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**Water Physico-Chemical Parameters Inter-Relationship and Heterotrophic Fungal Count of Ureje Dam in Ekiti State, Nigeria.**

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**Abstract**

The study of water quality and heterotrophic fungi count have great impact on the quality of aq`uaculture production. The interaction among water physico-chemical parameters of Ureje dam in Ekiti State and heterotrophic fungal count was studied from January to May, 2017 and five water samples were collected once every month at different depths using water sampling bottles. The dissolved oxygen, temperature, pH and water transparency were measured while the malt extract method was used for fungal count. The results show a mean of 22.680C for temperature, 7.41 for pH, 4.1mg/l for dissolved oxygen, 162.97µ for conductivity and 1.35 m for transparency at different depths and seasons. The highest temperature (25.20 c) was obtained in February, dissolved oxygen (6.28-6.50mg/l) was highest in January compared to other months while pH at 7.80-7.02 indicates that this water is very good for fish production. The mean pH for the wet season was 7.30 and 7.80 for the dry season. The conductivity was significantly different in all the depths and water samples collected at different days. Thus, the physico-chemical parameters observed at Ureje Dam were within the range that can support aquatic life and that the dam will be able to support diverse number of organisms from planktons, benthos to fishes and macrophytes. The fungal count was 4.2 x 102 (cfu/ml)and the major species were *Aspergillus fumigatus* (strain B), As*pergillus flavus* and *Penicillium sp.* The fungi count indicates that the water is contaminated with effluents from run-off, domestic and agricultural waste emptied into the dam via erosion.The data obtained should be used as baseline for decision making when Ureje dam is considered for human and animal use.

**Keywords**: Heterotrophic fungi, Physico-chemical, Ureje, transparency, conductivity, *Aspergillus fumigatus*

**Introduction**

It is generally accepted that good water quality is needed to maintain viable aquaculture production (King, 1998). This is because poor water quality results in low profit, low product quality and potential human health risks. The reduction in production occurs when the water contain contaminants that can impair development, growth, reproduction, or even cause mortality to the cultured species (Stone and Thormforde, 2003). Some contaminants may cause no obvious adverse effects but accumulate to the point where they threaten human health even at low concentrations (King, 1998). Efficient feed conversion, growth and marketability of the final product cannot occur unless the pond system is balanced or in harmony with nature. Therefore, the overriding concern of

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aquaculturist is to maintain, ‘balance’ or ‘equilibrium conditions’ with respect to water chemistry (Wurts, 2000). The required water quality is determined by the specific organisms to be cultured and has many components that are interwoven. Sometimes a component can be dealt with separately, but because of the complex interaction between the components, the composition of the total array must be addressed (Wurts, 2000).

Water quality for aquaculturist refers to the quality of water that enables successful cultivation of the desired fish species. Water is known to contain large quantities of chemical elements and physical parameters. The inter – relationship of both the physical and chemical parameters plays a great and important role in distribution and abundance of aquatic organisms (Summerfelt, 2008). Thus testing the quality of water is an important part of environmental monitoring because when water quality is poor it affects not only aquatic life but the surrounding ecosystem as well. Ground water is considered much more desirable for aquaculture because it has much more consistent water quality than surface water, and it is less likely to be contaminated by pathogens. As it may be impractical to regulate the volume of water in open ponds, species selection is largely dependent on the kind of water available (Huet, 2008).

There is a strong relationship between the quality of the water in the pond and that in the water-surrounding environment (Boyd, 1995). The fish perform all its physiological activities in the water – breathing, excretion of waste, feeding, maintaining salt balance and reproduction. Thus, water quality is the determining factor on the success or failure of an aquaculture operation. Optimal water quality varies by species and must be monitored to ensure growth and survival. The quality of the water in the production systems can significantly affect the organism's health and the costs associated with getting a product to the market. Water quality parameters that are commonly monitored in the aquaculture industry include temperature, dissolved oxygen, pH, alkalinity, hardness, ammonia, and nitrites. Depending on the culture system, carbon dioxide, chlorides, and salinity may also be monitored. Some parameters such as alkalinity and hardness are fairly stable but dissolved oxygen and pH fluctuates daily. It is important to establish a standardized water quality testing protocol for particular situations, know the tolerance range for the culture species, establish critical levels, and be prepared to act if a problem occurs (Boyd, 1998). Research and development in water quality have been going on for decades (Dunning et al, 1998). The balance of physical, chemical and biological properties of any given water body is thus an essential ingredient for successful production of fish and other aquatic resources. The presence or absence of certain chemical elements in a water body might be a limiting factor in the productivity of such water body (Adeosun *et.al*, 2014). Water quality should be maintained at levels sufficient for supporting healthy and fast growing fish. Operating a fish farm under limited water quality conditions can reduce the profitability of fish farming because the water quality problems can later lead to stress and reduce growth. These also increase the risk of infectious disease outbreaks and catastrophic loss of fish (Apeloko, 2013).

The objective of this study are to; analyze the temperature, pH, dissolved oxygen, conductivity and transparency of Ureje dam at different depths during the dry and wet seasons, determine the inter – relationship between the physico – chemical parameters of Ureje dam at different depths and compare the values of physio–chemical parameters of Ureje dam at different depths and seasons.

**Materials and methods**

**Study site**

The study was carried out at Ureje Dam (7º37'N, 5º13'E) in Ado local Government Area, Ekiti State.



Fig 1: Google map of Ureje Dam

**Water sample collection**

Water samples were collected once every month at different depths between January and May, 2017 and a total of five samples were taken using water sampling bottles. The sampling bottles were rinsed thoroughly with the dam water. Water samples were taken on board from canoe, the samples were taken very early in the morning at depth 30cm, 60cm and 90cm by avoiding trapping of atmospheric oxygen and holding the bottles upward. The samples were taken to the Department of Fisheries and Aquaculture Management, Ekiti State University for analysis using APHA, (1985) methods.

D**issolved oxygen analysis**

The concentration of dissolved oxygen in the sample collected was measured using Winkler’s titration method.

**Temperature**

Readings was taken in the laboratory using mercury – in – glass thermometer graduated in degree Celsius (0C). The thermometer was placed in water sample for about 5 minutes for it to stabilize after which the reading was taken and recorded and this was done thrice and the mean was determined.

**pH**

The pH meter electrode was dipped in the water sample; the readings were taken and recorded.

**Conductivity**

Conductivity meter was dipped in the water sample and reading was taken and recorded.

**Transparency**

Water transparency was measured with a Secchi disk. A Secchi disk is a metal disk, 8 inches in diameter that is lowered into the water on a cord. The depth that the Secchi disk can no longer be seen through the water is the Secchi depth. When the water transparency is high, the Secchi depth is high. When the water transparency is low and cloudy, the Secchi depth is low.

**Total heterotrophic fungal count**

The fungal count of the dam was done using malt extract. The medium was prepared according to Premalatha (2001) procedure and was sterilized at 1210C in the autoclave for 15 minutes. One mililitre of each dilution of the water samples from Ero dam and Ureje dam was plated out in duplicates into sterile petri dishes. The prepared malt extract agar of 10 mls in molten form was poured into the petri dishes holding 1 mililitre of water sample using pour plate method. For the agar to solidify, the petri dishes were allowed to stand. The plates were labeled accordingly and incubated at 300C for 5 days. The developed colonies were observed and counted while the isolates were identified using methylene blue stain.

**Results and Discussion**

**Results**

Table 1 shows the physic-chemical parameters determined in water samples collected from Ureje Dam.

**Temperature**

Temperature at date 1, 3, 4 and 5 did not differ with depth but decreased with depth at date 2. The highest temperature was recorded throughout the period water was sampled at date 2; depth 30 and 60.

**pH**

The pH values were not significantly different with depth at date 1, 2, 3, 4 and 5.

**Dissolved oxygen**

Dissolved oxygen though reduced with depth at dates 1 and 3 but the values were not significantly different at date 1 and date 3 at depth 30. Dissolved oxygen reduced at date 4 in depth 60 and 90 and also at date 5 in all the depth.

**Conductivity**Conductivity decreased at date 1 and 2 and increased at date 3, 4 and 5.

**Table 1:** The physico-chemical parameters of water samples in Ureje dam.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Period | Depth [cm] | Temperature [0C] | pH | DO2 [mg/l] | Conductivity [µ] |
| Day 1  (24/1/17) | 30  60  90 | 22.40±0.06a  21.68±0.03a  22.07±0.03a | 7.80±0.00a  7.51±0.00a  7.40±0.00a | 6.50 ± 0.05a  6.43 ± 0.21a  6.28 ± 0.02a | 256.67 ± 0.03a  270.33 ± 0.33a  269.33 ± 0.33a |
| Day 2  (20/02/17) | 30  60  90 | 25.23±0.09b  25.13±0.12b  22.53±0.03a | 7.25±0.02a  7.04±0.06a  7.02±0.02a | 5.50 ± 0.20a  5.58 ± 0.08a  3.75 ± 0.03b | 285.67 ± 0.03a  272.67 ± 0.88a  272.33 ± 1.33a |
| Day 3  (3/03/17) | 30  60  90 | 21.30±0.06a  20.13± 0.03a  20.30±0.06a | 7.40±0.00a  7.40 ± 0.00a  7.43 ± 0.03a | 4.06 ± 0.02a  3.34 ± 0.04b  3.20 ± 0.02b | 310.33 ± 0.33a  308.67 ± 0.33a  304.00 ± 2.08a |
| Day 4  (11/04/17) | 30  60  90 | 22.47±0.03a  21.40±0.06a  22.03±0.03a | 7.30 ± 0.00a  7.30 ± 0.00a  7.33 ± 0.03a | 4.05 ± 0.05a  3.10 ± 0.20b  3.10 ± 0.30b | 318.67 ± 0.33a  310.33 ± 0.33a  310.33 ± 0.58a |
| Day 5  (11/05/17) | 30  60  90 | 21.63±0.07a  21.97±0.03a  22.03±0.03a | 7.27 ± 0.01a  7.33 ± 0.01a  7.40 ± 0.02a | 1.70 ± 0.20b  2.30 ± 0.03b  2.00 ± 0.03b | 317.27 ± 0.01a  317.33 ± 0.01a  317.39 ± 0.02a |

Means with the same superscript are not significant (P<0.05) using SPSS

**Comparison of temperature at different, depths and dates**

Fig. 2: Temperature of water collected at different depths and dates

As shown in fig 2, highest temperature was recorded on date 1, 2, 3 and 4 at depth 30 while on date 5, it was recorded at depth 90. The highest overall temperature recorded was on date 2 and at depth 30 while the lowest was on date 3 at depth 90.

**Comparison of pH at different dates, depth and season**

Fig. 3: Effect of sampling dates and depth on pH of water samples

Fig 3 shows the pH values as affected by sampling depth and date. The overall highest pH recorded was on Date 1 and at depth 30 and lowest on Date 2 and at depth 90. Date 1, 2, 3, 4 and 5 had the highest temperature at depths 30, 30, 90, 90 and 90 respectively while the lowest was at depths 90, 90, 30/60, 30/60 and 30 respectively

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**Comparison of DO2 at different dates and depth**

Fig. 4: Effect of sampling dates and depth on DO2 of water samples

Fig. 4 shows that the overall highest DO2 recorded was on Date 1 at depth 30 and the lowest on Date 5 at depth 90. Dates 1, 2, 3, 4 and 5 had the highest DO2 at depths 30, 60, 30, 30 and 60 respectively while the lowest DO2 was at depths 90, 90, 90, 60/90 and 30.

**Comparison of conductivity at different dates an depths of sampling**

Fig. 5: Effect of sampling dates and depth on conductivity of water samples

As shown in Fig 5, conductivity decreased with time at dates 2 and 3. The highest conductivity was recorded on date 4 and the lowest was on date 1. It was also revealed that as dates increases, conductivity increased.

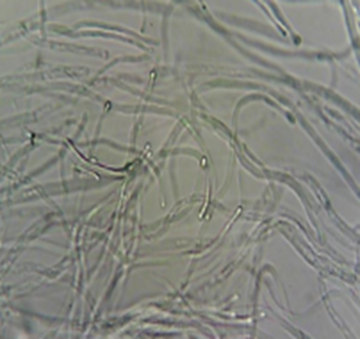
**Total heterotrophic fungal count (HFC).**

Table 2 shows the heterotrophic fungal count (HFC) of Ureje dam. *Aspergillus fumigatus* (strain B) had the mean count of 1.2x 102 (cfu/ ml) while *Penicillium sp* had the highest count of 2.0 x 102 (cfu/ml) and As*pergillus flavus* the lowest (1.0 x 102 cfu/ml).

Table 2: Heterotrophic fungal count (HFC)

|  |  |  |  |
| --- | --- | --- | --- |
| Fungal species | Heterotrophic fungal count (cfu/ml) | | |
| Minimum | Maximum | Mean |
| *Aspergillus fumigatus* (strain B) | 1.4 x 102 | 1.0 x 102 | 1.2 x 102 |
| As*pergillus flavus* | 1.0 x 102 | 1.0 x 102 | 1.0 x 102 |
| *Penicillium sp.* | 1.5 x 102 | 2.5 x 102 | 2.0 x 102 |
| Total heterotrophic count - - | | | 4.2 x 102 |

The microscopic view of fungi isolates from Ureje dam are as shown in Plate 1.



a: *Aspergillus fumigatus* (strain B) b: As*pergillus flavus c: Penicillium sp*

Plate 1: Microscopic view ofidentified fungi in water samples collected from Ureje Dam.

**Discussion**

The collection of water samples was done in the dry (January - February) and early wet (March - May) seasons, in which the amount and type of rainfall may play a significant part in regulating the various seasonal biological rhythms (Ayoade *et al*., 2006). The variations in physical and chemical conditions of fresh water ponds have generally been attributed to the effects of rainfall (Bello Olusoji *et al.,* 2006).

In the month of February, pH decreased with a rise in temperature, Kanu and Achi, (2011) reported that temperature determines fish culture conditions and any compound in pond water could bring about changes in water quality which may impair the development and survival of fish.

The fluctuation pattern showed a steady fall in the dissolved oxygen throughout the period of the experiment except for the month of April where the dissolved oxygen remained the same as in the month of march despite the rise and fall in the temperature and pH, which is in contrast with the relationship standard for water quality parameters, this could be due to a few reasons paramount amongst which is the dumping of refuse along the banks of the dam, effluents run-off been emptied into the Dam (Schwartz, 1994) and also the local people’s habit of defecating in the water. This corroborates Kanu and Achi, (2011) report that effluents are characterized by their abnormal chemical oxygen demand (COD), turbidity and conductivity. The maximum value of temperature was obtained in the month of February, this disagree with Adeosun *et al.,* (2014) whose maximum temperature was obtained in the month of March. This variance may be due to differences in the onset of wet season.

The temperature variation recorded during the study was optimum for normal growth and survival of aquatic organisms (Ugwumba *et al.,* 1993), Adebisi, (1981). Dissolved oxygen ranged between 6.28 to 6.50mg/l. These corroborate Oyekanmi *et al.,* (2017) where the average dissolved oxygen value was 6.21mg/l. Results obtained shows that the dissolved oxygen in Ureje dam is good for fish culture because throughout the five months of water collection the dissolved oxygen was not below 1.5mg/l (Adebola *et al.*, 2016).

The pH of Ureje dam (7.80-7.02) is very good for fish production. Boyd and Claude, (1979) reported that water with pH range of 5.5 to 9.0 are most suitable for fish production while Murdoch *et al.,* (2001) also stated that the optimal pH range for sustainable aquatic life is 6.5 – 8.2.

The average mean value of pH for wet season was 7.30 and dry season 7.80 (which was the peak of dry season). This might be due to the deposition of some organic matters into the Dam from run-off during wet seasons (Adefemi *et.al* 2007).

Conductivity also increased with increase in pH because increase in alkalinity hikes conductivity value. This corroborates the work of Oyekanmi *et al.*, (2017) who reported an increase in conductivity as pH increased. Dissolved oxygen reduced with increase in temperature.

It was also revealed from the analysis of February that as temperature increases, conductivity also increased, this was explained by Perlman (2014) where the interaction of electrical conductivity and temperature was studied.

*The fungi Aspergillus flavus* strain grew well at high temperature and it is an opportunistic human pathogen capable of causing diseases producing toxin called Aflatoxin B-type which can also cause liver cancer in humans (Bryden, 2012). The occurrence and presence of *Aspergillus fumigatus* and *Penicillium sp*s in the water of the dam revealed microbiological contamination and the water therefore needs to be treated by chlorination if it should be taken for drinking by man to avoid water borne diseases such as typhoid, diarrhea and cholera (Obasi *et. al* 2012).

**Conclusion and Recommendation**

The physico-chemical parameters observed at Ureje Dam were within the range that can support aquatic life. The dam has been quite productive and will support diverse number of organisms from planktons, benthos to fishes and macrophytes going by the abundance of chemical ions needed for inter-conversion of energy and production of organic materials present in the dam. The physico-chemical data obtained in this river could be used as a baseline and reference point when assessing the changes caused by nature and man within the dam. Ureje dam should be protected from destruction as a result of human activities so as to prevent the fishes from mortality.

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