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# CONTRIBUTION TO THE BACTERIOLOGICAL CHARACTERIZATION OF SOME SOURCES IN THE REGION OF TANGIER TETOUAN (MOROCCO)

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## ABSTRACT

Our study, based on the grid water quality World Health Organization (WHO, 2004), targeted the evaluation of bacteriology of water springs of the Tangier-Tetouan region (North- western Morocco). The analyses have involved eleven springs with that of the tap water for three companies. According to Rodier (1978 and 2009), the samples were taken from March/2013 to June/2013. The results for bacteriological analyzes showed that the region of Tangier-Tetouan generally has a bad quality within the germs examined during the study period. The evaluation of the bacteriological contamination shows variability from one source to another. Levels of the most important for different germs contamination are found in five water springs (Glaoui, Nakhla, Hamma, Sidi Talha and Gaznaya) throughout March during the period of rain. From the perspective origin, bacterial pollution at Glaoui and Nakhla springs is inexplicable. However, at Gaznaya springs, Sidi Talha and Hamma, the origin of the contamination is due to human fecal pollution.

**Keywords**: Quality, Spring water, Contamination, Microbiological and Pollution.

## RESUME

Notre étude a ciblé l'évaluation de la qualité physico-chimie, bactériologie et métaux lourds des eaux de sources de la région Tanger-Tétouan (Nord-ouest du

Maroc) en se basant sur la grille de la qualité des eaux selon l'Organisation Mondiale de la Santé (OMS, 2004). Des analyses ont concernés onze sources avec celle de l'eau de robinet pour trois compagnes. Les prélèvements ont été effectués du Mars/2013 au Juin/2013 selon Rodier (1978 et 2009). Les résultats obtenus pour les analyses microbiologiques ont montré que la région de Tanger-Tétouan a généralement une mauvaise qualité pour les germes examinés au cours de la période d'étude. Ces résultats relatifs aux contaminations les plus importants pour les différents germes sont atteints pour cinq sources (Glaoui, Nakhla, Hamma, Sidi Talha et Gaznaya) durant le mois de Mars où la période était pluviale. Du point de vue origine, la pollution bactérienne au niveau des sources Glaoui et Nakhla est inexplicable. Cependant au niveau des Sources Gaznaya, Sidi Talha et Hamma, l'origine de la contamination est due à la pollution fécale humaine.

**Mots clés :** Qualité, Eaux de source, Contamination, Micro-bactériologie, et Pollution.

## INTRODUCTION

The stakes of water on the water form a set of pressures that make the water vulnerable (Hugonin, 2011). Indeed, springs water having a natural water quality, are very vulnerable to any type of pollution caused by human actions and the influence of climate variability on the quantity and quality of surface run off feeding groundwater. (Saad et al., 2011).

Water is now a topic of increasingly sensitive. It is essential for human life, but this vital need can be associated with a diverse set of dangers that must be known to be better controlled; where the interest of the WHO recommended surveillance. Quality of the water consumed.

Water sources are a vital resource for the economy of the region. They are the crucial water resources for drinking water supply of much of the rural population and for irrigation of agricultural land (Guergazi et al., 2005).

The objective of this work is to study bacteriological quality of water springs in the Tangier-Tetouan (Northwestern Morocco) region, consumed by the local population.

## MATERIAL AND METHODS

### Sampling

The sources have been selected to have a representation on the spaced Tingitane peninsula. We conducted a total of thirty three samples for bacteriological analysis, sources and distributed as follows: Eleven samples during the period

of March 2013, eleven samples during the period April 2013 and during the eleven months May 2013.

**Study area**

The region of Tangier-Tetouan, having as the capital city of Tangier, covers an area of 11,570 km ², representing 1.6% of the total area of the Kingdom. It is bordered by the Mediterranean Sea to the north, the Atlantic Ocean to the west, the region of Taza-Al Hoceima-Taounate to the east and the Gharb-Chrarda-Beni Hssen South.
From the geographical point of view, the Tingitane Peninsula is characterized by a structural entity that is the Rif area according to (APDN, 2007).
Indeed, and outside the coastal plains areas geomorphology steep or heavily corrugated cover more than 80% of the region.

- Tangiers, located in the Strait of Gibraltar between the Mediterranean and the Atlantic Ocean, approximately coincides with the basin of the river M'harhar and presents an alternation of valleys, covered mainly Quaternary alluvium, marl and sandstone hills.
- Lower Basin Loukkos constituting the countryside the most developed in the region, thanks to good soils and abundant water and covering the clay alluvial plains and the sandy plateau of Larache.

Tangier Peninsula is characterized by a dense hydrographic network as wadis low flow and unsteady (Dakki, 2004).
By their position in the extreme north-west of the country and printed their raised by the many mountains of the Rif Mountains and the coastal plains variability basins Loukkos of Tangiers and the Mediterranean coast are subject to varying weather conditions.

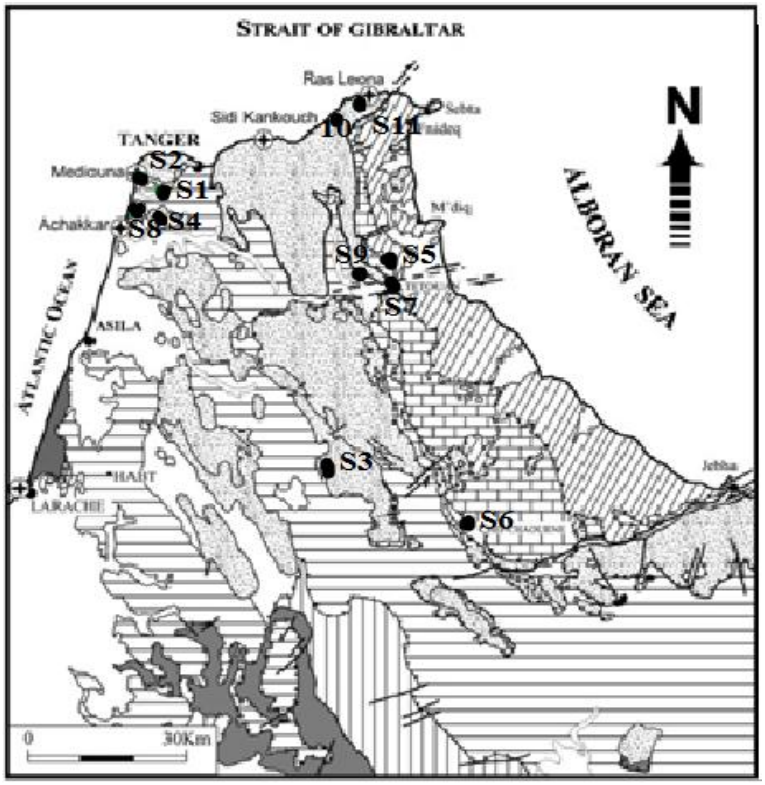


**Figure 1**: Location map sources studied in the Tangiers-Tetouan Region

**Microbiological analyzes**

For microbiological analysis, samples were collected using sterile Pyrex glass bottles (120°/ 20) fitted with screw caps: the submerged bottle filled and then closed before being returned. The samples were immediately placed in an insulated cooler where the temperature is kept between 2°C and 8°C; they are sent to the laboratory to be analyzed immediately on selective media according to FAS_ NF T 90-414.2000.

Germs test of fecal contamination (GTFC) choose according to Normalizes Moroccan 03.7.001 are:

-Escherichia coli (E. coli) is the most significant species of faecal contamination.

- Coliform bacteria (CB)
- Intestinal enterococci (IE).

## RESULTS AND DISCUSSION

### Evaluation of Bacteriological Contamination

It is evaluated from looking for witnesses of fecal contamination (urine, feces). Although these organisms are not directly pathogenic, their presence indicates a potential risk to consumer health.

### Escherichia Coli (E. Coli)

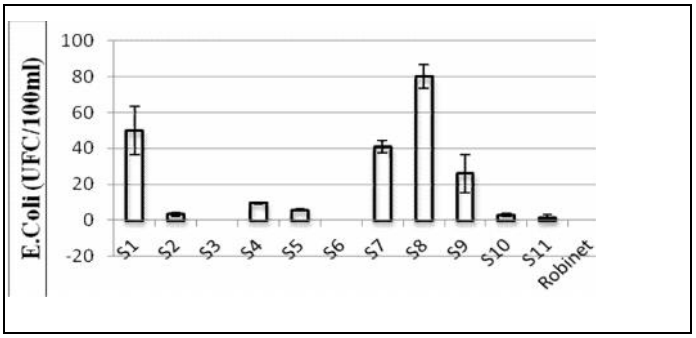


**Figure 2:** Spatial variation of mean values Escherichia Coli

The evaluation of the load faecal contamination through E. coli as a specific indicator of fecal pollution (Figure 2) is marked by contamination recorded in the rainy season in the month of March. Taking into account the weather conditions: water sources (shallow aquifers) are often contaminated after heavy rainfall (Rodier, 2009). In general, the S8 source with an average value of 80UFC/100ml seems to be the most contaminated by the microflora followed by S1 and S7, S9, S4 and S5. Other sources are not contaminated with E. Coli.

### Coliform bacteria (CB)

It is a historical indicator; therefore, the research is associated with that of E. coli in the standard (BOS ISO 9308-1). The difficulty of interpretation related to this indicator is that if indeed a number of highlighted bacteria indicative of fecal pollution, some are caused by environmental factors.
Monitoring during the three months of the load CB as shown in (Figure 3) is marked by a strong contamination recorded in the rainy season and especially during the month of March and early April. Generally, the source appears to be the most S8 contaminated then followed by S1 S7, S9 and S4.

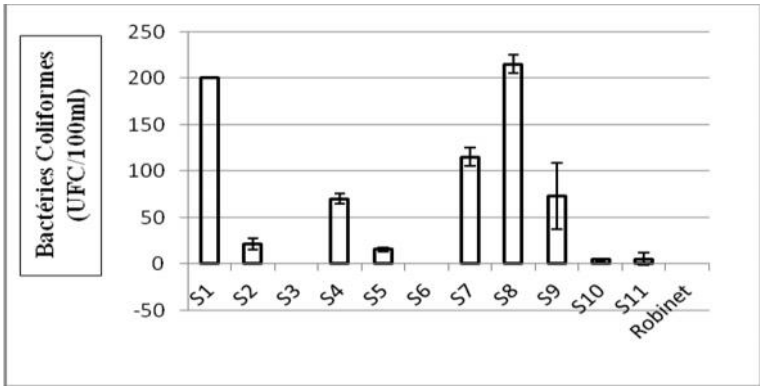


**Figure 3**: Spatial variation of mean values Coliform Bacteria

**Intestinal enterococci (IE)**

This group of bacteria is also considered a good specific indicator of fecal contamination. Several epidemiological studies have shown that the concentration of intestinal enterococci is best correlated with the appearance of gastrointestinal diseases (Servais et. Al 2009).
Monitoring the management of Intestinal enterococci shows that, like variations in E. coli and Coliform bacteria; the highest contaminations are recorded during March (Rainy). Generally, the source appears to be the most S8 contaminated then followed by S1 S7, S9 and S4. However other sources have either a very low contamination or none (Figure 4).

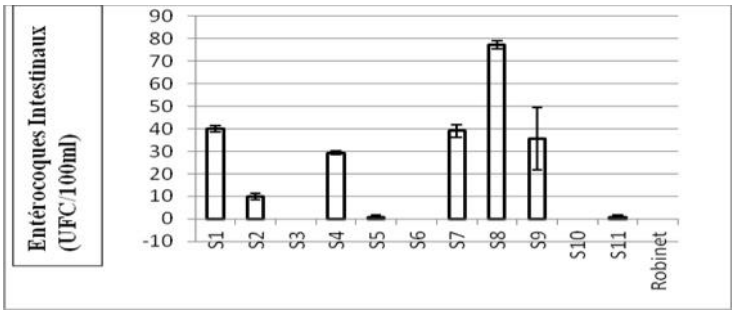


**Figure 4**: Spatial variation of mean values Intestinal Enterococci.

The analysis of the report CB/IE, which is considered a good indicator of the origin of the pollution shows that in the surveyed sources the contamination of water is originally human origin since the CB/IE ratio is greater than 1.

## CONCLUSION AND RECOMMENDATIONS

The results for bacteriological analyzes showed that the region of Tangier-Tetouan generally has a bad quality within the germs examined during the study period.

Bacteriological point view, the sources studied have very high concentrations of fecal contamination in almost all sources studied, which is undoubtedly a threat to residents who obtain water from these sources for most of their needs.

In general, Microbiological seeds were more directly related to human activities that took place in the area (agriculture, domestic waste, septic systems and application of deicing salts). These results are similar to those found in groundwater of Plio-Quaternary in Morocco (Belghiti et al., 2013).

To avoid the possibility of any sanitary risk it is recommended to:

- Treat these waters at the family level by the use of hypochlorite using a dropper,
- Marketing sources that have a good quality to participate in the economic development of the region.
- Garbage collection.

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