

Physico-Chemical, Bacteriological and Quality Analysis of Analamanga Spring Water (Antsiranana)

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Abstract For the physical parameters: the temperature is 22.4°C it is admissible for the drinking water standard (20°C – 25°C), the turbidity is 4.52 less than 5 NTU, the pH is 6, 94 between 6.5 – 9 and the conductivity is 408 µS/cm it is less than 3000 µS/cm. For the chemical parameters: the total hardness is 4.1°f the is less than 50°f, organic matter is 4 mg/L is greater the maximum value is 2 mg/L, calcium is 12.8 mg/L the maximum value is 120 mg/L, magnesium 2.19 mg/L the maximum value is 50 mg/L, Ammonium 0.28 mg/L the maximum value is less than 0.5 mg/L, sodium 17.92 mg/L the value maximum is 200 mg/L, chloride 39.05 mg/L the maximum value is 250 mg/L and total iron 0.04 mg/L the maximum value is less than 0.5 mg/L. For microbiological parameters: coliform bacteria greater than 2400NPP/100mL, the maximum value is zero, Escherichia coli less than 1 NPP/100mL the maximum value is zero and intestinal Enterococci less than 1 MPN/100mL the maximum value is zero.

Keywords Water, Physico-chemical, Bacteriological parameter

1. Introduction

The Analamanga spring water to be studied is located east of the University of Antsiranana. The water is underground, so for a long time, many people have been drinking and consuming spring water in daily life, especially people who live around the university, more precisely students who live on the university campus. Two causes for the use of water, firstly the water is clear and the taste is lovely, secondly the capacity of JIRAMA water is insufficient for the population.

The water is natural and well preserved, the volume of water remains observed for all years, even in the dry season. So they are satisfactory for the population used as drinking water.

This is why my study is carried out for the analysis of physico-chemical and microbiological parameters. My work is divided into three parts: the location of the study area followed by a general overview of water, (bibliographic summary) the second the materials and methods, the third part discusses the results and the discussion ends by the conclusion and recommendation.

2. Bibliographic Synthesis [2]

The total mass of water in the hydrosphere does not change over the years, it always remains constant; water

evaporates, forms water vapor which transforms into rain and supplies the seas, oceans and groundwater.

Lavoisier's famous phrase "Nothing is lost, nothing is created, and everything is transformed" can be applied to the water cycle.

Water changes state during its cycle, going from gas to liquid or solid. However, its quality has remained the same for three billion years, the date of its appearance on earth.

There are three types of natural water resources, namely: groundwater, surface water and saline water or sea water.

The general formula is H₂O, it dissociates into OH⁻ and H⁺, the hydrogen potential which determines whether water is acidic or basic.

The water is drinkable from verification of the conditions required for the EU and WHO standard.

3. Analysis Parameters [2]

Temperature is an important physical characteristic, it plays a role in the solubility of salts and especially gases; pH indicates the balance between acids and bases in an aqueous solution; turbidity indicates the state of the water is cloudy and also the transparency of the water and conductivity is the measure of the ability of water to conduct an electric current.

Total hardness is the measurement of the levels of calcium and magnesium that exist in the water; calcium, magnesium, chloride and sodium are key components or fundamental elements for water intended for human consumption; the existence of ammonium in water indicates pollution; Lead, Copper and iron are classified among the heavy metals; their existence in water is very dangerous for drinking water.

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Microbiological analysis is very useful for water intended for human consumption.

4. Materials and Methods

Sampling collection:

The sample is put in a well-closed plastic bottle, just before filling the water from the sample into the bottle, we will rinse three times in this bottle, especially for the analysis of the physicochemical parameters.

For the microbiological analysis sample, we put it in a well-closed sterilized bottle, to obtain concrete results.

All the results obtained are compared to the drinking water standards for the Malagasy State as Malagasy, and the European State, finally the World Health Organization as

responsible for global health.

The materials used during the analysis are

For the physical parameters: the temperature is measured by the thermometer, the turbidity is by the turbidimeter, the conductivity is by the conductivity meter and the pH is by the pH meter.

For chemical parameters: by volumetric and colorimetric dosage.

For microbiological parameters: Coliform bacteria and *Escherichia coli* by the ISO-9308-2 method and for intestinal *Enterococcus* is by IDX 33/03-10/13.

Norm of quality

a - Recommendation of the EM

b - Recommendation of EU

c - Recommendation of the WHO

a- recommendation of the EM [1]

Table 1. Drinking water standard according to the Malagasy State (EM)

Designation of the parameters		Limit acceptable	units
Parameters physical	pH	6,5 to 9	
	Temperature	25	°C
	Turbidity	< 5	NTU
	Conductivity	<3000	µS/cm
Parameters chemical	Chlorides	250	mg/L
	Magnium	50	mg/L
	Sodium	200	mg/L
	Calcium	150	mg/L
	Ammonium	< 0,5	mg/L
	Aluminium	0,2	mg/L
Parameters microbiological	Bacteries coliformes	0	NPP/100mL
	<i>Escherichia coli</i>	0	NPP/100mL
	<i>Enterocoques intestinaux</i>	0	NPP/100mL

b- Recommendation of the EU [1]

Table 2. Drinking water standard for the European Union (EU)

Designation of the parameters		Limit acceptable	units
Parameters physical	pH	6,5 to 9	
	Temperature	25	°C
	Turbidity	< 5	NTU
	Conductivity	<1800	µS/cm
Parameters chemical	Chlorides	250	mg/L
	Magnium	50	mg/L
	Sodium	200	mg/L
	Calcium	200	mg/L
	Ammonium	< 0,5	mg/L
	Aluminium	0,2	mg/L
Parameters microbiological	Bacteries coliformes	0	NPP/100mL
	<i>Escherichia coli</i>	0	NPP/100mL
	<i>Enterocoques intestinaux</i>	0	NPP/100mL

c- Recommendation of the WHO [1]

Table 3. Drinking water standard for the World Health Organization (WHO)

Designation of the parameters		Limit acceptable	units
Parameters physical	pH	6,5 to 8,5	
	Temperature	25	°C
	Turbidity	< 5	NTU
	Conductivity	<1000	µS/cm
Parameters chemical	Chlorides	250	mg/L
	Magnium	50	mg/L
	Sodium	200	mg/L
	Calcium	200	mg/L
	Ammonium	< 0,5	mg/L
	Aluminium	0,2	mg/L
Parameters microbiological	Bacteries coliformes	0	NPP/100mL
	Escherichia coli	0	NPP/100mL
	Enterocoques intestinaux	0	NPP/100mL

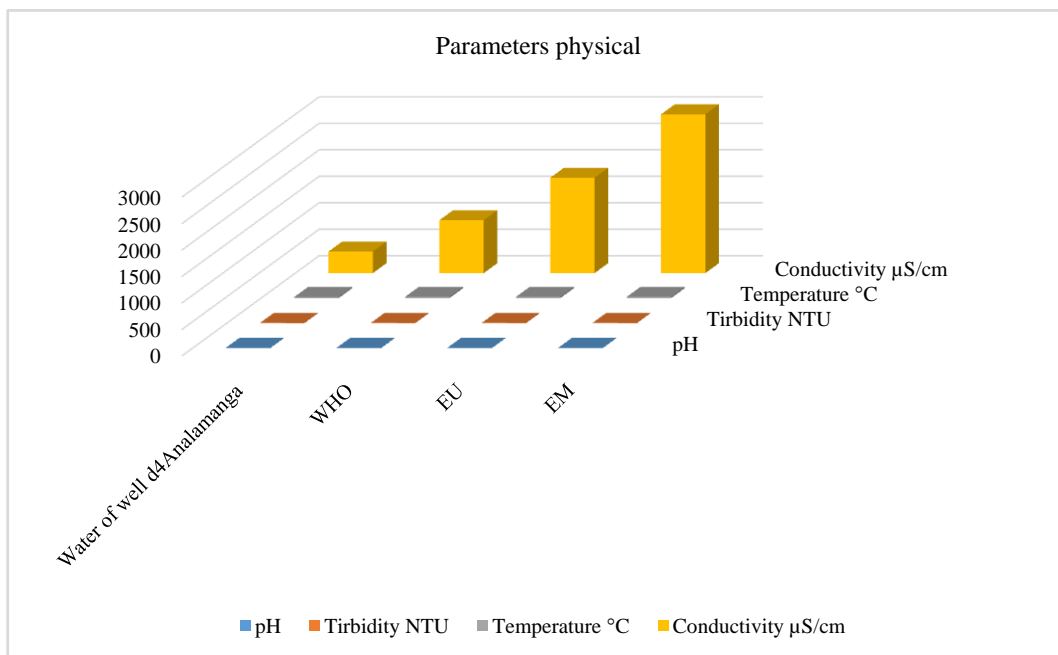
5. Measurement Results

A- Physical parameters [4]

The following table 4 shows the measurement results for the physical parameters of Analamanga spring water.

Table 4. Results of physical parameters

Paramètres physical	Units	Water of well d'analamanga	WHO	EU	EM
pH		6,94	6,5 à 8,5	6,5 à 9,5	6,5 à 9
Turbidity	NTU	4,53	5	5	5
Temperature	°C	22,4	25	24	25
Conductivity	µS/cm	408	1000	1800	3000



Results interpretation:

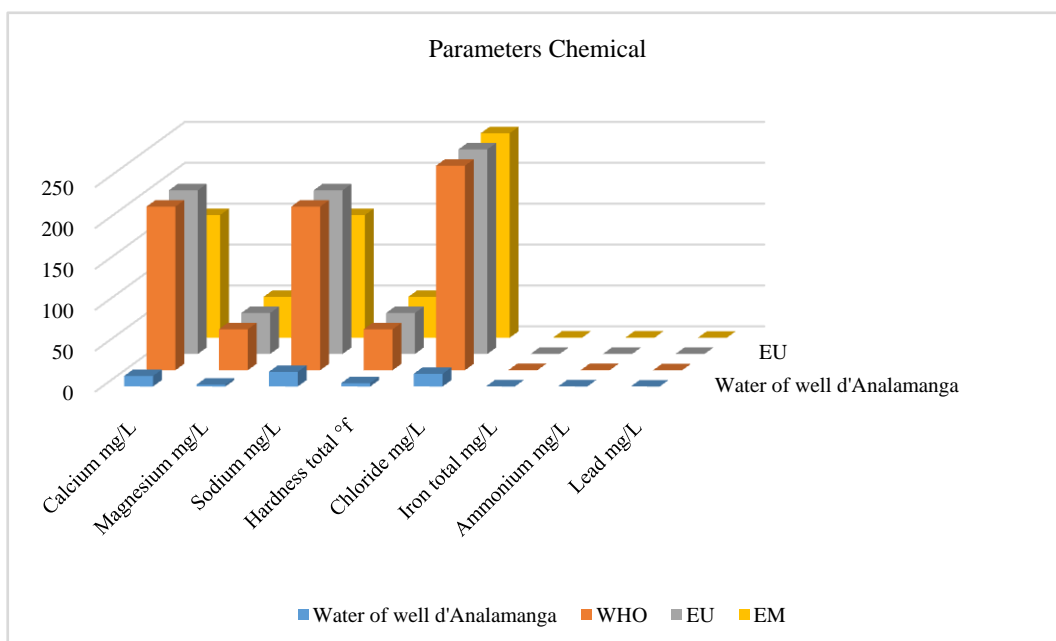
For the physical parameter obtained after the analysis is admissible for the drinking water standard, despite the turbidity value obtained almost maximum.

B – Chemical parameters [4]

The following table 5 indicates the measurement result for the chemical parameters of Analamanga spring water.

Table 5. Measurement result for the chemical parameter

Parameter chemical	Units of measure	Water of well d'analamanga	WHO	EU	EM
Calcium	mg/L	12,8	200	200	150
Magnesium	mg/L	2,19	50	50	50
Sodium	mg/L	17,92	200	200	150
hardness total	°f	4,1	50	50	50
Chloride	mg/L	15,5	250	250	250
Ammonium	m/L	0,28	0,2	0,4	0,4
Iron total	mg/L	0,04	0,2	0,2	0,2
Lead	mg/L	0	0,05	0,04	0,05



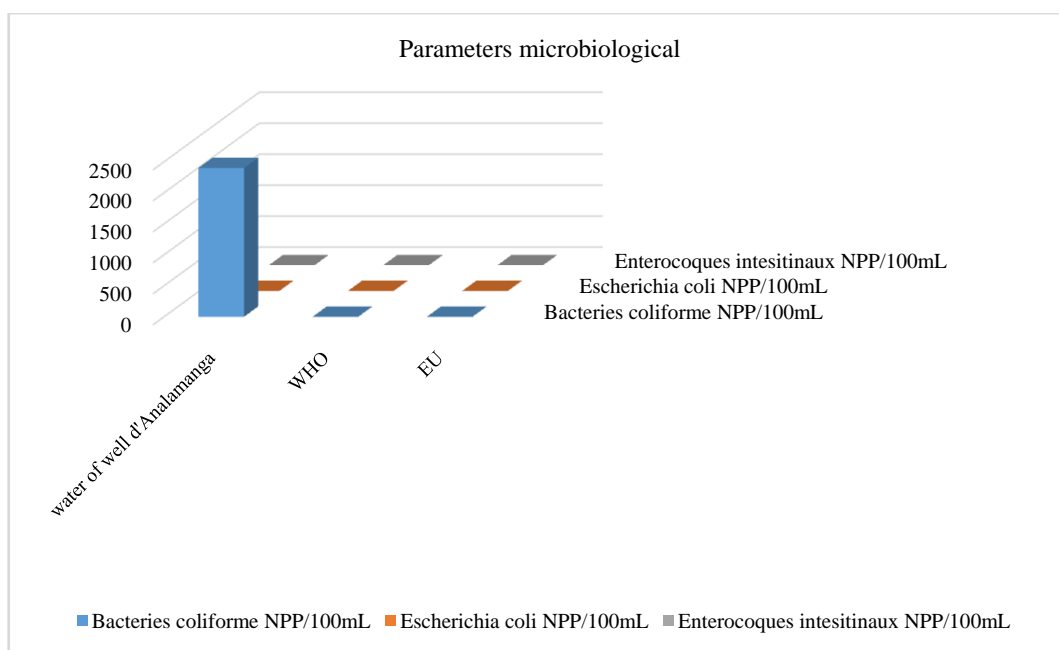
According to the results obtained, we can say that the chemical parameter of Analamanga spring water perfectly meets the standard required for water intended for human consumption.

C - Microbiological parameters [3]

The following table 6 gives the measurement results for the microbiological parameters of Analamanga spring water.

Table 6. Measurement result for the microbiological parameter just before treatment

Parameters microbiological	Units	Water of well d' Analamanga	WHO	EU
Bacteries coliforme	NPP/100mL	2400	0	0
Escherichia coli	NPP/100mL	1	0	0
Entéococoques intestinaux	NPP/100ml	1	0	0



Interpretation of result:

According to the result obtained, the water from the Analamanga spring is microbial, so it must be treated before being used.

I suggest the sodium hypochlorite treatment method. In a 1L of water analyzed, 1 g of sodium hypochlorite is poured. We leave it for 30 minutes and then we can carry out an analysis of the microbiological parameters, the following table 7 gives the result just after the treatment.

Table 7. Measurement result for the microbiological parameter just after treatment. [5]

Parameter microbiological	Units	Water of well d'Analamanga	WHO	EU
Bacteries coliformes	NPP/100mL	0,002	0	0
Escherichia coli	NPP/100mL	0,001	0	0
Enterocoques intestinaux	NPP/100ml	0,001	0	0

6. Interpretation of the Results

For physical parameters:

Temperature, conductivity, turbidity and pH are admissible to the standards required for drinking water, despite the turbidity value found almost maximum.

For chemical parameters:

The concentration of calcium, magnesium, sodium, chloride and total hardness found are admissible to the standard of water intended for human consumption, despite the insufficiency of the concentration found.

For the microbiological parameter just before treatment:

The Coliform bacteria found is very high for drinking water just before treatment.

Escherichia coli and intestinal Enterococci the value found is acceptable.

According to these results, the water is microbial so it must be treated before being used.

For the microbiological parameter just after treatment:

Just after treatment with sodium hypochlorite, the result obtained perfectly meets the drinking water standard.

7. General Conclusions

According to the results of each physical and chemical parameter in general are admissible for drinking water. Despite the concentration found for the chemical parameters are insufficient.

For the microbiological parameter, the value found is excluded for drinking water, so it must be treated before being used.

Finally I offer you the method to increase some levels of chemical parameters such as magnesium, sodium and calcium in water by the remineralization method.

Remineralization: by definition it is the increase in the levels of calcium or magnesium or sodium in the water.

A simple but effective method is to pour 1 mg of CaCO_3 powder into the water, stir for 5 minutes, then leave for 15 minutes, then filter with a ceramic filter. The clear water obtained is analyzed in the laboratory.

So we calculate with the reference of 1mg/L of CaCO_3 , therefore depends on the volume of water in the storage basin used.

I recommend that for the population uses it is water like drinking water, it is necessary to clean the surfaces near the source water.

It is necessary to protect the source and build a storage basin for ease of treatment in terms of microbiological parameters.

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