Determination and enumeration of *Cryptosporidium* oocysts and *Giardia* cysts in Legedadi (Addis Ababa) municipal drinking water system)

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Abstract

This study was aimed to determine the parasitological status of drinking water system in terms of *Cryptosporidium* oocysts and *Giardia* cysts at Legedadi site around Addis Ababa city. A total of 22 samples were tested using immuno-fluorescence technique from February to April, 2005 in which *Cryptosporidium* was detected in all samples at a concentration range of 1-7 and 33-53 oocysts/L in the treated and untreated water samples, respectively. Whereas, *Giardia* was found in 73% of the samples, with range 0-3 and 13-20 cysts/L concentration in the treated and untreated, respectively. The preliminary study has identified the need for timely follow-up of the water system in terms of cryptosporidiosis and giardiasis. [*Ethiop.J.Health Dev.* 2008;22(1):68-70]

Introduction

Recently, there has been a dramatic increase in the incidence of outbreaks of waterborne disease caused by *Cryptosporidium* and *Giardia* spp. worldwide. The environmentally robust *Cryptosporidium* oocysts and *Giardia* cysts are capable of persisting in the water system. They are extremely resistant to most disinfectants and are smaller enough to penetrate most drinking water treatment systems. These characteristics, coupled with the low number of (oo)cysts required for an infection make them among the most critical pathogens in the production of safe drinking-water from surface water (1). *Cryptosporidium* accounts for 165 (50.8%) and *Giardia* for 132 (40.6%) of the 325 waterborne outbreaks of parasitic protozoan disease, which have been reported worldwide so far (2). Although there are studies conducted in Addis Ababa showing high prevalence of cryptosporidiosis and giardiasis among HIV/AIDS patients (3) and diarrheic children (4, 5), there is no documented data showing the status of these organisms in the drinking water systems of the city. This study aims to verify the presence and concentration of *Cryptosporidium* oocysts and *Giardia* cysts in Legedadi site of the municipal drinking water system.

Methodology

The Legedadi source of the municipal drinking water treatment plant is located 35 kilometers to the north of Addis Ababa. It has a production capacity rate of about 160,000 m^3 water per day and accounts approximately for 70% of the Addis Ababa's drinking water system (6).

Thirty-liter volumes of treated and 10-liter volumes of untreated raw water samples (7) were collected from the Legedadi system in sterilized plastic containers throughout February to April, 2005. For the purpose of comparison, 30-liter volumes of treated water samples were collected from other 5 sources of municipal drinking water systems (Fanta spring, Akaki ground water, Nazareth, Shashemene and Zuway) at the treatment site. As a control, 30-liter volumes of 2 brands of Ethiopian commercialized bottled waters were also included in the study (Table 1).

Using a vacuum pump and sterile cellulose acetate membranes (47-mm-diameter, 1μm pore size, Pall life science Extra Thick Glass Fiber, USA), each sample was filtered under negative pressure at a rate of 2L/min. Each filter membrane was eluted by alternatively scraping it with a smooth-edged plastic loop and rinsing it with 0.1% Tween 80 detergent solution. Elute was centrifuged at 2,000xG for 15 minutes (8). The pellet was diluted to 1ml total volume with deionized water (HACH, USA). Aliquots of 10μl of the pellet were examined by immune-fluorescence according to the manufacturer's protocol (Meridian Diagnostics. Inc., Cincinnati, Ohio). All data were analyzed by computer using SPSS version 11.5 statistical package.

Results

A total of 22 water samples were tested. Both *Cryptosporidium* oocysts and *Giardia* cysts were detected in the municipal drinking water samples (Table 1). All the 15 bottle of water samples collected from the Legedadi system were positive for *Cryptosporidium* spp. and 11 of them were positive for *Giardia* spp. All the 5 samples collected from other municipal drinking water systems were positive for *Cryptosporidium* and only one of them (Nazareth) was positive for *Giardia*. However, the 2 brands of bottled waters were free of these organisms.

Approximately, 1-7 and 33-53 *Cryptosporidium* oocysts/L were detected in the treated and untreated water samples, respectively, whereas for *Giardia*, this concentration was found to be 0-3 and 13-20 cysts/L in the respective samples (Table 1). The treated water samples of the Legedadi system were divided into

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collected at tap, the end point, and collected at the treatment site, and in that case the concentration of *Cryptosporidium* at the tap was 1-7 oocysts/L, whereas, only 1 oocyst/L was found in each collected sample from the treatment site. The concentration of *Giardia* at the tap was 0-3 cysts per liter, but only one of the water samples collected from the treatment site was found to contain *Giardia* cyst (1 cyst/L).

Table 1: **Occurrence and concentrations of *Cryptosporidium* oocysts and *Giardia* cysts in Legedadi and other drinking water systems for Addis Ababa Municipality and some other towns, 2005**

Treatment System	Water Type			No. of Samples	No. Positive Samples for:		Cryptooocysts/L	Giardiacysts/L
	Treated		Raw		Crypto	Giardia		
	Reservoir	Tap						
Legedadi	✓			3	3	1	1	0-1
Legedadi		✓		9	9	7	1-7	0-3
Legedadi			✓	3	3	3	13-20	33-53
Nazareth	✓			1	1	1	3	2
Zuway	✓			1	1	0	1	0
Shashemene	✓			1	1	0	1	0
Fanta Spring	✓			1	1	0	2	0
Akaki						0	1	0
Groundwater	✓			1	1			
Bottled	✓			2	0	0	0	0

Reservoir: sample collected at the treatment site

Discussion

Both *Cryptosporidium* oocysts and *Giardia* cysts were found in the Legedadi water system, but *Cryptosporidium* prevailed with higher number of positive samples and at higher concentrations than *Giardia*. It was interesting to note that there was a 7-fold increase in the *Cryptosporidium* oocyst and a 3-fold increase in the *Giardia* cyst count by the time the treated water is ready for public consumption. These organisms are not capable of reproduction outside the appropriate host (1). Further, the water is distributed only within Addis Ababa city. Hence, the observed increments of the (oo)cysts might be due to urban input such as contamination (6) with human feces. According to the annual report of Addis Ababa water and sewerage authority, there is about 30-35% loss of treated water, which indirectly shows possibilities of leakages, during distribution (6), increasing the possibility of contamination of the tap water. The present study clearly indicates that the tap water infested with (oo)cysts could be a source of infection to humans. It will be further aggravated in the present scenario where HIV/AIDS patients are more prone for cryptosporidiosis infection.

The study stresses the importance of determining the species as well as the viability and infectivity of the (oo)cysts to human, prevalent in the drinking water system. Regulatory agencies should ensure the supply of a safe drinking water system for human consumption.

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