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# Assessment of the Microbiological Quality of Groundwater in Tipaza Region, Algeria

Lebik Hafida<sup>1\*</sup>, Elhadi Rafik<sup>2</sup>, Mahidine Sara<sup>1</sup> And Boutra Belgassim<sup>1</sup>

<sup>1</sup>Unité de Développement des Equipements Solaires, UDES, Centre de Développement des Energies Renouvelables, CDER, 42415, Tipaza, Algeria.

<sup>2</sup>Centre De Recherche Scientifique et Technique en Analyses Physico – Chimique, CRAPC, 42415, Tipaza, Algeria.

\*Corresponding author's email: lebikhafida@yahoo.com

## ABSTRACT

Groundwater contamination is now a global issue, especially in the northern part of the country where urban development in coastal towns has led to an increase in the population's demand for water and to overexploitation of groundwater resources. This has put pressure on the resource and led to a deterioration of its quality. The present study reports the assessment of microbiological characteristics of different groundwater sources in the region of Tipaza. The study involved carrying out a detailed survey of over 200 sampling points. In the first stage, a careful examination of the historical water quality data was conducted, removing springs that were not intended for human consumption, those impacted by drought, and those that had already been tapped and treated. Following this, a carefully selected list of nineteen springs was chosen for further study. The results revealed that, of the 19 springs surveyed, only one met the drinking water quality criteria, while the rest were of poor bacteriological quality, with the pollution indicators analyzed: *faecal coliforms*, *streptococcus*, *E. coli* and *sulphate-reducing* bacteria, exceeding the limit recommended by the Algerian *Water Quality Guidelines for groundwater intended for human consumption* (no risk target water quality range: 0 count/ 100 ml for *E.Coli*, 0 count in 100 ml for *streptococcus* bacteria 0 count/20ml for *sulphate-reducing* bacteria).

**Keywords:** Groundwater, microbiological, assessment, *E. Coli*.

## 1 Introduction

Groundwater quality is becoming increasingly degraded. To protect the population, it's important, even vital, to monitor its quality to prevent the risks associated with potential contamination. Especially in regions reliant on groundwater as a vital resource. The degradation of groundwater quality is often associated with agricultural activity, which involves the use of fertilizers and pesticides that are the main cause of groundwater contamination with nitrate [1]. According to the National Agency of Water Resources, significant sections of rivers in the Tafna, Macta, Cheliff, Soummam and Seybous basins are polluted. The populations lacking access to water is compelled to use existing natural resources (principally groundwater in Algeria), although the quality of the latter may be inappropriate for human consumption. Many people used to think that soil could effectively remove or absorb a large portion of the microorganisms present in surface water before it reaches groundwater, however, it is clear today that the global issue of exposure to microbial pathogens exists and poses health risks, as evidenced by the cholera outbreak in 2018 [2]. In this context, the present study aimed to assess the microbial quality of groundwater and its suitability for drinking and domestic purposes in Tipaza's Area. Sampling campaigns for microbial analyses in the region to provide a detailed view of microbiological groundwater quality.

## 2 Experimental

The study is being carried out in the wilaya of Tipaza, which covers a total area of 1 707 km<sup>2</sup>, subdivided into 10 regions, and the choice of sources to be analyzed is based on the study of overall water quality according to the monitoring history established by the Ministry of Irrigation. Only sources intended for human consumption were retained and the sources already treated were eliminated. A final list of nineteen sampling points were selected for the study and samples were collected during 2022-2023. Samples were



collected according to ISO 19458, ISO 19458:2006 Water quality: Sampling for microbiological analysis. A burner was used to sterilize the taps before sampling. Water samples were collected in sterile glass labelled bottles of 1L, in duplicate, stored at 4°C, and transported to the laboratory for microbial analysis. In situ measurement of pH, conductivity, dissolved oxygen and temperature were performed using HANNA instrument. Analysis of microbial parameters were performed according to ISO 9308-1:2014, Membrane filtration method for Escherichia coli and coliform bacteria determination, ISO 19250: 2010, for Detection of Salmonella and ISO 7899-2 for the detection and enumeration of intestinal enterococci.

### 3 Results and Discussion

The microbial analysis results, presented in table 1 show that, except for sample 13, all the water samples exceeded the limit recommended by the Algerian *Water Quality Guidelines for groundwater intended for human consumption*.

Parameter	Coliform Bacteria	Escherichia coli	Intestinal enterococci	sulphate-reducing bacteria	Salmonella spp
Unit	UFC/100ml	UFC/100ml	UFC/100ml	UFC/100ml	UFC/20ml
Sample 1	>150	>150	3	31	Abs
Sample 2	0	0	0	64	Abs
Sample 3	>150	50	0	0	Abs
Sample 4	100	100	44	120	Abs
Sample 5	>150	>150	18	31	Abs
Sample 6	>150	100	1	8	Abs
Sample 7	>150	>150	44	7	Abs
Sample 8	105	105	7	3	Abs
Sample 9	>150	>150	8	0	Abs
Sample 10	>150	>150	26	120	Abs
Sample 11	>150	>150	2	0	Abs
Sample 12	>150	>150	2	2	Abs
Sample 13	0	0	0	0	Abs
Sample 14	70	70	0	0	Abs
Sample 15	65	65	0	3	Abs
Sample 16	>150	30	0	0	Abs
Sample 17	>150	80	0	0	Abs
Sample 18	7	7	0	0	Abs
Sample 19	>150	>150	12	30	Abs

### 4 Conclusions

Human-generated pollution from household and improper waste disposal, along with sanitation systems, as well as increasing population density in the coastal cities, significantly contribute to the deterioration of groundwater microbial quality. The study findings highlight a high contamination rate in the analyzed samples, surpassing the limit recommended by the Algerian Water Quality Guidelines for groundwater intended for human consumption. Therefore, ongoing microbial assessment of groundwater quality is imperative to prevent the proliferation of waterborne diseases.

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