

Assessment of the quality of drinking water supplied to the Community of Piaçaguera, Paranaguá - PR

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Abstract: Water is an essential element for the maintenance of life on planet Earth. In order to guarantee the quality mentioned, the present work aimed to evaluate the physical-chemical parameters of drinking water, before and after being treated, and distributed to the Community of Piaçaguera, Paranaguá, PR, between March and July, 2020. The community has its own treatment plant that is managed by residents who have practical knowledge, but without academic or professional knowledge. Phosphate and nitrogen compounds were evaluated, which were quantified through spectrophotometric and conductimetric methods, as well as parameters such as pH and turbidity. The results obtained were compared with the norms established by Conama and ANVISA and thus it was possible to perceive that the only parameter that is far above the established norms is the phosphorus element, whose concentration exceeds 100 times the maximum allowed value of this substance.

Keywords: Spectrophotometry, Water resources, fishing community.

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I. INTRODUCTION

Piaçaguera is a fishing traditional community located near Paranaguá-PR port, which the inhabitants are in major descendants from the first residents of this location decades ago, confirms local the merchant Mr. Odair dos Santos (personal communication, august 20 of 2020). The biggest community's source of income is obtained from the fishing, handicraft and tourism, according "island president" Mr. Danir Ramos (personal communication, August 20th, 2020). As many family's parents have your own motorized boats that use as a means of transportation, sometimes this mean of transportation is used commercially to enhance household's income with the groceries and tourist freight or seasonal residents, being that the principal clients are those descendants, that have a community's house, but they just use in certain dates of the year, like holidays or final year festivities.

Mr. Odair dos Santos indicates that Piaçaguera's community is mistakenly called Piaçaguera island, because even if appears to be an island, it's still part of continent and can be difficultly accessed through PR-405 highway using present trails in the forest (personal communication, August 20th, 2020).

Mr. Danir Ramos (personal communication, August 20th, 2020) also confirms that Piaçaguera counts with your own water distribution center. This water's distribution process is administrated by a resident of community, which don't have professional or academic knowledge related to water treatment, just practical knowledge, that was obtained during this period in which he made the local's water treatment.

In 2020 the General Assembly of United Nations Organization (ONU), by means of your resolution n°64/292, recognized the rights to drinking water and clean, and right to sanitation as essential for the full enjoyment of life and all human rights. And in year of 2000 the ONU approved the Millennium Development Goals to period from 1990 to 2015. Between yours eight goals counts consists of the reduction by Half of people's number that starve in the world without access to drinking water and basic sanitation services (Costa, 2014).

For this reason, appeared the interest to analyze and evaluate physical-chemical parameters in hydric resources of this Paranaguá region, especially that one which is distributed by the treatment station to human consume.

The superficial water quality is directly related with the sustainability capacity from aquatic ecosystems, human consume and even, according with the potability and balneability of them (Spiro & Stigliani, 2008). So, it is the resultant from anthropic actions contaminants, like dissolved total solids (DTS), which according to Reis, França, Motil, Cordeiro & Rocha (2015) is one of the ways of characterization from anthropogenic actions. In the present study in addition to the DTS's, some chemical elements were quantified, such as nitrogen, which second Lee (1980) shows the largest number of inorganic species with solubility high

degree in water and with different numbers of oxidation. One of these compounds is ammonia, which second Miwa, Freire & Calijuri (2007) is easily found solubilized in hydric resources due to organic nitrogen decomposition process, where it is in form of amino acids, proteins constituents, and undergoes hydrolysis by intermedium from proteolytic enzymes produced by microorganisms (Singo, Ramos & Rocha, 2020).

Other way to found nitrogen is the nitrite that presents oxidation +3, being that this anion finds essential conditions in saliva and gastrointestinal tract to react with secondary and/or tertiary amines in acid medium to produce nitrosamines, mutagenic and carcinogenic substances. This anion also has the property to oxidize hemoglobin in methemoglobin, whereas, in that form, this substance isn't capable to combine with oxygen, causing deaths of people that ingest solutions where this ion is present, especially babies (Reis et al. 2015). In hydric resources with elevated concentrations of organic matter occurs the nitrification process, in other words, the transformation of ammonia in nitrite (Barbosa, Tavares & Navoni, 2019). This fact happens due to autotrophic bacterial attacks from genus *Nitrosomonas* e *Nitrobacter* (Reis et al. 2015).

Other element evaluated during this work was the phosphorus in form of phosphate ion (Lopes, Carvalho, Gomes & Rocha, 2019). The living beings need significant concentrations of phosphorus element in all your biochemistry structure, whether DNA, RNA, proteins, ATP, NADH, among others. But in the environment, when in quantity below of $0,150 \text{ mg L}^{-1}$, it leads to eutrophication process, that is the excessive formation of algae and microalgae that stay on surface in hydric resources, thus blocking the light passage to occurs the photosynthesis process within the same hydric resource. With this occurs the oxygen dissolved decrease and eventually decreasing the quantity of species which live there (Souza, Silva, Carvalho & Rocha, 2019).

The characterization and quantification of physical-chemical parameters from potable water provided to Piaçaguera's Community, Paranaguá-PR, will be able to contribute to the water quality improvement offered to residents, that uses to different human needs, since though personal communication, one resident who did not want to be identified mentioned that the only way of treatment that water of Piaçaguera receives is a chlorine unknown dosage to "clean" the water supplied to community.

II. EXPERIMENTAL PROCEDURE

2.1 Sample Collection.

Monthly were taken water's sample for a period of five months, in three geographic points of Piaçaguera's Community, which is hydro-fueled by the oyster's river, located in three equidistant community regions, as follows respectively the main author residence of this work ($25^{\circ}47'86,61''\text{S}$, $48^{\circ}49'02,76''\text{W}$), the water treatment center, where through a pipe was possible to collect water before being treated ($25^{\circ}47'90,97''\text{S}$, $48^{\circ}48'34,02''\text{W}$), and the commercial establishment of community resident ($25^{\circ}47'97,57''\text{S}$, $48^{\circ}47'54,85''\text{W}$). Subsequently the samples were taken to the Environment Impacts Evaluation Laboratory (LAVIMA) from Paraná State University, Paranaguá Campus, where carried out the physical-chemical testing. The samples 1 and 3 are removed samples from faucets used in each of these residences. In the Figure 1 are shown pictures adapted from Google Maps.

2.2 Temperature Measurement

During the sample collect process was carried out with a glass thermometer, inside of water, the temperature value measure of it. After was performed the air temperature measure directly above of water samples, to verify heat balance of the two systems.

2.3 Ammonium spectrophotometric analysis

To quantify the ammonium ion in the samples was used the spectrophotometric method of indophenol blue (Standen & Taliaard, 1997). To obtain the color, measured in 630nm, are added the samples in solutions containing Carboic Acid and Sodium Nitroprusside, followed by Sodium Hydroxide and sodium dihydrogen Dichloroisocynurate addition and awaits 30 minutes to occur the reactive process. The stand curve was obtained with absorbance values taken from ammonium standard solution (0,01; 0,05; 0,10; 0,20 e $0,40 \text{ mg L}^{-1}$ of nitrogen in ammonium ion form), considering that the quantification was performed with five replicates to minimize analytical errors). That way after measured the absorbance values of each standard solution is determined graphically the equation o line and through it is determined in each one of the analyzed samples. In the Figure 2 were represented (A) the ammonium standards after the addition of reactive solutions and (B) the ammonium standard curve obtained to quantification of the ammonium concentration values from third sampling.

Figure 1. Representation from the sample collection locations 1, 2 and 3. From left to right and from the top down we have: Satellite image from municipality of Paranaguá – PR, topographic image from community of Piaçaguera-PR, satellite image from collection location 1 (main author home), Satellite image from water treatment center of community (represented by the number 2) and sample collection location 2 (represented by the number 2.1) and the satellite image from sample collection location 3 (commercial establishment of one resident)

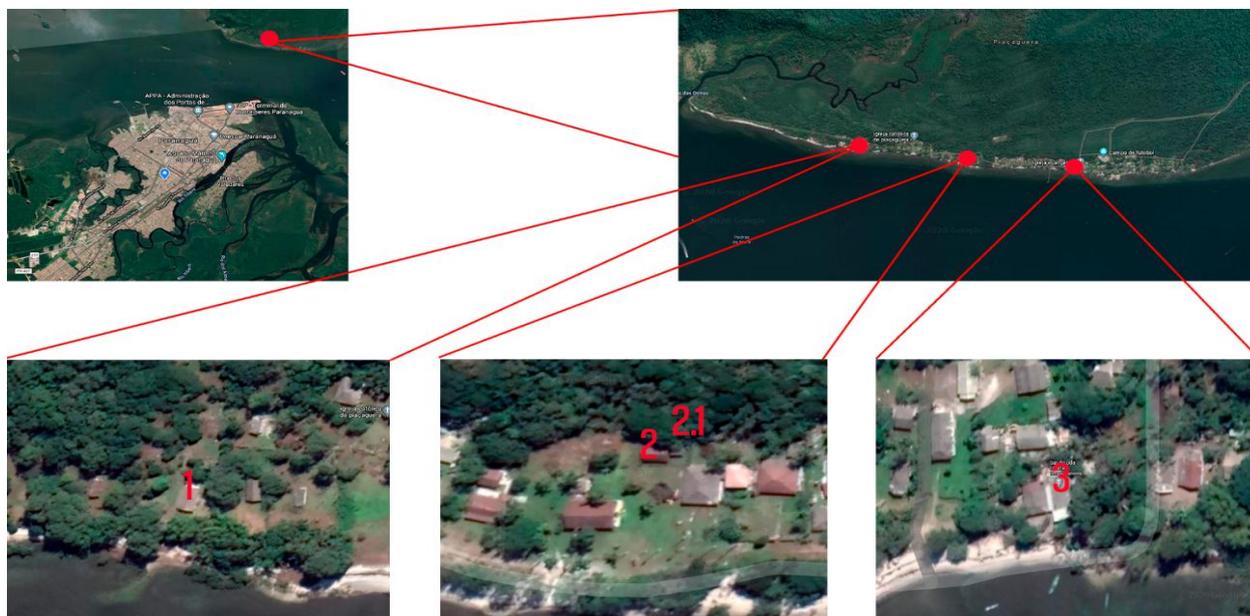
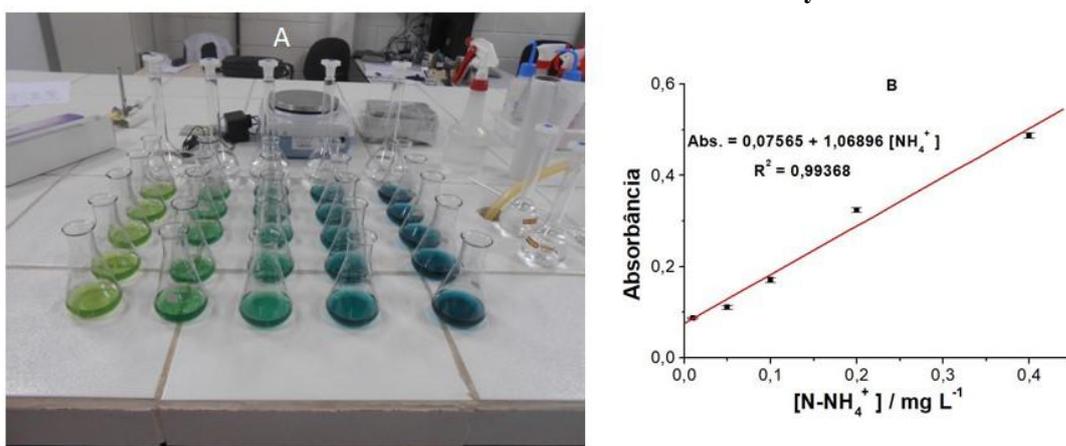


Figure 2. (A) Picture of the ammonium standard solutions (0,01; 0,05; 0,10; 0,20 e 0,40 mg L⁻¹) after the reactive solution addition. (B) Graphic representation of linear equation of the line from ammonium standard absorbance results in accordance with your concentration.



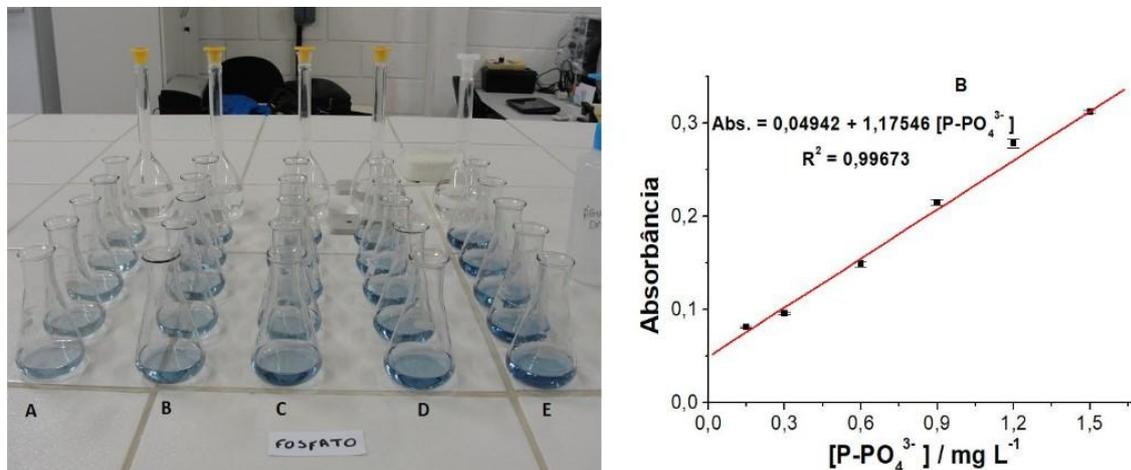
2.4 Phosphorus Spectrophotometric Analysis

The Chemical element phosphorus present in samples also was determined spectrophotometrically in form of phosphate using the spectrophotometer U2M Quimis. For it is used a method that mix the samples or the standard solutions with molybdate ammonium, ascorbic acid, nitric acid and glycerin, thus causing the color formation of blue molybdenum (Masini, 2008). Then were realized the absorbance value measures in the spectrophotometer in 660nm, including the calibration of the equipment and blank obtainment.

All analytical samples were done with five replicas, to minimize the possible mistakes. The showed result was obtained by the media and standard deviation from these values. With these values was outlined the standard curve and from it was obtained the straight-line equation used to get phosphate values present in the sample from different locations. In the Figure 3 are represented (A) the phosphate standards after the reactive

solutions addition and (B) the phosphate standard curve obtained to quantify phosphorus in form of phosphate in the third sampling.

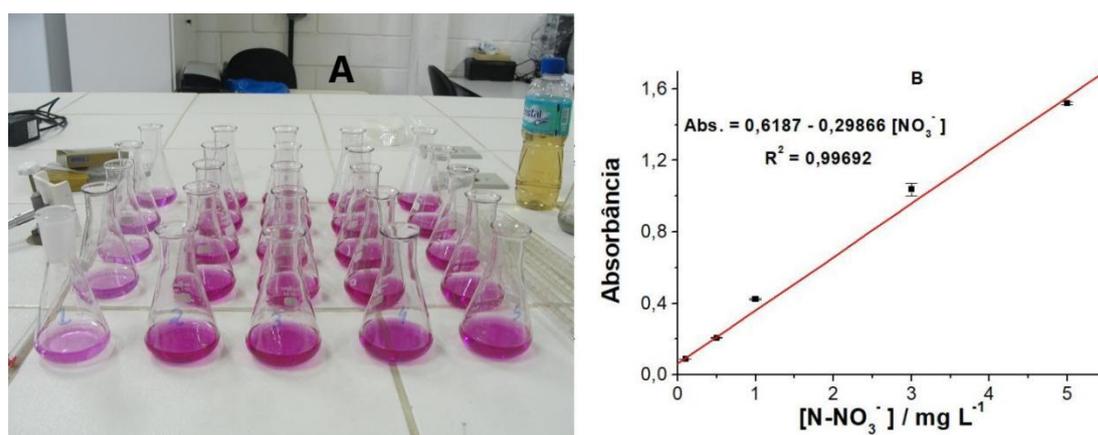
Figure 3. (A) Phosphate Standard solutions Picture (0,15; 0,30; 0,60; 0,90; 1,20 e 1,50 mg L⁻¹). (B) Graphic representation of straight-line equation from phosphate standards absorbance results as a function of their concentration.



2.5 Spectrophotometric Nitrate Analysis

Before measuring the amount of nitrate in each of the samples, the nitrate ion is reduced to nitrite with zinc powder, since the nitrate ion cannot be quantified using Griess method (1879). Two hours later the solution is filtered to remove the zinc and thus stop the reduction reaction. A solution of sulfanilamide, naphthyl ethylenediamine dihydrochloride, and phosphoric acid is added to the filtrate (Rice et al, 2012). The reaction process is allowed to continue for 15 minutes and then measurements at 545nm are performed on both the samples and the standard solutions. Figure 4 shows (A) the nitrate standards after the reduction of nitrate to nitrite and the addition of the reactive solution, and (B) the nitrate standard curve obtained for the quantification of the nitrate values from the third sampling.

Figure 4. (A) Image of the Nitrate standards solutions (0.1; 0.5; 1.0; 3.0 and 5.0 mg L⁻¹) after the reduction of nitrate to nitrite and the addition of the reactive solution. (B) Graphical representation of the Linear Equation of the Linear Equation of the absorbance results of the nitrate standards as a function of their concentration.



2.6 Potentiometric and Conductimetric Tests

Potentiometric assays were performed in PHS-3E PHTEK benchtop pH meter after calibration with pH 7.0 buffer solution and pH 4.0 buffer solution. Conductimetric tests were also performed to determine the electrical conductivity and the concentration of Total Dissolved Solids (TDS). In addition to quantifying the concentration of dissolved oxygen (DO).

The turbidity determinations of the samples were performed in the AKSO TU2106 portable digital turbidimeter, after calibration of the equipment with 0 NTU solution and later with 800 NTU solution.

All tests were performed in the Laboratory for Environmental Impact Assessment (LAVIMA) of the Paraná State University (UNESPAR), Paranaguá Campus.

III. RESULTS AND DISCUSSIONS

3.1. Temperature

The results obtained from the temperature measurement at the time of collection are shown in Table 1.

Samples	Collection Point 1 / °C		Collection Point 2 / °C		Collection Point 3 / °C	
	Water	Air	Water	Air	Water	Air
March	31	31	24	25	25	26
April	22	22	23	22	24	23
May	22	21	23	22	24	23
June	26	26	25	24	21	26
July	21	22	21	21	22	23

The results obtained by measuring the temperature values of the samples show that there are no relevant problems resulting from anthropic actions in them, because there is a thermal balance between the two systems, since the difference in air and water temperature in the samples at the time of collection does not exceed two to three degrees, as determined by Section 4, Article 34 of Chapter IV of Resolution 357 of Conama 2005, with the exception of the month of June in sample 3 where there is a difference of five degrees Celsius.

3.2 Dissolved Oxygen.

Table 2 shows the mean values, as well as the standard deviation of the experiment, and the results are expressed in mg L⁻¹.

Table 2. Mean values of the results for the amount of dissolved oxygen in the samples, the results were expressed in mg L⁻¹.

Month	Collection Point 1 / mg L ⁻¹	Collection Point 2 / mg L ⁻¹	Collection Point 3 / mg L ⁻¹
March	5,9 ± 0,1	9,8 ± 0,2	7,5 ± 0,2
April	8,4 ± 0,3	8,3 ± 0,1	7,8 ± 0,1
May	9,4 ± 0,2	8,3 ± 0,2	9,6 ± 0,1
June	7,5 ± 0,3	7,7 ± 0,4	6,3 ± 0,7
July	7,3 ± 0,2	9,8 ± 0,2	8,2 ± 0,1

The Article 14 of Section II of Resolution 357 of 2005 from Conama states that the dissolved oxygen found in samples of continental water used for human consumption should not be less than 6 mg L⁻¹. Therefore, evaluating all the DO results obtained in this study, it can be seen that in all samples analyzed, the values were within the standards established by Conama, with the exception of sample 1 evaluated in the month of March. In this sample, the DO value was one tenth less than the recommended values, and when the margin of error of the

standard deviation is considered, the value can be up to two tenths less than the recommended values. But this was the only result, and in the following months the values became normal.

3.3 pH

The average pH values found in the measurements are shown in Table 3.

Table 3. Average pH values, as well as the standard deviation value obtained in the pH tests, in five replicates of each of the samples.

Month	Collection Point 1	Collection Point 2	Collection Point 3
March	6,52 ± 0,50	6,52 ± 0,20	6,64 ± 0,40
April	6,93 ± 0,16	6,98 ± 0,80	6,91 ± 0,90
May	6,01 ± 0,50	6,00 ± 0,20	6,04 ± 0,10
June	5,79 ± 0,30	5,82 ± 0,40	5,66 ± 0,60
July	6,19 ± 0,80	6,27 ± 0,60	6,30 ± 0,50

The Article 14 of section II of resolution 357 of 2005 from Conama establishes that the pH value of continental water for human consumption should be within the limit of 6.0 to 9.0. After the analytical determinations it was noticed that most of the pH values of the samples are within the allowed limit, except for the three June samples, where an increase in acidity in the water resource from rain or anthropic actions may have caused this difference in pH. However, when the results are evaluated considering the standard deviations, a larger number of samples have more acidic characteristics than those recommended by the norm. This shows that in the water resources of the region the process of decomposition of organic matter is producing a greater amount of H⁺ ions.

3.4 Electric Conductivity.

With the results of the analysis of the electrical conductivity of the samples it was possible to estimate the amount of ions that are present in the samples, since the higher the values of electrical conductivity the greater the presence of ions in the samples so that these ions conduct electrical energy.

Table 4. Average electrical conductivity of the samples measured in $\mu\text{S cm}^{-1}$.

Month	Collection Point 1 / $\mu\text{S cm}^{-1}$	Collection Point 2 / $\mu\text{S cm}^{-1}$	Collection Point / $\mu\text{S cm}^{-1}$
March	40,54 ± 0,22	39,38 ± 0,13	40,65 ± 1,25
April	51,36 ± 1,64	50,75 ± 0,25	53,39 ± 0,08
May	55,03 ± 0,05	54,84 ± 0,60	55,27 ± 0,06
June	54,27 ± 0,51	54,35 ± 0,09	56,97 ± 0,12
July	52,20 ± 1,80	51,10 ± 0,90	53,90 ± 1,80

Comparing the results obtained from the electrical conductivity in the samples, with the values represented in Figure 5 that Pinto et al. (2008) adapted from the resolution 357 of 2005 of Conama, the allowable limit is 50 to 70 $\mu\text{S cm}^{-1}$. Only the samples collected in the month of March are below the minimum allowed limit, remembering that very low values of electrical conductivity show that these samples have a low presence of ions. Thus, a hydroelectrolytic unbalance can occur, which according to Evora et al. (1999) can

cause symptoms of dehydration, edema, hydric intoxication and problems related to the lack of certain ions such as calcium, potassium and sodium.

Figure 5. Limits of the analyzed parameters for classification in the Fresh Waters Classes in Brazil.
Source: Pinto et. al. (2008) taken from Conama's Resolution n. 357 of 03/17/2005.

Classes	Limites para o Enquadramento
Especial	Nas águas de classe especial deverão ser mantidas as condições naturais do corpo de água. OD + 10,0 mg/l pH 6,0 a 9,0 Turbidez até 40 NTU Condutividade Elétrica até 50 μ m
I	OD 10 a 6 mg/l pH 6,0 a 9,0 Turbidez até 40 NTU Condutividade Elétrica 50 até 75 μ m
II	OD 6 a 5 mg/l pH 6,0 a 9,0 Turbidez 40 até 100 NTU Condutividade Elétrica 75 até 100 μ m
III	OD 5 a 4 mg/l pH 6,0 a 9,0 Turbidez até 100 NTU Condutividade Elétrica 100 até 150 μ m
	OD - 4 mg/l pH 6,0 a 9,0

3.5 Dissolved Total Solids (DTS).

The mean values of electrical conductivity were obtained from the five repetitions of each sample and are shown in Table 5 and expressed in mg L^{-1} .

Table 5. Average values of total dissolved solids in the water in mg L^{-1} .

Month	Collection Point 1 / mg L^{-1}	Collection Point 2 / mg L^{-1}	Collection Point 3 / mg L^{-1}
March	21,41 \pm 0,16	21,29 \pm 0,10	21,54 \pm 0,04
April	25,98 \pm 0,63	25,36 \pm 0,09	26,74 \pm 0,04
May	27,54 \pm 0,01	27,14 \pm 0,03	27,42 \pm 0,15
June	27,62 \pm 0,05	27,15 \pm 0,04	27,55 \pm 0,34
July	26,50 \pm 1,00	25,80 \pm 0,70	27,10 \pm 0,70

At the end of the analytical tests, it was observed that the results obtained are below the maximum limit allowed for continental waters, and that in the Section II, Article 14 referring to water quality standards presented by Conama define a limit of 500 L^{-1} . Because it is continental water, the samples that were collected present low values and within the established standards in relation to total dissolved solids.

3.6 Turbidity

Turbidity is a physical property of fluids that is caused by the reduction of its transparency due to the presence of suspended materials. Table 6 shows the turbidity values for each of the samples, after obtaining the average value of five replicates per sample.

Table 6. Average turbidity values for each of the samples evaluated.

Month	Collection Point 1 / NTU	Collection Point 2 / NTU	Collection Point 3 / NTU
March	19,0 ± 1,7	22,0 ± 0,6	19,7 ± 1,0
April	5,3 ± 0,4	15,1 ± 0,1	7,5 ± 0,3
May	11,3 ± 0,3	22,2 ± 0,1	9,4 ± 0,1
June	2,1 ± 0,8	36,7 ± 0,4	2,4 ± 0,1
July	2,4 ± 0,5	15,7 ± 0,3	2,6 ± 0,1

3.7 Color.

The color tests aim to identify the natural color level of the water body, which is expressed in PCU (Platinum and Cobalt units). This unit was developed by Hazen and means the equivalent amount of milligrams of the elements platinum and cobalt present per liter of solution (mg Pt-Co L⁻¹). In the Table 7 shows the color values obtained after finding the average value of the five replicates performed for each of the samples.

Table 7. Average color values of the collected samples expressed in PCU.

Month	Collection Point 1 / PCU	Collection Point 2 / PCU	Collection Point 3 / PCU
March	5 ± 0	29 ± 15	5 ± 2
April	0 ± 0	4 ± 2	0 ± 0
May	0 ± 0	4 ± 2	0 ± 0
June	5 ± 0	58 ± 3	12 ± 3
July	0 ± 0	6 ± 2	0 ± 0

The “L” item of Article 14 of Section II of Conama Resolution 357, published in 2005, defines the color in samples for class 1 continental waters to have a natural color level of the water body in mg Pt-Co L⁻¹, but does not cite values for this. Remember that these waters can be used to supply water for human consumption, after simplified treatment. This value is quoted for class 2 continental waters that can be supplied for human consumption, after conventional treatment. It is then defined as 75 mg Pt-Co L⁻¹.

To consider the value for continental waters of class 1, we sought the parameters from Appendix 10 of Annex XX of Anvisa's Consolidation Ordinance 05/2017, published on 09/28/2017. In this document, Anvisa determines that the organoleptic standards of potability have 15 PCU as color limit.

Therefore, evaluating these quality parameters, all the results obtained are in accordance with the legislation, including all the values of sample 2, since the water from this sampling point undergoes a treatment process before being sent for human consumption.

3.8 Ammonium

The results obtained in the ammonium (NH₄⁺) assays are shown in Table 8. They are expressed in µg L⁻¹, and were obtained from the average of the values obtained in the five replicates performed on each of the samples.

Table 8. Average values of ammonium concentration of the collected samples, values expressed in $\mu\text{g L}^{-1}$.

Month	Collection Point 1 / $\mu\text{g L}^{-1}$	Collection Point 2 / $\mu\text{g L}^{-1}$	Collection Point 3 / $\mu\text{g L}^{-1}$
March	15,4 ± 6,5	111,8 ± 30,3	95,2 ± 17,0
April	2,1 ± 1,4	1,8 ± 0,7	2,1 ± 0,8
May	39,5 ± 1,8	50,9 ± 3,0	38,6 ± 1,2
June	95,6 ± 2,9	110,3 ± 2,9	96,3 ± 5,5
July	109,9 ± 5,6	114,1 ± 9,8	113,1 ± 4,9

Item II of Article 14 of Section II of Resolution 357/2005 of Conama establishes that the concentration of ammoniacal nitrogen, for pH values below 7.5, should be less than 3.7 mg L^{-1} , or $3,700 \mu\text{g L}^{-1}$. Therefore, all the values observed in Table 8 are within the limit established by Conama. The ammonium ion is very important in the production of fertilizers and plastic fibers and was detected in the samples collected. Remembering that this ion is a byproduct of the oxidative decomposition of all organic matter present and dissolved in water resources, according to the Portuguese Society of Pediatrics (2016), the excess of ammonium in the body causes hyperammonemia, which causes mainly neurological changes. In newborns, the acute presentation of weak suction, hypotonia, progressive lethargy, and convulsions is common, with possible rapid progression to coma and death.

3.9 Phosphate.

The values obtained from the phosphate (PO_4^{3-}) assays are shown in Table 9 and are expressed in mg L^{-1} . These values were obtained by averaging the results from the five replicates performed at each of the sample points.

Table 9. Mean values of phosphorus concentration in the form of phosphate of the collected samples and expressed in mg L^{-1} .

Month	Collection Point 1 / mg L^{-1}	Collection Point 2 / mg L^{-1}	Collection Point 3 / mg L^{-1}
March	15,38 ± 0,14	15,23 ± 0,49	15,00 ± 0,63
April	8,29 ± 0,15	8,51 ± 0,07	8,68 ± 0,12
May	9,83 ± 0,08	10,06 ± 0,11	9,93 ± 0,02
June	10,11 ± 0,04	10,41 ± 0,09	10,28 ± 0,06
July	7,05 ± 0,11	7,27 ± 0,02	9,33 ± 3,42

Item II of Article 14 of Section II of resolution 357/2005 of Conama establishes the limit of up to 0.100 L^{-1} for total phosphorus measured in samples of water in lotic environments of class 1. For class 3, however, this limit is up to 0.150 mg L^{-1} . If we observe the maximum value for class 3, which is the maximum value for continental waters, we observe that the values found are more than a hundred times greater than the values established by Conama.

Remembering that these values are not harmful to humans, since living beings have significant concentrations of phosphorus in their biochemical structures, such as DNA, RNA, proteins, and other biological species. The biggest problem is with regard to the eutrophication of water resources, which, according to Von Sperling (1996, apud Thomann and Mueller 1987), is the excessive growth of aquatic plants, both planktonic and adherent, to levels that are considered to cause interference with the desirable uses of the body of water, and that as a consequence can cause disturbance of mosquitoes and other insects, fish mortality, strong odor in the water, and especially the low concentration of dissolved oxygen due to the decrease of photosynthesis in deeper regions of the water resource, due to the difficult incidence of light in the water body.

3.10 Nitrate.

The results presented in Table 10 are the average values of the results obtained in five replicates performed in each of the analytical determinations of the evaluated samples for nitrate (NO_3^-), and the results were expressed in mg L^{-1} .

Table 10. Average values of nitrate nitrogen concentration of the collected samples, expressed in mg L^{-1} .

Month	Collection Point 1 / mg L^{-1}	Collection Point 2 / mg L^{-1}	Collection Point 3 / mg L^{-1}
March	0,09 ± 0,01	0,13 ± 0,01	0,13 ± 0,01
April	0,05 ± 0,01	0,12 ± 0,01	0,12 ± 0,01
May	0,18 ± 0,00	0,19 ± 0,00	0,18 ± 0,00
June	0,01 ± 0,01	0,01 ± 0,01	0,02 ± 0,01
July	0,25 ± 0,15	0,22 ± 0,08	0,22 ± 0,01

Article 14 of section II of CONAMA resolution 357/2005 establishes that the maximum value of nitrate that can be found in samples of continental water used for human consumption must be 10 mg L^{-1} .

The results obtained are well below the limit established by the regulatory agency, where the results observed are between 0.01 and 0.25 mg L^{-1} , therefore within normality.

IV. CONCLUSION

Evaluating the water quality parameters that were measured here, such as temperature, dissolved oxygen, electrical conductivity, total dissolved solids, color, ammonium, nitrate, and turbidity, and discussed individually agree with the values recommended by Conana or Anvisa.

Two factors presented values farther from those recommended by the regulatory agencies. The first was the pH values that presented relatively more acidic values than those indicated in the cited resolutions. Most likely due to the characteristics of oxidative processes of organic matter that occur in the water resources of the region, and that do not interfere significantly in the quality of water consumed by humans. Remembering that man normally feeds on substances with a much more acidic character than these waters. Like Coca-Cola, which, after a search on its official website, indicates that the pH value of this soft drink is around 2.5. Another example that can be cited is that of carbonated water, which has pH values between 5 and 6.

Scinocca (2017) cites in a publication the speech of doctor Théo Webert who states that the consumption of acidic foods ends up favoring clinical medical conditions. According to a study by Indiana University, some examples can be ulcers, skin problems, arthritis, osteoporosis, and even fatigue and depression. But even if the values are close to normal, drinking water is a human right, and it is the duty of the distribution and treatment agencies and the government to ensure that the water is within the national parameters.

The second element to present discrepant values in relation to the standards in force was the element phosphorus in the form of phosphate ion, which is exaggeratedly above the allowed by the resolution 357/2005 of Conama, which was the basis used for the comparison of data in this work. In the long term, the high concentration of phosphate is not harmful to humans, since this ion is present in proteins, DNA, RNA, ATP, among others.

Recalling that Von Sperling (1996, apud Thomann and Mueller 1987) states that eutrophication can cause interference with negative results, such as disturbance of mosquitoes and other insects, fish mortality, strong odor in the water, and especially the low concentration of dissolved oxygen due to the decrease of photosynthesis in deeper regions of the hydric resource as a result of the difficult incidence of light in the hydric body.

Finally, an evaluation of the storage and distribution system of the water supplied to the community of Piaçaguera is recommended, since there are cases where the levels of the parameters analyzed before and after treatment end up being very similar, thus demonstrating an inefficiency in the treatment of the water.

Conflict of interest

There is no conflict to disclose.

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