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Physicochemical Quality of the water Table of Temara the Salted Rabat Region Kenitra, Morocco

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Abstract**: *Water is a vital element for the development and maintenance of life on our planet, for which it is necessary to preserve and ensure the continual persistence of water, not only to provide man with a sufficient quantity for these needs but to assure him an ir upright quality of this water. The main objective of this work is to evaluate the physicochemical quality of the water of the Temara water and the comparison of this quality with Moroccan and international standards. Physico-chemical analyzes showed true variations in the different parameters studied, related to the impact of agricultural activities. The physicochemical characterization of the samples revealed a pH close to neutrality and relatively high salt contents. The chloride content was between 14.20 and 958.5 mg / l. For nitrate and nitrite load varies and 0.5 mg/L and 5.7 mg / L. These parameters of pollution were relatively high , compared to the average concentrations usually met for Moroccan drinking .The results obtained clearly exceed the standards of WHO (World Health Organization). Effluents therefore constitute a health risk. In conclusion, the pretreatment of these waters is strongly recommended.***

Keywords**: Groundwater - Water pollution - Physico-chemical Characteristics-Morocco.**

I. INTRODUCTION

Water is a renewable resource as evidenced by the well-known cycle of water : evaporation, condensation, precipitation and runoff, then new evaporation and repetition of the cycle1. From this perspective, the quantities of water should not be depleted. However, we realize today that drinking water is not inexhaustible. The acceleration of population growth is leading to a vertiginous increase in water needs. In addition, they produce more and more waste (agricultural, industrial) that contribute to polluting the water in ways that are irreversible, especially in the absence of a water purification system, as is the case in several developing regions. It is therefore because water stocks are disappearing that the issue of water becomes problematic, it is mainly because the polluting activities of humans, in the absence of sanitation networks, poison the water. water and that the resource is unequally distributed geographically. All living organisms contain water. In humans, water is the main component of the body. The body of an adult contains up to 70% water. Blood, for its part, contains 82% water, while some fruits, vegetables and marine animals are made up to 95% 2. Of course, the water needs are very large since it contributes to the proper functioning of the body by facilitating the circulation of blood and breathing, transporting nutrients to the cells and promoting the elimination of waste and toxins. Water is therefore essential for all living organisms. Drinking water, exempt from pathogenic germs (bacteria, viruses) and parasitic organisms, does not cause any health risks according to the World Health Organization (WHO). Its potability characteristics meet standards established either at national or international level.

Medium and method of study

This study was conducted on 20 wells distributed at the sheet of Temara is located is a Moroccan urban commune, capital of the prefecture of Skhirat - Temara, in the region of r s alé- kénitralampshade. The samples were taken over four periods during the year 2017-2018. The analyzes were carried out at the ORNVAG laboratory , Kenitra .
We will, at first, to characterize the physico-chemical water quality of 20 wells with a discussion in relation to the standards and previous studies. In a second step, we will study an explanatory analysis by a statistical study based on a Principal Component Analysis (PCA).

II. RESULTS AND DISCUSSION

The results are presented in Table 1 :

Table 1 : Basic statistics of physicochemical parameters for well waters in Témara

		Nitrites	Iron	Nitrates	Free chlorine	Total chlorine
	MOY	0.04	0.06	1.26	0.03	0.04
	MIN	0.00	0.00	0.00	0.00	0.00
	MAX	0.60	0.36	4.70	0.08	0.12
Summer	AND	0.13	0.09	1.20	0.02	0.03
	MOY	0.00	0.04	1.06	0.01	0.02
	MIN	0.00	0.00	0.00	0.00	0.00
	MAX	0.01	0.31	4.00	0.08	0.08
fall	AND	0.00	0.07	1.18	0.02	0.02
Winter	MOY	0.01	0.08	1.93	0.08	0.07

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	MIN	0.00	0.00	0.30	0.00	0.00
	MAX	0.05	0.62	5.70	0.53	0.57
	AND	0.01	0.14	1.30	0.15	0.12
	MOY	0.03	0.11	1.70	0.05	0.08
	MIN	0.00	0.01	0.50	0.00	0.01
	MAX	0.40	0.72	3.10	0.13	0.68
Spring	AND	0.09	0.16	0.75	0.03	0.15
		Hardness	**chlorides**	**pH**	**salinity**	**T° (°C)**
	MOY	75.92	256.04	7.50	0.61	19.5
	MIN	29,5	142.00	6.75	0.00	16.4
	MAX	120.50	692.25	8.33	3.50	26.5
Summer	AND	26.42	126.42	0.39	0.80	2.2
	MOY	74,9	229.63	6.58	0.58	18.0
	MIN	21	67,45	5.90	0.00	13.1
	MAX	146.00	919.45	6.90	3.10	21.2
fall	AND	33,79	179.32	0.25	0.69	2.2
	MOY	54.43	110.58	7.21	0.64	13.4
	MIN	18	14.20	6.40	0.10	8.5
	MAX	121.00	958.50	7.72	2.90	16.0
Winter	AND	26.75	210.61	0.31	0.70	1.8
	MOY	72.35	127.82	7.39	0.50	16.8
	MIN	24	31.95	6.50	0.10	13.4
	MAX	222.50	812.95	8.10	2.70	24.0
Spring	AND	58.16	176.42	0.50	0.62	4.2

1- Temperature

The temperature of the water is an important factor in the biological production makes it affects pr es s physical and chemical opriétés in particular its density, viscosity, solubility of its gas (in particular that of oxygen) and speed of chemical and biochemical reactions[3-5].

In Témara, values fluctuated between 26.5 ° C recorded in well 10 in summer and 8.5°C recorded at well 7 during winter. Summer experienced the highest temperatures ranging from 17.1 to 26.5°C while winter experienced the lowest temperatures (8.5 and 16.5°C). Spring recorded temperatures between 13 and 21.2°C while in the fall the temperatures oscillated between 14 and 24 °C.

2- Hydrogen Potential (pH)

At the Temara level, pH varied during this study from 8.3 at well 11 in summer to 5.9 at well 5 in fall. Autumn waters are all slightly acidic (mean pH = 6.58) (which may be due to rainfall during this period). Summer and winter are the times when the pHs are slightly basic; the respective average pH values are 7.49 and 7.38. These results are similar to those found at the level of the water table of M'nassra in Morocco Bricha (2007)[6]

3 - Total hardness

The total hardness of a water is produced by the calcium and magnesium salts it contains. The carbonate hardness that corresponds to the carbonates and bicarbonates content of Ca and Mg and while the non-carbonated hardness produced by the other salts. Hardness is measured by the hydrotimetric titre expressed in ° F (French degree); 1 °F corresponds to 10 mg of calcium carbonate in 1 liter of water.It results mainly from the contact of the groundwater with the rock formations: The calcium derives from the attack of the CO_2 dissolved by the limestone rocks (dolomies) or from the dissolution in the form of sulphate in the gypsum. The hardness of natural water depends on the geological structure of soils crossed. It expresses the sum of calcium and dissolved magnesium reported in equivalent amounts of calcium carbonates; It is expressed as degree f English ° F corresponding to 4 mg / l Ca^{2+} or 2.43 mg/L Mg^{2+} or 10 mg/liter $CaCO_3^-$.

In this study, the hardness in Temara varied between 222.5 °F at well 20 and 21° at well 18. The spring period experienced low values. The variation in hardness from one well to another could be related to the lithological nature of the geological formation of the groundwater. I n fact, the calcareous soil gives calcium hardness in these waters, are often Karst limestone features and soil allow rapid infiltration of rainwater allowing them pro tection runoff and their evaporation. They reappear in the vicinity of feet of the limestone massif in the form of large springs. These results remain broadly comparable to those found by Belghiti et al.[7], el markhi et al.[8], Burkholder et al.[9], and others authors reported lower values[10-11]. According to European standards, the hardness should be between 15 and 30 °F[12]. Indeed a hard water (higher than 20 ° F) with a pH> 7, would favor the hooking and the scaling of the pipes and consequently the constitution of the biofilm[13], This is the case with most of our results. However, very hard water even at 180°F would have no effect on the health of poultry[14], it would even be beneficial for mineralization of bones[15].

However, Damron in 2008 reports that a calcium hardness of over 100 ° F has no effect on chickens, which is the case with our waters, while a magnesium hardness of over 100 ° F would result in swollen hocks and shortened shin bone is the case of all wells studied given the calcareous nature of soils. However, these problems were not observed in the farms studied.

4 - Nitrates and nitrites

They are widespread in the environment, and are found in most food products, in the atmosphere and in much of the water[16]. Nitrates are produced during the final stage of decomposition of organic matter, nitrites are produced in the intermediate stage and rapidly convert to nitrates[17].

In Témara, the values found range from 0.5 mg/L to 5.7 mg/L for nitrates (Table 1). These values are minimal compared to the threshold advocated by the European standards which is 50 mg /L.As for nitrites, they varied between 0 and 0.6 mg/L. Wells 6 and 9 showed values that exceed the nitrites standards (0.1 mg/L), this could be due to fertilization since these sites contain fruit trees (peach and olive trees). In fact, nitrates and nitrites indicate contamination by fertilizers or human or animal waste.

They are toxic in all poultry species[18] could lead to a decrease in performance by methemoglobin effect[19], and can lead to high mortality in young people[20] Levallois and Phaneuf and laying and laying hens in spawning[21-22] and even a decline in sexual performance in the male[23].

5 - Chloride

The chlorine in the water is in the form of chloride ion, its presence is linked with a percentage of 90% to the presence of Sodium; chlorides depend on the geological formation of the aquiferregions[24].

The results recorded in this study varied between 958.50 mg/L, at well 18 and 14.20 mg/L at wells 2 and 12 at the Témara level. The summer and fall periods averaged 256 and 229 mg/L respectively, while the winter and spring periods averaged 110 and 127 mg/L, respectively. Outside well 18, the chloride values are less than 400 mg in all other wells (threshold recommended for drinking water for human consumption in Morocco[11].

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The European standards for poultry set this threshold at 200 mg / L, which shows that 60% of the wells studied exceed the standards.

Waters rich in chloride are laxative and corrosive[25-28]. Belghiti in 2013[25] recorded values of 70 to 872 mg/L, Abdemoutalib reported values of 5.8 to 312 mg/L, however Oueslati reported very high values in Tunisia (up to 1666 mg/L), Akchour and Coulibaly reported higher values (above 2000 mg/L especially in the coastal areas of Casablanca and Agadir); in France the values recorded by Balloy are between 30 and 159 mg/L.

6 - Salinity

R represented mainly by sodium. The results observed on the Témara region o nt oscillated between 0 and 3.5 ppt. Well18 showed values above 2.5 ppt over the four periods. The averages of the four periods are respectively 0.61; 0.64; 0.58 and 0.50 ppt. Wells 9, 15 and 19 have values greater than 1 ppt² (value recommended by European standards).

7- Iron

It is an abundant element in rock, it is the fourth most common element in the earth's crust and so widely present in groundwater[24]. The results observed in Témara vary between 0 and 0.72 mg/L of iron. The averages of the four periods were 0.06; 0.04; 0.07 and 0.11 mg/L, only the well 12 recorded values higher than 0.3 mg / L, the values of the well 11 are slightly important (0.15 to 0.28 mg/L).

8- Free chlorine and total chlorine

In the Temara aquifer, the recorded levels of free and total chlorine are normal and hardly exceed 0.5 mg/L outside wells 10th t in winter and in summer well 9 ; all other values are less than 0.1 mg / L.

The wells in our study are well below these values and therefore can be used for safe drinking water vaccination.

Explanatory analysis

1-statistical analysis

One-dimensional statistical analysis methods are applied to statistically characterize the studied variable of each chemical element during sampling campaigns. We interestin especially to calculate some standard statistical parameters: average, minimum, maximum, variance, standard deviation and coefficient of variation.

The comparison of the different parameters, their means, standard deviations, maximum values, variances and the coefficients of variation for the sampling set during our study allowed, through the analysis of the variation, to detect differences more or less significant.

2-Analysis of matrices of correlations

The correlations between the physicochemical elements studied give information on the strength of the associations between them. The correlation matrices of the 10 parameters measured during our study are presented in Table 2.

Table 2: Matrix of correlations of physicochemical parameters in Témara

	nitrites	Iron	nitrates	Free chlorine	Total chlorine	Hardness	chlorides	pH	Salinity	Temperature
nitrites	1									
Iron	-0.16	1								
nitrates	0.03	**-0.61**	1							
Free chlorine	0.03	0.01	-0.12	1						
Total chlorine	-0.03	-0.05	-0.1	**0.94**	1					
Hardness	-0.09	-0.4	0.39	-0.01	-0.01	1				
chlorides	0.09	0.12	-0.1	0.31	0.33	-0.25	1			
pH	-0.18	**0.77**	**-0.77**	0.14	0.1	**-0.55**	0.29	1		
Salinity	0.2	**-0.77**	**0.77**	-0.1	-0.08	**0.52**	-0.12	**-0.98**	1	
Temperature	-0.15	0.25	-0.35	0.29	0.23	-0.07	0.01	0.39	-0.38	1

pH, hardness and nitrates are positively correlated ; they are negatively correlated with salinity and iron. These are positively correlated.

Free chlorine and total chlorine are very significantly correlated.

3- Principal Component Analysis (PCA)

We realized u statistical study by principal component analysis for all quantitative variables studied (10 variables) on 80 water samples, to explain the evolution of different parameters analyzed.

Each water sample from a sampling campaign constitutes a statistical unit and the 10 physico-chemical parameters (temperature, pH, hardness, nitrates, nitrites, chlorides, salinity, iron, free chlorine and total chlorine) studied are the variables that characterize these statistical units. Statistical processing of the data is done through the use of the Statistica software, on 20 stations during the 4 campaigns.

First, we performed a spatial analysis of physicochemical parameters. The first two axes of the PCA (46.34% of the total information) of the physicochemical data are used to describe the correlations between the variables which are related to the spatio-temporal structure.

Table 3: Contribution of the first two axes to the total variance.

	Own value	Variability	Cumulative %
F1	2.525662	25.25662	25.2566
F2	2.108188	21.08188	46.3385

The first axis (25.26%) takes into account total chlorine and iron. This could be interpreted as a concentration gradient of iron and total chlorine from right to left. The well 12 and to a lesser degree the well 4, 5, 11 and 13 contain more iron and total chlorine. PH, temperature, salinity and chlorides are inversely correlated s iron and total chlorine and are leading into the well 18 and dan s a lesser extent the well 15 and the well 17 axis. This reflects a gradient Mineralis ation from right to left.The second axis (F2 with 21.08%) shows a gradient of pollution (nitrates and nitrites), the wells 6, 8 and 9 are the most polluted it is in an agricultural region , the least polluted are the wells of Aguelmouss1 10, 16 and 19.

While the wells 2, 10, 16, 19 and 20 have presented hard water with a temperature and free chlorine higher. These results corroborate found in forward-looking analysis.

III. CONCLUSION

The results of innovativ a ts of physical-chemical analyzes of groundwater in the study area showed concentrations above the standard and which are a consequence of the geological nature and human activity. The evolution of the physicochemical parameters of the studied waters showed a significant spatio-temporal variation, the tablecloth of temara knows important salinity levels . These two parameters are explained exclusively by the geological nature of the two regions.

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