observed and estimated in pond 'A' (with pondtoss) while pond 'B' (without pondtoss) had 21 species.

In this study, the plankton richness, diversity and evenness of distribution weregreater in pond A compared to pond B (control pond).[27](Ludwig, 1999) indicated thatOrganic fertilizers are the foundation of the food chain that nurtures bacteria, protozoans, zooplankton, and ultimately the fish fry.The dynamics of plankton population is greatly dependent on environmental order/disorder, grazing rate of zooplankton on phytoplankton and the degree of fish predation on zooplankton, especially in fish ponds.Here, under probiotic condition, there was amplified richness, abundance and diversity of the plankton. During the study period, among phytoplankton, theChlorophytes were more common. The phytoplankton populations reduced in the order ofCyanophytes, Bacillariophytes,Pyrrophytes, Euglenophytes and Rhodophytes whereas among zooplankton,theCladocerans were the more common zooplanktersand others decreased in the order of copepods, mollusks, rotifers and protozoans. There were no prevalent (>70%) or dominant (up to 50%) species. The plankton distribution was mostly polymictic. In the ponds, initial plankton sampling was done before stocking the fish. At this interval,some species of plankton were not observed,but later appearedin thesubsequent weeks (Ephemeral, Passive Preponderance), whereas some species had a consistent abundance (Lunar, Active Preponderance). The small number of plankton and subsequent disappearance (Ephemeral) might be due to favored predation by the fish.Plankton groups could be minimum in populations or absent in the natural habitats either because of predation or due to the other un-favourable environmental inconveniences.[28](Geiger,1983) postulated that predation wields the main single impact on pond zooplankton communities.

It is known that, fish can attain either isometric growth, negative allometric growth or positive allometric growth. Isometric growth is associated with no alteration of body form as an organism matures with corresponding increase in both length and weight. Negative allometric development implies the fish becomes slenderer / slimmer as it increases in weight while positive allometric growth implies the fish becomes relatively deeper-bodied as it increases in length[29] (Riedel, Caskey, and Hurlbert, 2007). When "b" which is the growth regression slope value or growth exponent obtained from the length-weight equation is equal to three (3), isometric pattern of growth occurs but when b is not equal to 3, allometric pattern of growth occurs, which may be positive if b>3 or negative if b<3. In allometric relationship linking length and weight the "b" value ranges between 2.5 and 4.5[30](Shafee and Connan, 1978).

From the results obtained in this study, the "b" value (growth exponent) for *Heteroclarias* in pond A was 2.946, 3.223 and 2.795, whereas the "b" value for *Heteroclarias* in pond B was 2.850,1.932 and 2.686 for September, October and November respectively and these (except for the outlier = 1.932 in October) were all within the reported range of 2.5 to 4.5 by [30](Shafee and Connan,1978). This showed that pond A and pond B in September had negative allometric growth but whereas, pond A in October showed positive allometric growth (indicating that the fingerlings grew faster in weight than in length),pond B showed negative allometric growthsignifying that the fingerlings were still growing quicker in length than in weight. This is a pointer that ontogenetically, and concomitant with the development of brain, sensory, respiratory organs and feeding, the

fingerlings were growing quicker in length than in weight.Pond A and pond B in November had negative allometric growth indicating that the fish is growing quicker in weight than in length [31](King,1980).Correlation coefficient returned a value of between -1 and +1; where -1 means there is a strong negative correlation and +1 means that there is a strong positive correlation. Here,*Heteroclarias,* showed a high degree of positive correlation in pond A, (r= 0.907, 0.953 and 0.882)and relatively lower positive correlationfor pond B (r= 0.892, 0.843 and 0.869) in September, October and November respectively.

Condition Factor 'K' also provides information when relating two populations living in a particulartrophic level, populationcompactness, climate and other conditions, [32](Bagenal and Tesch, 1978). It is thus asign of growth, feeding intensity and degree of feed utilization in the fish.The mean condition factor (K) obtained for *Heteroclarias* in pond A were 1.08, 1.01 and 1.06, while in pond B the mean condition factors were 1.02, 1.00 and 1.03 in September, October and November respectively.[33](Fafioye, and Oluajo, 2005),described 'k' value between 0.64 and 1.99 for five fish species at Epe Lagoon, Nigeria. The value obtained from this study showed that *Heteroclarias* in pond A and B were in good condition.[34](Odedeyi, Fagbenro, Bello-Olusoji and Adebayo, 2007),conveyedthat there was decrease in condition factor with increase in individual sizes. Condition factor of *Heteroclarias* in both ponds experimented was at a suitable range showing that the experimental fingerlings were in good state from the beginning through to the end. However, results showed that 'K' was better for the fish in Pond A than in Pond B.

Productivity / Yield was detected to be greater in pond A (with pondtoss) than in pond B (without pondtoss),because pondtoss increased the buildup of the various planktonic groups in the pond which may have served as natural food for the fingerlings, reduced the likelihood of disease outbreak and thus the effect of cannibalism was reduced since zooplankton remainedricher in pond A than pond B. The probioticalso had a positive effect on pond water by increasing or enhancing the quality of water, thereby providing more conducive and favorableconditions for the fingerlings. The dissolved oxygen, alkalinity, pH, and ammonia were all of more optimum levels in pond A than in pond B, as a consequence of the application of the probiotic, Pondtoss. November had the highest yield in pond A (with Pondtoss),when 42,250 fingerlings were harvested whereas in pond B (without pondtoss) 30,200 fingerlings were harvested. October yield in pond A was 34,500 fingerlings while, in pond B 22,428 fingerlings were harvested. Pond A in September had a yield / output of 25,200 fingerlings while pond B had productivity output of 15,000fingerlings.Consequently, therefore, it was observed that the pond with probiotic produced a better condition and yield of *Heteroclarias* fingerlings.

Owing to the statistic that Fish production in Nigeria is increasingly becoming lower than Demand and expansion in facilities and infrastructure are finite in nature, this research was carried out to explore intensification in aquaculture through the use of probiotics.

V. Conclusion

The result of the research showed that pondtoss-probiotic can play a keyrole in sustainingoptimal water parameters and plankton abundance, resulting in the production of fingerlings in better condition,greater population and eventual fish yield.

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