INFLUENCE OF pH AND SALINITY ON THE MICROBIOLOGICAL QUALITY OF A WATER SOURCE (AIN ZINA, W. DJELFA, ALGERIA)

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The water establishes an environment which pollutes easily and can carry undesirable or toxic substances as well as microorganisms that are dangerous for humans. That is why, we suggested making the study of microbiological quality of a source water of the rural region of Ain Zina (Wilaya of Djelfa, Algeria) according to its pH and salinity.

Two sampling points are made at the level of the study area: the first concerns the source itself, "Ain Zina" (S) with three samplings at 10-day intervals, (SP1, SP2, SP3), and the second at a drilling water (F) located 100m from the source with three different samples at 10 days intervals (FP1, FP2, FP3). The results of physico-chemical analysis show that the pH is between 7.35 and 7.81 for surface temperatures of 17.7 to 20 ° C with an average salinity of 0.52 ± 0.10 ‰.

Regarding the results of the bacteriological analyzes carried out on the samples of underground waters and those coming from the boreholes, there was a total absence of microbiological contamination.

Keywords: water, microbiology, analysis, salinity, samples

1. Introduction

Water is an environment that pollutes easily and can carry undesirable or toxic substances as well as microorganisms that are dangerous for humans. For this reason, the quality assurance and water hygiene are priority requirements in public health [2]. To ensure its quality and potability, it must be regularly monitored in specialized control laboratories, from its origin until its consumption [2,3,6]. This resource, indisputably valuable and irreplaceable, is unfortunately not accessible to any inhabitant, and for some regions, the water crisis is so pronounced with harmful consequences that have repercussions on the various sectors of development such as health, agriculture, livestock farming, fishing, transportation and waste management [1,2].

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The rural region of Ain Zina is a small village distance from Djelfa city by 7 km, whose main activity is cattle breeding mainly the dairy sector and some cultures. These sectors require a large and continuous water supply, individual local drilling and natural underground source: source of Ain Zina.

This region not being served with drinking water dues to the state pipeline network, the inhabitants obtain water from this source as well for their consumption, for the watering of their cattle and for the watering of their cultures, from where the interest of the study of the microbiological and physicochemical quality of this water source.

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2. Materials and methods

The experimental study consists in physicochemical and microbiological analyzes of the groundwater used in the watering of the Ain Zina region (Djelfa town), with a view to defining the quality of these waters and detecting any microbiological contamination of this source.

Sampling Mode. Two sampling points were set up at the level of the study area: the first concerns the source itself Ain Zina (S) with three samples at 10-day intervals (SP1, SP2, SP3), and the second at a drilling (F) located 100 m from the source, still with three different samples at 10-day intervals (FP1, FP2, FP3), the interest of these two points lies in the fact of their location, the source being the supply point of the inhabitants and the drilling point is the exit point of the water on surface, and is located at 100 m of the source

Sampling technique for water samples. The sampling of our samples is done directly at the source and drilling, in sterile flasks, leaving a volume of air to allow agitation before analysis in the laboratory. Flasks previously identified and labeled will be transported to cold enclosures (4-8 °C). The analyzes were carried out within a maximum of 8 hours

Methods of analysis

• The pH: By directly immersing the electrode in the bottles carrying the samples and reading the pH meter after the stability of the value.

• Salinity (‰) at temperature (°C): To measure these parameters, a refractometer is used. The results are displayed directly on the device.

Microbiological Analyses. There are several methods for counting total coliforms, but membrane filtration is currently the most used in the ADE laboratory (Algérienne des Eaux), it consists of a presumptive identification and counting step.

Coliform enumeration

Operating mode. Membrane filtration: prepare a sterile area: place the Tergitol 7 agar plates and sterile pipettes around the Bunsen burette and place the sterile membrane on the filtration system. Shake the vial vigorously and finally pour 100 mL of water sample and filter by aspirating with a vacuum pump.

Seeding: Cultivation in sterile area. then open the filtration system and remove the membrane with sterile forceps and finally the membrane is deposited on the agar, contaminated side up. The nutrients in the agar cross the membrane, allowing the growth of surface bacteria.

Incubation: Place the dishes in an oven at 37 °C (incubate the lid boxes downwards so that condensation accumulates in the lid). For coliform research, place the dishes at 37 °C for 24 and 48 hours. For thermotolerant coliforms, place the dishes at 44 °C for 24 and 48 hours.

Colony identification and enumeration: The enumeration of bacteria is based on the principle that a colony is formed by divisions of a single microorganism. Examine the membrane at the end of the incubation, through the lid.

Coliforms: are considered to be characteristic colonies that are yellow-orange in color.

Thermotolerant coliforms: the same colonies are considered to be characteristic as for coliforms, but after incubation at 44 °C. Count the colonies by marking each colony on the bottom of the box with an indelible marker.

Enumeration of *Streptococci*

Operating mode. The same amounts of water are filtered as for the coliforms according to the same technique. The medium used in this case is the middle of Slanetz. After filtration, the membranes are placed on Slanetz medium and then incubated at 37 °C. for 48 hours; Membrane analysis is carried out to observe the formation of colonies with a diameter of 0.5 to 2 mm and stained in brick red. All these steps correspond to the presumptive test of streptococci in general (qualitative analysis). Thus, the suspected colonies are counted and

subcultured in a tube containing LITSKY medium, and then they are incubated at 37 °C. for 24 hours in the oven. This step confirms the presence of faecal streptococci. Tubes contain a disorder (confusion) and/or the appearance of a purple pastille at the bottom (in fact), represent circles rich in faecal streptococci (primary qualitative analysis).

3. Results and discussion

A preliminary physicochemical analysis of the Ain Zina water shows that the obtained values are included in the usual standard norms cited in the JORADP, 2011 as found in Table 1.

Table 1

Physicochemical results of groundwater analysis, Ain Zina region, Wilaya of Djelfa, Algeria

Sample points / Parameters	Source			Drilling			Algerian Standards (JORDP, 2011)
	SP1	SP2	SP3	FP1	FP2	FP3	
pH (pH unity)	7.81	7.51	7.35	7.69	7.61	7.49	$6.5 \leq pH \leq 9$
T °C	18.2	18.9	20	17.7	19.2	18.8	25
Conductivity (µs/cm)	1197	1199	1198	807	903	1035	2800
Sal (‰)	0.6	0.6	0.6	0.4	0.4	0.5	-
NH_4^+ (mg/L)	0.04	0.06	0.05	0.06	0.06	0.09	≥0.5
NO_2^- (mg/L)	0	0	0	0	0	0	0.2
NO_3^- (mg/L)	4.89	3.77	5.72	0	0	0	50
PO_4^- (mg/L)	0	0	0	0	0	0	5
Cl^- (mg/L)	120.7	99.4	120.7	92.3	78.1	106.5	5
SO_4^{-2} (mg/L)	320	250	320	90	120	180	400
Ca^{2+} (mg/L)	104.8	107.2	97.6	64	64	57.6	200
Mg^{2+} (mg/L)	31.59	29.16	42.28	28.18	26.73	35.4	-
TH (°F)	39	38.8	41.8	29	27	29	200

With: SP1: Source 1st sample. FP1: Drilling 1st sample. SP2: Source 2nd sample. FP2: Drilling 2nd sample. SP3: Source 3rd sample. FP3: Drilling 3rd sample

The obtained values of physico-chemical analysis of this groundwater, allow us to consider that this water source has a good quality in accordance with the standard norms of the country [5]. So, these preliminary physico-chemical analyzes allowed us to make a complementary study on the influence of the pH. salinity and temperature on the microbiological development of this water source.

pH and salinity

The pH values of groundwater at the source points (SP1. SP2. SP3) and at drilling points (FP1. FP2. FP3) vary between 7.35 and 7.81 (Fig. 1), with an average of 7.56 ± 0.23 for the source and 7.60 ± 0.10 for drilling. Compared to the standards, the obtained results, showed that the groundwater of Ain Zina (Djelfa town) is in accordance with the national standards (6.5 ≤ pH ≤9) according to JORADP [5].

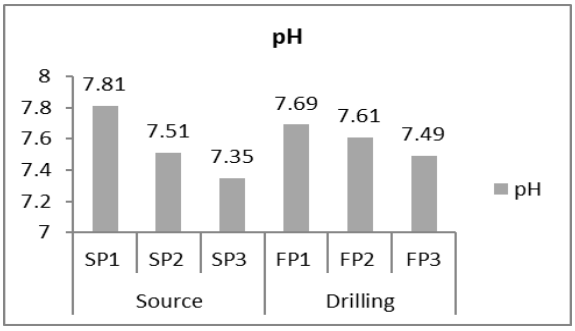

Fig. 1. pH concentration at the 2 sources (S. F) at Ain Zina. Djelfa

The ANOVA analysis of the pH variations of the different water samples taken at two water points (P and F) showed no significant difference (p = 0.7987 > 0.05. α = 5%)

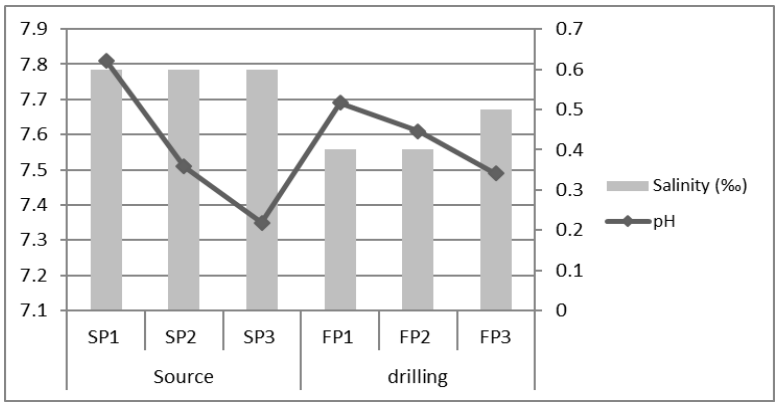

Fig. 2. Correlation between pH and salinity at the two sources (S. F) at Ain Zina. Djelfa

Fig. 2 shows that the measured pH is on average 7.58 ± 0.16 for a salinity average measured of 0.52 ± 0.10 ‰. The two parameters don't seem to have an effect on each other.

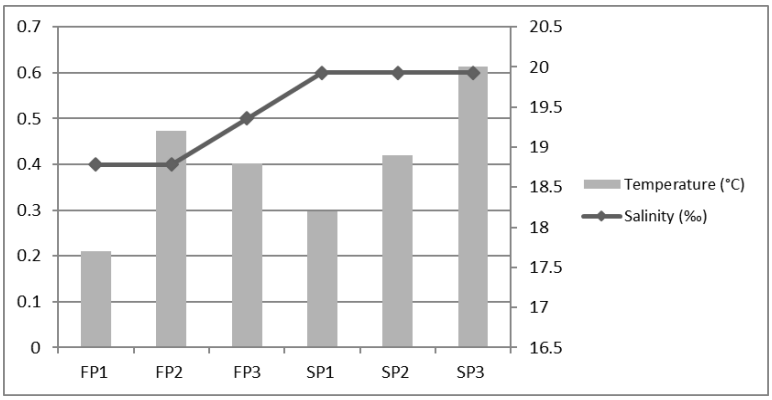

Fig. 3. Correlation between salinity and temperature at the two sources (S. F) at Ain Zina. Djelfa

Regarding to a possible relation between the salinity rate and the variation of the temperature, we note from Fig. 3 that there is an increase of the salinity values probably following a rise of the temperatures (± 0.10 ‰ for ± 0.80 °C). Thus, the highest salinity rate recorded was for SP3, which is 0.6 ‰ in combination with the highest temperature rate recorded, equal to 20 °C. We can assume that the temperature has an effect on the salinity level.

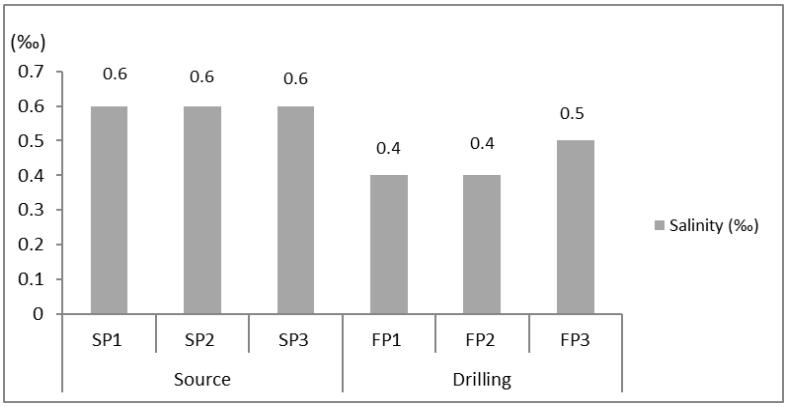

Fig. 4. Concentration of salinity at the two sources (S. F) at Ain Zina. Djelfa

Thus, Fig. 4 shows that the salinity rate for the various samplings varies between 0.4 ‰ and 0.6 ‰ with an average of 0.52 ± 0.10 ‰. The ANOVA analysis of the variations of the different salinity levels of the water samples taken at the two water points (S and F) showed a significant difference between the two for a P value = 0.007 (> 0.05 for α = 5%)

All our physico-chemical analyzes results are better than those found by Maoui in 2011 and turn around 8 for the pH, thus highlighting a very high pollution rate. On the other hand, our results are similar with Bouabdallah, 2015. [4,7].

4. Evaluation of a microbiological contamination

The interest of finding such indicators lies in the property they can sporulate which makes them particularly resistant to disinfection treatments. They are currently considered as good indicators of the efficacy of treatments against parasites. Streptococci are considered as witnesses to fecal contamination by pathogenic germs. Their presence in drinking water is a formal indication of recent and massive contamination.

The results of the bacteriological analyzes carried out on the samples of the natural waters underground and those coming from the boreholes are free in germs (total flora fecal coliforms. Streptococci) sought with the exception of total coliforms ≤ 15 found in spring water, noting that this water is untreated it can be removed by simple chlorination. So, this water does not present any risk of contamination of bacterial origin. The results for fecal coliforms, total coliforms and streptococci were negative in all samples analyzed during the experimental work performed. (Table 2).

Table 2

Results of bacteriological analyzes of the two water points (S. F) of Ain Zina, Willaya of Djelfa, Algeria

Sample point	Salinity (‰)	national standards	pH	national standards	faecal coliforms UFC/100 ml	total coliforms UFC/100 ml	faecal Streptococci UFC/100 ml
SP1	0.6	≤1%	7.81	6.5 ≤ pH≤ 9	abs	15≥	abs
FP1	0.4		7.69		abs	abs	abs
SP2	0.6		7.51		abs	15≥	abs
FP2	0.4		7.61		abs	abs	abs
SP3	0.6		7.35		abs	15≥	abs
FP3	0.5		7.49		abs	abs	abs

With : SP1: Source 1st sample. FP1: Drilling 1st sample. SP2: Source 2nd sample. FP2: Drilling 2nd sample. SP3: Source 3rd sample. FP3: Drilling 3rd sample

Bacteria, in general, grow very well on media whose pH is close to neutral (6 to 7.5), also the temperature deeply influences the multiplication and the bacterial metabolism (action on the speed of the biochemical reactions) [8]. The determination of the physicochemical and bacteriological parameters has shown that the natural groundwaters of Ain Zina used for feeding and watering villagers in drinking water is of good quality and free from any microbiological contamination.

5. Conclusion

The results of physico-chemical analysis show that the pH is between 7.35 and 7.81 (around the neutral). The surface temperatures of the borehole water show temperatures ranging respectively from 17.7 to 20 ° C with an average salinity of 0.52 ‰ ± 0.10 ‰. According to national standards (JORADP. 2011), Ain Zina's groundwater presents no risk to the consumer. Thus, for this region, which is not served by drinking water through the state network, the study of the microbiological quality of this source water according to its pH and salinity has demonstrated the absence of any microbiological contamination.

So, to preserve the quality of this water, we recommend that the public be aware of the danger of garbage disposal. particularly in the vicinity of wells, ponds or waterways as well as the development of a system for the treatment of wastewater artisanal waters and finally a sensitization the population on the interest of the bacteriological analyzes of well water and boreholes.

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