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Determination of phytoplankton species in the Stomach of Tilapia Fish (*Oreochromis niloticus* L.)

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Abstract

The condition of a fish pond's physiochemical parameters determines whether it is artificial or natural. One of the most significant tropical and subtropical freshwater fish is the tilapia (Oreochromis niloticus L.), which can eat both tiny zooplankton and phytoplankton. The purpose of this investigation was to determine the phytoplankton species found in the stomach and gut of tilapia (Oreochromis niloticus L.). Based on the physical traits of the phytoplankton species, fishpond waters, fish guts, and fish stomachs were identified using established procedures. The conventional techniques were employed to measure the physicochemical characteristics. Cyanophyceae and Chlorophyceae made up the majority of the phytoplankton that was discovered in the stomach, gut, and pond waters. Anabaena and Microcystis, two potentially poisonous cyanophyta species, were the most significant and prevalent phytoplankton species discovered in the intestines of tilapia. The study area's fish pond water had physicochemical parameter values of 26.3 o/oo for salinity, 7.1 for pH, 6.3 mg/L for dissolved oxygen, and 27.4°C for temperature. The study's findings may be applied to the biomanipulation of bothersome phytoplankton blooms in pond environments. The variation in the gut and stomach phytoplanktons of Tilapia fish was thus shown by the current preliminary investigation, which may be helpful in the creation of probiotics, medications, and industrial enzyme production. The pond under study was steady and appropriate for fish farming, with the goal of reintroducing fish to areas with a deficiency of fish populations.

Keywords: Phytoplankton, Physicochemical, Tilapia, Water quality.

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INTRODUCTION

Fish and zooplankton feeding on phytoplanktons can be a major contributor to the reduction of algal blooms (Mohamed *et al.,* 2019). Tilapia (*Oreochromis niloticus* L.) is one of the most important freshwater fish that can feed on both phytoplankton and smaller zooplankton (Mohamed *et al.,* 2019). Naturally, Tilapia fish feeds on phytoplankton species, as they are rich in vitamin precursors, growth promoters and essential fatty acids (Mohamed *et al.,* 2019). However, some phytoplankton species can produce toxins that may negatively affect fish health or accumulate in their tissues posing a risk to human health upon consumption of such contaminated fish (Mohamed, 2016). Therefore, before selecting fish as food, the types of phytoplankton consumed by fish need to be determined. Food and feeding habit of fish is widely used to ascertain the analysis of phytoplankton composition in fish gut contents (Nath *et al.,* 2015)

High ingestion rates and digestion efficiencies makes tilapia to have negative effects on phytoplankton especially cyanobacteria (Mohamed *et al.,* 2019). Silva *et al.* (2014) suggested that raring tilapia is an effective way to control algal blooms in water body. Conversely, some studies reported that phytoplankton biomass are not affected by tilapia in the aquatic systems (Mohamed *et al.,* 2019). Furthermore, Semyalo *et al.* (2011) stated that there is no significant relationship between the phytoplankton in tilapia food and microcystin concentrations in the water. The present study was carried out to determine the composition of phytoplanktons in the stomach of Tilapia fish.

MATERIALS AND METHOD

Collection of fish samples and analysis of gut and stomach contents

The Department of Biological Sciences at Bayero University in Kano provided the fish samples of tilapia (*Oreochromis niloticus*) from their three aquariums. To get rid of phytoplankton that was adhered to their body surfaces, the live fish samples were cleaned with distilled water. Fish were dissected, scarified, and weighed. For microscopic inspections, the guts of each fish were removed and preserved in 1ml of Lugol's solution. According to Prescott (1978), the phytoplankton species in fishpond waters, fish gut, and fish stomach were identified based on the physical characteristics of the phytoplankton species. The digestibility of the phytoplankton species was assessed by tilapia fish. Sedgwick-Rafter was used to count these species under an inverted binocular microscope.

Physicochemical parameters

At the sample collection site, the temperature of the pond water sample was measured using a portable mercury-in-glass thermometer in a 250 ml glass beaker. HANNA Instrument's digital pH metre model HI 8424 microcomputer was used to measure the pH of pond water samples. Dissolve oxygen was determined using a portable dissolve oxygen analyzer (Danba *et al*., 2015).

RESULTS

Tables 1 and 2 display the species makeup of phytoplankton found in fishpond waters as well as in the stomach and gut of tilapia fish. Microscopic analysis of the phytoplankton composition in fishpond water and the contents of the stomach and gut showed that all phytoplankton belonged to the families Cyanophyceae, Chlorophyceae, and Euglenophyceae.

Table 1. Phytoplankton species Composition in the fishpond water (cells x10^6 gut^{-1})

Algal species	Family	Frequency ±S.E.M
Anabaena sp.	Cyanophyceae	36.0±0.14
Oscillatoria sp.	Cyanophyceae	43.0±0.11
Chlorella vulgaris	Chlorophyceae	48.2±0.33
Cladophora sp.	Chlorophyceae	45.0±0.23
Euglena sp.	Euglenophyceae	61.0±0.53
Spirogyra sp.	Chlorophyceae	58.0±0.23

Table 2. Phytoplankton species Composition in fish gut and stomach of Tilapia fish (cells x10^6 gut^{-1})

Algal species	Family	Frequency ±S.E.M
Anabaena sp.	Cyanophyceae	13.0±0.34
Oscillatoria sp.	Cyanophyceae	24.6±0.24
Chlorella vulgaris	Chlorophyceae	23.4±0.46
Cladophora sp.	Chlorophyceae	18.0±0.53
Euglena sp.	Euglenophyceae	32.0±0.33
Spirogyra sp.	Chlorophyceae	43.0±0.46

Water quality parameters measured in the fishpond water are presented in Table 2. Values observed were within the tolerant range of Tilapia. Temperature, salinity, pH and DO were recorded 27.4 ^{o}C, 26.3, 7.1 and 6.3 mg/l.

Table 3. Physicochemical parameters measured in the fishpond water

Parameters	Values ±S.E.M
Temperature (^{o}C)	27.4±0.33
Salinity (o/oo)	26.3±0.34
Ph	7.1±0.42
DO (mg/l)	6.3±0.33

DISCUSSION

The findings demonstrated that the majority of phytoplankton species found in fishpond waters are found in the stomach and intestines and are the primary source of food for tilapia fish. During the study period, the most prevalent phytoplankton groups found in the stomach and gut of Tilapia fish were the Chlorophyceae. These results are thus in agreement with those obtained by Mohamed *et al.* (2019). The abundance of phytoplankton in fishpond waters tends to affect changes in food items for Tilapia fishes. However, Salazar Torres *et al.* (2016) stated that Cyanophyceae were the most abundance in the tilapia gut and stomach contents and confirmed. More recently, Osti *et al.* (2018) found that abundance of Cyanophyceae and in fishponds was 2 to 3 times more than that in the system without tilapia, indicating the feeding of Tilapia on cyanobacteria. This is in line with the findings of this study which indicated the abundance of Chlorophyceae and Cyanophyceae. Tilapia fish feed on all *Anabaena* (Cyanophyceae) without any avoidance for toxic species. Mohamed *et al.* (2019) stated that Tilapia fish feeding on phytoplankton played an important role in reducing the abundance of bloom-forming species such as *Oscillatoria sp*. According to Salazar Torres *et al.* (2016) Tilapia has the potential to reduce approximately 60% of Cyanophyceae community in fishpond waters. The feeding habitat is one of the factors may responsible for the presence of gut biota in these fishes. Tilapia fish have been shown to have a specific indigenous gut micro-biota and it may change with fish age, nutritional status, and environmental conditions (Kanagasabapathy *et al.,* 2012). The abundance of these species in fish gut seems dependent on the density of these species in the environment and the condition of fish (Mohamed *et al.,* 2016).

Interestingly, this study showed that Tilapia could ingest both filamentous, colonial and single celled forms phytoplankton. This supports the fact that tilapia is capable of efficiently ingesting small and large phytoplankton (Mohamed, 2016). Tilapia can suppress phytoplankton biomass in freshwater bodies, with higher efficiency at feeding on larger algal and cyanobacterial forms than on small ones (Osti *et al.*, 2018). Fish do not necessarily digest and assimilate phytoplankton; this process is typically facilitated by two mechanisms: a stomach pH below 1.5, which lyses algal cell walls, and the physical grinding of phytoplankton cells between two pharyngeal plates of tiny teeth. This indicated that Tilapia fish were able to digest some phytoplankton, but not able to digest some algal cells (Mohamed and AL-shehri, 2013). This is consistent with several research' findings that the majority of phytoplankton cells can be digested by tilapia fish since their digestive systems have a pH of roughly 1.4. Mohamed *et al.* (2019) showed that Tilapia is among the very few fish species which are capable of digesting cyanobacteria.

Kanagasabapathy *et al.* (2012) reported that insects and crustaceans comprise a large portion of the diet of *Oreochromis niloticus*, *Oreochromis niloticus* have the ability of feeding on either small or bulky particles and can efficiently filter and utilize a broad range of particle sizes. The food items in the stomach content of *Oreochromis niloticus* indicates that zooplankton feed mainly on animal food substances comprising of insect pupae, insect larva, protozoa and detritus.

The results on the physicochemical parameters of the pond was compared with the water quality standard of Danba *et al.* (2015). The study's mean temperature range of 27.4°C may indicate that this parameter had no effect on the water quality and that other elements are still important for the successful production and conservation of this type of fish. The results of this investigation showed that the pH range of 7.1 indicates that the water is neutral.
This finding is in agreement with Danba *et al.* (2015), who stated that the best water for fish cultivation is that whose pH is neutral or slightly alkaline ranging from 7 to 8.

Young fishes, especially hybrid species, may die in productive ponds with daytime pH values of 10, especially if the pond has little alkalinity. One of the most significant abiotic factors affecting life in every aquatic habitat is dissolved oxygen. In the research area, the lowest soluble oxygen content was 6.3 mg/l. For fish ponds, this is often a moderate dissolve oxygen value. The moderate oxygen value could be due to the time of sampling which was done between 1:00 pm when there is photosynthesis by algae to increase the oxygen in the pond water and the oxygen manufactured in the day time has not been exhausted by fishes, bacteria and zooplankton (Danba *et al.,* 2015). Low levels dissolve oxygen less than 0.3 is a lethal concentration that can put undue stress on fish and are often linked to fish kill incidents (Rashmi *et al.,* 2014). The low or moderate dissolve oxygen could be due to the presence of microbes, phytoplankton and zooplankton as they consume high quantity of oxygen as well. Normally high dissolve oxygen is encountered in unpolluted ponds and low dissolve oxygen in polluted ponds (Ehiagbonare and Ogunrinde, 2010). Further depletion of dissolve oxygen to the level of anaerobic is most critical manifestation of pollution (Rashmi *et al.,* 2014).

CONCLUSION

The study's findings indicate that tilapia have high rates of both ingestion and digesting for various phytoplankton types. As a result, tilapia might present chances to manage dangerous cyanobacteria in pond waters. However, phytoplankton identified were Cyanophyceae, Chlorophyceae and Euglenophyceae with *Euglena* and *Spirogyra* as most abundant algal species.

The study's physicochemical parameters demonstrated that the levels attained were within allowable bounds, making them appropriate for *Oreochromis niloticus* cultivation and, consequently, aquaculture. Therefore, it is advised to continuously monitor these physicochemical properties, as doing so will yield information on preventing fish death. In order to produce larger, healthier fish for human consumption and to turn a profit, it would also benefit farmers to maintain adequate water quality in fish ponds.

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