Archives of Razi Institute, Vol. 77, No. 2 (2022) 821-825

DOI: 10.22092/ARI.2022.357106.1977

Original Article

An Investigation of Parasitic Protozoa in Drinking Water in Samarra, Iraq

Saleh Mohammed Al-Samarrai, A[1], Razooq Hameed Al-Samarrai, R[2]*, Ibrahim Hamdi, B[3]

1. College of Applied Science, University of Samarra, Samarra, Iraq
2. Department of Applied Chemistry, College of Applied Science, University of Samarra, Samarra, Iraq
3. Department of Pathological Analysis, College of Applied Science, University of Samarra, Samarra, Iraq

Received 14 December 2021; Accepted 16 January 2022
Corresponding Author: dr.rafah_alsamarrai@uosamarra.edu.iq

Abstract

Protozoan parasites are very important in drinking water production systems because their cystic forms are stable in the environment and resistant to conventional disinfection methods. The present study aimed to investigate protozoan parasites in the drinking water of different places in Samarra, Iraq. To this end, 100 samples of tap drinking water were collected from 10 places in Samarra, Iraq (i.e., Al-Sekek, Al-Kadesia, Alzeraa, Al-Shuhdaa, Al-Muthana, Al-Shorta, Al-Mamal, Al-Khedraa, Al-Efraz, and Al-Jubereaa), from the beginning of December to the end of February. After sample collection, water samples were examined to detect oocysts or cysts of protozoan parasites by using Direct wet smear, Lugol's iodine, and Modified Ziehle Nelseen stain methods. The results indicate that 80% of the samples under investigation were infected with protozoan parasites, and the ratio of diagnostic parasites in the samples under investigation was determined at 36% with *Entamoeba histolytica*, 23% with *Giardia lamblia*, and 21% with *Cryptosporidium parvum.* The findings reveal the presence of protozoan parasites in the drinking water of the area under study and specify the need for a rapid improvement of the monitoring systems for the treatment of drinking water to control diseases caused by these pathogens, as well as to identify the sources of contamination.

Keywords: *Cryptosporidium parvum*, Drinking water, *Entamoeba histolytica*, *Giardia lamblia*, Protozoa parasite

1. Introduction

Due to the transmission of pathogens, such as bacteria and parasites, through drinking water, the study of water hygiene is very important in controlling and preventing diseases. Waterborne or water-washed parasitic diseases have caused epidemic and endemic diseases in both developed and developing countries (1). The water-borne protozoan parasites in humans include *Toxoplasma gondii*, *Entamoeba histolytica, Cyclospora cayetanensis*, *Isospora belli*, *Blastocystis hominis*, *Balantidium coli*, *Acanthamoeba* species (spp.), and *Naegleria* spp. (1, 2). Samarra is an Iraqi archaeological city, which is located in the north of Baghdad, the capital of Iraq (120Km), and is characterized by its rising population density (3) (Figure 1).

The main source of drinking water in Samarra, Iraq, is the Tigris river near the city, which is also used with groundwater in industry, as well as agriculture, and other purposes in the city (3-5). Since the quality of water is of significant importance for humans, animals, and plants, any chemical, physical, and biological changes in water properties may affect the living organisms and make water unsuitable or polluted (6). Many researchers have investigated the chemical, physical, and biological properties of drinking water in Samarra, Iraq. Dheyab (7) found that the concentration

of dissolved oxygen was 4.75 ppm (at 23˚C), chlorine was 2.97 ppm (more than the normal limit), electrical conductivity was 0.3 cm/m (within the normal limit), total soluble salt was 201 ppm (within the normal limit), turbidity was 2.26 Nephelometric Turbidity Unit (more than the normal limit), and pH was 7.99 (more than the normal limit). In another study, Ibrahim, Al-Tawash (8) indicate that water in Samarra is not drinkable, according to the Water Quality Index, and also it contains high concentrations of heavy metals (more than the standard limit), such as Cd, Se, Fe, Li, Pb, Mn, Ni, Hg, Cr, Be, As, V, Al, and uranium. Moreover, it was found that the drinking water in Samarra, Iraq, was also contaminated with microorganisms, including *Escherichia coli*, *Enterobacter aerogenes*, *Pseudomonas aeruginosa* (9), and *Cryptosporidium parvum* (10).

Therefore, the present study aimed to evaluate protozoan parasites in the drinking water of different places in Samarra, Iraq.

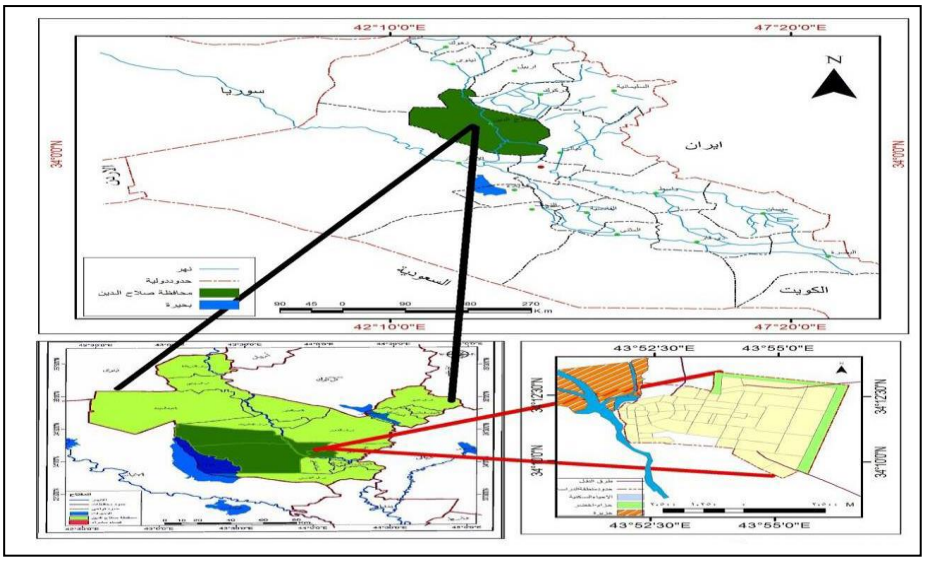

Figure 1. Geographic location of Samarra, Iraq

2. Materials and Methods

2.1. Sample Collection

In total, 100 samples of drinking water were collected in sterilized plane tubes (10-20) ml from 10 places in Samarra, Iraq (i.e., Al-Sekek, Al-Kadesia, Alzeraa, Al-Shuhdaa, Al-Muthana, Al-Shorta, Al-Mamal, Al-Khedraa, Al-Efraz, and Al-Jubereaa), from the beginning of December to the end of February. The water samples were collected in clean and sterilized disposable plastic bottles, and they were then labeled and transported to the laboratory of parasites for parasitology examination.

2.2. Parasitological Detection of Water Samples

Water samples were examined to detect oocysts or cysts of protozoan parasites by using the Direct wet smear, Lugol's iodine, and Modified Ziehle Nelseen stain methods, The direct wet smear and Lugol's iodine were utilized to detect *Giardia lamblia* by the identification of cysts, the Modified Ziehle Nelseen stain was used to detect *Cryptosporidium parvum* red-pink oocysts (11), and the Lugol's iodine was employed for the detection of *Entamoeba histolytica* cysts (12).

2.3. Statistical Analysis

The results were analyzed by the SPSS software (version 20), and the significant differences between mean±SD were assessed by the independent sample t-test with a $P<0.05$ significance level.

3. Results

The present study evaluated the prevalence of parasites in the drinking water of Samarra, Iraq, during different months. The findings indicate that 80% of the collected specimens were infected with parasites (Table 1).

Table 1. Percentage of the parasitic infection in the specimens collected from different places in Samarra, Iraq

Sample area	No of samples under examination	No of infected samples	Infection percentage (%)
Al-Sekek	11	8	72.7%
Al-Kadesia	8	6	75%
Alzeraa	14	10	71.4%
Al-Shuhdaa	12	12	100%
Al-Muthana	9	9	100%
Al-Shorta	10	8	80%
Al-Mamal	10	5	50%
Al-Khedraa	13	11	84.6%
Al-Efraz	7	7	100%
Al-Jubereaa	6	6	100%
Total	100	80	80%

As can be seen in table 1, the highest percentage of infection with parasites (100%) was found in Al-Shuhdaa, Al-Muthana, Al-Efraz, and Al-Jubereaa, whereas the lowest percentage (50%) was detected in Al-Mamal. The percentage of infection in other places were 71.4% in Alzeraa, 72.7% in Al-Sekek, 75% in Al-Kadesia, 80% in Al-Shorta, and 84.6% in Al-Khedraa.

The results also showed that the infection percentage slightly differed in different months of sample collection, and the total percentage was determined at 80% in December, 79.17% in January, and 80.43% in February. It is thus indicated that the highest percentage of infection prevalence (80.43%) was in February (Table 2).

Table 2. Percentage of infection with parasite based on the month of sample collection

Sample area	No of the samples under examination	No of infected samples	Infection percentage (%)
December	30	24	80%
January	24	19	79.17%
February	46	37	80.43%
Total	100	80	80%

Furthermore, three types of protozoan parasites were detected in the studied water samples, which include *Entamoeba histolytica* (36%), *Giardia lamblia* (23%), and *Cryptosporidium parvum* (21%) (Table 3).

Table 3. Prevalence of diagnostic *protozoan parasites* in the drinking water samples of Samarra, Iraq

Diagnostic parasite	Exanimated samples	Infected samples	Infection percentage (%)
Entamoeba histolytica	100	36	36%
Giardia lamblia		23	23%
Cryptosporidium parvum		21	21%
Total	100	80	80%

4. Discussion

Water pollution is a major problem for human health worldwide since polluted water causes many deaths each year, especially among children and older people. Water pollution includes microorganisms (i.e., bacteria, viruses, and parasites) or chemicals (e.g., heavy metals); therefore, water loses its quality and becomes unsuitable for humans, animals, and plants. In the last 10 years, the number of waterborne diseases, especially those caused by parasites, increased due to the contamination with wastewater since 80% of untreated wastewater is dumped into the environment and pollutes the rivers. Parasitic diseases are transported by the drinking water and cause endemic or epidemic diseases in both developing and developed countries (2). Therefore, it is essential to take necessary measures to improve the quality of water by the identification of these organisms.

The results of the current study indicated the presence of protozoan parasites, which include *Giardia lamblia* cysts and *Cryptosporidium parvum* oocyst, in the drinking water. Cysts and oocysts of parasites were found resistant to environmental conditions and chlorine. Small size (1-17 micrometers) *Cryptosporidium* spp. oocytes and *Giardia* spp. cysts

can pass through water purification systems and cause an epidemic after drinking water (13, 14).

The findings also revealed the presence of *Entamoeba histolytica* cysts in a ratio higher than other parasites, which is one of the most important parasitic pathogens in polluted water supplies. The leading cause of water contamination with protozoa worldwide is *Entamoeba histolytica*, which is also responsible for the high mortality rates in children (15).

Many studies have identified the presence of cysts and oocysts of the three diagnostic parasites (*Entamoeba histolytica*, *Cryptosporidium parvum*, and *Giardia lamblia*) in the drinking water in Iraq. Baqer, Hammood (1) identified *Cryptosporidium parvum* and *Giardia lamblia* in the tank water in Baghdad, Iraq, while Koloren and Ayaz (16) identified *Cryptosporidium parvum* in the environmental water in Turkey. Additionally, AL-Samrri (17) detected *Cryptosporidium* oocysts in the drinking water in Samarra, Iraq. The present study recommends that efforts should be made to protect raw water from sources of contamination by maintaining water treatment systems. The main source of drinking water contamination with parasites in Samarra, Iraq, is breakages and cracks of drinking water tubes between water stations and houses, as well as the contamination of water in tubes with the contaminated groundwater.

Authors' Contribution

Study concept and design: R. R. H. A.
Acquisition of data: A. S. M. A.
Analysis and interpretation of data: B. I. H.
Drafting of the manuscript: R. R. H. A.
Critical revision of the manuscript for important intellectual content: R. R. H. A.
Statistical analysis: A. S. M. A.
Administrative, technical, and material support: R. R. H. A.

Conflict of Interest

The authors declare that they have no conflict of interest.

References

1. Baqer NN, Hammood AH, Hassan KF, Hassan ESA-d. Detection of water-borne parasites in drinking water of Baghdad, Iraq. Afr J Infect Dis. 2018;12(2):1-6.
2. Cotruvo JA, Dufour A, Rees G, Bartram J, Carr R, Cliver DO, Craun GF, Fayer R, Gannon VP, editors. Waterborne zoonoses. IWA publishing; 2004.
3. Northedge A. Remarks on Samarra and the archaeology of large cities. antiquity. 2005;79(303):119-29.
4. Ibrahim H. Investigating Groundwater Quality in the Azraq Oasis Area Using GIS and Remote Sensing: Thesis Al-Bayt University; 2006.
5. Ibrahim ZH, Ibrahim SA, Shaban AH, Jasim KA, Mohammed MK. Radiological Dose Assessments for Workers at the Italian Fuel Fabrication Facility at Al-Twaitha Site, Baghdad–Iraq with Aid of GIS Techniques. Energy Procedia. 2017;119:709-17.
6. Cunningham WP, Cunningham MA. Environmental Science A Global Concern (Eleventh). Mc Graw Hill Companies; 2010.
7. Dheyab MA. study of some physical and chemical properties of drinking water in Samarra city and comparing with mineral water. Tikrit J Pure Sci. 2016;21(4).
8. Ibrahim SA, Al-Tawash BS, Abed MF. Environmental assessment of heavy metals in surface and groundwater at Samarra City, Central Iraq. Iraqi J Sci. 2018;59(3A):1277-84.
9. Khalaf AT, Jassim AA, Muaffaq A. Water Piped to some Areas in Samarra City. Tikrit J Agric Sci. 2017;17.
10. AL-Nazzal AL, Khaleel YI. Isolation and identification of pathogenic bacteria from drinking water in Salahdeen province by using membrane filter Method. J Univ Anbar Pure Sci. 2009;3(3).
11. Markell EK, Voge M. Medical parasitology. 1976.
12. Cheesbrough M. District laboratory practice in tropical countries, part 2: Cambridge university press; 2005.
13. Hambidge A. Reviewing efficacy of alternative water treatment techniques. Health Estate. 2001;55(6):23-5.
14. Moore A, Vesey G, Champion A, Scandizzo P, Deere D, Veal D, et al. Viable Cryptosporidium parvum oocysts exposed to chlorine or other oxidising conditions may lack identifying epitopes. Int J Parasitol. 1998;28(8):1205-12.
15. Ghasemi E, Rahdar M, Rostami M. Prevalence of Entamoeba histolytica/dispar in drinking water in the city

of Shush, Khuzestan Province in 2011. Int J Curr Microbiol App Sci. 2015;4(2):582-8.

16. Koloren Z, Ayaz E. Genotyping of Cryptosporidium spp. in environmental water in Turkey. Acta parasitologica. 2016;61(4):671-9.

17. AL-Samrri AIM. The role of water in distributiom of Cryptosporidium parvum in Samarra city. Tikrit J Pure Sci. 2006;11(1).