Control of the Water Quality of Antsidihy Lake Located in the District of Nosy-Be, Diana Region (Madagascar)

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***Abstract*—For physical parameters: Conductivity the value found is 1031 µS / cm the limit value 100- 1000 µS / cm, the turbidity the value found is 0.78 NTU the maximum value <5 NTU, the pH is 6.96 the limit value between 6.5 - 9 and the temperature is 21 °C the maximum value <25 °C. So for the physical parameters perfectly meet the standards required for water intended for human consumption. For chemical parameters: the mineralization the concentration is 955 mg / L the limit concentration 1000 mg / L, the total hardness is 18.3 °f the maximum concentration 50 °f, the calcium is 20 mg / L the maximum concentration 100mg / L, magnesium is 1.46 mg / L the limit concentration 50 mg / L, potassium is 5.5 mg / L the required concentration <12 mg / L, sodium is 80.5 mg / L the limit concentration 200 mg / L, Chlorides is 124.5 mg / L the maximum concentration <250 mg / L, the iron is 0.015 mg / L the required concentration <0.02 mg / L and the Lead is 0, 01 mg / L the limit concentration 0.05 mg / L. For the chemical parameters the concentrations found are acceptable for international standards, despite the insufficiency of some concentrations compared to international standards, such as magnesium, potassium and calcium. For microbiological parameters: microorganisms at 36 °C is 1.005 NPP / mL compared to standards <100mL, Coliform bacteria is 0, Escherichia Coli is 0 and Intestinal enterococci is 0, the requirements for water intended for human consumption is zero. So the microbiological parameters of Antsidihy Lake water perfectly meet the standard required for drinking water.**

***Index Terms*—Physical Parameters, Chemical Parameters, Microbiological Parameters, Quality Control.**

I. Introduction

Water is the most essential element in the life of living beings. Yet millions and millions of people around the world are experiencing water shortages and are struggling daily to find drinking water to meet their basic needs. Millions of children still die each year from preventable water-borne diseases. Water not only meets basic human needs, but also contributes to sustainable development. (CNURE, 2005)

Having access to sufficient drinking water for daily needs reduces poverty, malnutrition; reduces infant mortality; achieves a viable environment; increase opportunities to improve education; is progressing towards gender equality because most of the world's women and girls fetch water. (CNURE, 2005)

In Nosy-Be, the JIRAMA company has been distributing drinking water there since 1945 but over the years, the number of the population increases and the current infrastructures of drinking water supply no longer allow to properly serve the town of Nosy- Be. The city has known for half a decade severe water supply problems manifested by weaknesses of chronic pressure, even by cuts in several districts; so people consume Antsidihy lake water for their daily needs.

This study has three parts, the first of which contains the measurement results for the physical parameters, the second of which discusses the analysis results for the chemical parameters and the third part concerns the analysis of microbiology parameters. Followed by a general discussion which will conclude with a general conclusion.

A. Problem Statement

The numbers of the populations increase, therefore the water distributed by the company JIRAMA does not satisfy the daily needs of the inhabitants. The people who live around the towers of Lake Antsidihy use water for all daily needs, like bathing and drinking but the big problem are

i. The quality of the water is unknown at the level of the physico-chemical parameters;
ii. The situation of this lake at the level of pathogenic germs.

B. Research Objective

The first objective of my research, to know the rates of the physico-chemical parameters and microbiologies of the water of lakes Antsidihy. The second objective, determination of the concentration of each parameter and identified in relation to international standards for drinking water. The third objective, in order to conclude that the population of Nosy-Be who live on the shores of the lake uses water safely.

II. General

A. Location of the study area

Nosy-Be is the largest island in Madagascar, which is located in the Mozambique Channel, northwest of Madagascar, between 13 ° 11 'and 13 ° 30' south latitude and between 48 ° 22 'and 48 ° 8 'East longitude. It measures

30 km from north to south and 19 km from east to west. Nosy-be is a District belonging to the DIANA region, in the province of Diego-Suerez.

By its geology, its relief and its 12 large sacred lakes. This geographic location allowed me to direct my research on this island because it has a large reservoir of water with its countless lakes

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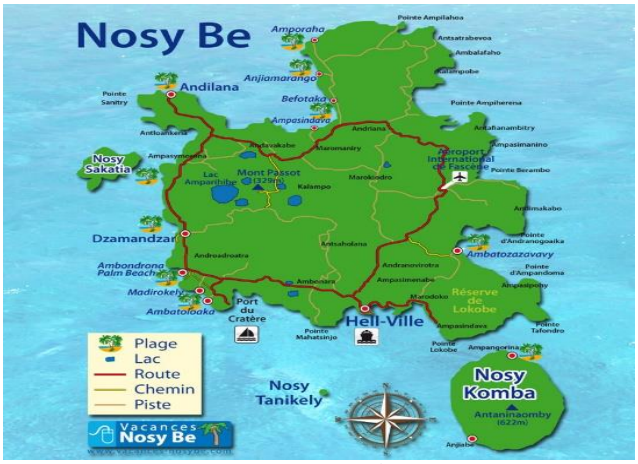

Fig.1.Geological map of Nosy-Be

B. Characteristic of Antsidihy Lake

The characteristics of Antsidihy Lake are summarized in the following table.

TABLE I: CHARACTERISTIC OF ANTSIDIHY LAKE

Lake	Area (ha)	Volume (m^3)	Maximum depyh (m)	Minimum depth (m)
Antsidihy	44	126.10^5	47	29

Fig. 2. Antsidihy Lake

C. Characteristics of the physico-chemical and microbiological parameters

As the temperature highlights the contrasts of water on a medium, it is possible to obtain information on the origin and flow of water. The turbidity and transparency of water is an important parameter in the various standards setting the quality of drinking water. The pH measures the concentration of H + ion in water, to know that water is an acid, a basic and neutral. Measuring the conductivity makes it possible to assess the quality of the salt dissolved in the water.

Measuring mineralization indicates the levels of organic matter that exists in water. Calcium, magnesium and sodium are very abundant elements in water intended for human consumption, their deficiency of the low concentration in water is very dangerous for human life. Total iron plays a very important role in water intended for human consumption, but international standards strictly requires the concentration not to exceed 0.02 mg / L. Lead is a lord and toxic metal their presence in water for drinking water is not admissible to international standards.

Microbiological parameters, if one of the four exists in drinking water, the water is not used before treatment.

III. MATERIALS AND METHODS

A. Materials for physical parameters:

We use the thermometer, turbidimeter, conductimeter and pH meter.

For chemical parameters: We use the PERKIN ELMER model 1100B and visible UV spectrophotometer for the measurement of cations and anion. For microbiology parameters, Microscope with UV lighting; vortex agitator; 25 mm diameter polycarbonate filter membrane; 25 mm diameter cellulose membrane and 13 x 125 mm threaded glass tubes.

B. Methods

For physical parameters, measure directly with your device and carefully read the values indicated in this device.

For the temperature we use the thermometer for the measurement; for pH, the pH meter is used; for turbidity measurement, the turbidimeter is used and for conductivity measurement, the conductivity meter is used. For the chemical parameters, the cations and the anion, such as **Ca^{2+}, Mg^{2+}, Na^{+}, K^{+}, Pb^{2+}, Fe^{2+} and Cl^{-}** are by the PERKIN ELMER model 1100B equipped with specific lamps for the metering elements, gas and l with and with samples to be analyzed and by the visible UV spectrophotometer, varied with visible wavelengths.

For the cations **Ca^{2+}, Mg^{2+}, Na^{+}, K^{+}, Pb^{2+} and Fe^{2+}**:

Reagent I: Dichloroisocyanuric acid 2 g; Sodium hydroxide 130 g and distilled water 1000 mL

Reagent II: Sodium tricitrate 130 g; Sodium salicylate 130 g; 0.97 g sodium nitropruciate and 1000 mL distilled water.

Take 40mL of water to analyze; add 4 mL of reagent I and add 4 mL of reagent II and add to 50 mL of distilled water and wait 1 h 30 min then there are color changes; read with wavelengths varying between 525 nm ≤ £ ≤ 655 nm. The result is given directly in mg / L. For the **Cl^{-}** ion: Mixed reagent: Sulfanilamide 40 g; Phosphoric acid 100mL; N-1-Naphtyl ethylene diamine 2 g and distilled water 1000 mL

Take 50 mL of water to analyze, add 1 mL of the mixed reagent and wait 10 minutes. The appearance of color and perform the reading at the wavelength 543 nm. The result is given directly in mg / L.

For microbiological parameters: the analysis result is given by determining the number of germs per milliliter of sample by extrapolation.

Number of total germs per mL = Average number of germs per square × Number of squares Dilution filter factor

Sample volume (in mL)

Mc Crady and Man proposed the mathematical calculation of the estimate of the NPP of the microorganism initially present in the suspension, based on a Poisson distribution model.

The NPP is given by solving the equation:

$$\sum(ni - pi) = \sum \frac{pimie^{-vid}}{1 - e^{-vid}}$$

ni = Number of tubes per dilution
pi = number of positive tubes at this dilution
vi = volume inoculated per tube
d= NPP estimate

IV. Results of Analysis

A. Physical parameters

1) Temperature [5]

TABLE II: Water Temperature of Lake Antsidihy

Site	Temperature [°C]
Antsidihy	21
WHO	<25
EU	<25
EM	<25

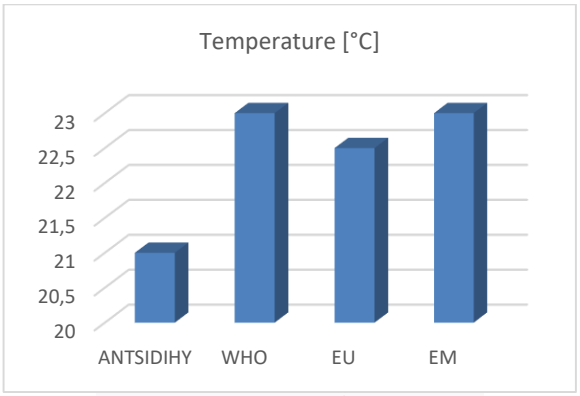

Fig. 3. Water Temperature of Lake Antsidihy

2) pH [5]

TABLE III: pH of Antsidihy Lake Water

Site	pH
Antsidihy	6,96
WHO	6,5 – 8,5
EU	6,5 - 9
EM	6,5 – 9,5

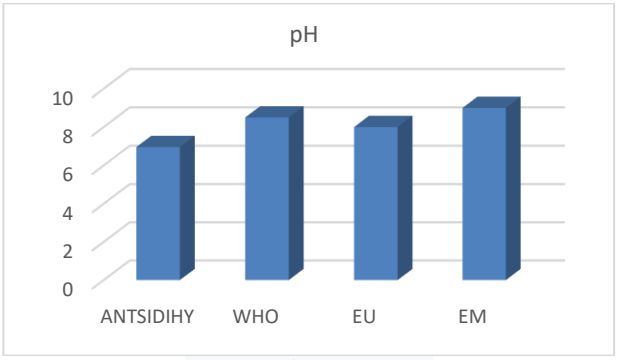

Fig. 4. pH of Lake Antsidihy

3) Turbidity [2], [3]

TABLE IV: Turbidity of Antsidihy Lake Water

Site	Tubidity [NTU]
Antsidihy	0,78
WHO	< 5
EU	< 5
EM	< 5

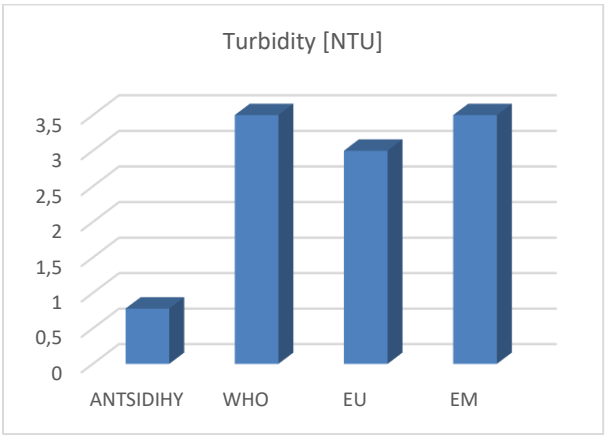

Fig. 5. Turbidity of Antsidihy Lake Water

4) Conductivity [15]

TABLE V: Conductivity of Antsidihy Lake Water

Site	Conductivity [µS/cm]
Antsidihy	1 031
WHO	100 – 1000
EU	180 - 1000
EM	< 3000

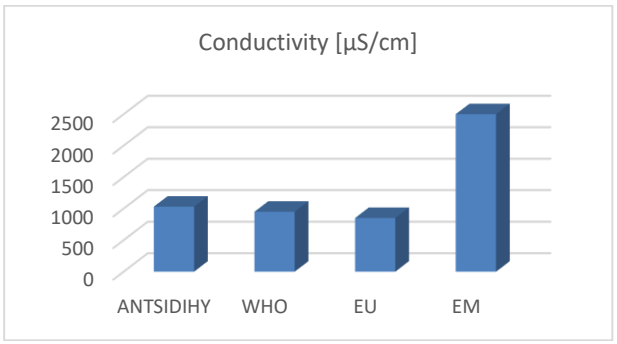

Fig. 6. Conductivity of Antsidihy Lake Water

B. Chemical parameters

1) Mineralization [14]

TABLE VI: Concentration of Mineralization of Antsidihy Lake Water

Site	Mineralization [mg/L]
Antsidihy	955
WHO	1000
EU	1500
EM	1000

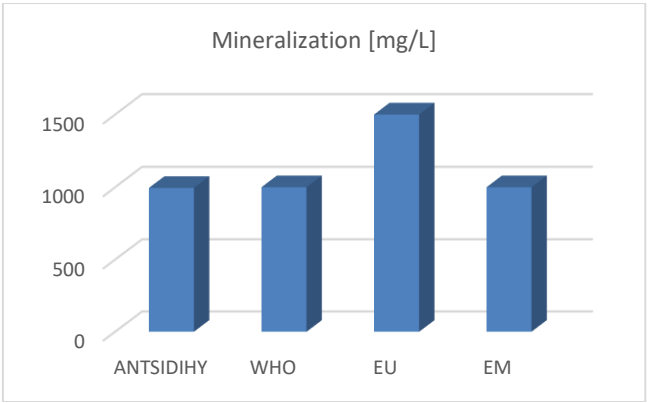

Fig. 7. Concentration of mineralization of Antsidihy Lake Water

2) Total hardness [6]

TABLE VII: CONCENTRATION OF THE TOTAL HARDNESS OF ANTSIDIHY LAKE WATER

Site	Total hardness [mg/L]
Antsidihy	18,3
WHO	50
EU	50
EM	50

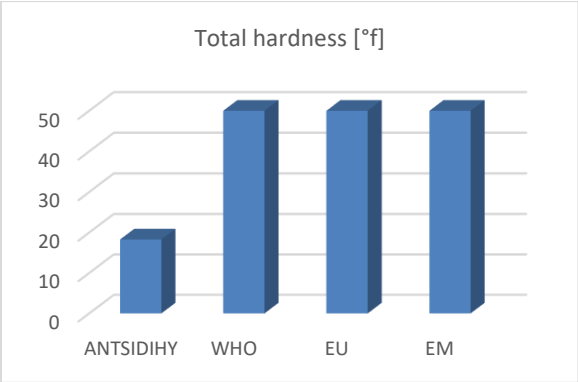

Fig. 8. Concentration of the total hardness of Antsidihy lake water

3) *Calcium [7], [8]*

TABLE VIII: CALCIUM CONCENTRATION OF ANTSIDIHY LAKE WATER

Site	Calcium [mg/L]
Antsidihy	20
WHO	100 – 140
EU	100
EM	100

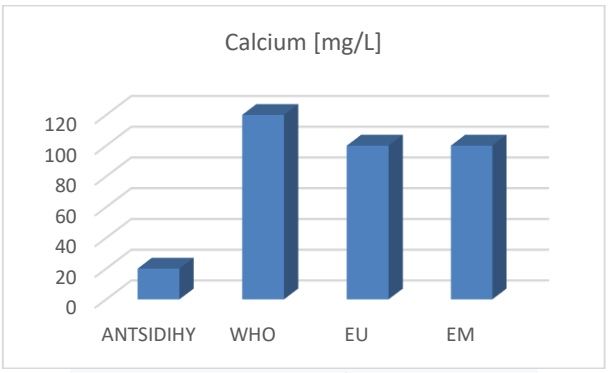

Fig. 9. Calcium concentration of Antsidihy Lake water

4) *Magnesium [8]*

TABLE IX: MAGNESIUM CONCENTRATION IN ANTSIDIHY LAKE WATER

Site	Magnesium [mg/L]
Antsidihy	1,46
WHO	50
EU	50
EM	50

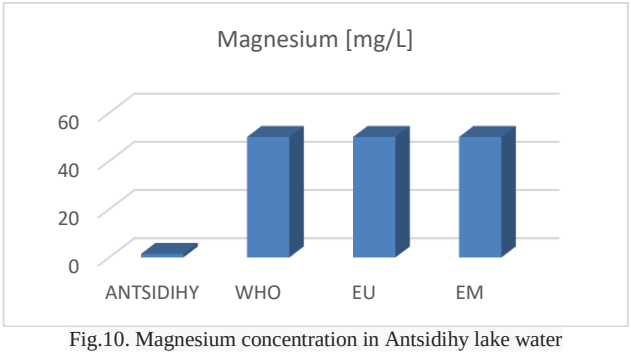

Fig.10. Magnesium concentration in Antsidihy lake water

5) *Potassium [12], [13]*

TABLE X: POTASSIUM CONCENTRATION IN ANTSIDIHY LAKE WATER

Site	Potassium [mg/L]
Antsidihy	5,5
WHO	12
EU	12
EM	12

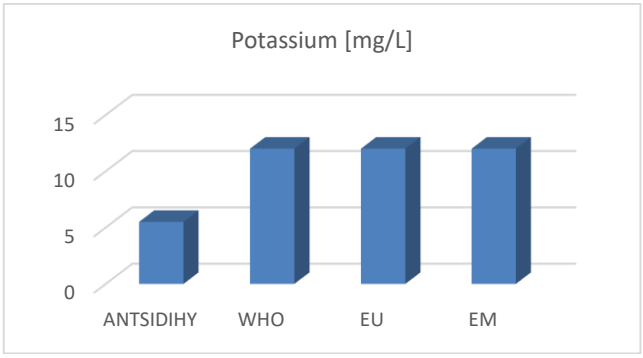

Fig. 11. Potassium concentration in Antsidihy lake water

6) *Sodium [12], [13]*

TABLE XI: CONCENTRATION OF SODIUM IN ANTSIDIHY LAKE WATER

Site	Sodium [mg/L]
Antsidihy	80,5
WHO	200
EU	200
EM	200

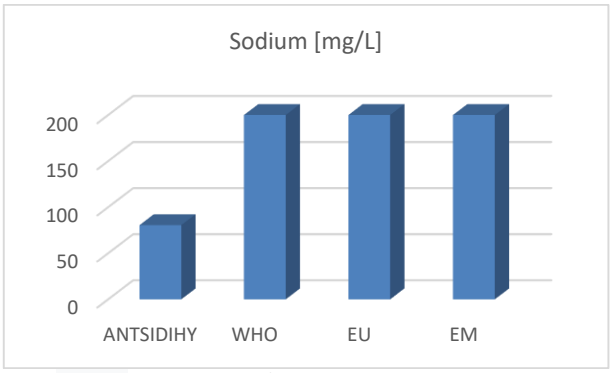

Fig. 12. Concentration of Sodium in Antsidihy Lake water

7) *Chlorides [9]*

TABLE XII: CONCENTRATION OF ANTSIDIHY LAKE WATER CHLORIDE

Site	Chlorides [mg/L]
Antsidihy	124,5
WHO	250
EU	250
EM	250

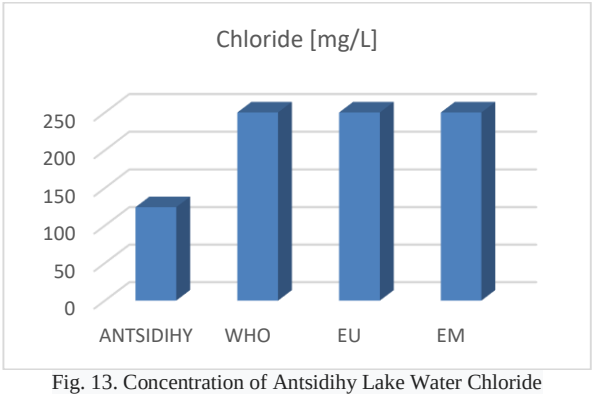

Fig. 13. Concentration of Antsidihy Lake Water Chloride

8) Total iron [10]

TABLE XIII: TOTAL IRON CONCENTRATION IN ANTSIDIHY LAKE WATER

Site	Total Iron [mg/L]
Antsidihy	0,015
WHO	<0,2
EU	< 0,5
EM	< 0,5

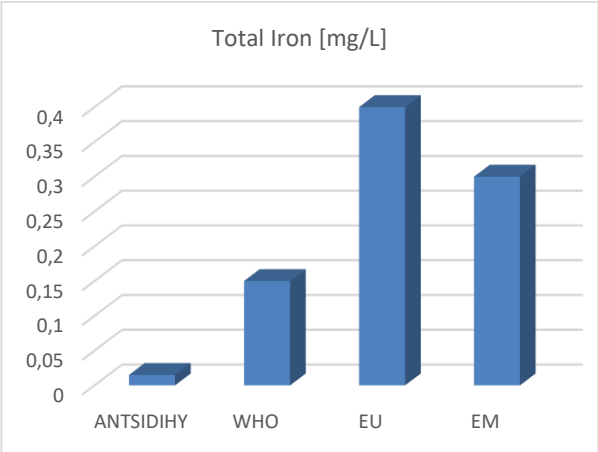

Fig. 14. Total Iron concentration in Antsidihy lake water

9) Lead [11]

TABLE XIV: CONCENTRATION OF LEAD IN WATER FROM ANTSIDIHY LAKE

Site	Lead [mg/L]
Antsidihy	0,01
WHO	< 0,5
EU	< 0,5
EM	< 0,5

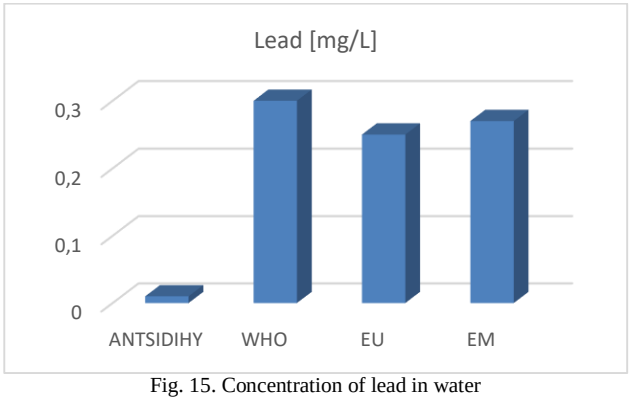

Fig. 15. Concentration of lead in water

C. Microbiological parameters [4]

The four microbiological parameters required for water intended for human consumption are given in Table XV below.

TABLE XV: MICROBIOLOGICAL PARAMETERS

Lake Antsidihy	Results	Units	WHO	EU	EM
Microorganism at 36°	1,005	NPP/mL	<20	<10	<10
Coliform bacteria	0	NPP/100mL	0	0	0
Escherichia Coli	0	NPP/100mL	0	0	0
Intestinal Enterococcus	0	NPP/100mL	0	0	0

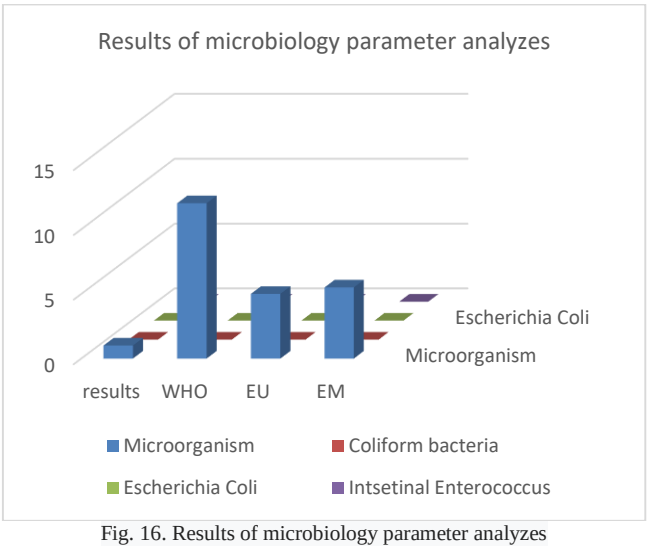

Fig. 16. Results of microbiology parameter analyzes

V. DISCUSSION

A. For physical parameters:

Temperature: the value found is 21 °C, the limit value for drinking water is less than 25 °C, it is admissible for the three international standards.

PH: the value found is 6.96; the value required for drinking water to be between 6.5 and 9, therefore this value is included in the range required for water intended for human consumption. [1]

Turbidity: the measurement result gives 0.78 NTU, the international standard requires a value less than 5 NTU, so the water is clear and good.

Conductivity: the value found is 1031 µS/cm, the two international standards for intended for human consumption require the interval from 180 µS/cm to 1000 µS/cm, so the amount of salts dissolved in water is very high.

B. For chemical parameters:

Chloride: the concentration found is 124.5 mg / L, the maximum concentration for drinking water is 250 mg / L, this water is rich in Chlorine according to the result obtained, so it is good. Sodium: the concentration found is 80.5 mg / L, the limit concentration for drinking water is 200 mg / L, the value found is not far from the international standard, therefore the water is drinkable for the population. Potassium: the concentration is 5.5 mg / L, the international recommendation requires that the potassium concentration for drinking water is 12 mg / L, so it is acceptable and people use water safely [1].

Magnesium: the concentration is 1.46 mg / L, the standards require for drinking water a limit value of 50 mg / L; Antsidihy lake water is low in magnesium. Calcium: the concentration is 20 mg / L, international standards require the concentration between 100 mg / L to 140 mg / L, for water intended for human consumption. Therefore, the concentration of calcium in the sample is insufficient.

Total hardness: the concentration is 18.3 °f; for the water to be drinkable, the concentration must be 50 °f. So the value is admissible despite its insufficiency [1].

Mineralization: the concentration is 995 mg / L, the limit value for drinking water, varies from 1000 mg / L to 1500 mg / L. Doc water is quite rich in mineralization.

Total iron: the concentration is 0.015 mg / L, drinking water conditions require the concentration below 0.2 mg / L. So it is admissible for water intended for human consumption.

Lead: the concentration is 0.01 mg / L, the three drinking water standards require the concentration to be less than 0.5 mg / L. So the water in Antsidihy lake is good. Microbiological parameters: The concentration found for each parameter is perfectly meets the standards required for water for human consumption.

VI. CONCLUSION

The work described in this document brings a new field for the physico-chemical and microbiological analysis of the water of Lake Antsidihy.

The physical parameters, the value found is acceptable for water intended for human consumption despite the value of the conductivity is high. So the amount of salt dissolved in the lake water is very high.

Chemical parameters: the concentration found remains insufficient for water intended for human consumption, especially the abundant parameters in water such as magnesium and calcium the values are very low by international standards.

Microbiology parameters: no pathogenic germs, so the Antsidihy lakewaterisgood. So the population of Nosy-Be who live on the outskirts of the lake Antsidihy can use in precaution and without health risk at the microbiological level, despite some insufficiencies of the concentration for calcium and magnesium in the water of the lake. Next time I will suggest a method for you how can we increase the concentrations of calcium, magnesium, sodium and potassium.

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