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EVALUATION OF PARASITES OF MEDICAL IMPORTANCE IN DRINKING WATER SOURCES IN OKURA DISTRICT, DEKINA LOCAL GOVERNMENT, KOGI STATE, NIGERIA

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ABSTRACT

A study was conducted on drinking water sources in Okura district, Dekina Local Government, Kogi State to examine parasites of medical importance. A total of 300 water samples were collected from two sources (Borehole and River water) in three communities (Anyigba, Egume and Ochaja) between the months of November 2014 and January 2015. In all the two sources, water was contaminated with eggs, trophozoites, cysts, oocysts, larvae and juveniles of parasites. Parasites were isolated using sedimentation method and viewed microscopically. In borehole water samples, the highest prevalence of 15.6% (7) was observed for Hookworms, followed by 13.3% for both G. lamblia and C. parvum while the least was B. coli and D. caninum with both having a prevalence of 2.2% (1). In River water, Taenia spp. had the highest prevalence of 11.7% (35) followed by Hookworm (9.3%, 28) and G. lamblia (7.3%, 22). River samples had total prevalence of 229 (83.58) while borehole had 45 (16.42%) with overall prevalence of 274 (91.33). Comparison of the prevalence between River and Borehole showed significant difference ($P<0.05$) with Rivers having more parasite contamination than boreholes. Preventing waterborne disease and the health effects of water contaminations is vital to public health. The inhabitants of the studied area were advised to stop defecating near their drinking water sources to reduce the rate at which these parasites contaminate water. Therefore, boiling of drinking water will help eliminate the parasites to ensure the safety and hygienic quality of the water.

INTRODUCTION

Water is of fundamental importance to human life, animals and plants. It is of equal importance with the air we breathe in maintaining the vital processes of life and it makes up 60% of body weight in human body. Among the various sources of water, borehole water is known to be more appropriate and often meets the criteria of quality water in most African countries, Nigeria inclusive. Borehole water is particularly important as it accounts for 80% safe drinking water for rural areas where population is widely dispersed and the infrastructure needed for treatment and transportation of used surface water does not exist. Nevertheless, there are various ways borehole water may suffer pollution e.g. land disposal of solid wastes, sewage disposal on land, agricultural activities such as fertilizers, herbicides etc., urban runoff and polluted surface water. The WHO recommends that borehole should be located at least thirty meters (30m) away from latrines and seventeen meters (17m) from septic tanks (Bonjoch *et al*., 2004).

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Biological contaminants such as bacteria, viruses, fungi, protozoa and helminth constitute the major cause of food-borne and water-borne diseases with varying degrees of severity, ranging from mild indisposition to chronic or life-threatening illness, or both (Okonko *et al*., 2009b). An estimated 1.1 billion persons (one sixth of the world's population) lack access to clean water and 2.6 billion to adequate sanitation WHO, 2005; Okonko *et al.,* 2008b, Okonko *et al*., 2009b). *Cryptosporidium* infection, caused by *Cryptosporidium parvum*, for example has been reported in persons for 3days of age to 95years of age but data suggest that young people are more susceptible to infection (Ronald, 2004).Water is a major conduct of these parasites and contaminated water is an important source of human infection either by direct consumption or by the use of contaminated water. There are three major groups of helminthes containing members that have man as their host, there are, flukes (Trematoda), tapeworm (Cestoda) and roundworms (Nematoda). Helminthes infections are spread through ingestion or inhalation of their ova, some of which can survive outside the host for a long period of time or via larvae or cercariae penetrating skin exposed to infected soil or water. Waterborne helminth includes *Fasciola* spp, *Taenia* spp,

Fasciolopsis buski, *Ascaris lumbricoides*, etc. In spite of the importance of helminthes ova as waterborne parasites, little attention has been paid to them in terms of their characterization and control. Globally, there are 5 million people suffering from helminthiasis, mainly in developing countries, it is important to note the infective stage is the egg not the worms helminths are not microbes although their eggs are microscopic (Jimenez-cisneros, 2007). Lack of information on pathogenic and parasitic microorganisms in water sources creates some uncertainties in our understanding of the overall quality of drinking water in our communities. To bridge this information gap, there is an urgent need for the determination of protozoan and helminths organisms associated with drinking water in our communities. Thus, regular physico-chemical, microbiological and parasitological evaluation of water at sources must be carried out to determine or check the effectiveness of treatment process (Okonko *et al*., 2008a; Okonko *et al*., 2008b; Okonko *et al*., 2009a; Okonko *et al*., 2009b). Therefore, this study is aimed at determining the parasitological status/quality in different sources of drinking water in Okura district in Dekina Local Government, Kogi State.

MATERIALS AND METHODS

The study was conducted for parasitological evaluation of different water sources i.e. borehole and rivers in three towns namely Ochaja, Egume and Anyigba of Okura district, Dekina Local Government, Kogi state.

Sample Description

The study involves sampling twice per month for three consecutive months (November 2014 to January 2015) from the three towns for protozoan and helminthes ova, oocyst, cyst and larvae for bore hole and river water. The sampling method of collecting water from the river source involves the upper and the lower course of the water body.

Collection of Water Samples

A total of 300 water samples were collected from borehole and river water in clean bottles. The samples were labelled with dates of collection, nature or source of water, the site of collection and transported to the laboratory of Department of Biological science, Kogi State University, Anyigba for further process.

Sampling Procedure

Water samples collected were transported to the laboratory and filtered through a filter sieve of 0.5µm mesh size. After filtration, the filtrate was discarded and the residue rinsed with 50ml of distilled water into a beaker. The content of the beaker was poured into a centrifuge tube and centrifuge at 500rpm for 2minutes, the supernatant was discarded and the sediment re-suspended in 10ml of physiological saline and centrifuged. The resulting sediment was re-suspended in 7ml of 10% formaldehyde and 3ml of ethyl acetate after the supernatant was discarded. The tube was closed with a stopper and shaken vigorously for thorough mixing of the solution and centrifuged at 500rpm for 2minutes. The tube was rested on a rack and four layers were visible i.e. the top layer of ethyl acetate, followed by a plug of dirt, a clear layer of formalin and the last layer of sediment. The first three layers were poured out leaving a small amount of formalin for suspension of the sediment.

Parasite Detection and Prevalence Rate

Using a pipette, the sediment was removed and placed on the slides. A drop of Iodine stain was added and covered with a cover slip then examined under microscope at X10 and X40 objectives. The prevalence rate of parasites in water samples was determined with the following formula;

Prevalence Rate = No. of concentrated water sample infected with parasite/Total no. of concentrated water samples examined) ×100.

Statistical Analysis

Data were analyzed using simple descriptive statistics and t-Test using the SPSS version 21.0 software. P values less than 0.05 were considered to be statistically significant.

RESULTS

A total of three hundred (300) samples were collected from both River and Borehole, out of which twenty four (21) parasites (protozoan and helminthes) were isolated. These parasites includes: *Giardia lamblia*, *Cryptosporidium parvum*, *Indamoeba buestcchlii*, *Entamoeba histolytica, Balantidium coli*, *Chilomastix mesnili*, *Diphyllobothrium latum, Faciola* spp, *Clinorchis sinensis*, *Metagonimus yakogawai*, *Paragonimus westermani*, *Taenia* spp, *Hymenolepis dimunata*, *Dipylidium caninum, Gastrodiscoides hominis*, *Hymenolepsis nana*, *Enterobius vermicularis, Trichuris trichiura, Strongyloides stercoralis, Ascaris lumbricoides* and Hookworms (Plate I). The species of parasites were in various stages of development, ranging from eggs, cysts, oocysts, trophozoite, to larvae.

Table 1. Parasites Stages Found in Different Sampling Points of Rivers (Anyigba, Egume and Ochaja)

Parasites	Stages	Sampling Points
Giardia lamblia	trophozoite	upper region
Cryptosporidium parvum	oocyst	upper region
Iodamoeba buetschlii	cyst/trophozoite	upper/lower region
Entamoeba hystolytica	Cyst	upper region
Balantidium coli	Cyst	upper region
Chilomastix mesnilii	cyst, trophozoite	upper/lower region
Diphyllobothrium latum	Egg	upper region
Fasciola spp	Egg	upper region
Clonorchis sinensis	Egg	upper /lower region
Metagonimus yakogawai	Egg	upper region
Paragonimus westermani	Egg	upper region
Taenia spp.	Egg	lower region
Hymenolepis dimunata	Egg	upper/lower region
Dipylidium caninum	egg capsule	upper region
Gastrodiscoides hominis	Egg	upper region
Hymenolepis nana	Egg	upper/lower region
Enterobius vermicularis	Egg	upper/ lower region
Trichuris trichiura	egg	upper / lower region
Strongyloides stercoralis	Larvae	upper / lower region
Ascaris lumbricoides	Egg	upper / lower region
Hookworms	larvae, egg	upper / lower region

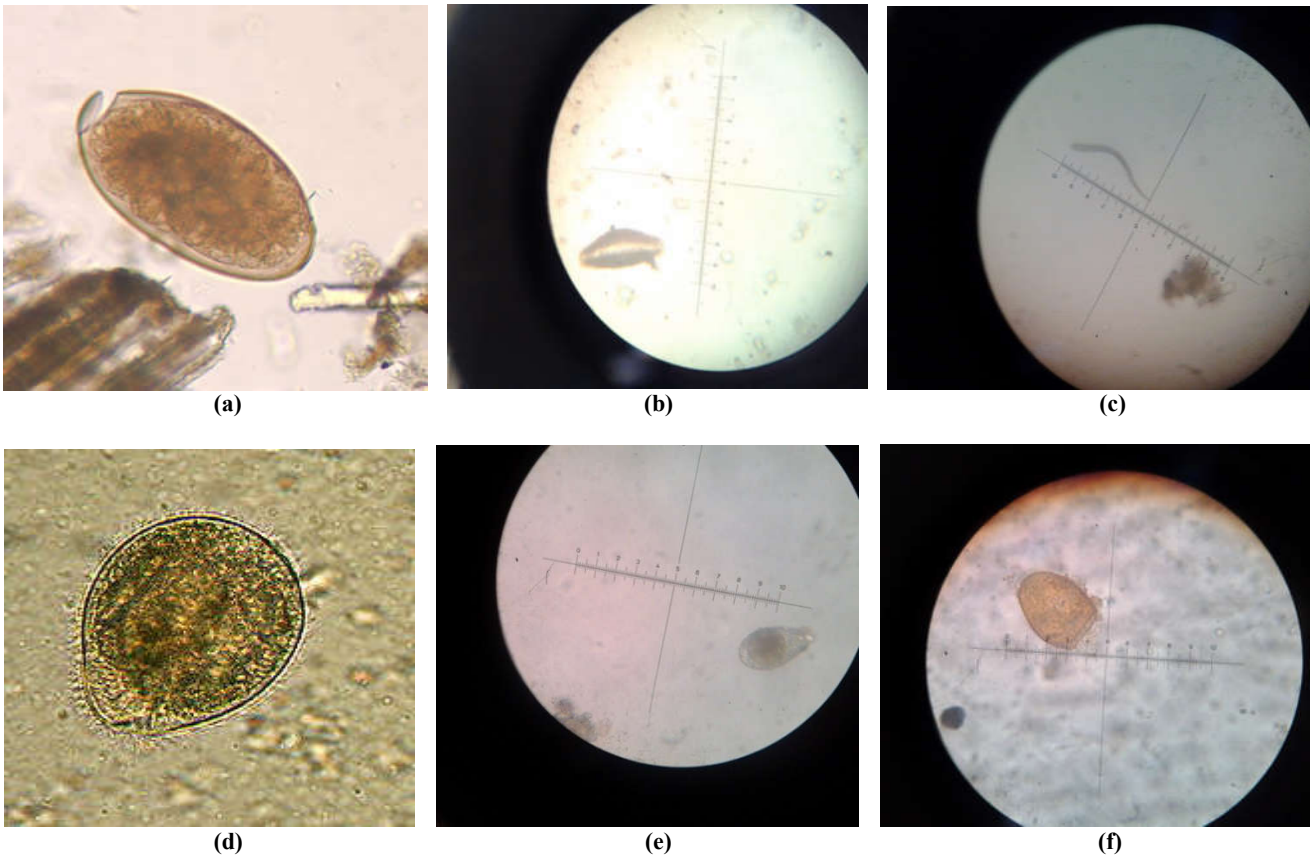

Plate 1. (a) Fasciola spp (egg x 40) (b) E. vermicularis (egg x40) (c) S. stercoralis (larvae x40) (d) Balantidium coli (e) C. sinensis (egg x40) (f) Paragonimus westermani (egg x40)

Table 2. Occurrence of Parasites from River and Borehole Water in Anyigba, Egume and Ochaja

Parasites	Anyigba (n=100)		Egume(n=100)		Ochaja (n=100)		Total (%)
	River Water (%)	Borehole Water (%)	River Water (%)	Borehole Water (%)	River Water (%)	Borehole Water (%)	
Giardia lamblia	7(31.8)	4(18.2)	3(13.6)	2(9.1)	6(27.2)	0(0.0)	22(7.3)
Cryptosporidium parvum	4(23.5)	2(11.8)	2(11.8)	1(5.9)	5(27.2)	3(17.6)	17(5.7)
Iodamoeba buetschlii	2(25.0)	0(0.0)	5(62.5)	0(0.0)	1(12.5)	0(0.0)	8(2.7)
Entamoeba hystolytica	4(26.7)	2(13.3)	2(13.3)	1(6.7)	5(33.3)	1(6.7)	15(5.0)
Balantidium coli	8(50.0)	1(6.25)	3(18.8)	0(0.0)	4(25.0)	0(0.0)	16(5.3)
Chilomastix mesnili	2(28.6)	0(0.0)	2(28.6)	0(0.0)	3(42.9)	0(0.0)	7(2.3)
Diphyllobothrium latum	4(44.7)	0(0.0)	3(33.3)	0(0.0)	2(22.2)	0(0.0)	9(3.0)
Fasciola spp	7(46.7)	0(0.0)	5(33.3)	0(0.0)	3(20.0)	0(0.0)	15(5.0)
Clonorchis sinensis	4(50.0)	0(0.0)	1(12.5)	0(0.0)	3(37.5)	0(0.0)	8(2.7)
Metagonimus yakogawai	2(22.2)	0(0.0)	4(44.4)	0(0.0)	3(33.3)	0(0.0)	9(3.0)
Paragonium westermani	2(33.3)	0(0.0)	0(0.0)	0(0.0)	4(66.7)	0(0.0)	6(2.0)
Taenia spp.	16(45.7)	2(5.7)	7(20.0)	0(0.0)	9(25.7)	1(2.9)	35(11.7)
Hymenolepsis dimunata	2(25.0)	0(0.0)	3(37.5)	0(0.0)	4(50.0)	0(0.0)	8(2.7)
Dipylidium caninum	2(28.6)	1(14.3)	2(28.6)	0(0.0)	1(14.3)	0(0.0)	7(2.3)
Gastrodiscoides hominis	1(12.5)	0(0.0)	4(50.0)	0(0.0)	3(37.5)	0(0.0)	8(2.7)
Hymenolepsis nana	2(28.6)	1(14.3)	1(14.3)	0(0.0)	2(28.6)	1(14.3)	7(2.3)
Enterobius vermicularis	4(36.4)	2(18.2)	2(18.2)	1(9.1)	1(9.1)	1(9.1)	11(3.7)
Trichuris trichiura	5(35.7)	2(14.3)	3(21.4)	1(7.1)	2(14.3)	1(7.1)	14(4.7)
Strongyloides stercoralis	4(33.3)	1(8.3)	2(16.7)	2(16.7)	3(25.0)	0(0.0)	12(4.0)
Ascaris lumbricoide	2(16.7)	1(8.3)	5(41.7)	2(16.7)	1(8.3)	1(8.3)	12(4.0)
Hookworms	8(28.57)	3(10.71)	12(42.86)	3(10.71)	1(3.57)	1(3.57)	28(9.3)
P value	0.012*		0.023*		0.009**		

The entire Protozoan parasites occurred at the upper course and most of the helminthes occur freely at both the upper and lower course as shown in Table 1. Occurrence of the parasites associated with drinking water from Okura District is presented in table 2. *Taenia* eggs 11.7% (35) was most predominant followed by Hookworms 9.3% (28), *G. lamblia* (eggs and Trophozoites) 7.3% (22) and *C. parvum* (oocyst) 5.7% (17) while *P. westermani* (eggs) had the least prevalence of 2.0% (6). Table 3 shows the distribution of parasites according to the sources of drinking water in Okura district. In borehole water samples, the highest prevalence of 15.6% (7) was observed for Hookworms, followed by 13.3% for both *G. lamblia* and *C. parvum* while the least was *B. coli* and *D. caninum* with both having a prevalence of 2.2% (1).

Table 3. Distribution of Parasite According to the Sources of Drinking Water in Okura District, Dekina

Source	Borehole (%)	River (%)	Total (%)
Giardia lamblia	6 (13.3)	16 (7.0)	22(7.3)
Cryptosporidium parvum	6 (13.3)	11 (4.8)	17(5.7)
Iodamoeba buetschlii	0 (0.0)	8 (3.5)	8(2.7)
Entamoeba hystolytica	4 (8.9)	11 (4.8)	15(5.0)
Balantidium coli	1 (2.2)	15 (6.6)	16(5.3)
Chilomastix mesnili	0 (0.0)	7 (3.1)	7(2.3)
Diphyllobothrium latum	0 (0.0)	9 (3.9)	9(3.0)
Fasciola spp	0 (0.0)	15 (6.6)	15(5.0)
Clonorchis sinensis	0 (0.0)	8 (3.5)	8(2.7)
Metagonimus yakogawai	0 (0.0)	9 (3.9)	9(3.0)
Paragonium westermani	0 (0.0)	6 (2.6)	6(2.0)
Taenia spp.	3 (6.7)	32 (14.0)	35(11.7)
Hymenolepsis dimunata	0 (0.0)	8 (3.5)	8(2.7)
Dipylidium caninum	1 (2.2)	6 (2.6)	7(2.3)
Gastrodiscoides hominis	0 (0.0)	8 (3.5)	8(2.7)
Hymenolepsis nana	2 (4.4)	5 (2.2)	7(2.3)
Enterobius vermicularis	4 (8.9)	7 (3.1)	11(3.7)
Trichuris trichiura	4 (8.9)	10 (4.4)	14(4.7)
Strongyloides stercoralis	3 (6.7)	9 (3.9)	12(4.0)
Ascaris lumbricoide	4 (8.9)	8 (3.5)	12(4.0)
Hookworms	7 (15.6)	21 (9.2)	28(9.3)
Total	45 (16.42)	229 (83.58)	274 (91.33)

In River water, *Taenia* spp. was highest with a prevalence of 11.7% (35) followed by Hookworm (9.3%, 28) and *G. lamblia* (7.3%, 22). River samples had total prevalence of 229 (83.58) while borehole had 45 (16.42%) with overall prevalence of 274 (91.33). Comparison of the prevalence between River and Borehole showed significant difference ($P<0.05$) with Rivers having more parasite contamination than boreholes.

DISCUSSION

A total of 300 water samples were collected from two different sources (Borehole and River water) and examined from three towns (Anyigba, Egume and Ochaja) in Okura district of Dekina Local Government, Kogi State to determine the presence and prevalence of parasites. Among the several parasites isolated, *Giardia* spp, *Cryptosporidium* spp were found across the borehole and river waters in the three towns of Okura district. The results of the study confirm the findings of clinical studies conducted that had shown the presence of these two parasites in the human population (Guerrant, 1970). Both *Giardia* and *Cryptosporidium* were known to cause gastroenteritis and were considered two of the leading causes of waterborne diseases in the United States as reported by Furness *et al.* (2000). Similar studies, conducted in Sri Lanka also confirmed the findings (Quintero and de Ledesma, 2000; WHO, 2004). The high prevalence rate of both the *Giardia* cyst and *Cryptosporidium* oocyst in the river might be as a result of unsanitary attitude of people who defecate near the rivers and activities of farm animals like goat and cattle which harbour the parasites and this could result in the outbreak of *Giardiasis*. The result also revealed that among the protozoans, *G. lamblia* has the highest occurrence, 7.3% and was found in the three months of the study. It was also observed that *Teania* spp (eggs) had the highest prevalence of 12.6% among helminthes and occurring all through the months of the study period.

The different parasites species were more concentrated at the upper course than the lower course of the rivers, which could be as the result of humans and animals activities, defecating near the rivers and streams. The upper course is usually characterized by swift flow, a high degree of oxygenation and low temperature. The Protozoan occurred mostly at the upper course and the helminthes occurred freely at both the upper and lower course of the rivers. *Entamoeba* cysts were also recovered from the water sources. *E. histolytica*, *G. lamblia* and *C. parvum* are three of the major causes of parasitic induced diarrhea diseases as reported by Hernandez and Avendendo (2001) and the most common cause of infection worldwide (Tanyuksel *et al*., 2001). The high infection with these parasites confirms that domestic animal and human beings that drink unprocessed or untreated river and borehole water are easily affected by water borne diseases (Al-Khafaji *et al*., 1999). Apart from identification of these parasites in the water samples, it was also observed that most of the water samples contained dirts and debris, colored particles and other things which contributed in a great deal by contaminating and polluting water and the same way makes it unsafe for human consumption

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