GSC Biological and Pharmaceutical Sciences

eISSN: 2581-3250 CODEN (USA): GBPSC2

Cross Ref DOI: 10.30574/gscbps

Journal homepage: https://gsconlinepress.com/journals/gscbps/

(Research Article)

Prevalence of protozoans in drinking and recreational water sources around the Federal Capital Territory (FCT), Nigeria

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GSC Biological and Pharmaceutical Sciences, 2025, 31(03), 275-280

Publication history: Received on 01 September 2024; revised on 14 June 2025; accepted on 17 June 2025

Article DOI: https://doi.org/10.30574/gscbps.2025.31.3.0381

Abstract

Protozoa parasites are eukaryotic organisms and are widely distributed in water environments. They cause food-borne diseases as well as survive in hostile environment for a long time. It is therefore worthy and necessary to understudy their occurrence and prevalence in drinking and recreational environmental water around the Federal Capital Territory, Abuja, Nigeria. In this study, 120 water samples were collected from Kwalita, Toge, Sherete, Pyakasa, Usuma lower Dam in and around the FCT and analyzed by microscopy. From the results, 59 out of 120 water samples were positive for protozoa. Out of the positive samples, the following were recorded; 22 Amoebae (37.3%), 13 ciliates (22.0%), 19 flagellates (32.2) and 5 cryptosporidium (8.5%). Parasites such as found in this study have been reported to cause several illnesses in humans and animals. To minimize the associated health-risks, it is hereby recommended that routine screening for these parasites particularly at household level and provision of adequate and safe drinking water would help to control the parasites.

Keywords: Prevalence; Protozoa; Waterborne; Parasitic and Community

1. Introduction

Parasitic protozoans are organisms that are widely distributed in nature, especially in water environments. Their ability to cause food-borne diseases as well as survive in seemly hostile environment for prolonged periods make them a central of study in recent years. There has recently been a number of cases with outbreaks of waterborne parasitic diseases worldwide due to collapse of many communities sanitary and water supply systems, especially in the less developed Countries (Pandak et al., 2021). In these less developed countries, modern tests for protozoa are either lacking or not frequently performed in addition to absent of basic treatment tools in such facilities (Reyna-Fabián et al., 2016). Usually, comprehensive assessment protocol includes isolation and examination of sampled water to the laboratory for cysts and oocysts of pathogenic enteric protozoa using standard methods such as filtration and microscopic search for representation indicator organisms (Martínez-Castillo et al., 2018). In many regions of the world, the most important agent for the distribution of these important agents is the infected human or animal, who, through unhygienic practices secretes invasive cysts and oocysts in their faeces and are thus transmitted via faecal-oral route (Mills et al., 2015). As a results of the abundance of the parasites in water, infection occurs through drinking water or ingestion through accidental swallowing of recreational water during swimming activities. Even where filtration of the water is carried out, the sizes of most filters allow the protozoans to pass through them thereby rendering the water unsafe for drinking (Degu et al., 2016). Most of these parasitic agents also have very high stability status in water as such they are able to maintain viability up to several months in water and that gives them ample opportunity to be able to infect wider range of hosts. Their high survival has been attributed to the possession of thick wall around their cysts and oocysts which make them able to remain in "Freezing" state of suspended animation over a long period of time (Lambrecht et al., 2015).

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Wastewater containing faeces can enter the water supply systems in various ways including wastewater overflow, agricultural and industrial effluent. These various sources can carry the causative agents of protozoan disease along into the soil where root crops are cultivated or the water bodies used for irrigation and recreational purposes (Bui et al., 2012). In terms of safety of water use, confined water such as well and borehole sources are the most reliable of all, though there has been reported cases of Salmonella spp. been shed into confined water where there are breakdown in hygiene management order (Scharff, 2012). In many developing countries, the traditional methods of drinking water treatment, though lead to decreasing and reduction of the protozoa incidences, does not offer complete solutions (Vaerewijck et al., 2014). Popular methods of water treatment processes include coagulation, flocculation, and settling the solids materials from the liquid phase particles by gravity. In the process, the protozoa, bacteria, and viruses are adsorbed and are removed (Scharff, 2012). Though high percentage of the parasites are recorded to be removable by these methods, the methods are regarded as economically unprofitable for developing countries due largely to the relative cost and maintenance (Dupuy et al., 2014).

Research findings have shown that protozoan parasites are identified as the second most frequent etiological causes of the mortality among children under five years old worldwide. They are transmitted through water thereby causing epidemic and endemic diseases in both developed and developing countries. It is well established that many genera of the protozoa are human and animal pathogens with many being well adaptable to local environments. Unfortunately, only limited information is available on these organisms in developing countries including Nigeria. Parasitic protozoa are ubiquitous in the environment and they are found to be responsible for some epidemic and endemic human diseases. Improvement of water sanitation and hygiene could prevent the deaths of more than two million children under the age of five annually. One of the main cause of mortalities is diarrhoea. Despite the location of the community water bodies being around the Federal capital of Nigeria, unfortunately, water quality problems and massive faecal contamination remain a serious concern. Knowledge of water analysis in these and other locations around ought to be of necessity because most countries in the tropical areas already have water supply challenges. Therefore, any outbreak of gastrointestinal parasitic disease in these areas, giving their proximity to the dense population of the federal capital, may be a big epidemic challenge. It is therefore worthy and necessary to understudy the occurrence and prevalence of these protozoa from drinking and recreational environmental water around the FCT, Nigeria.

2. Material and methods

2.1. Sampling

For analysis purposes, water samples were collected from River, streams, Lakes and ponds used for domestic and recreational exercises. From each site, 120 water samples (Fifty liters for each) were collected from five communities (Kwalita, Toge, Sherete, Pyakasa, Usuma lower Dam) in and around the FCT between January to May 2024. The samples were transported to the laboratory and left undisturbed for 24 hours at room temperature (Nakada-Tsukui and Nozaki, 2016).

2.2. Identification of Parasites

Afterwards, the supernatant was sucked and removed and the sediments of each sample was examined microscopically, as a 0.9% saline smear, for parasite cysts, trophozoites and helminth eggs (Rosado *et al*., 2017). The respective sample were stained with Lugol's iodine, modified Ziehl-Neelsen acid-fast stain (hot method) and the trichrome technique before being examined under the microscope.

3. Results

Forty-eight out of 120 water samples were positive for parasitic contamination with cyst and oocysts of four parasitic protozoans. Table 1 shows the occurrence and distribution of parasites in the water samples collected from the locations understudied. As there were differences amongst positive samples according to clearance, from low to high turbidity, so also the number of parasites. Amoebae has the highest occurrence in all the water bodies put together accounting for 37.3% followed by the flagellates, 32.2% and the least was Cryptosporidium spp., 8.5%. In terms of the presence and contamination of the water bodies, ponds and lakes were the most contaminated. The flagellates had the highest occurrence in the lakes, 14.3%, followed amoebae in the pond, 14.1%. Amoebae was not detected in the stream although they had 13.0% and 10.2% in lakes and River respectively. Cryptosporidium was neither detected in the river nor in the streams. Table 2 presents the rate of parasitic contamination in the studied samples based on the community from where the water samples were collected. There were no flagellates in water samples collected from Toge nor was there ciliates from samples from Pyakasa during the period under study. The highest number of parasites was Cryptosporidium sp from water obtained from Toge followed by flagellates from water obtained from Pyakasa.

Table 1 Occurrence and Distribution of Parasites in Water Sampled

Sample	Parasite (%)			
	Amoebae	Ciliates	Flagellates	Cryptosporidium
River	10.2	-	07.4	-
Streams	-	02	05.6	-
Lakes	13.0	08	14.3	3.4
Ponds	14.1	12	4.9	5.1
Total	37.3	22.0	32.2	8.5

Key: - = Absent; Hanis *et al* 1st School of Life Sciences International Conference Book of Proceedings 2024

Table 2 Parasitic Occurrence (%) based on Location (Jan. – May, 2014)

Location	Amoebae (%)	Ciliates (%)	Flagellates (%)	Cryptosporidium (%)
Kwalita	12.3	23.6	31.5	32.6
Toge	30.9	15.4	-	53.7
Sherete	43.6	11.4	25.7	19.3
Pyakasa	23.1	-	48.8	28.1
Usuma lower Dam	26.7	32.3	19.7	21.3

Key: - = Absent

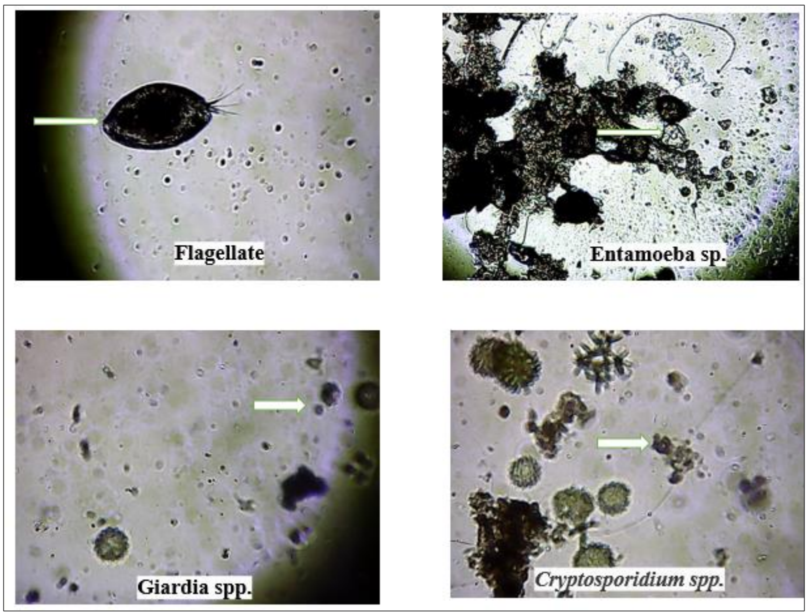

Figure 1 Photographs of parasites under the Microscope

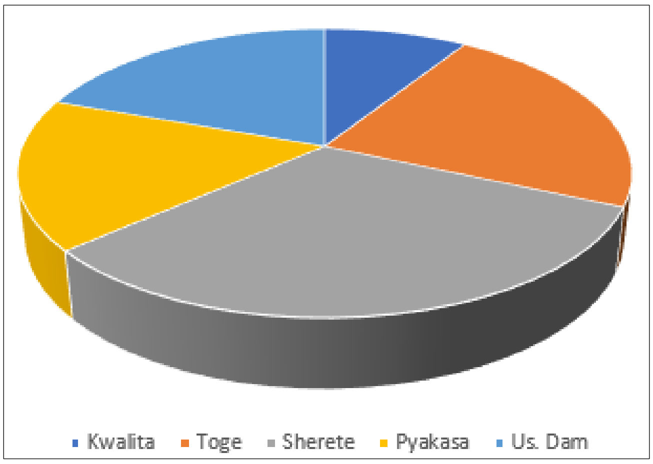

Figure 2 The distribution of Entamoeba in the studied Locations

Hanis et al 1st School of Life Sciences International Conference Book of Proceedings 2024

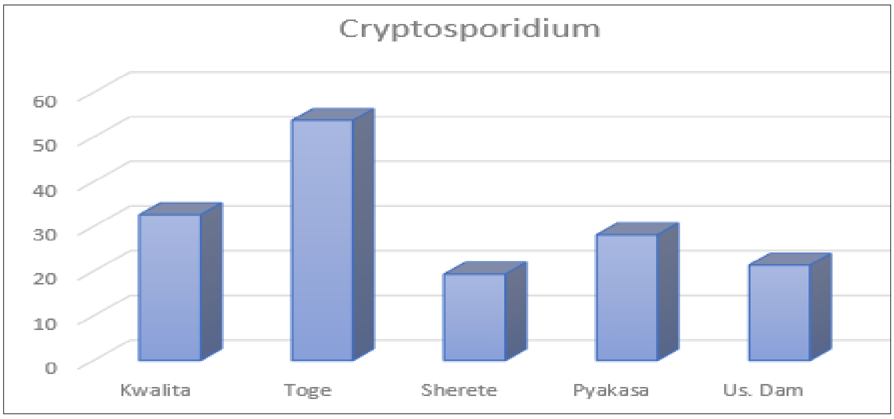

Figure 3 Distribution of Cryptosporidium in the studied areas

4. Discussion

Several researches have evaluated the incidence of parasitic occurrence in our water bodies. However, there is need to constantly carry out the incidence to take into consideration the lifestyles and activities of the inhabitants within the location which could predispose such water bodies to re-emergence of the parasites. Coşkun et al. (2013) reported similar incidence in their work on the Isolation and identification of free-living amoebae from tap water in Sivas, Turkey. Also, such encounter was reported by Adamska (2015) in his research on the Molecular characterization of Cryptosporidium and Giardia occurring in natural water bodies in Poland. These findings were positively correlated with clinical laboratory reports from Ahvaz, according to which Entamoeba histolytica were more predominant than other protozoan pathogens in gastrointestinal tract of patients. According to the report, the second most frequent infection was that caused by Cryptosporidium spp that was detected in most positive samples. This was however contrary to the report in this study where Cryptosporidium spp. was the least prevalent in this study. There was no detection of Ciliates in Pyakasa and flagellates in Toge water samples. No detection of parasites might be as a result of the season in which the samples were taken or the filtration method. Low percentage of water samples might also be accounted for low occurrence of the parasites in the study areas and this does not agree with other investigations from several reports from other parts of the world such as those of Obaseki et al., (2016) in a reportable case of fatal granulomatous amoebic encephalitis in an immunocompetent Nigerian confirmed by molecular studies-polymerase chain reaction (PCR). In the present study, all samples from all the locations were grossly contaminated by protozoan parasites in varying degrees. This agrees with the findings of Balderrama-Carmona et al. (2014) in their report on the Quantitative microbial risk assessment of Cryptosporidium and Giardia in well water from a native community. According to this research flowing water, river and stream had low occurrence or none-detection which might be due to the nature of the water current. The level of contamination by parasite in the studied location is a true reflection of the kind of microbial infection they might be encountering since most of the water used are not subjected to any major treatment before use (Karakavuk et al., 2018). In those villages for instance, most drinking water sources are obtained from surface water, which could be more easily contaminated with parasitic protozoa from animals and human. Also, nearness of the water source to their homes and lack of readily available sources often forces them to use the water as their main sources except during raining season when they occasionally collect rainwater. Water bodies in some of the communities are exposed to sewage system from the cities where untreated contaminated water entered directly into them as earlier reported by Chomba et al., (2017). This often is responsible for gross contamination of drinking water with parasitic agents. Generally, the current study showed that the rate of parasitic infections in drinking and recreational water is considerably high. Total reliance on streams and ponds for routine water usage should be discouraged (Silva et al., 2015).

This is because, diseases caused by water-related protozoans like Entamoeba can be hazardous. It is widely reported that the pathogenesis of E. histolytica is multifactorial, because the virulent molecules of the parasite, as well as the host's immune response, are said to play an important role in the pathogenesis of the disease, causing damage to tissues that facilitate entry to systemic sites (Lv et al., 2013). The destructive mechanisms of E. histolytica include contact with target cells, cytolysis, and phagocytosis, and the degradation of ingested cells. After contact with trophozoites in the epithelium, the cells increase the paracellular permeability produced by the opening of the TJ junctions and the distortion of the microvilli (Ayaz et al., 2011). Superficial blisters and tiny focal discontinuities appear in the host plasma membrane, displacing and separating neighboring cells and compromising membrane integrity. The severity in the individual however differs. Cryptosporidium was found to be widely distributed throughout the studied locations. Fig. IV. Shows the relative percentage distribution.

Water distribution system from centrally treated house should therefore be promoted by using effective disinfect techniques while the construction of pipe water network should be considered. Also, this research showed that aside the challenges of lack of modern good portable water system, few available ones should be used with hygiene practice to avoid contamination by adopting personal protection. The use of molecular techniques for precise identification of parasites is recommended also.

5. Conclusion

From this study, we alluded to the fact that the occurrence of parasites especially *Cryotosporidium spp.* in the water bodies signifies a high contamination with high health risks.

The lack of provision of basic amenities for the communities where samples were taken is a suggestion for the high incidence of the parasite.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

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