

# Chemical Compostion of Earthen Pond Feed from Spring Water, in Asaba Campus, Asaba, Delta State, Nigeria

Olele Nkeonyeasua Florence, Nwabueze Arimiche Agatha and Ekelemu Jerimoth Kesiana

*Department of Fisheries, Delta State University, Asaba Campus, PMB 95074, Delta State, Nigeria*

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**Abstract:** Sound pond productivity accompanied with adequate fish health is maintained, when water quality parameters are conducive. The study evaluated the chemical composition of a pond feed from spring water, in Asaba Campus. Sampling was carried out from September 2011 to February 2012 on a monthly basis. Surface water samples were collected between the hours of 7:00-9:00 am from the pond on each sampling day. Hydrogen-ion-concentration was in the range of 6.5 to 8.0 units. Dissolved oxygen was the highest in February 2012 with a value of 11.0 mg/L while it was the lowest in December 2011 with a value of 9.0 mg/L. Biological oxygen demand ranged from 3.5 to 5.0 mg/L. The chemical oxygen demand was the highest in December (10.00 mg/L) and lowest between January and February (8.0mg/L). The highest alkalinity was observed in October with a value of 1.05 mg/L and lowest in December with a value of 0.042 mg/L. Conductivity values ranged from 0.075 to 0.12  $\mu$ S/cm. Total phosphorus was the highest in October with a value of 1.01 mg/L and lowest in December with a value of 0.83 mg/L. Total dissolved solids ranged from 90 to 105 mg/L. Values of physico-chemical parameters revealed that the pond was not polluted. Water quality analysis of the aquatics is of economic advantage to the fish farmer, hence, the need for its assessment at regular intervals. This is a quality assurance process that assures early dictation of toxic substances and mitigation processes to adopt before problems arise. In this way, the good health of organisms in the aquatic ecosystem and those of human dependent on them are guaranteed.

**Key words:** Chemical composition, pond water, spring water, Asaba campus, Asaba, Delta State, Nigeria.

## 1. Introduction

Water bodies are potential media for the production of aquatic organism [1]. This is because such media are conducive for the functioning and sustenance of aquatic lifes [2]. Access to regular and adequate, supply and maintenance of good water quality will guarantee the wellbeing of aquatic organisms for a successful aquaculture venture.

Fishes like other organisms have tolerable limits for water quality parameters in which they perform optimally. Any abnormal drop or increase within these limits adversely affects their body functions [3]. The recent increases in intensive aquaculture production in

Nigeria require adequate knowledge of water quality in order to apply necessary management measures as the need arises [4].

Water quality is the combination of properties of water that are manifested in relation to their usage for human activities and usage by other living creatures etc. [5]. Water is the most abundant compound on the Earth's surface, covering about 70% of the planet [6]. Springs are the surface evidence of a vast underground water resource [7]. According to both authors, most springs have conductivity ranges between 120 and 4,300  $\mu$ S/cm. However, the specific conductance of spring water recommended was generally less than or equal to 500  $\mu$ S/cm. They opined that such conductance indicates the presence of small amounts of minerals dissolved in them [8]. The quality and

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**Corresponding author:** Olele Nkeonyeasua Florence, Ph.D., associate professor, research fields: fish breeding and hydrobiology. E-mail: nkeonyeasua.olele@uniben.edu.

quantity of water discharged by springs varies greatly because of factors such as the quality of water recharging the aquifer and the nature of bedrock/substratum over which the spring water flows through [9]. Water quality could be impaired when freshwater mixes with pockets of ancient seawater in the aquifer or when seawater along the coast mixes with spring water, thus representing the general water quality in the ground-water system [9].

Chemical composition of spring water are oxygen demand (8.5 mg/L), biological oxygen demand (4.5 mg/L), total dissolved solids (102 mg/L), pH (7.2 units) and dissolved oxygen (10 mg/L) concentrations [10]. The Albert Agriculture and Rural Development reported standard composition for spring water as follows: hardness (48.00 mg/L), conductivity (0.05 mS/cm), total phosphorus (0.79 mg/L), fluoride (0.50 mg/L), nitrite (1.00 mg/L), nitrate (1.4 mg/L), chloride (19.7 mg/L), sodium (18.1 mg/L), potassium (8.77 mg/L) and ammonia (0.97 mg/L) [11]. It was reported that the overall pH range for spring water was generally between 6 and 8 units [12]. From the fore reports, it is evident that no study has been conducted on the chemical composition of the pond of study. The environment of the pond is a dumping ground for domestic wastes disposal from—inhabitants in that locality. Knowledge of the water quality status and probable extent of pollution in the pond becomes essential in order to preserve its valuable resources for future generation.

## 2. Materials and Methods

### 2.1 Study Area

The study area is located between longitude 06°49'E and latitude 06°14'N of the equator. The pond lies in the tropical rainforest zone, characterized by seven months of rainy season that spans between April and October, punctuated by a short break in August when there was very little or no rainfall. The annual rainfall of the study area ranged between 1,500.0 and 1,849.3 mm [13].

### 2.2 Sample Collection

Sampling was conducted between September, 2011 and February, 2012 from the ponds on a monthly basis, between the hours of 7:00 and 9:00 am on each sampling day. The samples were immediately conveyed in an ice chest to the Fisheries Laboratory (located within the campus) for chemical analysis as reported [14].

Mean monthly concentrations for pH, dissolved oxygen, biological oxygen demand, chemical oxygen demand, alkalinity, conductivity and total phosphorus were analyzed using standard procedures [15].

### 2.3 Statistical Analysis

Data generated from the laboratory, were subjected to one way analysis of variance (ANOVA) using the SPSS software. Differences between means were separated using Duncan's Multiple Range Test (DMRT).

## 3. Results and Discussion

Water quality studies are essential for setting base line standards [14]. This is because against these standards further studies can be evaluated.

### 3.1 Chemical Oxygen Demand (COD)

Data on chemical oxygen demand (COD) of the pond are presented in Table 1. Significant differences ( $P < 0.05$ ) were observed during the months. The table further shows that the highest value for COD was recorded in December 2011 with a value of 10.00 mg/L and lowest between January and February 2012 with a value of 8.0 mg/L. These values were higher than those reported in dug well pond having a range of  $2.15 \pm 0.16$  mg/L to  $2.64 \pm 0.14$  mg/L; and for borehole tank with a range of  $1.27 \pm 0.06$  mg/L to  $2.21 \pm 0.52$  mg/L [16]. However, higher values were recorded in earthen ponds 30.87 mg/L to 134.65 mg/L by the same researchers. The higher value of 162-397 mg/L reported [14] corroborates with the results of other researchers [17], but were in contrast with those

of present study.

Chemical oxygen demand determines the concentration of oxygen required for chemical oxidation of organic matter. It also shows the amount of dissolved oxygen used for the oxidation of organic matter including the non-biodegradable matters present in the habitat. Low concentration indicates the presence of low organic matter, while high concentration indicates pollution resulting from high organic matter decomposition [16]. The concentration in this study shows that the pond was not polluted. This revelation is based on the fact that the pond contains low concentration of organic matter.

### 3.2 Biochemical Oxygen Demand (BOD)

Biochemical oxygen demand varied significantly during the study. The highest value was 5.5 mg/L while the least was 3.5 mg/L Table 1. Both values are below the standard limits of 30 mg/L, reported for polluted water [18]. This observation was suggestive that the pond water of study was not polluted and so the fishes may not be negatively affected. However, a lower permissible limit of 4 mg/L for polluted water was reported [19]. This later value was comparable with those of present study, where a value of 5.5 mg/L was observed. This revelation suggests that the pond of study was likely to be experiencing mild pollution. Data realized from the present study was slightly higher than those reported [14] where a range value of 1.69 to 3.38 mg/L was observed. The accumulation of low concentration of BOD in stressed organisms could be suffocating to organisms, leading to death [19].

### 3.3 Dissolved Oxygen (DO)

Table 1 shows variation in dissolved oxygen concentration in the pond of study. The values were highest in February 2012 (11.0 mg/L) and lowest in December 2011 (9.0 mg/L). No significant differences were noticed for the data realised in the months of November and January. The values [16] reported in dug well pond ( $4.8 \pm 0.76$  mg/L to  $6.30 \pm 0.17$  mg/L)

was lower and in contrast with those of the present study. Similarly, the dissolved oxygen concentration of borehole tank reported by same authors was equally low  $4.22 \pm 0.18$  to  $5.74 \pm 0.52$  mg/L. Other values reported in earthen ponds were even lower, ranging from 2.35 to 6.25 mg/L [16]. The high concentration of dissolved oxygen in the present study shows that the pond was not polluted. This observation emanates from the fact that the pond is supplied from nearby spring that flow's in from a height. This action entraps oxygen, which enriched its concentration in the pond. The pond may also have had the high capacity to hold oxygen. Data on dissolved oxygen (9.0-11.0 mg/L) obtained from this study was lower than those reported [20], 9.3-16.2 mg/L. They opined that the minimum value of oxygen required in any tropical fish culture was 5 mg/L. Dissolved oxygen in its aqueous state plays a vital role in the biology of cultured organisms [21].

### 3.4 Total Dissolved Solid (TDS)

The total dissolved solid observed in the present study varied from 90 mg/L in February to 105 mg/L in December, Table 1. This value was in contrast with those of researchers [14] who reported higher values (22-960 mg/L) where farmers used feeds to supplement pond nutrients. Opinion expressed by other researchers [22, 23] revealed that feeds introduced into ponds during fish rearing often increased the total dissolved solids which may pollute the system. The total dissolved solids of dug well pond [16] were comparable with those of present study. It ranged from  $100.91 \pm 12.1$  mg/L to  $120.78 \pm 0.40$  mg/L. Similarly, the variation in total dissolved solids of borehole tank ranged from  $88.21 \pm 0.72$  mg/L to  $111.34 \pm 2.05$  mg/L [16]. Higher values were also reported [16] for analysis made in earthen pond whose values ranged from 323 to 1,132 mg/L.

In water bodies, total dissolved solids could be high especially when they are composed of carbonates, bicarbonates, chlorides, phosphates and nitrates of

**Table 1 Mean chemical composition of a pond feed by spring water.**

Sampling period	COD (mg/L)	BOD (mg/L)	DO (mg/L)	TDS (mg/L)	pH units	Total (mg/L)	alkalinity	Conductivity ( $\mu$ S/cm)	P (mg/L)
Sept.	9.00 <sup>c</sup>	5.00 <sup>b</sup>	9.50 <sup>d</sup>	100.00 <sup>ab</sup>	8.00 <sup>a</sup>	0.08 <sup>b</sup>		0.080 <sup>ab</sup>	0.85 <sup>b</sup>
Oct.	8.50 <sup>d</sup>	4.50 <sup>c</sup>	10.00 <sup>c</sup>	102.01 <sup>ab</sup>	7.50 <sup>b</sup>	1.00 <sup>a</sup>		0.100 <sup>a</sup>	1.01 <sup>a</sup>
Nov.	9.50 <sup>b</sup>	4.00 <sup>d</sup>	10.50 <sup>b</sup>	98.00 <sup>b</sup>	6.50 <sup>cd</sup>	1.05 <sup>a</sup>		0.075 <sup>b</sup>	0.90 <sup>ab</sup>
Dec.	10.00 <sup>a</sup>	3.50 <sup>e</sup>	9.00 <sup>e</sup>	90.00 <sup>c</sup>	7.00 <sup>c</sup>	0.042 <sup>c</sup>		0.090 <sup>a</sup>	0.83 <sup>b</sup>
Jan.	8.00 <sup>e</sup>	5.50 <sup>a</sup>	10.55 <sup>b</sup>	103.03 <sup>ab</sup>	6.80 <sup>c</sup>	0.070 <sup>b</sup>		0.120 <sup>a</sup>	0.95 <sup>a</sup>
Feb.	8.00 <sup>e</sup>	5.00 <sup>b</sup>	11.00 <sup>a</sup>	105.30 <sup>a</sup>	7.88 <sup>a</sup>	0.045 <sup>c</sup>		0.083 <sup>ab</sup>	0.79 <sup>c</sup>

Values with the same superscript on the same column are not significantly different at ( $P > 0.05$ ) confidence limits. Where COD = chemical oxygen demand, BOD = biological oxygen demand, DO = dissolved oxygen, TDS = total dissolved solids, pH = hydrogen ion concentration and TP = total phosphorus.

calcium, magnesium, sodium, potassium manganese, organic matter, salt and other particles [16]. High values reflect the extent of pollution, while low values reflect conductive water quality. The highest amount of TDS observed in the present study is low (105.30 mg/L) when compared to 500 mg/L reported by Standard Organization of Nigeria, 2007. The pond of study is therefore not polluted.

### 3.5 Hydrogen-ion-concentration (pH)

Values for pH in this study ranged from 6.5 to 8.0 units Table 1. Significant differences ( $P < 0.05$ ) were observed throughout the months except in December and January when no significant difference was recorded (Table 1). Values of this parameter could be compared with a value of 8.2 to 9.45 reported [16]. High pH values were a reflection of the alkaline nature of the pond [16]. This happening is a direct reflection of high temperature that reduced the solubility of carbon-iv-oxide. High photosynthetic activities could equally result to increased pH value. Adequate pond productivity and fish health could be maintained, when water pH was conductive. Adequate and desirable pH for freshwater pond as observed in the present study was 6.5-8.0. Similar pH ranges reported by other researchers are as follows: 5.5-10.0 units were reported [24]; 7.3-8.3 units were reported [25] while a range of 6.75-7.10 units was reported [14]. The desirable range for pond pH was 6.5-9.5 while a range of 5.5-10.0 units could still be acceptable [24].

### 3.6 Total Alkalinity

Alkalinity was the highest in November with a value of 1.05 mg/L and lowest in December with a value of 0.042 mg/L, showing that from alkalinity view point, the water quality of the pond of study was conductive. Data of the present study was lower than the value 10.6 mg/L, reported [26] and 10.04-12.47 mg/L [14]. Alkalinity is the buffering capacity of water. Waters with high alkalinity are undesirable because of the associated excessive hardness or high concentrations of sodium salts contained in them [14]. However, the reported alkalinity in the present study was within the acceptable range for aquaculture practices [27]. An alkalinity range of 25-100 mg/L, recommended [28], was far higher than the ones reported earlier. Thus, the result of this study in terms of alkalinity was not supportive of those reported [28]. Alkalinity concentration was important for fish culture, because it was a measure of the calcium and magnesium status of the water body.

The alkaline nature of water bodies emanates from the presence of OH, CO<sub>3</sub> and HCO<sub>3</sub> ions, together with the ability of the water to resist changes in pH upon addition of acid. The alkalinity of dug well pond was low [16]. The high alkalinity reported during certain months of the study may be due to low water table and lower temperature bringing down the rate of decomposition of salts to a minimum thereby increasing alkalinity [16].

The alkalinity range of 35 to 135 mg/L reported [14]

was higher than that of the present study. A higher alkalinity range of 171.2-235.5 mg/L was reported for unpolluted pond [29]. The conflicting data on the standards for evaluating water bodies based on their alkalinity concentrations needs to be substantiated from further studies.

### 3.7 Conductivity

The conductivity value of the present study was in the range of 0.075 to 0.12  $\mu\text{S}/\text{cm}$ , Table 1. A higher level 5.06-7.017 mS/cm of conductivity was reported from a natural body of water in Okada town [30]. This result was not supported by those of this present study. However, a lower value 0.006-0.017 mS/cm was reported [14].

### 3.8 Total Phosphorus

Variations in phosphate content of the pond were shown in Table 1. It was the highest in October with a value of 1.01 mg/L and lowest in December with a value of 0.83 mg/L, Table 1. These values were in line with the value of 1.00 mg/L reported [31, 32]. These values were not comparable with the value of 1.47 mg/L reported from polluted water [14]. Phosphate content in dug well ponds ranged from  $1.65 \pm 0.06$  to  $2.37 \pm 0.17$  mg/L, while those from borehole tanks ranged from  $1.14 \pm 0.09$  to  $2.36 \pm 0.03$  mg/L [16]. Phosphate occurs in natural waters at reduced concentrations as many aquatic plants absorb and store phosphorous many times their actual immediate needs [16]. Observance of high concentration may be due to solar radiation, which might have encouraged the biological degradation of organic matter present [14, 16].

## 4. Conclusions

The pond of study was not polluted based on results of the chemical parameters observed. Although frequent water quality analysis may not be of economic advantage to the fish farmer, the need to embark on it as often as possible is paramount. This is

because such analysis ever remains a quality assurance process to ensure that there are no toxic substances in the ponds leading to possible bio-accumulation. In this way the good health of the aquatic ecosystem, humans and environment can be guaranteed.

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