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Assessment Of Parasitological Contamination Of Groundwater In The El Hajeb Region (Morocco)

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ABSTRACT
Globally, inadequate water supply, sanitation, and hygiene are major contributors to mortality and burden of disease. In the region of El Hajeb (Morocco), the inadequacy of the public network for the distribution of drinking water and the persistence of drought in recent years has forced the majority of the population to resort to water from wells, boreholes and sources. However, following the presence of a dump in the surrounding area, concerns have continued to increase due to the appearance of many water-borne diseases. The aim of this work is to microbiologically characterize the groundwater in the El Hajeb region (Morocco), in order to verify its state of salubrity and to sensitize the local population on water-borne diseases. To do this, a first sampling campaign was conducted for 29 months (from May 2016 to January 2017). A total of 43 stations (wells, boreholes and sources) were selected for monthly analyzes of parasites (Helminth eggs and Protozoan cysts) by the filter membrane method. The methods of microbiological analyzes referred to the techniques for assessing the quality of water described by Rodier (1978, 2009). The results of the count exceeded national and international standards in the majority of stations especially those located near the dump. The aim of this study is to assess the association of lacking access to water and sanitation with water-transmitted helminth infections, taking into account the differences in route of infection among species and the availability of adequate water and sanitation at home.

KEY WORDS: groundwater, Contamination, parasites. analyzes. dump. leachate

INTRODUCTION

Parasite are above all the physical environment (water reservoir, canal, etc.) and the physico-chemical characteristics that create the conditions conducive to the proliferation of vectors and intermediate hosts of the parasites. Among the parasites pathogenic for humans and which are transmissible by water, the most important are protozoa and helminths. Among the intestinal protozoa pathogenic to humans and transmissible by drinking water, there may be mentioned: Entamoeba histolytica, Giardia sp and Balantidium coli which respectively transmit amebiasis, giardiasis and balantidiosis. All of these protozoa have been linked to outbreaks of drinking water. Giardia cysts and

Cryptosporidium oocysts are very resistant to disinfectants, especially chlorine. Thus, the Giardia cysts must be exposed to a chlorine concentration of 5 mg/L for 30 min to have 99% elimination. For Cryptosporidium oocysts 240 min contact with chlorine having a concentration of around 30 mg/L is necessary to obtain the same result. The branch of the worms or helminths, includes two classes: the Némathelminthes are cylindrical worms with non-segmented body coated with hard integuments with complete digestive tract their sexes are separated and their males are smaller than the females. Whereas the Plathelminths are flatworms with segmented or not segmented body with absent or incomplete digestive tract and hermaphrodites most often. Maturation of helminth eggs requires good oxygenation, an optimal temperature between 25 and 30°C, little light, a high humidity and sandy soil or coal dust.
The aim of this work is to microbiologically characterize the quality of groundwater consumed and used by the population of this region in irrigation and possibly identify the causes of pollution of this water.

MATERIALS AND METHOD

Groundwater sampling

Choice and method of sampling
During the first campaign (May-2015 to January-2017), a sampling network was chosen and consists of 43 stations, symbolized by W (well), B (drilling) and S (source) and distributed over the entire study area, with a higher density around the uncontrolled landfill and along the direction of flow of the groundwater.
During these two hydrological cycles, samples were taken monthly according to the method of Rodier, 2009 in polyethylene bottles with a capacity of 5 liters. The samples were then immediately transported in cold boxes at a temperature below 5 °C to

the laboratory where they were stored in the dark in a 4 °C refrigerator before analysis. The microbiological analysis was carried out within a maximum of 48 hours after the sample was taken.

Germs sought

During our work, we searched for pollution indicator germs, which parasites: Helminth eggs (H) and Protozoan cysts (P) Analysis techniques In this study, the count of total germs is done by epi-fluorescence: the method comprises a fixation allowing the conservation, a coloring with a fluorescent compound, a vacuum filtration on a non-fluorescent

polycarbonate membrane and a counting with an epi-fluorescence microscope.

The parasites are recovered by immunocapture on magnetic beads. The separation is done by immunomagnetic process (IMS). The identification and the counting of the parasites are carried out by immunofluorescence and on the other hand by the capture of helminth eggs which is done by concentration of a large volume of water (10L), elution then centrifugation puit enrichment by flotation and examination of the floating fragments or surface layer of the supernatant in the form of a slide and coverslip under the microscope at ×100 magnification.

RESULTS AND DISCUSSION

The results of the microbiological analyzes of the water from the stations are given in Table 1. We found that the microbiological quality of the water was unsatisfactory for all the waters of the stations studied. This non-compliance is mainly due to the presence of pollution indicators. This contamination has been attributed to the infiltration of leachate from the dump and to poor hygiene. Most of the stations were present before the landfill was set up, others were installed after it opened. These stations were undeveloped, some wells were fitted or not with concrete coping but all in the open air and devoid of a cover which constitutes a safety and resource protection device. These conditions are not in accordance with Article 53 of Law n ° 10-95 on water published in 1995 by the Ministry Delegate to the Minister of Energy, forming Mines, Water and Environment [1], responsible for water, saying that any open water distribution system intended for human consumption is prohibited. The surroundings designed to avoid any stagnation of water which favors the development of a flora dangerous for the aquifer have not been fitted out. As a result, the water table has been easily invaded by surface runoff of rainwater, causing human wastewater discharged all around the soil surface. These germs were detected most often during the dry season (June, July and August) and the rainy season (October, November, December and January) but to a lesser degree. Indeed, the contamination attenuated during the rainy period by dilution could be due to runoff of rainwater which increases the bacterial concentration of groundwater [1-2]. Contamination during the dry seasons could be attributed to several factors such as the very high temperature observed during the study period seems to have an effect on the dynamics of bacterial communities [3].

Table 1 Microbiological quality of groundwater during the 1st camping (Shapiro-Wilk test)

Parameters	Groundwater samples (n=86)				
	Moy ± SE	Min	Max	*p-Value*	F. Norm 2013
H/10L	0,52±0,10	0	2	< 0,0001	0
P/10L	30,69±5,45	0	126,5	< 0,0001	0

Min. : minimum value; Max. : maximum value; Avg.:Average value ; SE. : Standard error; CFU: colony-forming units

The decrease in groundwater levels during the dry season in many places causes the concentration of these different germs to increase. In addition, the unhygienic drawing conditions at the majority of stations have favored their microbial pollution.

The population of Helminth's eggs (H) was low and showed concentrations ranging from a minimum of 0 EGGS/10L to a maximum of 2 EGGS/10L with an average of 0.52±0.10 EGGS/10L. The enumeration of Protozoan cysts (P) indicated concentrations which varied between a minimum of 0 KYSTS/10L and a maximum of 126.5 KYSTS/10L with an average of 30.69±5.45 KYSTS/10L (Table 1). Statistics have shown that for helminths and protozoa 42% and 50% of the stations surveyed, respectively, revealed negative analyzes, ie absence of eggs and cysts (Figures. 1 and 2). These stations are located far and upstream from the dumping site in the direction of the flow of the water table.

The contamination of the vast majority of stations studied

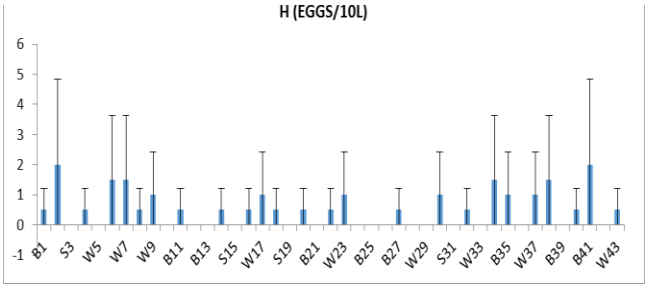

Figure 1 Spatial evolution of H concentrations in groundwater stations

by pathogenic bacteria can be explained according to the pre-established survey, by the poor protection of wells and sources and the non-compliance with protection perimeters. Likewise, the absence of the appropriate sanitation system and surrounding pollution such as cattle ranching, the existence of septic tanks and latrines and the promiscuity of

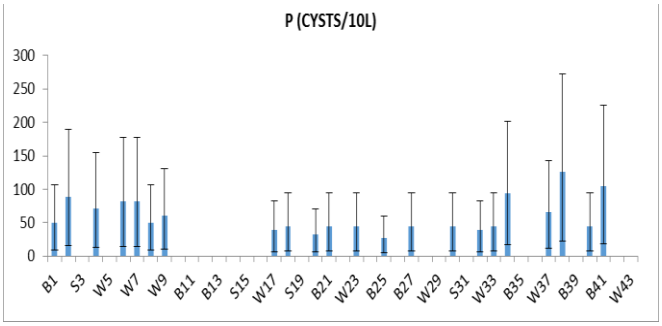

Figure 2 Spatial evolution of P concentrations in groundwater stations

the wild dump that generates leachate are widely implicated in this pollution. In addition, local well diggers dug the wells. They do not contain a nozzle and therefore have no lateral tightness. Thus, bacteria immobilized by adsorption at the well wall can live for a long time in moist soil. As a result of heavy precipitation, the walls of the wells collapse, favoring the passage of bacteria into the water. The soil is permeable and the water table is recharged by infiltration.

Almost always open or semi-closed by a sheet metal plate, they are not protected from runoff water. The drawing buckets are generally left on the ground very close to the well. So a large part of the water pollution can be attributed to poor protection of wells without minimizing the drawing technique. The pollution of wells is therefore also linked to that of the surface. In fact, the groundwater supply area being entirely occupied by dwellings, due to the lack of wastewater evacuation infrastructure, this water is evacuated in sumps, in gutters, or even directly in the street. In addition, the populations empty the contents of the sumps directly into the streets. The infiltration of all this water through the ground to the shallow groundwater can only contribute to the pollution of nearby wells. So the nature of the soil and the absence of interior lining in the wells play an important role in this pollution.

CONCLUSION

Drinking water should not contain any traces of helminth's eggs and protozoan cysts in drinking water does not generally indicate faecal contamination, but rather a degradation of the bacterial quality of the water. The presence of helminth's eggs and protozoan cysts varies considerably from a wet season to the dry season due to dilution. The values recorded for most of the microbiological parameters greatly exceeded the standards for water intended for consumption.

The results of the water analysis allow us to conclude that the quality of these waters is average upstream of the landfill and far from any anthropogenic contamination (wild landfill, septic tanks and latrine ...). In conclusion, the groundwater in the El Hajeb region (Morocco) and cannot therefore be used raw for human consumption. Otherwise, treatment with chlorination is necessary or compulsory. However, these waters can be used for irrigation but not for market gardening in the region, these waters can, under certain climatic conditions, constitute risks of pollution transfer. To improve the quality of groundwater we offer the following solutions:

- In the short term, we must raise awareness and encourage people to treat station water before consumption, and reassure them

that we can reduce all diseases of water source by an adequate supply of safe water and by improving sanitation and hygienic conditions.
In collaboration with the health services, could be developed

- After monitoring treatment processes such as chlorination.
- In the medium term, the supply of peripheral districts could be ensured by deep boreholes capturing the deep aquifer. On the other hand, ensure the water supply by the modern supply network supplying drinking water to the districts not yet sufficiently endowed. Finally, steps must be taken to rehabilitate the dump and better design of cesspools and sumps. This will reduce pollution of the surface water table; in order to protect populations from ailments linked to drinking water.

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