BACTERIAL CONTAMINATION OF WATER SUPPLIES OF THE VALLEY ASSIF EL MAL POPULATION (MARRAKESH AREA)

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The quality of drinking water directly affects the well-being of individuals with cumulative effects at every social level. Even so, 884 million people in the world still do not get their drinking-water from improved sources, almost all of them in developing regions (W.H.O & UNICEF, 2010). It has been estimated that waterborne diseases kill more than 5 million people annually (Hunter et al. 2002). The microbial pathogens responsible for most of these deaths originate from human and animal feces.

In rural areas, the majority of the population has neither a supply of clean drinking water or proper sanitation. This is the case of the valley Assif El Mal, a tributary left bank of the Tensift Riversituated at 80km south-west from the Marrakech city. It drains a watershed of 517 square kilometers, where people resort to archaic method as the only source of water for any purpose. The river water and water stored in reservoirs (which are a tanks built traditionally buried in the ground) are the principal water supplies available in the region.

The objective of the present study is to assess the bacteriological and physical-chemical quality of water (in reference to the Moroccan standards) in five sampling sites located along the River of the valley Assif El Mal and in six reservoirs in the area downstream, fed from the same river and usually used for drinking water. Comparison between winter and summer seasons was established. In addition, a correlation between bacteriological and physical-chemical variables was determined to reveal the process and the origin of possible levels of contamination.

Samples were collected monthly (during winter and summer 2010) in two bottles; 0.5 L in a sterile bottle for microbiological analysis and 1.5 L in a plastic bottle for chemical analysis. Water temperature, electrical conductivity and dissolved oxygen were measured in situ. A photometric method was used for the determination of $NO2^-$ and $SO4^{2-}$. Total hardness, Mg and Ca concentrations were done by complexometric titration using EDTA. Cl^- concentrations using argentometric titration. While the microbiological analyses were performed using Standards Moroccan (2003, 2005 and 2006) analytical methods.

Thus, results show that river water and water stored in prospected reservoirs reveals a light chemical contamination. They are rich in Mg^{2+} and Ca^{2+}, which makes them very hard. Generally, for all water resources investigated, concentrations of chemical elements analyzed were lower to acceptable limit for drinking water according to Moroccan standards.

The bacteriological results showed (Tab.1 & Tab.2) that in one hand, these waters has bad microbial quality because of their load in fecal indicators bacteria such as, fecal coliforms, fecal streptococci and other pathogenic bacteria like *Salmonella sp*, *Staphylococcus aureus, Clostridia* and *Pseudomonas aeruginosa*.

Tab.1: Evolution of the bacterial load (CFU/ 100ml) at all sites of river (O) and reservoirs (R) in the study area during winter period 2010.

	fecal coliforms	fecal streptococci	*Staphylococcus aureus*	*Clostridia*	*Salmonella sp*	*Pseudomonas aeruginosa*
O1	134±16	37±13	126,6±34,4	612±65	–	–
O2	221±22	130±12	203±29	882±64	–	–
O3	336±45	139±3	198±52	949,5±21,5	+	–
O4	518±23	212±45	349±18	1123±112	+	+
O5	576±36	241±36	416,5±39,5	730±28	+	+
R1	$1,50^{E}$+03	$8,54^{E}$+02	$1,42^{E}$+02	$8,86^{E}$+02	+	+
R2	$1,74^{E}$+03	$8,77^{E}$+02	$3,11^{E}$+02	$7,36^{E}$+02	+	+
R3	$1,31^{E}$+03	$6,14^{E}$+02	$5,14^{E}$+02	$1,20^{E}$+03	+	+
R4	$1,67^{E}$+03	$4,74^{E}$+03	$1,09^{E}$+03	$1,41^{E}$+03	+	–
R5	$2,48^{E}$+03	$2,98^{E}$+03	$2,96^{E}$+02	$1,11^{E}$+03	+	–
R6	$2,96^{E}$+03	$7,61^{E}$+03	$1,47^{E}$+03	$1,66^{E}$+03	+	+

(+): present, (–): absent; CFU (Colony forming units)

Tab.2: Evolution of the bacterial load (CFU/ 100ml) at all sites of river (O) and reservoirs (R) in the study area during summer period 2010.

(UFC/ 100ml)	fecal coliforms	fecal streptococci	*Staphylococcus aureus*	*Clostridia*	*Salmonella sp*	*Pseudomonas aeruginosa*
O1	206±12	76±15	374±27	860±4	–	–
O2	201±15	101±12	360±31	1500±51	–	–
O3	334±22	166±8	440±12	949±21,5	+	–
O4	518±16	206±34	549,67±10,5	1565±15	+	+

O5	582±44	212±22	573,33±18	730±28	+	+
R1	2,20E+04	7,43E+14	850±6	1738,67±30	+	+
R2	2,92E+04	2,31E+03	9,71E+02	1,66E+03	+	–
R3	2,03E+04	1,63E+03	1,27E+03	1,91E+03	+	+
R4	2,77E+04	9,04E+03	2,22E+03	2,12E+03	+	+
R5	1,13E+04	5,20E+03	6,55E+02	1,83E+03	+	+
R6	3,12E+04	1,38E+04	2,38E+03	2,87E+03	+	+

(+): present, (–): absent; CFU (Colony forming units)

On the other hand, there are significant quantitative increases of germs during low water in comparison to the flood period, with increasing gradient upstream to downstream during those two seasons.

In general, these bacteria abundance undergoes spatio-temporal fluctuations. These findings suggest a high prevalence of household level pathogen bacterial contamination and a corresponding vulnerability to infection by diarrhea-causing pathogens. Most chemical characteristics were relatively stable with time, but exhibited apparent spatial fluctuations. So, the water quality in the studied area was bad and needs a prior treatment before use.

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