

## **Analysis of The Environmental Impacts Caused to The Water of Miriti Lake in The Municipality of Manacapuru-Am.**

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### **ABSTRACT**

*Despite the great supply of water resources, the Amazon Hydrographic Region shows signs of environmental degradation when it comes to water quality, especially in areas located near major urban centers. The purpose of this work was to go to the field to collect water samples from the Miriti-AM lake, to evaluate the physico-chemical and microbiological parameters of the same, being selected for evaluation: pH, turbidity, temperature, BOD<sub>5</sub>, OD and thermotolerant coliforms. The parameters of Water Quality (QA) analyzed were compared with the limits established by CONAMA Resolution 357/2005. At all points the presence of thermotolerant coliforms was not found but, it was found the presence of gram-negative bacteria which indicates total coliforms. With the project carried out in Lake Miriti-AM, it was verified that the water condition of this spring is not fully within the quality standards established by the legal norms for use of class I waters, requiring intervention measures for the protection of this source for control and adaptation of standards that are in disagreement with legal norms.*

**Keyword:** water quality, physical-chemical, microbiological parameters.

## **INTRODUCTION**

With the creation of the Industrial Pole of Manaus - PIM (one of the pillars of the Zona Franca, Manaus), the city was once again an industrial center (RIKER et al., 2016) attracting strong population growth and urban development to the region not only in Manaus, but in the cities around it, such as Iranduba, Itacoatiara and Manacapuru. In addition to this growth, some problems such as urbanization, population increase, lack of basic sanitation and pollution of rivers and streams.

The municipality of Manacapuru is located 86 km from Manaus, being indicated by the last census of the IBGE (2017) as the fourth most populous city in the state and has agriculture as one of the largest sources of economy of the municipality. At the same time, we know that agriculture is UNESCO (2003) as one of the factors of pollution of water bodies, along with urbanization.

According to Mota (2003), despite the great supply of water resources, the Amazon Hydrographic Region shows signs of environmental degradation when it comes to water quality, especially in areas located near major urban centers. One point that caught our attention was the neglect of the public power of the municipality that needs to intervene in this reality that plagues the mother nature, area of the source of the river Miriti, but also all the springs that are suffering with this environmental degradation. It is necessary that there is an effective action of the competent organs in relation to the preservation of nature.

Water is one of the most important elements of planet Earth, essential to every living being (DANTAS, 2008). It is extremely important for human life, since it provides a number of indispensable uses for survival, such as human consumption, electricity production, industrial supply, irrigation, recreation and leisure activities (BARROS et al. 2012). Pollution, its misuse, degradation among others, characterize the most aggravating environmental problems in the country and in the world with water resources. At the same time, these do not only affect large urban centers, as in the case of Lake Miriti that supplies the population of Manacapuru.

Given the need to seek a deeper understanding on the issue of the environmental impacts caused to Lake Miriti, we reflect with greater emphasis on this research and seek to find solutions that would minimize this situation that is being defended, because when we talk about environmental issues, we are reviewing facts and opinions that diverge from non-protection of nature.

Water quality results from natural phenomena and anthropic actions, with the generation of domestic or industrial effluents, or by the application of agricultural inputs and inadequate soil management, contributing to the incorporation of organic and inorganic compounds into the water courses, , these actions end up affecting their quality (CORADI; FIA; PEREIRA-RAMIREZ, 2009).

The water required for human consumption requires some requirements, one of the ways to do this monitoring is through the Water Quality Index (IQA), the main qualitative indicator. According to the National Water Agency (ANA, 2013), establishing a parameter that indicates water quality is an important tool to guide planning and management actions.

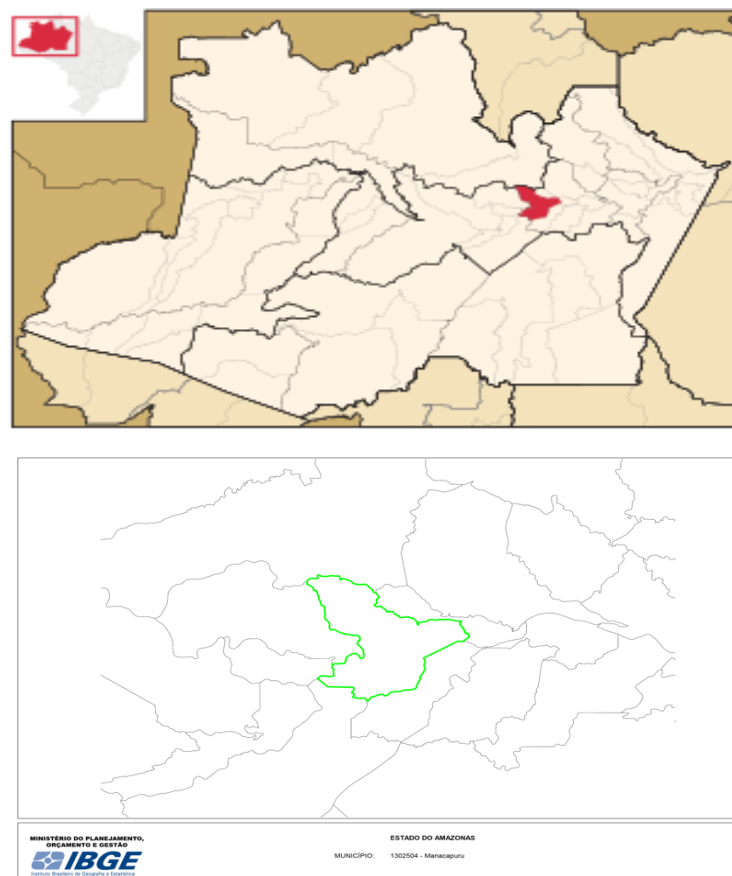
Water unfit for human consumption can bring some consequences if ingested like diarrhea, hepatitis A, intestinal infection, among other diseases caused by bacteria that develop in water. For this reason, it is of the utmost importance that water for water supply is treated correctly, and water quality is an indispensable aspect. Tundisi et al. (2008) emphasize that the knowledge of water quality and the use and

occupation of its watersheds is necessary also to draw up planning and management strategies, projecting future scenarios, such as increased water demand, changes in landscape mosaics resulting from the development of the region and even the possible consequences of global climate change. In view of this reality, this study requires a deeper understanding of the issue in question, which is due to an environmental impact caused by nature. The purpose of this study was to analyze water quality aspects of Lake Miriti located in the municipality of Manacapuru-AM.

## MATERIALS AND METHODS

### Characterization of the study área

Manacapuru is a Brazilian municipality located in the metropolitan region of Manaus, capital of Amazonas, Lake Miriti (object of study) is a freshwater river, a place where there is a beach resort, very frequented by tourists and the people of the municipality of Manacapuru, is approximately at km 86 of the Manoel Urbano-Am 70 highway. It is a small tributary of the left bank of the Solimões River. The location of the municipality is shown in Figure 1.



**FIGURE 1:** Location of Manacapuru in Amazonas.

The collection areas will be as follows: in two points widely used for leisure and recreation of the local community and visitors, being bathhouse of Miriti P1, edge of Miriti P2 and at its point of collection for distribution of the city P3.



**FIGURE 2:** Satellite image of the study site with collection points

**Table 1:** Geographical location of the three collection points in Lake Miriti-AM.

Places	Geographic Coordinates	
	Latitude	Longitude
<b>P1</b>	S 3°17'17"	W 60°36'58"
<b>P2</b>	S 3°17'01"	W 60°36'54"
<b>P3</b>	S 3°15'44"	W 60°37'38"

**Physico-chemical and microbiological analyzes**

The water samples collected from the Miriti lake were collected in May (early dry season) and October (early rainy season) in 2018 in the morning. The parameters of Water Quality (QA) analyzed were compared with the limits established by CONAMA Resolution 357/2005 (Brazil, 2005). The quality of the water is related to its intended use for human consumption, bathing, irrigation and others, and for each of the uses there is a quality standard specified by the legislation.

For pH measurement, its determination was made at the point of collection in YEP ECOSENSE PH100A portable digital pegameter, first calibrated with standard solutions. Regarding the determination of water conductivity, this was obtained through a portable probe of the YSI PRO 30 conductivity meter, this sensor provides accurate and quality data.

The OXIMETRO YSI - PRO ODO equipment was used to determine dissolved oxygen (DO). This equipment is a portable probe that allows the measurement of dissolved oxygen and water temperature, measurements were made in loco. Figure 3 shows the equipment used to measure dissolved oxygen (A), pH (B), temperature and conductivity (C) of Lake Miriti.

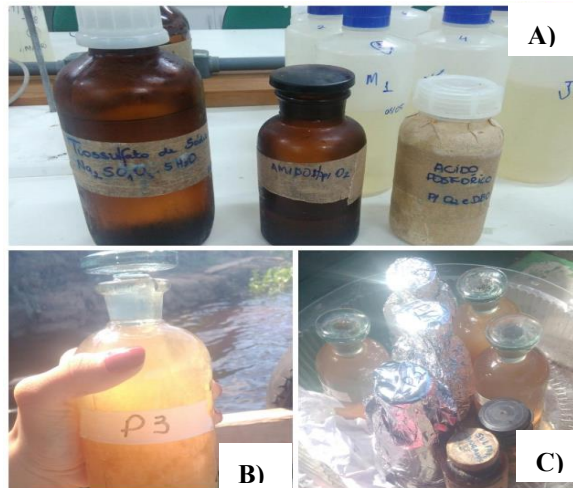


**FIGURE 3:** - A): OXIN A) R YSI - P B) DO (imag C) n on 05/15/2018 at 10:57 am on the Miriti lake); B): YSI ECOSENSE PH100A (image taken on 05/15/2018 at 10:55 am on the Miriti lake); C): Conductivity meter YSI PRO 30. Authorship: Author 2018 (A and B) and internet image (C).

The Biochemical Oxygen Demand (BOD) determines the presence of a water source for the decapitation or decomposition of organic matter. The procedure of collecting each sample of water is the standard, in the literature as in DERÍSIO (2012), which is the water is collected in glass bottles with a volume of approximately 300 ml. In this analysis, two vials were selected at each collection point, which were filled until transhipped. This procedure was carried out with great care, because air bubbles inside the samples are avoided because the air can be altered in the results of the analysis.

The dissolved oxygen content (OD) was determined by the Winkler method. This method consists of adding sodium azide to one of the samples (Figure 4) and coating the second vial with laminated paper to avoid light contact, which procedure will be performed in one of the vials of all dilutions. After the samples are sent to a greenhouse at 20 ° C for 5 days and then the BOD5 (BOD within 5 days) is determined. It is worth emphasizing that the second sample weak at all points of collection was not added any type of solution (ASS).

Using the samples BOD5 and ASS were added 2 mL of manganous sulfate, 2 mL of sodium azide, under stirring. After decanting, 2 mL of sulfuric acid was added. 100 ml of the sample was titrated with sodium thiosulfate using starch as indicator, so the initial OD was used as the volume of sodium thiosulfate. Figure 4 shows the procedure for collecting, storing and analyzing water for BOD determination.



**FIGURE 4:** A) Solution of sodium thiosulphate, starch and sulfuric acid (taken on 05/15/2018 at 15:25 in the morning); B) Collection of water sample from Lake Miriti (taken on 05/15/2018 at 10:58 AM on Lake Miriti); C) Collection of water sample from Lake Miriti (taken on 05/15/2018 at 11:30 am on Lake Miriti). Authorship: Author 2018

After completion of the above procedures, the Biochemical Oxygen Demand is determined by the following calculation of concentration:

$$(1) \quad \text{MgO}_2/\text{L} = \frac{\text{Cons.tiosulfato} \times \text{N} \times 8 \times 1000}{\text{vol.do fasco}-2} = \text{OD}_{\text{final}}$$

$$(1.1) \quad \text{F.DBO}_2 = \frac{5}{\text{dias de incubação}}$$

$$(1.2) \quad \text{mgDBO}_2 = \text{OD}_{\text{inicial}} - \text{OD}_{\text{final}} \times \text{F.DBO}_2$$

Where: N is the normality of the sodium thiosulfate solution and f is the dilution factor.

### Coliform Analysis

According to Rodrigues et al. (2002) Thermotolerant Coliforms are beings present in high amounts in human feces and warm-blooded animals. Bacteria known as fecais or thermotolerant, withstand high temperatures above 40 ° C, and when found in water samples are a strong indication that the water is contaminated by feces and sewage.

The concentration of coliforms is a determinant factor that makes it possible to detect the existence of pathogenic microorganisms, those that are responsible for the process of response related to water, such as typhoid, paratyphoid fever, dysentery and cholera (CETESB, 2008). The standard pattern of image collection is the same using CETESB, (2011) in which the water samples are collected in the same way for a microbiological analysis. In this work three 250ml glass containers were collected, sterilized in an autoclave, which after collection were kept in a thermal container with ice avoiding the proliferation of

bacteria. On the other hand, the methodology used was that of multiple tubes (APHA, 1995), which has the function of detecting microorganisms in liquid samples.

The multi-tube method allows the quantification by "most probable number" (NMP) of microorganisms, being the most traditional for determination of the concentration of total and thermotolerant coliforms (ALVES et al., 2002). This method is divided into the following phases: presumptive and confirmatory, the latter being carried out only if there is positive growth in the first phase.

The procedure of the presumptive phase consists in homogenizing certain volumes of the sample in series of tubes containing, in the bottom, an inverted tube for collecting gas and laurel tryptase, where all the tubes are incubated at a temperature of 35°C for 24 a 48 hours for the following identification if there was acidification or gas production, from the fermentation of lactose in the culture medium used in this test, being a positive presumptive result for the presence of bacteria of the coliform group.

In the confirmatory phase cultures were transferred with positive presumptive results for prepared tubes, as described above, but with bright green broth, and incubation was also carried out at 35°C for 24 to 48 hours. Gas production confirms the presence of bacteria in the coliform group. The chemical and microbiological analyzes were carried out in the laboratories of Limnology and Microbiology, Federal University of Amazonas - UFAM.

## RESULTS AND DISCUSSION

During the month of October the collection in point 1 can not be performed because the area of the Miriti resort is closed for construction of the new bridge that connects Manaus to Manacapuru. In this study, the results of the variables of points P2 and P3 in the month of May are within the standards required by CONAMA Resolution 357/2005 (Brazil, 2005), with point P1 a small difference in the parameter pH, in relation to what was established by it. The limits established by CONAMA Resolution 357/2005 for QA are shown in table 2.

**Table 2.** Limits established by CONAMA Resolution N°. 357/2005

Parameter	Limit resolution CONAMA 357/2005
Ph	6,0 a 9,0
Temperature	Less than 40 ° C
DBO	3mg/L O <sub>2</sub>
OD	6mg/L O <sub>2</sub>
Conductivity	Value not determined
Thermotolerant Coliform	200 NMP por 100 ml

In all the points were not found the presence of thermotolerant coliforms but, it was found the presence of gram-negative bacteria which indicates total coliforms at points P2 and P3. Some factors that may be related to these results are the amount of litter deposited on the lake by the population and even used as sewage by many residents of the municipality.

According to Goulart and Callisto (2003), the lack of basic sanitation and the lack of sensitivity of low-income residents living near water bodies have a direct influence on the deposition of materials in water courses, which use this resource because they require a medium to solve their sanitation problems. Over time the resource becomes a deposit of garbage and sewage, the aquatic ecosystem ends up being degraded becoming a potential vehicle of diseases for the population. The results obtained for the samples tested are shown in table 3.

**Table 3.** Values of the water quality standards analyzed in the two months of collection in Lake Miriti.

Month	Points	pH	Temp.	OD	Cond.	DBO	Col. Term o.
May	P1	5,20	28,6 °C	4,86	8,5	1,86	-
	P2	6,36	29 °C	2,5	21,9	1,17	-
	P3	6,6	28,6 °C	2,06	23,5	2,38	-
October	P1	-	-	-	-	-	-
	P2	6,4	31,2	7,86	22,3	4,91	-
	P3	6,4	30,9	4,63	23,9	2,13	-
<b>Temp = Temperature; Cond = Conductivity; Termo = Thermotolerant Coliform</b>							

The Potential of Hydrogen between the three points collected ranged from 5.20 to 6.6, with only slightly acidic P1 (lower pH) slightly below what was established in the legislation, with the other points very close. There are some factors that cause the pH to vary depending on the relationships between organic matter, living beings, rock, air and water. The decomposition of organic matter may also be associated with the acidity present in a watercourse. PH values far from neutrality may interfere with aquatic life, such as fish (SPERLING, 2005).

The temperature of the water has a direct influence on the collection time and climatic conditions. All collections were performed in the morning between 8 and 11 o'clock and tabs were within the limits established by resolution CONAMA 357/005 (Brazil, 2005). October was the month that presented the highest values of temperature being higher than 30° C at all points of collection.

Dissolved oxygen (OD) is of fundamental importance for aerobic organisms, such as fish that need the oxygen dissolved in water for their survival (FUZINATTO, 2009). The OD parameter at the collection points showed that their values had a great variation in the respective months of collection, showing much lower values in the three points compared to what is established in the resolution CONAMA 357/005 in the month of May, indicating strong pollution. Such results are directly related to the amount of domestic and sanitary pollutants received, these consume large amounts of oxygen available for oxidation of matter.



The month of October showed in P3 a higher result than the one collected in May, but not yet within the standard and P2 had a higher concentration at this site, being higher than 6mg / L O<sub>2</sub>, which may correspond to the greater flow of this area.

Regarding the electrical conductivity, there is little variation during the collection periods at all sample points, having values not higher than 24  $\mu\text{S} / \text{cm}^{-1}$ . The Ministry of Health does not establish maximum values for the electrical conductivity parameter by means of Ordinance No. 2.914 / 2011, although this is related to the local climatic conditions and geochemical characteristics and can still be applied to collaborate in the studies of total solids.

The results obtained in the analysis of BOD<sub>5</sub> showed that during the month of May all samples collected from the points selected for analysis were in agreement with the limits recommended by CONAMA Resolution n° 357, in the month of October P3 was still in compliance and P2 had a high value to that established in the standard being 4.91 mg / L. The decrease of dissolved oxygen content in a watercourse may indicate activity bacterial decomposition of organic matter. The greater the amount of organic matter present, the more OD will be required for the decomposing beings to stabilize it, so the greater the degree and pollution the greater the BOD.

## FINAL CONSIDERATIONS

With the project carried out in the Miriti-AM lake, as a whole, of the physicochemical and microbiological parameters, in the three points of collection during the months selected for evaluation it was verified that despite suffering antropic influence, this lake still has parameters of Water quality, but it is not fully within the quality standards established by CONAMA 357/005 (BRASIL, 2005) for class I waters, requiring protection of this source for control and adaptation of the standards that are in disagreement with the legal norms.

Finally, it would be feasible to carry out a more comprehensive research from the lake downstream upwards, with studies of all physicochemical and microbiological parameters, seeking to alert the population about the importance of quality from the resource and also to propose public planning policies urban and that aim at the preservation of the environment, since this makes it possible to have more control over the quality of the spring and still allows to have a planning for the recovery of the same.

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