

Physicochemical and bacteriological quality of drinking water from different regions of the wilaya of Skikda (Algeria)

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ABSTRACT

The objective of this study is to evaluate the physicochemical and bacteriological quality of drinking water from different origins in the region of Skikda, Algeria (groundwater, dams and desalination). The study was carried out for a period of 3 months.

KEY WORDS

Drinking waters; bacteriological pollution; physico-chemical parameters; Skikda.

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INTRODUCTION

Water is an important vital resource. Being an essential element in our life, both for human consumption and for industrial use, its quality is a constant concern of the authorities in order to protect the environment and the health of living beings.

Water intended for human consumption must have a certain number of organoleptic, physico-chemical and microbiological characteristics. Sometimes it can become an important reservoir for the dissemination of microorganisms (bacteria, viruses, protozoa and parasites), making it unsuitable for consumption. In recent years, water quality control has become a major and mandatory operation. Other similar studies were conducted by our group (Ouamane et al., 2016).

In this study, we will try to determinate the physicochemical and bacteriological quality of drinking water from five sites in the region of Skikda (two underground springs, two dams and the water from the desalination plant) thus covering

the different types of drinking water supplying the region.

MATERIAL AND METHODS

The wilaya of Skikda is located in the North-East of Algeria, it includes 38 municipalities, 14 of which are coastal, divided into 13 dairas. The wilaya is supplied by four dams: the Zerdez dam (with a capacity of 20 million m³), the Guenitra dam (with a capacity of 125 million m³), the Zit Emba dam (with a capacity of 120 million m³) and finally the Beni Zid dam (with a capacity of 50 million m³); it includes also 53 sources (ABH Constantine and ANRH Skikda, 2005).

Our study is based on the physico-chemical and bacteriological analysis of drinking water from different origins: groundwater from the western region of Skikda (2 underground sources located in the mountains of Collo (Ouled Atia), water from the dams of Béni Zid and Oum Etoub

and desalination water from the Skikda station (Fig. 1, Table 1).

The samples, transport and analysis of drinking water samples were conducted according to guidelines for the monitoring of the quality of swimming waters. This monitoring program was carried out for a period of three months (March 2019-April 2019). The collected data were measured in each water sample taken per month per site. The analysis focuses on the quantification of faecal indicator bacteria (total coliforms, thermotolerants, faecal streptococci and sulfo-reducing clostridiums) using the method of the enumeration in liquid medium by determining the most probable number (MPN) and incorporation into agar; as well as determining certain physicochemical parameters (electrical conductivity, pH, dissolved oxygen, ...) (Table 2).

| Sample | Site | Type of water |
|--------|----------------|---------------|
| S1 | Béni Zid | Spring |
| S2 | Ouled Atia | Spring |
| S3 | Béni Zid | Dam |
| S4 | Oum Etoub | Dam |
| S5 | Station Skikda | desalination |

Table 1. Identification of the different samples.

The health status of drinking water is assessed based on the results obtained and compared to thresholds, quality bacteriological and physico-chemical criteria present in the Executive Decree No. 11-125.

RESULTS AND DISCUSSION

As regards the average results recorded for the various physico-chemical parameters, we note that these are in line with the quality standards required for drinking water by the texts in force, for spring water (sites 1 and 2) and of poor quality for the other three sites (dam water and desalination) (Table 3).

Site 3 (water from Beni Zid Dam) has high average rates for turbidity and TDS parameters. Turbidity can be due to the poor quality of the source water, to improper treatment, etc. Regarding the level of total dissolved solids (TDS), this parameter is not a concern for the health of consumers, it only allow to judge only the flavour of the water, a level below about 600 mg/l generally corresponds to good water, drinking water becomes significantly and gradually undrinkable when TDS levels exceed about 1000 mg/l. High levels of TDS can lead to consumer complaints due to excessive crusting in pipes, radiators, boilers and domestic appliances (WHO, 2017).



Figure 1. Study area: location of sampling sites.

For the average results of the bacteriological parameters, we note that the majority of the water is of good quality except for site 1 (Béni Zid spring water) which records high levels of total and thermotolerant coliforms synonyms of recent faecal contamination (Table 4). This can be explained by climatic conditions during the study season and by runoff.

- Source water from the Ouled Atia (S2) site is of good quality according to national and international standards.

| Parameters | Methods |
|--|--|
| <u>Physical</u> PH Dissolved oxygen Temperature Conductivity TDS Turbidity | electrochemical |
| <u>Chemical</u> Total hardness Calcium hardness Chloride Nitrite COD Nitrate Phosphate Iron Sulfate Ammonium Alkalinity TA and TAC Heavy metals | Volumetric Spectrophotometric |
| Quantified germs | Methods used |
| total Coliforms | determination of the most probable number (MPN) |
| thermotolerant Coliforms | |
| <i>Escherichia coli</i> | |
| faecal streptococci | |
| sulfo-reducing clostridiums | incorporation into agar |

| Site | pH (6.5-9) | Temperature (C°) (25) | Electrical conductivity (µS/cm) (2800) | Dissolved oxygen (mg/l) (5-8) | Turbidity (NTU) (5) | TDS (mg/l) (<600) | TA et TAC (mg/l) (0.3) | THMg (mg/l) (150) | THCa (mg/l) (200) | TH _T (mg/l) (200) | Chlorures (mg/l) (500) |
|------|---------------|-----------------------------|---|--|---------------------------|-------------------------|---------------------------------|-------------------------|-------------------------|------------------------------------|------------------------------|
| S1 | 0.7 | 19.3 | 198.8 | 5.08 | 1.12 | 97 | 7.70 | 7.30 | 4.80 | 21.60 | 31.16 |
| S2 | 6.37 | 20.5 | 197.6 | 5.48 | 0.38 | 97 | 3.30 | 12 | 8 | 20 | 21.81 |
| S3 | 6.72 | 22.1 | 1839 | 7.67 | 6.51 | 901 | 7.15 | 9.60 | 4 | 13.60 | 37.39 |
| S4 | 7.57 | 19.1 | 567 | 2.5 | 4.06 | 278 | 13.97 | 16.40 | 24.80 | 41.20 | 60.76 |
| S5 | 7.87 | 20.0 | 567 | 6.28 | 0.21 | 278 | 18.70 | 6.40 | 1.60 | 8 | 155.80 |

| Nitrate (mg/l) (50) | Nitrite (mg/l) (0.1) | Phosphate (mg/l) (5) | Iron (mg/l) (0.3) | Sulphate (mg/l) (400) | Ammonium (mg/l) (0.5) | COD (mg/l) | Cooper (mg/l) (2) | Nickel (µg/l) (70) | Lead (µg/l) (10) | Manganese (µg/l) (50) | Zinc (mg/l) (5) | Cadmium (µg/l) (0.01) |
|---------------------------|----------------------------|----------------------------|-------------------------|-----------------------------|-----------------------------|---------------|-------------------------|--------------------------|------------------------|-----------------------------|-----------------------|-----------------------------|
| 0.004 | 0.10 | 0.51 | 0 | 107.28 | 0 | 0 | 0 | 0 | 0 | 0 | 0.08 | 0.024 |
| 5.75 | 0.03 | 0.70 | 0 | 217.60 | 0 | 0 | 0 | 0 | 0 | 0 | 0.15 | 0.0028 |
| 0 | 0.18 | 1.09 | 0 | 8.28 | 0 | 0 | 0 | 0 | 0 | 0 | 0.06 | 0.0028 |
| 21.62 | 0.22 | 0 | 0 | 1293.48 | 0 | 0 | 0 | 0 | 0 | 0 | 0.13 | 0.0021 |
| 0 | 0.13 | 0 | 0.007 | 2.32 | 0.09 | 0 | 0 | 0 | 0 | 0 | 0.05 | 0.0021 |

Table 3. Average results of the physico-chemical parameters measured.

| | Total coliforms (/100ml) (0) | Thermotolerants Coliforms (/100ml) (0) | E. Coli (/100ml) (0) | Faecal Streptococci (/100ml) (0) | Clostridia sulfito- reducers (/100ml) (0) |
|----|---------------------------------------|---|----------------------------|---|---|
| S1 | 23 | 23 | 0 | 0 | none |
| S2 | 0 | 0 | 0 | 0 | none |
| S3 | 0 | 0 | 0 | 0 | none |
| S4 | 0 | 0 | 0 | 0 | none |
| S5 | 0 | 0 | 0 | 0 | none |

Table 4. Average results of the bacteriological parameters measured.

allows us to conclude that these waters are of good potability.

From a bacteriological point of view the results obtained showed that:

- source Ouled Atia (S2), dams Béni Zid and Oum Etoub (S3 and S4), and desalination water (S5) are of good bacteriological quality.
- the Beni Zid (S1) source is of poor quality.

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