THE RELATIONSHIP BETWEEN SOME PHYSICOCHEMICAL PARAMETERS AND PLANKTON COMPOSITION ON FISH PRODUCTION IN PONDS

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ABSTRACT

The effect of physico-chemical parameters and plankton composition on fish production in ponds was investigated in six fish farms viz. (1) Zartech Farms, Ibadan, (2) Oladipupo Fish Farms, Epe (3) Busal Fish Farms, Victoria Island, Lagos, (4) Oba Farms, Aja, Lagos, (5) Glorious Farms, Lageiu, Ibadan and (6) Sunbeg Farms, Oluyole, Ibadan for eight weeks. The physicochemical parameters investigated were temperature=25-30°C, transparency=0.45-0.57m, dissolved oxygen=3.0-10.9 mg/l, pH=6.0-7.7, dissolved carbon dioxide=5.46-28.3 mg/l, total alkalinity=44.37-80.0ppm, chemical oxygen demand=31.88-72.18 mg/l and biological oxygen demand=0.66-48.34 mg/l. Plankton composition varied and was made of four families of phytoplankton namely: Cyanophceae, Chlorophyceae, Dinophyceae and Diatomida; and four families of zooplankton viz: Protozoa, Rotifera, Copepoda and Dinoflagellates. Farms 1 and 6 recorded the highest average weight of about 1.0 Kg and average total length of about 40.0cm for the two fish species. This study showed that fish yield was dependable on the quality and management of pond water characteristics.

Key words: Fish production, physicochemical parameters, plankton, *Heterobranchus longifillis* and *Heteroclarias* sp

INTRODUCTION

Fish growth depends on water quality in order to boost its production and physicochemical parameters are known to affect the biotic components of an aquatic environment in various ways (Ugwumba and Ugwumba, 1993). A knowledge of hydrological conditions and plankton of any body of water is not only useful in assessing its productivity, but will also permit a better understanding of the population and life cycle of the fish community (Adebisi, 1981; Ayodele and Ajani, 1999). Dhawan and Kaur (2002) observed that feeding and fertilization work together to make efficient and effective increase in fish production. It then follows that the stocking rate of ponds will determine to a large extent, the optimum quality of fish to be reared per unit area of ponds, since there is always a complex way of feeding (food chain) which results from the close association of various organisms that live, grow and multiply in water (Boyd and Lichtkoppler, 1985).

In the presence of environmental stress such as low dissolved oxygen, high temperature and high ammonia (Boyd, 1981) the ability of organisms to maintain its internal environment (i.e. metabolism, catabolism and reproduction) is reduced (Ezra and Nwankwo, 2001). In view of this, monitoring of water quality, which centers on determination of optimal, sub-lethal and lethal values of physicochemical parameters standardized for fish culture should be embraced (Body and Lichtkoppler, 1985). Such physicochemical parameters include dissolved oxygen (DO_2), temperature, dissolved carbon dioxide (DCO_2), pH, conductivity, chemical oxygen demand (COD) and biological oxygen demand (BOD).

Several of these physicochemical parameters have been studied on indigenous habitats (APHA, 1991, Boyd, 1981, King, 1998, Ezra and Nwankwo, 2001 and Fafioye *et al.*, in press). However, pond habitats can be easily manipulated by controlling the water characteristics for an optimum environment yielding high level fish production. This study therefore focuses on :

(a)estimation of some physcio-chemical parameters (i.e. temperature, transparency, dissolved oxygen, pH, DCO_2, COD and BOD) of six Fish Farms viz. Zartech (Ibadan), Oladipupo (Epe), Busal (Lagos), Obas (Aja), Glorious (Ibadan) and Sunbag (Oluyole).
(b) abundance of plankton i.e phyto and zooplankton
(c) suitability of pond water for fish production.

Materials and Methods

Six fish farms viz. Zartech (Ibadan), Oladipupo (Epe), Busal (Lagos), Obas (Aja), Glorious (Ibadan) and Sunbag (Oluyole) were studied. In each fish farm, four ponds were randomly sampled and results presented in a generalized form as these farms were observed to use similar feeding regime.

Water samples were taken from each experimental pond at the different sites once a week for eight weeks at 09.00hrs. Readings of some water parameters were done on the sites while the others were estimated at the laboratory.

Temperature: Mercury in glass thermometer (50°C) was lowered into water up to 2cm below the water surface, allowed to stabilize for 2 minutes and readings were taken in degree Celsius (°C).

Transparency: A weighted secchi disc of 20cm in diameter, painted in alternative black and white colours was lowered into each pond until it just disappeared and pulled up until it appeared again. The two readings were recorded and an average value was calculated to give Secchi disc transparency.

pH: The pH of samples were measured using a hand held Sigma Hanna Checker 1 pH meter.

DO_2: Winkler's titrimetric method was used to estimate the level of DO_2 in mg/l for each pond.

DCO_2 : Four drops of phenolphthalein was added to 100ml of sampled water and titrated with 0.0454N sodium carbonate (Na_2CO_3) solution till a faint pink colour was obtained. The amount of DCO_2 in mg/l was calculated as follows:

$$DCO_2/mg^{-1} = \frac{NaCO_3(ml)N.22.1000}{Volume\ of\ sample(ml)}$$

Alkalinity, COD and BOD: The values of these parameters were calculated using standard methods described by Boyd (1979) and APHA (1991).

Plankton: Plankton net (mouth area = 40cm^2, mesh size = 500µm) with a 10ml bottle attached to the apex was used to collect plankton samples. Ten vertical and horizontal hauls were made and the net was dragged over a distance of 5m to make a semi-lunar arc. Concentrated samples were poured into labelled one litre jars and 4% formalin added to preserve the organisms. The covered jars were taken to the laboratory and allowed to stand for 24 hours to obtain 10ml supernatant. Plankton species were identified with illustrationss by Jeje and Fernando (1986), while the number of plankters was estimated using the Sedgwick – Rafter counting chamber as described by Boyd (1979).

Fish: *Heterobranchus longitillis* and *Heteroclanias* sp. were the two fish species cultured in the six fish farms. Weight (kg) and length (cm) of fish were measured using top loading Metler balance and a metre wooden board, respectively. A random sampling of twenty fish per pond for each fish species was used and the average weight and length estimated at the start and end of the experiment.

RESULTS

The mean variations recorded for physico-chemical parameters of sampled ponds in the six farms are shown on Table 1. Mean water temperature ranged between 25°C (Farm 4) and 30°C (Farm 1), mean transparency ranged between 0.45 (Farm 1) and 0.57m (Farms 5 and 6), mean DO_2 was between 3.0mg/l (Farm 3) and 10.9mg/l (Farm 1), mean pH values of 6.0 (Farm 3) and 7.7 (Farm 1), mean DCO_2 was 5.46gm/l (Farm 4) and 28.3mg/l (Farm 2), mean total alkalinity was 44.37ppm (Farm 5) and 80ppm (Farm 1), mean COD was 31.88mg/l (Farm 1) and 72.18mg/l (Farm 5), while mean BOD values ranged between 0.66mg/l (Farm 1) and 48.34mg/l (Farm 3).

Phytoplankton composition of four families viz. Cyanophyceae, Chlorophyceae, Dinophyceae, and Diatomida identified were listed in Table 2. Chlorophyceae family dominated with 21.6%, followed by Diatomida (12.83%), Dinophyceae (7.25%) and Cyanophyceae (1.14%).

Zooplankton compositions of the sampled farms' pond waters were made of rotifers, copepod, protozoans and desmid (Table 3). Protozoans had the highest representatives with paramecium constituting the most abundant species (24.93%) followed by Chlamydomonas (14.87%) and Copepods (1.49%).

Weight and length of *H. longitillis* and *Heteroclarias* sp. in the six fish farms varied (Table 4). Farms 1 and 6 recorded the highest average weight of about 1.0kg for the two fish species. The average total lengths of *H. longifilis* (38.4 – 40.5cm) and of *Heteroclarias* sp. (31.5 – 35.3cm) in farms 1 and 6, respectively were highest.

DISCUSSION

The various water physico-chemical parameters recorded for the six farms were favourable for fish culture and they fell within the standard range already documented. Mean surface water temperature of 25 to 30°C recorded agreed with the ranges recorded by Hassan (1974), Ugwumba and Ugwumba (1993) and ranges earlier documented by Boyd (1979) for freshwaters. The least temperature of 25°C might be due to shading of ponds in Farm 4 by branches of trees surrounding it. This prevented sunrays from direct contact with the water surface.

Mean transparency values of 0.45 – 0.57m recorded were similar to values documented by Hassan (1974), Adebisi (1981), Egberongbe (1986), Ugwumba and Ugwumba (1993). This shows that the pond waters contain adequate nutrients hence it's being fairly turbid (Ugwumba and Ugwumba, 1993).

Mean DO_2 with higher ranges of 5 – 10.9mg/l recorded fell within the ranges documented by Swingle (1969), Boyd (1979) and Alabaster (1982) for good water quality on fish culture. This is because oxidation coverts otherwise poisonous compounds to useful material. It also encourages good feeding, food utilization and high stocking density of fish eggs, larvae and adults (Alabaster, 1982).

The average pH values of 6.0 – 7.7 recorded in this study were within pH values of 6.5 – 9.0 documented by Swingle (1961) and Boyd (1985) as values most suitable for fish production for maximum productivity.

The mean total alkalinity of 45 – 80ppm recorded agreed with the range values documented by Moyle (1946) and Boyd (1981) for natural waters. The value of dissolved carbon dioxide (5.46 – 28.3mg/l) recorded fell within the range accepted (4.5 – 60mg/l) for fish production (Haskel and Davies, 1958; APHA, 1991).

The mean values recorded for both biological and chemical oxygen demands (BOD and COD) were according to the values documented by Boyd (1979; 198[illegible] 1985). The marked differences of the values of these physico-chemical parameters in the different farms might be due to effects of temperature, plankton density and concentration of organic and related factors.

The phytoplankton compositions of each fish farm agreed with the reports of Adebisi (1981) and Ayodele and Ajani (1999) that blue-green algae, green algae and diatoms dominate many tropical African lakes. The zooplankton composition that was dominated by *Paramecium* and followed by *Chlamydomonas* sp. was similar to Egborge (1981b) documentation. There may be alternation in abundance between Crustaceans and Rotifers as reflected in distribution and abundance of zooplankton in the sampled farm ponds. This alternation in abundance of species was reported in lake Asejire as a booster for all year round food for fish in the lake (Egborge, 1981b). Sharma and Shrestha (2001) documented similar result in fish diversity and fishery resources of the Tinau River, Western Nepal. Therefore it may be stated that there was a consistent availability of zooplankters to the fish species throughout the culture period in the experimental farms.

The relationship between fish yield and water pararneters showed that no single parameter can be singled out in relation to fish growth and health. However, five of these parameters (i.e. temperature, DO_2, transparency, pH and alkalinity) must be kept at optimal level to guarantee high fish yield. The high temperature of 30°C and 27°C recorded for Farms 1 and 6, respectively, might have resulted in better feeding and food conversion for the fish. This, according to Lin (1951) who documented temperature range of 27 and 32°C will allow tropical fish to eat more and grow faster. Water transparency is inversely proportional to the abundance of most plankton; hence an increase in plankton will reduce transparency of water. But an increase in plankton will avail ample food availability to fish for high productivity as reported in Farm 1 (Dhawan and Kaur, 2002). Therefore, it is concluded that all the listed physico-chemical parameters studied and the plankton composition documented gave average requirement for all the parameters needed for fish growth and survival, the fluctuation accounted for the different fish yields, while the ponds' waters were suitable for fish production.

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