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Physical-Chemical Evaluation in Biodisponible Water Samples used for Consumption

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Abstract— *Water is a vast biomolecule in the systems, it can come from surface water or from underground abstraction, in order to consider it pure, it is necessary to evaluate its physical, chemical and biological characteristics, since it is directly linked to the health of the population. The objective is to evaluate the main chemical and physical parameters in order to compare and verify the quality of the natural waters that are distributed to the population of the municipality of Boquira-Ba, making a comparison between the dry and rainy periods. The physical-chemical parameters analyzed were: hydrogen ionic potential (pH), electrical conductivity, turbidity, resistivity, total dissolved solids (STD), hardness and alkalinity. The data obtained were compared to the values established by the Resolution of the National Council for the Environment (Conama) 357/2005 and Ordinance of MS 2914/2011. The samples collected during the dry season when compared to the rainy season showed a variation in the results, but remained at the maximum allowed values, thus proving to be quality water for consumption. Only two periods in the dry season (P3 and P4) and (P9 and P10) rainfall presented a variation in conductivity, resistivity and hardness, thus compromising the quality of this water.*
Keywords— ***groundwater, surface water, quality parameters.***

I. INTRODUCTION

Fundamental to the life of living beings, water is a vast biomolecule in systems (Brito, 2017). With the increase of the economy and the indiscriminate use of water resources, it can be exhausted since most of this good is unfit for use, 95.1% of which is salt, 4.7% of glaciers and only 0.147% for consumption (Barreto & Bitar, 2011).

According to Coletti et. al. (2010), the concept of water quality does not mean that it is pure, the physical, chemical and biological characteristics can confirm its potability, and these are linked directly with the health of the population. The waters used for human consumption may come from surface water, groundwater abstraction and also rainwater, the surface and groundwater being the ones most used by the Brazilian population, since most of the time they present potability and thus be distributed for urban and rural populations (Pereira et al., 2018).

According to ordinance no 2914 of the Ministry of Health (2011), water must meet consumption standards, and regardless of their origin should not pose risks to human or animal health, and is suitable for producing and preparing food, drinking and personal hygiene (Portfolio No. 2,914, Of December , 2011).

The waters according to their environment of origin can present varied characteristics, from where they circulate to where they are stored. In this context it is necessary to differentiate them from the natural ones for those that have been contaminated by human action, since in some cases, taking into account availability and demand, contaminated water is offered, making it impossible to use and use it without prior treatment (Oliveira & Silva, 2013).

Several factors can influence the water quality of the springs, such as rainfall, vegetation cover, livestock activities in their surroundings, among others (Ako et al., 2012). Thus, it is necessary to monitor the quality of the water through the physical-chemical aspects, which will allow to perceive possible changes generated by natural or anthropic actions (Marmontel & Rodrigues, 2015).

The physical-chemical analysis allows to identify if the water is at optimal levels, not bringing risks to human health as well as other ecosystems (Braga, 2015). By means of the ordinances and resolutions it is possible

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to verify if the water samples are within the quality standards determined (Parron et al. 2011).

Resolution 357/2005 provides for the classification of water bodies and environmental guidelines for their classification, as well as establishing the conditions and standards for the discharge of effluents, and other measures. The water quality standards established in the resolution establish individual limits for each parameter (Resolution No. 357, Of March 17, 2005).

Since water is a common good, essential for human survival and other ecosystems, it is necessary to control it, in order to guarantee the quality and safety to those who consume it. Therefore, the present study aimed to evaluate the main physico-chemical parameters in order to compare with the maximum values allowed by current legislation and verify the quality of the natural waters that are distributed to the population, making a parallel between periods of drought and rainy in the municipality of Boquira-Ba.

II. METHODOLOGY

Location of study area

The place of study is located in the municipality of Boquira-BA (name of indigenous origin that means 'D'Agua', because it has plenty of aquatic sources), is located in the Southwest of Bahia. Known for the extraction of zinc, lead, silver and gold, it has a total territorial unit area of 1,426,233 km² (IBGE, 2018).

According to the National Guide for Collection and Preservation of Samples (2011), water quality is given by its analysis, which allows identifying risk factors for those who consume and use it for various activities. In this way, the sampling sites should be more comprehensive, so 6 (six) points were chosen, which are distributed to the population, being 3 (three) points of springs and 3 (three) tubular wells (Brandão, 2011).

Data collections

The samples were collected in a drought period (October 2018) and in the rainy season (February 2019), in new 1.5 L polypropylene bottles, for collection at springs the bottle was washed with the water of collecting 3 (three) times, filling the bottle halfway and despising the liquid, after which it performed the collection procedure filling the bottle completely, in the direction of the stream with a depth of 15 - 30 cm. Collection in tubular wells, the water must be pumped until it is completely eliminated from the tubing, and it must be performed at a faucet closer to the site, following the hygienization of the bottle (Apha, 1998).

The collection was carried out between springs and tubular wells, respectively named as: Big Brush Spring (P1, dry and rain); Caldeirão Well (P2 drought and rain); Well Chico iron (P3 drought and rain); Well Working village (P4 drought and rain); Spring of the Forest (P5 dryness and rainfall); Rising Shots (P6 drought and rain).

Study variables

The analyzes of the samples were carried out in the chemistry laboratory of the Faculdade Independente do Nordeste, using calibrated equipment such as: Quimis microprocessed conductivity meter, Model Q405M, serial number: 09112578. For Conductivity, Resistivity and Dissolved Total Solids analysis; HANNA Instruments Microprocessed Turbidimeter Model Q279P, Serial No.: 10014168. For the analysis of Turbidity; Quimis bench thermometer, model Q400AS, serial number: 08071347. For pH analysis; The titration method for Alkalinity and Hardness analysis was done in triplicates according to the practical manual of water analysis and in accordance with Standard Methods for Water and Wastewater (Funasa, 2013; Apha, 1998).

The data were processed using statistical methods, and the results obtained will be compared with the maximum values allowed (VMP) according to CONAMA resolution 357/2005 and Portaria MS nº 2914/2011.

III. RESULTS AND DISCUSSION

Six samples of water were collected for physico-chemical analysis to determine the parameters of water quality, being: pH, conductivity, turbidity, resistivity, total dissolved solids, alkalinity and hardness. The results of these analyzes served to evaluate the quality of each one of them.

Hydrogen ionic potential (pH)

Hydrogen ion potential (pH) is the concentration of H + ions in a solution and indicates whether the medium analyzed has basic, acidic or neutral characteristics. The natural waters usually have a basic character, they can also present acidic character which does not become undesirable for consumption, because, mineral waters have these characteristics. However, in the long term the acid becomes corrosive in pipes and the basic one can cause incrustations (Santos, 2016; Ueda, 2013).

According to ordinance No. 2914/2011 of the Ministry of Health, the water suitable for consumption must have pH between 6.0 and 9.5. PH levels outside the parameters can lead to various health disorders such as irritation of the eyes, skin and mucous membranes

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(Pereira et al., 2018, Portfolio No. 2,914, December 2011).

Table.1: Demonstrating the variations of the parameter of Hydrogenion Potential..

SAMPLES	RAINY	STRETCHING
P1	5,37	5,82
P2	5,84	6,39
P3	6,93	7,39
P4	8,15	8,33
P5	7,24	7,14
P6	5,76	6,31
MEAN	6,55	6,90

Source: Own author.

We can observe in table 1 (drought period) that P1, P2 and P6 are below the values recommended by the ordinance, and points P3, P4 and P5 are in normality. We can already notice that the values of P2 and P6 that were below increase and only the P7 remained, could be due to the lack of ciliary forest in its return. The divergence between values from one period to the next may be due to drought and shortage of rainfall to previous periods.

Electrical Conductivity (C.E.)

The electrical conductivity in water occurs with the ability of the salts dissolved in it to become electrolytes capable of conducting electric current, indicating salts in the medium (Daltro, 2017).

It immediately does not cause harm to humans, in aquatic environments it can be a valuable indicator of contamination (Ferreira et al., 2015). When electrical conductivity is associated with the presence of ions in the water, farmers who own irrigated crops may have damage to their land. As is not shown in the VMP legislation for electrical conductivity, Kpdes (2010) and Logan (1965) say that the values range from 300 µS / cm to 750 µS / cm, this is the limit value for the analyzed water to be considered saline and improper for consumption (Kpdes, 2010; Logan, 1965).

Table.2: Demonstrating the variations of electrical conductivity.

SAMPLES	RAINY	STRETCHING
P1	5,20 us/cm	17,01 us/cm
P2	30,5 us/cm	32,2 us/cm
P3	1714 us/cm	1923 us/cm
P4	1511 us/cm	1675 us/cm
P5	16,45 us/cm	13,73 us/cm
P6	32,7 us/cm	34,5 us/cm
MEAN	551,6 us/cm	615,9 us/cm

Source: Own author..

Analyzing Table 2, we can see that only P3 and P4 are well above the literature, and points P1, P2, P5 and P6 are within normal limits. We noticed that the points P1, P2, P5 and P6 (rainy) increased their values, but nevertheless they remained in normality, being able that with the increase of the rains the quantity of salts are more easily dissolved in the middle, and in the P3 and P4 we had an increase in what was already considered a high value, which also justifies the issue of other points, in which case this water already becomes unfit for consumption.

Resistivity

A resistance omitted by a material to the flow of electric current when it is subjected to an external electric field, is classified as electrical resistivity. It is an inverse parameter to the electrical conductivity (Freitas, 2008). The average values allowed are not contained in the Resolution of the National Environmental Council (Conama) 357/2005.

Table.3: Demonstrating the variations of Resistivity.

SAMPLES	RAINY	STRETCHING
P1	69K Ω/cm	62K Ω/cm
P2	32,3K Ω/cm	31,2K Ω/cm
P3	520 Ω/cm	534 Ω/cm
P4	613 Ω/cm	606 Ω/cm
P5	69K Ω/cm	70K Ω/cm
P6	27,8K Ω/cm	29,3K Ω/cm
MEAN	33,3K Ω/cm	32,3K Ω/cm

Source: Own author.

As the parameter is inversely proportional to that of the conductivity, we can observe that when compared to the results, the parameter was confirmed, because when the conductivity value is high, that of the resistivity was shown to be low.

Turbidity

Turbidity is a parameter that characterizes the quality of the water by means of the measurement of the dispersed light, the recommended one is that the water does not have color or turbidity, because the appearance of color in the sample can lead to rejection being associated with waste water, usually due to suspended matter, organic and inorganic matter (Brito et al., 2017). Therefore, in the organoleptic parameter, the water must be colorless, insipid and odorless, and according to MS Ordinance No. 2914/2011 the maximum allowed value for turbidity is 5 NTU (Pereira et al., 2018; December 12, 2011, Daltro, 2017).

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Table.4: Demonstrating Turbidity variations..

SAMPLES	RAINY	STRETCHING
P1	0,18 NTU	3,66 NTU
P2	0,70 NTU	1,01 NTU
P3	0,03 NTU	0,00 NTU
P4	0,39 NTU	0,00 NTU
P5	0,05 NTU	0,00 NTU
P6	0,00 NTU	0,00 NTU
MEAN	0,225NTU	0,778NTU

Source: Own author.

The values found during the dry season are in the range of 0.00 NTU and 0.39, all within the maximum allowed value (VMP). In the rainy season we can observe that the range is between 0.00 NTU to 3.66 NTU, the results remain within the VMP, but it is noted that in the rainy season the turbidity in some points increased, indicating that in that sample possibly there was an increase in suspended materials, but not enough to make it improper.

Total Dissolved Solids (STDs)

Total Dissolved Solids defines the volume of organic and inorganic substances in molecular or ionic forms, thus being a parameter of evaluation of water quality. The increase in STD is also associated with nitrate concentrations in the medium (Kent & Landon, 2013).

According to CONAMA Resolution 357/2005 and MS Ordinance No. 2914/2011, the maximum permitted value for STD is 1000 mg / L (CONAMA 357/2005 and MS Ordinance No. 2914/2011).

Table.5: Demonstrating as parameter variables total dissolved solids.

SAMPLES	RAINY	STRETCHING
P1	7,20 mg/L	8,03 mg/L
P2	15,6 mg/L	15,5 mg/L
P3	953 mg/L	914 mg/L
P4	801 mg/L	820 mg/L
P5	7,34 mg/L	7,30 mg/L
P6	17,8 mg/L	16,9 mg/L
MEAN	300,3mg/L	296,9mg/L

Source: Own author.

We can see in table 5 that the points P1, P2, P5 and P6 have much smaller values, and the points P3 and P4 the values increase significantly. It is seen that in P1 and P4 the values increased little, and points P2, P3, P5, and P6 decreased when compared to the dry season. Probably what made the values increase was to rainwater, as they may have carried salts that increased STD concentrations. However, all samples had the maximum permitted value according to the legislation.

Dureza

One of the interferers of water quality, hardness is an association of calcium to bicarbonate being transformed into calcium carbonate by heating or increasing Ph (Piratoba, 2017). It is usually influenced by anthropogenic activities, and its main sources of hardness are calcium and magnesium (Nazir, 2015). Ordinance 2914/2011 Ministry of Health recommends that the maximum permitted hardness value for drinking water should be 500 mg/L (Portal N ° 2,914, December, 2011).

Table.6: Demonstrating the variations of the Hardness parameter.

SAMPLES	RAINY	STRETCHING
P1	0mg/L	0 mg/L
P2	0mg/L	0 mg/L
P3	537 mg/L	264 mg/L
P4	556 mg/L	336 mg/L
P5	0 mg/L	0 mg/L
P6	0 mg/L	0 mg/L
MEAN	182,2mg/L	100mg/L

Source: Own author.

Based on the results of table 6, only P3 and P4 showed to be "very hard" water (more than 350) and the other points the samples are considered "soft", and at points P3 and P4 (rainy) (200 to 350). The "hard" water does not pose problems with the potability, but presents an unpleasant taste (brackish), characteristic of the two altered points.

Alcalinidade

The alkalinity in the water indicates the amount of ions reacted in order to neutralize the hydrogen ions. Neutralizes acids, having as function the buffering of water resisting pH variations (Brasil, 2014). According to the water quality control manual, water from springs has alkalinity values in the range of 30 to 500 mg / L of $CaCO_3$ (Brasil, 2014).

Table.7: Demonstrating Alkalinity Parameter Variations.

SAMPLES	RAINY	STRETCHING
P1	30 mg/L	26 mg/L
P2	30 mg/L	26 mg/L
P3	404 mg/L	72 mg/L

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P4	332 mg/L	74 mg/L
P5	22 mg/L	22 mg/L
P6	18 mg/L	24 mg/L
MEAN	139,3mg/L	40,67mg/L

Source: Own author.

According to table 7, we can observe that according to the VMP P1 and P2 are within the standard, P3 and P4 even though they are with much higher values still are still in the VMP and this can be directly connected to the parameter hardness, because they are points that has a greater similarity, and finally P5 and P6 that are with values below, which can be justified by the drought of rains in the period. At points P1, P2, P5 and P6 we can note that both are with the values below, this is probably due to the increase of rainfall in the period causing pH variation since, it can affect the speed of its buffering function, the point P3 and P4 there was a significant decrease and remained within the VMP.

IV. CONCLUSION

The present study, with the objective of evaluating the quality of the bio-available water that is distributed to the municipality of Boquira-Ba, through the physical-chemical parameters can be concluded that based on CONAMA Resolution 357/2005 and MS Ordinance No. 2914 / P1, P2, P5 and P6 (drought period), as well as P7, P8, P11 and P12 (rainfall) presented values of pH, conductivity, resistivity, STD, turbidity, hardness and alkalinity within what is recommended by legislation, and are considered suitable for consumption by the population. The points P3 and P4, respectively tubular wells, showed values of conductivity, resistivity and hardness above the MPV by the current resolutions, this presented result can be consequence of the lack of maintenance of the structure of the well or the location and inadequate construction. The methods of analysis used were efficient for the determination of the results of the physical-chemical parameters used in the work.

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