

Distribution of the *Giardia* sp. ¹ cysts in the Mfoundi Water Basin (Cameroon): influence of some physico-chemical factors of the medium

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ABSTRACT

The resistant form of *Giardia* sp. was isolated and then identified in the waste water and surface water of the Mfoundi River Basin. The cysts of *Giardia* were identified after centrifugation and coloration with Lugol iodine. *Giardia* cysts reached a population of 891 cysts/l in the effluent of the University Hospital Centre (CHU) and 240 cysts/l in the effluent of Messa residential quarter. Environmental factors like ammonia, biochemical oxygen demand (BOD), turbidity and suspended solids were measured. The results indicated an acute presence of *Giardia* sp. cysts in the region under study.

Key words: *Giardia* sp. cysts, Mfoundi River Basin, Environmental Sanitation.

RESUME

La forme de résistance de *Giardia* sp a été isolée et identifiée dans les eaux usées et les eaux de surface du réseau hydrographique du Mfoundi Les kystes de *Giardia* ont été identifiés après centrifugation et coloration avec la solution de Lugol ioduré La densité des kystes de *Giardia* atteint 891 kystes /L dans l'effluent du Centre Hospitalier (CHU), et 240 kystes/l dans l'effluent du quartier résidentiel de Messa .Les facteurs environnementaux tels que l'ammoniaque ,la demande biochimique en Oxygène (DBO),la turbidité et les matières en suspension ont été mesurés .Les résultats montrent une forte présence des kystes de *Giardia* sp. dans la zone étudiée.

Mots clés: Kystes de *Giardia* sp., Réseau hydrographique du Mfoundi, Santé environnementale.

INTRODUCTION

Waterborn infections represent an important cause of illnesses in developing countries. These illnesses are responsible for most of the infant mortality. Bacteria is considered as the main pathogen in water (Stine *et al*;2005). Research in the developed countries indicated some protozoan parasites such as *Giardia* sp. as an important cause of diarrhoeic illnesses (Simadibrata *et al*;2004). The cysts of *Giardia* sp. can survive in the aquatic medium for an extended period of time (Scott, 1998). Giardiasis is characterised by profuse, watery and non-bloody diarrhoea, abdominal pain and cramping, nausea and weight loss. Giardiasis is a gastrointestinal illness caused by the flagellated protozoan, *Giardia intestinalis* (*G. Lamblia* or *G. duodenalis*). Some symptoms last for a long time while others can lead to death. The infection rate for giardiasis is predicted as highest in developing countries (Black 1996). This disease is highly correlated to the Human Immune Virus (HIV), which is at the origin of the immune deficiency of the human host, and thus the cause of an increase in the prevalence of this parasite (Gassama *et al*;2001, Guk *et al*;2005). Transmission of *Giardia* sp. is direct from faeces to mouth, and many epidemiological outbreaks have been associated

with its presence in water. This is usually accompanied by the elimination of the cysts with the excreta (Jephcott *et al*; 1986).

Giardia has been considered as the most commonly diagnosed intestinal parasite in public health laboratories in the United States (Bruce *et al*; 2000). The presence of *Giardia* cysts and other pathogenic micro-organisms in the environment is a potential health risk to the population. (Barrell *et al*; 2000). The entire community must contribute in the adequate management of the water resources. (Djeuda Tchapinga *et al*; 2001). Some strains of *Giardia* sp. are more pathogenic than others. (Upcroft *et al*;1999).

The Nyong river is the main source of potable water for the regions of Yaounde and Mbalmayo. The objectives of our research were to determine the distribution of *Giardia* cysts in the Mfoundi water basin, which is the main tributary of the Nyong river, and to establish correlation between *Giardia* cysts and some physico-chemical factors which favour the transportation of the cysts in the water basin.

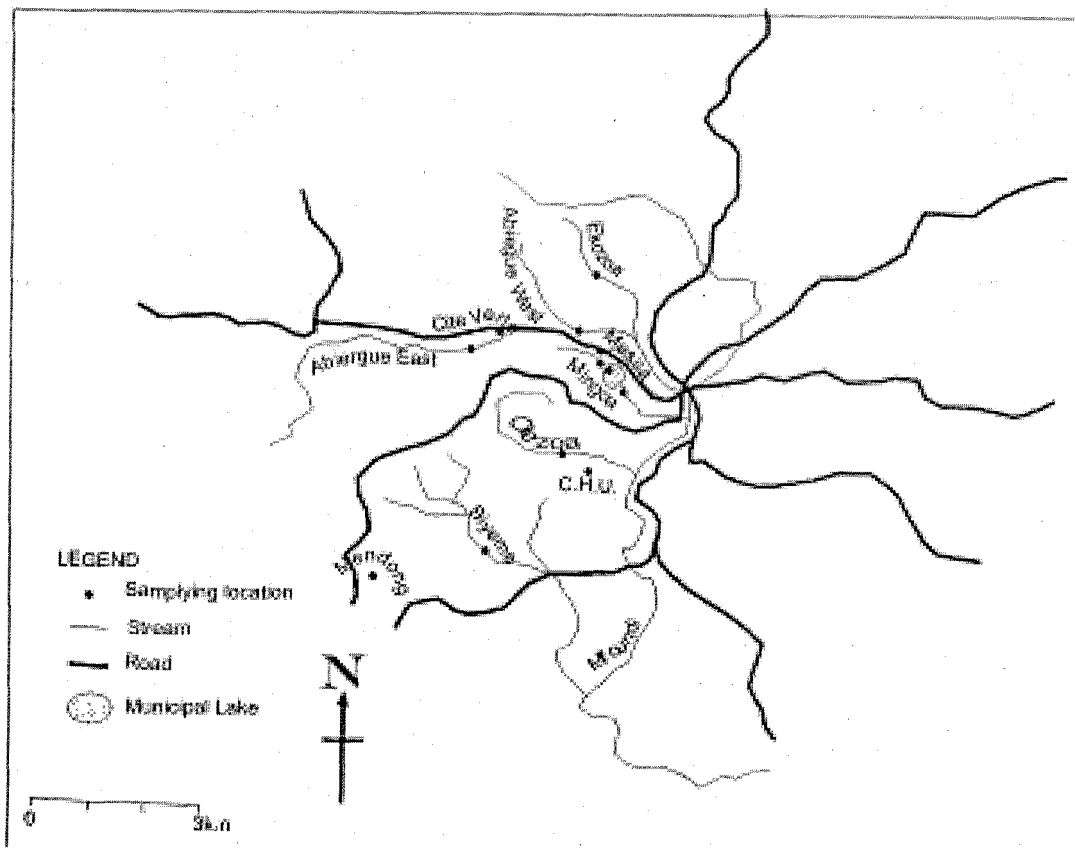


Figure 1:Map of Yaounde indicating sampling locations.

MATERIAL AND METHODS

Giardia cysts were detected from water by a concentration of particles contained in 10 litre sample. The samples were collected weekly from the wastewaters (University Hospital Centre effluent, residential quarter effluent of Messa, Cité Verte, Mendong), streams (Abiergue East, Abiergue West, Mingoa, Biyeme, Olezoa and Ekozoa) and the Municipal lake of Yaounde (figure 1). Sampling was carried out in December 2002 and January 2003. The samples were allowed to settle in the laboratory. The deposit was distributed in centrifugation tubes and fixed with formaldehyde. The samples were centrifuged and zinc sulphate added to the tubes to enable a re-suspension of the *Giardia* cysts for eventual coloration with a solution of Lugol iodine. The cysts were observed under the olympus microscope at 400 and 1000 magnification.

The biochemical oxygen demand (BOD₅) was measured using the respirometry method, ammonia by the Nessler method, turbidity and suspended solids by direct reading on the spectrophotometer. The Pearson's correlation coefficient was calculated for the biological and physico-chemical parameters as follows:

$$P_{x,y} = \frac{\text{cov}(x,y)}{\sigma_x \cdot \sigma_y} \text{ where } -1 \leq \sigma_{xy} \leq 1$$

and

$$\text{cov}(x,y) = \frac{1}{n} \sum_{j=1}^n (x_j - \mu_x)(y_j - \mu_y)$$

RESULTS

The values of the physico-chemical and biological indicators were assessed in the Mfoundi River Basin. The indicators of organic contamination were 80mg/l O₂, 100 mg/l O₂, 130 mg/l O₂ and 150mg/l O₂ in Mingoa , Biyeme, Ekozoa, Abiergue East and Abiergue West respectively(Figure 2a). The highest values of BOD₅ were obtained in Messa, Cité Verte and Mendong, they were 275mg/L O₂, 580mg/L O₂, 230mg/L O₂ respectively. These are effluents of some residential quarters in Yaounde (Figure 2a)

The values of ammonia ranged from 1.5mg/L to 3.5mg/L in most of the sampling points (Figure 2d). Suspended solids varied from 120mg/l to 850mg/l in the aquatic system assessed(Figure2b). The highest values were obtained in the Mendong residential quarter and the Municipal lake . The lowest value of turbidity was 50FTU in Cité Verte while the

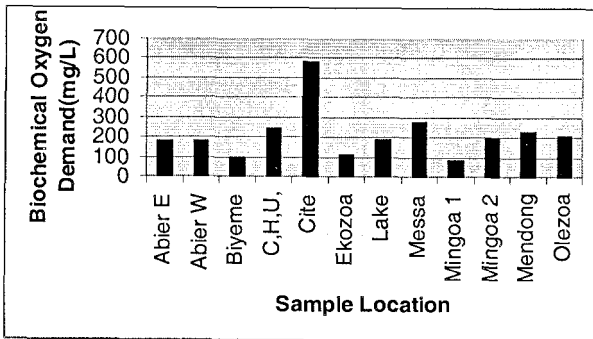


Fig:2a Variation in concentration of Biochemical Oxygen Demand at the different sampled sites.

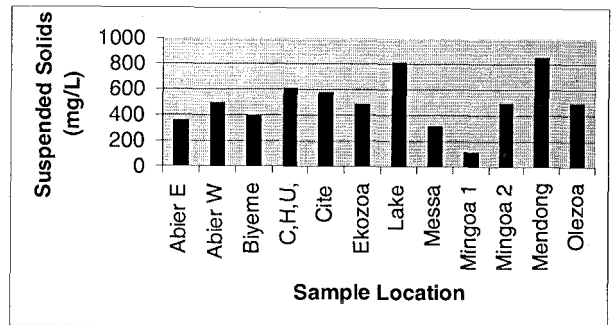


Fig:2b Variation in concentration of Suspended Solids at the different sampled sites.

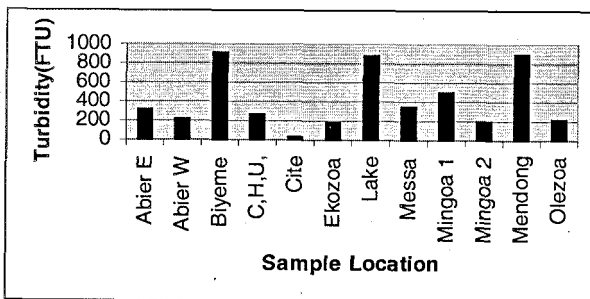


Fig.2c: Variation in concentration of Turbidity at the different sampled sites.

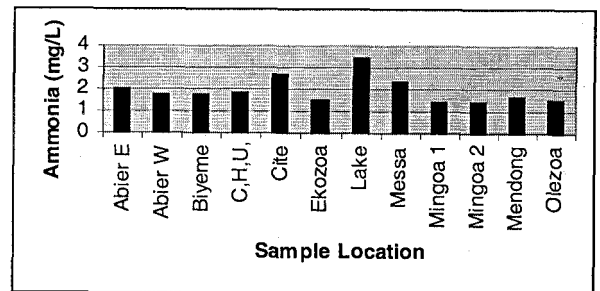


Fig.2d : Variation in concentration of Ammonia at the different sampled sites

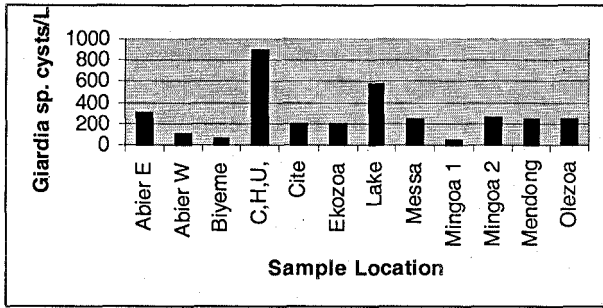


Fig.3: Giardia sp. Cysts in the Mfoundi river basin.

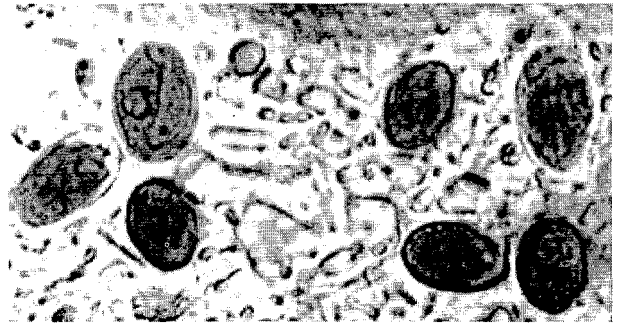


Fig.4.: Giardia sp. Cysts.

highest values was 900FTU in the Municipal lake and the Mendong sampling locations(Figure 2c).

The lowest densities of Giardia cysts identified were 50 cysts/L in Mingoa and Biyeme, 100 cysts/L in Abiergue West, 180 cysts/L in Ekozoa and Cité verte respectively(Figure 3). The highest cyst counts were obtained in the municipal lake with 550 cysts/L and the University Hospital Centre (CHU) with 990 cysts/L. There was a positive correlation obtained for these cysts with the values of BOD₅, NH₃ and Suspended solids. The Pearson's correlation coefficient was 0.105 for BOD₅, 0.32 for NH₃ and 0.500 for suspended solids (Table 1).This indicates a high significance for the presence of Giardia cysts with the variation of Suspended solids in the hudrosystem assessed.

DISCUSSION

Cysts of Giardia sp. were isolated and identified in the Mfoundi River Basin. Gardias protracted communicability, low infection dose and environmental resistance, make it easily transmitted by drinking water, recreational water , food and from person to person. Their elimination and inactiva-

tion from wastewater is complicated by their small size . Their resistance to chlorination (Adam, 1991) and their persistence and long periods of infection make this parasite a danger to the community.

The high values of turbidity and suspended solids observed in the water basin, (900FTU in Mendong, 925FTU in Biyeme, 875FTUin the Municipal lake) and the high values of suspended solids(619mg/L in the effluent of the University Hospital and 565 mg/L in Cité Verte) could influence the sedimentation and the consequent transportation of the cysts with the organic matter in the medium. (Figure 2b,c). Turbidity which is caused by inorganic and organic debris can interfere with the concentration, separation and the observation of the water sample for Giardia cysts (EPA, 2001).

Giardia has been identified as the etiologic agent associated with most water-borne outbreaks, and it's presence in high values in the wastewater and surface water of Yaounde (891cysts/L in the University Teaching Hospital effluent, 908cysts/L in the Cité Verte effluent, 650 cysts/L in the Biyeme stream) exposes the inhabitants to this communicable disease (Figure 3). These values also indicate the low level of sanitation in the community.

Table 1: Pearson's correlation of Giardia cysts with chemical parameters at 5% significance.

Parameter	Pearson's correlation coefficient (P)
G.Cyst/L Vs Biochemical Oxygen Demand	0.105679
G.Cyst/L Vs Ammonia	0.327868
G.Cyst/L Vs Suspended Solids	0.50072
G.Cyst/L Vs Turbidity	-0.04650

The high values of BOD₅ (366.33mg/L O₂ in Messa, 219.8mg/l O₂ in the Olezoa stream and 327.7mg/l O₂ in the Mendong residential quarter effluent) and the corresponding high values of ammonia (2.11 mg/L in Messa and 2.7 mg/L in the Cité Verte residential effluent) indicate a corresponding high Pearson's correlation of these indicators of contamination and the charge of enteroparasites (Table 1). The cysts present in the environment should likely have a human origin and are thus

directly eliminated into the streams with faeces.(Dieng , 1999). These cysts must therefore be associated with *Giardia duodenalis* (lambda) which is the species infecting man (Figure 4).

The population should adequately dispose its waste so as to minimise the risk of intestinal diseases (Faye *et al*, 1998). The process of sedimentation is more efficient in removing the cysts, than the physico-chemical treatment of wastewater (Adin *et al*, 1998). A waste stabilisation pond is very efficient in the removal of the *Giardia* cysts as they easily settle with the sediments (Wiandt , 2000). This should be coupled with definitive catchment control policies so as to reduce the likelihood of enteropathogens accumulating in the water system (Smith *et al*, 1995). This elimination of the cysts in the wastewater and surface water will reduce the chances of the cysts being transmitted to its human host, and thus a reduction of the prevalence of giardiasis in the region.

CONCLUSION

The cysts of *Giardia* sp. were isolated and identified in the wastewater and surface water of Yaounde. The high values of the cysts indicate that an appropriate program for treatment, distribution and protection of the Mfoundi water basin is very necessary so as to avoid an epidemic of giardiasis in Yaounde and its environs.

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