FIRST REPORT AND PREVALENCE OF SESSILE CILIATE (*Vorticella* sp.) IN CULTURED *Clarias gariepinus* IN NIGERIA

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ABSTRACT
Fish parasites commonly cause portal for secondary infections, hindering high productivity leading to economic loss in fish production. Protozoan parasites are a significant group of pathogens affecting cultured fish. The present study was carried out to investigate the prevalence of parasites infecting different stages of cultured Clarias gariepinus in Lagos State. A total of 487 cultured Clarias gariepinus were collected randomly from different culture facilities in culture systems and parasitological examinations were conducted on them. Identification keys with morphometric criteria were used to identify Vorticella sp from other sessile ciliates. Vorticella sp. was observed on the skin and intestine. It was found in all the culture systems and developmental stages. The highest prevalence for Vorticella sp. was found on adult skin (12.84%) and intestines (3.85 %). The mean intensity of Vorticella sp. was highest on fingerlings skin (23.88) and juvenile intestine (16). The mean water parameters showed a suitable range for their survival. This study is the first report of this sessile ciliate in Nigeria, indicating that more parasites are yet undiscovered in aquaculture.
Keywords: Parasitic occurrence, predilection site, *Vorticella* sp, *Clarias gariepinus*, intensity.

INTRODUCTION

The Clariid, *Clarias gariepinus* is one of the fish regularly cultured as fish food in earthen ponds or concrete tanks in Nigeria (Akinwole and Adedayo, 2014; Oluwalola, *et al.*, 2019), owing to several favorable cultural potentials (Obiekezie and Ekanem, 1995). It is a good source of protein in human diets because of its nutritive value (Alune and Andrew, 1996). Parasites and diseases have always been associated with poor production of cultured and feral fish (Subasinghe *et al.*, 2002), they often reduce the immunity of the host thereby causing ease of secondary infections resulting in nutritive devaluation and subsequent economic losses (Onyedineke *et al*., 2010). Most often, helminths and crustacean parasites were more studied than protozoan parasites of cultured and feral fish (Lom and Dykova, 1992, Akinsanya and Otubanjo, 2006). However, more awareness has been given to parasitological studies in fish development in ponds and other fish enclosures as a result of intensification in production (Igbani, Hauwa, and Tukura, 2019). In Nigeria, several researchers have reported ecto- and endo- parasites of various fish species of catfishes (*Clarias gariepinus*, *Chrysichthys nigrodigitatus*, *Malapterurus electricus*) and Tilapias (*Oreochromis niloticus* and *Tilapia zillii*) from different aquatic ecosystems with ciliates and metazoan (Okunade *et al*, 2018; Uhuo and Obi, 2015; Eyo, Edet, and Ekanem, 2015; Adeogun *et. al.* 2014; Omeji, *et al.* 2014; Abidemi-Iromini and Eze, 2011; Omeji, Solomon and Idoga, 2011). Parasitic ciliates are pathogenic protozoans that may not be alarming in the wild but are considered to be a serious problem in aquaculture causing severe losses (Van As and Basson, 1988; Dickerson and Clark, 1996). Many cultured fishes are vulnerable to sessile peritrichs such as *Vorticella* sp., *Apiosoma* sp., and *Ambiphrya* sp., (Abdel-Baki *et al*., 2014; Woo and Leatherland, 2006; Viljoen and Van As 1985); *Apiosoma* sp (Sogbesan, Tukura, and Ekundayo, 2018); *Epistylis* sp (Viljoen and Van As, 1985) but the sessile ciliate; *Vorticella* sp., has not been reported in culture fish in Nigeria to the best of our knowledge. The sessile peritrich (*Vorticella* spp) found in fish are typically ectocommensals attaching to their substrates by a stalk (Viljoen and Van As, 1983), using their hosts as a living, moving substrate for convenient access to the source of food particles, organic debris and waterborne bacteria (Lom and Dykovà, 1992). The species of Vorticella are identified using gene sequence information (Ji *et al*., 2015; Liang *et al*., 2018) and modern molecular methods combined with morphological characteristics (Sun *et al*., 2013a; Wang *et al*., 2017). *Vorticella* species of the family Vorticellidae are one of the important peritrichs commonly found in marine, freshwater, and terrestrial biotopes (Sun *et al*., 2005; Lynn, 2008) having conical and an inverted bell-shaped body with highly contractile unbranched stalk longer than the size of the body.

They are filter feeders characterized into two forms; the trophont (possessing stalk for anchoring to the desired substratum) and a free-living telotroch (Hirst, Kita, and Dawson, 2011). *Vorticella* sp. are free-living organisms but become facultative parasites externally under adverse environmental conditions when the fishes are stressed (Basson and Van As, 2006). At high densities, sessile ciliates caused high mortality in juvenile and adult cultured fish leading to severe

economic losses globally (Van As and Basson, 1987). However, the importance of *Vorticella* sp has been reported as a target for bioengineering microfluidic devices (Ryu *et al.*, 2016), biocontrol agents for mosquitoes with a 90 % reduction in adult development (Patil., *et al.* 2016) and serves as an indicator for healthy ecosystem (Perez – Uz *et al.*, 2010).

MATERIALS AND METHODS

Sampling Techniques

Sampling was conducted from March 2017 to August 2018 and total numbers of 500 *Clarias gariepinus* were randomly collected from different culture facilities across the three Agricultural zones in Lagos State, Nigeria, and transported to the laboratory in respective jerry cans at 5 fish per container to avoid stress and mortality. A scoop net was used to harvest the fry and fingerlings while a hand net was used for juveniles and adults in concrete tanks, plastic tanks, and tarpaulin vats but dragnet for adults in earthen ponds.

Parasitological Examination

External Organs

The skin was scraped using a coverslip and the wet smear was placed on the glass slide while the operculum was opened and a small portion of the gill was cut and placed on the glass slide with a drop of distilled water and viewed under Olympus microscope at high power magnification (×40) for protozoan parasites (Hanish, 2010; Ekanem *et al.* 2011) and identified using appropriate keys (Viljoen and Van As, 1983; Lom and Dykova, 1992; Jayasree *et al*., 2001).

Internal Organs

The internal organs observed were the intestine, liver, and trunk kidney. The abdomens of the fish (excluding the fry) were incised with scissors and a scalpel to open the visceral to locate the desired organs. The intestine was longitudinally incised and the waste was removed to expose the intestinal wall which was scraped and the content was smeared on the glass slide for parasitic examination. The quantum size of the liver and trunk kidney was harvested each using scissors and placed on the glass slide, slightly masticated and compressed with another glass slide, and viewed under the microscope.

Prevalence of Parasites and Mean Intensity

The prevalence (%) of the parasite and mean intensity levels were determined using the method of Bush *et al.* (1997).

$$\text{Prevalence (\%)} = \frac{\text{Number of individual host species infected with a particular parasites}}{\text{Number of hosts examined}} \times 100$$

$$\text{Intensity of infection} = \frac{\text{Total number of particular parasites species in a sample of a host species}}{\text{Number of infected individuals of the host species in the sample}}$$

Water Quality Measurement

The pH, water temperature, and dissolved oxygen were recorded using Hanna digital meters at the sampling site. Transparency was measured with Secchi disc and titrimetric method using respective Hanna reagents for ammonia, nitrite, iron, alkalinity, and hardness according to (APHA, 2005).

RESULTS

Occurrence and prevalence of *Vorticella* sp

The sessile ciliate species, *Vorticella* sp are characterized into two forms; the trophont (possessing stalk for anchoring to the desired substratum) and a free-living telotroch (Plate 1a, 1b, and 1c) were identified on the skin and intestine of developmental stages of cultured *Clarias gariepinus* (Table 1). The parasitological examination revealed the occurrence of *Vorticella* sp., for the first time in culture systems in Nigeria. *Vorticella* sp. were found in all the culture facilities used for rearing and developmental stages. They were found on the skin of 75 – 100 % of the fish stages harvested in all culture facilities except plastic tanks with 25% occurrence (Table 1).

Vorticella sp. occurred in intestines of fingerlings and juveniles reared in plastic and tarpaulin vat respectively. The prevalence of *Vorticella* spp on fish skin was highest in adults (12.84%) followed by fry (9.41%) and least in juveniles (3.54%). On the intestine, the highest prevalence of *Vorticella* sp was found in adults (3.85) (Table 2).

The intensity of *Vorticella* sp on the developmental stage of *Clarias gariepinus*

The intensity of *Vorticella sp* on the skin of *Clarias gariepinus* was highest on fingerlings (23.88) followed by juveniles (14) whereas juveniles had the highest intensity (16) in the intestine examined (Table 2).

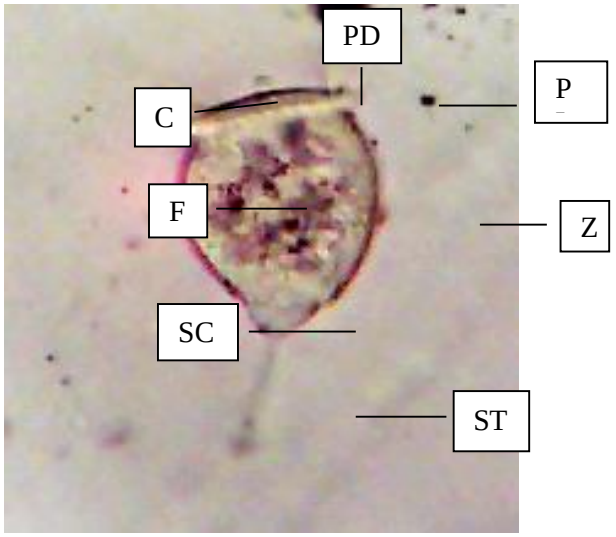

Plate 1a: *Vorticella* sp x 400

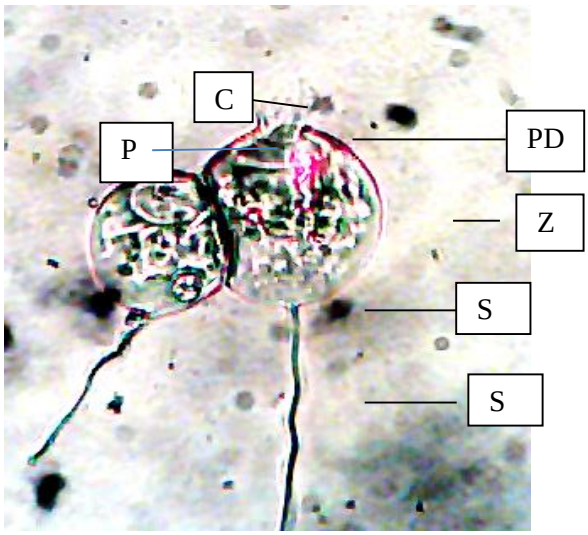

Plate 1b: *Vorticella* sp x 400

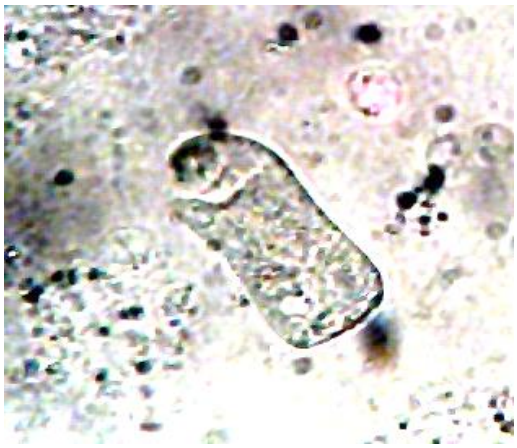

Plate 1c. Telotroch of *Vorticella* sp x 100

Plate 1a and 1b : C – Cilia, F – Food vacuole, SC – Scopula, ST – stalk, PL – Peristomial lip, PD – Peristomial disc, Z - Zooid

Table 1: Occurrence of *Vorticella* sp on the skin and in the intestine of developmental stages of *Clarias gariepinus* reared in different culture facilities

Culture Facilities	Developmental Stages	Site of location *Vorticella* sp.	
		Skin	Intestine
Earthen ponds	Fry	-	-
	Fingerlings	+	-
	Juveniles	+	-
	Adults	+	-
Concrete tanks	Fry	+	-
	Fingerlings	+	-
	Juveniles	+	-
	Adults	+	-
Plastic tanks	Fry	+	-
	Fingerlings	-	+
	Juveniles	-	-
	Adults	-	-
Tarpaulin vats	Fry	+	-
	Fingerlings	+	-
	Juveniles	+	+
	Adults	-	-

Table 2: Prevalence and intensity of *Vorticella* sp. on the skin and in the intestine of developmental stages of cultured *Clarias gariepinus* in Lagos State.

Developmental Stage	Numbers of fish examined	Skin			Intestine		
		NFI	Prevalence (%)	Intensity	NFI	Prevalence (%)	Intensity
Fry	85	8	9.41	9.25	0	0	0
Fingerlings	95	8	8.42	23.88	1	1.05	7
Juveniles	198	7	3.54	14	2	1.01	16
Adults	109	14	12.84	10	4	3.85	8.5

NFI – Number of infected fish

Water Quality Parameters

The water parameters recorded in culture systems for *Vorticella* sp. in this study were shown in table 3. The range of water parameters under which *Vorticella* sp thrived were pH (6 – 8), water temperature (29 – 33 ^{o}C), dissolved oxygen (1 - 8mgl^{-1}), ammonia (1 – 3.3mgl^{-1}), nitrite (0.06 – 1.30 mgl^{-1}), iron (0 – 1.40 mgl^{-1}), alkalinity (28 – 128 mgl^{-1}), hardness (90 – 760 mgl^{-1}) and transparency (22 – 50 cm).

Table 3: **Water quality parameters in culture tanks of *Clarias gariepinus* with *Vorticella* sp.**

Water Parameters	*Vorticella* sp
Water temperature (^{o}C)	30.77 ± 1.58
pH	6.99 ± 0.81
Dissolve Oxygen (mgl^{-1})	4.30 ± 3.01
Ammonia (mgl^{-1})	2.58 ± 0.64
Nitrite (mgl^{-1})	0.64 ± 0.58
Iron (mgl^{-1})	0.54 ± 0.85
Alkalinity (mgl^{-1})	78.18 ± 49.69
Hardness (mgl^{-1})	433.64 ± 341.78
Transparency (cm)	35.76 ± 13.40

DISCUSSIONS

Vorticella sp was found on the skin of cultured *Clarias gariepinus* in this study conforming to the findings of several researchers on different fish species such as cultured *Oreochromis niloticus* (Abdel – Baki *et al.*, 2014), wild *Sarotherodon galilaeus* (Reda, 2011), *Cyprinus carpio* and *Ctenopharyngodon idella (*Guguloth *et al*., 2013) contrary to the reports on *Vorticella* sp., found in the gills of *Clarias gariepinus* (El-Tantawy and El-Sherbiny 2010); *C. carpio* and *C. idella (*Dash *et al*., 2015) and skin and gills of *Planiliza abu* (Al-Musawi and Al-Rubaie, 2018). The *Vorticella* sp., found on all the stages implies that they were found in a hatchery and grow–out. The presence of parasites on the skin may be due to their first contact in the culture environment as well as large surface to search for food similar to the report on *Vorticella* sp., attaching to the fin of flounder, *Platichthys flesus* L（Öztürk and Özer, 2010). The presence of *Vorticella* sp in the intestine may be accidental through ingestion since the intestine recorded minimal values in the study which may agree with the free-living nature of the parasite by preferring the external organs for attachment for ease of accessing the source of food particles such as waterborne bacteria and organic debris (Lom and Dykovà, 1992). The prevalence of *Vorticella* sp., in all the developmental stages, ranged from 3 – 13 % which has similar trends of 8 – 11 % and 9.25 – 15 % in *Cyprino carpio* and *Ctenopharyngodon idella* respectively (Gadadhar, Debolina, and Raghu, 2015). The sessile ciliate was able to withstand stress conditions range of water parameters especially dissolved oxygen (1 – 8 mgl^{-1}), ammonia (1 – 3.3 mgl^{-1}), nitrite (0.06 – 1.30 mgl^{-1}) hardness (90 – 780 mgl^{-1}). The implication is that *Vorticella* sp will comfortably adapt and survive in a suitable and probably stressed culture environment as long as the hosts are alive.

CONCLUSION

The report of *Vorticella* sp represents the first record of the parasites in *Clarias gariepinus* and culture fish in Nigeria. There are many protozoans and metazoans yet to be discovered and reported for aquaculture interest to improve the management protocol in fish health for better yield in fish produce.

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