Journal of Environmental Analytical Chemistry

Hassidou et al., J Environ Anal Chem 2019, 6:2

Research Article Open Access

Contribution to the Study of the Drinking Water Quality in Niger Republic: Determination of pH, Conductivity, Temperature and, Some Anions Concentration of Tibiri-Maradi Drinking Water

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Rec date: September 16, 2019; **Acc date:** September 24, 2019; **Pub date:** October 03, 2019

Abstract

This work is a contribution to the study of the quality of drinking water in Niger Republic. It concerns the physicochemical characterization of Tibiri drinking water. Thus, pH, conductivity, temperature and, some anions (nitrates, chlorides, fluorides, and bicarbonates) concentration are evaluated. The results obtained showed that this water are acidic and not agree WHO standards of drinking water; their conductivity indicate that their degree of mineralization is low and obey also to the WHO standards; the temperature measured as well as anions concentrations determined are in agreement with WHO standards. Therefore, Tibiri drinking water quality is quite good in terms of temperature, conductivity, and ions analyzed.

Keywords: Drinking water; Physico-chemical characterization; WHO standards; Tibiri; Maradi; Niger Republic

Introduction

Drinking water is water that can be drunk without any risk for health. The standards have been established for several harmful substances and elements [1]. Human drinking water must contain neither dangerous substances nor pathogens microorganisms [2]. Water is the most abundant compound is the world. There is no life without water. Around 1.5 billion of people have not potable water. About thirty thousand persons die each day by drinking hazardous water. These reports show the importance of dangers for drinking unsafe water and the necessity to evaluate the physicochemical quality of drinking water before consumption to prevent diseases which can be caused for human [3].

This study aims to appreciate the physicochemical quality of Tibiri commune drinking water. Thus, water samples were collected from twelve fountains, and pH, conductivity, temperature, nitrates, chlorides, fluorides, and bicarbonates ions concentrations are determined.

Materials and Methods

Sampling area

The sampling were taking place at Tibiri commune (Maradi region) located at middle-south of Niger Republic between 13°30' and 13°34' North latitude, and 7°1' and 7°3' East longitude. Samples were collected from twelve fountains in 1.5 mL PET bottles washed with distilled water (Tables 1 and 2).

Analyzes

Samples collected are submitted to physicochemical analyses. Thus, pH, conductivity, temperature, nitrates (NO^{3-}), chlorides (Cl^{-}), fluorides (F^{-}) and bicarbonates (HCO^{3-}) are determined for all samples.

- pH and Temperature values are measured using pH-meter waterproof pH-Testr® 30 double function.
- Conductivity is determined using conductometer Eutech Instruments Cyberscan CON 110.
- Nitrates, chlorides, fluorides, and bicarbonates concentrations are determined using JENWAY PFP7 Flame Photometer.

Results and Discussion

pH

The pH values measured at the twelve points studied are given in Table 1. They vary from 5.76 at Sabon Gari and Kantin Boudou points to 6.6 at Kassouwa point. It is important to note that only kassouwa fountain's pH obeyed to international standards [4,5]. In addition, the value of pH obtained for the same fountain is in the range of natural water reported previously [6]. Otherwise, all fountains water studied have an acidic pH which can be responsible of trichloroacetic acid formation when disinfection by chlore [7]. The values of pH founded in the present study are lower than that obtained by Kahoul and Touhami when evaluating physicochemical of Annaba (Algeria) drinking water [8].

Conductivity

The conductivity values obtained are given in Table 1. They vary from, 94.5 µs/cm for Goummar 1' fountain to 165.6 µs/cm for Kassouwa fountain. It is important to note that all fountains water studied has not exceeded the WHO, and Moroccan standards [9,10]. Otherwise all fountains water is low mineralized [11]. It is also important to note that conductivity values obtained in the present study are lower that reported by Kahoul and Touhami in their previous study about Annaba drinking water [8].

Temperature

The values of temperature recorded range from 13.8°C for Kantin Boudou fountain to 19.9°C for Wadata fountain (Table 1). Thus, conductivity of all fountains studied is not in agreement with WHO standards [5]. Otherwise, it is important to note that, excepted Kantin Boudou fountain, all fountains water have conductivity values between the values of conductivity measured for Annaba drinking water reported in the similar previous study [8]. However, all fountains water studied have their conductivity agreeing the WHO standards [9]. Only Kantin Boudou fountain water has a conductivity value which is not in agreement with Moroccan standards [10].

Fountain	pH	Conductivity (µs/cm)	Temperature (°C)
Goummar 1	5.9	94.5	16.5
Goummar 2	5.86	100	15.7
Sabon Gari	5.76	100	17.1
Wadata	5.95	100.6	19.9
Ma Yankka	5.85	100.6	18.6
Kassouwa	6.6	165.6	15.7
Sarkin Fawa	5.9	103.1	15.9
Dogouwa Kassa	5.83	102.2	15.8
Dan Fillo	5.83	101.9	16.6
Kantin Boudou	5.76	101.8	13.9
Hilin Sarki	5.8	94.6	15
Magagi	5.85	100.5	16.3

Table 1: pH, conductivity, and temperature values for Tibiri fountains water analyzed.

Anions

Nitrates: The nitrates concentration determined vary between 14.08 mg/L and 29.48 mg/L for Goummar 1 and Sabon Gari fountains, respectively (Table 2). All these values obtained agree Algerian standards [12], and European standards [13]. Only Goummar 1 and 2, and Ma Yankka fountains water have nitrates concentrations between 1.93 and 17.6 mg/L obtained for Annaba drinking water [8]. Otherwise, the values of nitrates concentrations found in this study have not reached 50 mg/L, limit value not to exceed recommended for WHO 2011 [9] and Moroccan standards 2008 [10]. Therefore, all fountains waters studied cannot cause methemoglobinemie as reported previously [14].

Chlorides: The chlorides concentration values range from 2 to 4 mg/L. It is very important to note that same values have obtained for lot of fountains (Table 2). Otherwise, the chloride concentrations values measured for all samples are very lower than that reported by Kahoul and Touhami [8] during their study about Annaba drinking water. In addition, they agree the Algerian standards 1992 [15], Moroccan standards 2008 [10], and WHO standards 2011 [10] which are 500 mg/L, 750 mg/L, and 250 mg/L, respectively. So Tibiri fountains waters are not harmful for health in term of chlorides ions [16-19].

Fluorides: Concentration values of fluorides ions obtained in this study are between 0.1 mg/L and 0.32 mg/L for Goummar 2 and Kantin Boudou, respectively (Table 2). These concentrations values are in agreement with WHO standards 2011 [10] superior limit value which is 1.5 mg/L.

Bicarbonates: Concentrations of bicarbonates ions vary between 18.3 mg/L and 48.8 mg/L. It is important to note that several samples have same concentrations values of bicarbonates (Table 2).

Fountains	Nitrates NO^{3-} (mg/L)	Chlorides Cl^{-} (mg/L)	Fluorides F^{-} (mg/L)	Bicarbonates HCO_3^{-} (mg/L)
Goummar 1	14.08	3	0.1	24.4
Goummar 2	14.08	3	0	18.3
Sabon Gari	29.48	3	0.09	18.3
Wadata	18.04	4	0.06	24.4
Ma Yankka	16.28	4	0.12	24.4
Kassouwa	25.52	2	0.32	48.8
Sarkin Fawa	25.96	4	0.29	18.3
Dogouwa Kassa	19.36	4	0.25	24.4
Dan Fillo	24.2	4	0.08	18.3
Kantin Boudou	18.04	4	0.01	18.3
Hilin Sarki	22	4	0.04	18.3
Magagi	27.72	3	0.08	24.4

Table 2: Nitrates, chlorides, fluorides and bicarbonates ions concentrations for Tibiri fountains water analyzed.

Discussion

Tibiri drinking water is acidic and can therefore release metals used to made canalizations such as Fe, Cu, Pb, Ni, Cr, and Zn [20]. Conductivity permits to appreciate the level of water mineralization [9]. Subsequently Tibiri drinking water is low mineralized. Otherwise, Tibiri drinking water is good quality in term of temperature values measured.

Nitrates are natural ions present everywhere in environment. They are the product of nitrogen oxidation by microorganisms in crops, ground, and water. Tibiri drinking water is acceptable in term of amount of nitrates ions. Chlorides ions are worldwide in nature. Their amount in water is variable and is linked to ground nature. Tibiri

drinking water contains very lower amount of chloride ions. Fluor has not play an essential metabolic role for animals and human, but it plays a fundamental role, at its fluoride ions form, during the formation of fluoroapatite in teeth and bones [21]. When the amount of fluoride ions in drinking water is weak (less than 0.5 mg/L), it is recommended to do a fluor supplementation for children in form of fluoride cooking salt or medications [22]. Hence, a supplementation of fluor is needed to insure the protection of children teeth who drinking this water. Bicarbonates ions in water are due to the dissolution of carbon dioxide in natural water sources. An important quantity of carbon dioxide leads to very gaseous water [23]. Tibiri drinking water has no risk for irrigation [24].

Conclusion

Some parameters which can influence the quality of drinking water of Tibiri commune is reported is this paper. Thus, pH, conductivity, temperature, nitrates, chlorides, fluorides, and bicarbonates ions concentration are determined. The comparison of the results obtained with some previous studies and some standards (WHO, Algerian, Moroccan, European) showed that our results are in agreement with these standards excepted pH values. Therefore, Tibiri commune drinking water, in spite of their acidic character, is quite good in terms of other parameters analyzed.

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