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ASSESSMENT OF THE MICROBIOLOGICAL QUALITY OF WATER FOR HUMAN CONSUMPTION IN A QUILOMBOLA (RURAL) UNIT IN GOIÁS – BRAZIL

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ABSTRACT

Introduction: Water is an essential and irreplaceable substance in all stages of life; however, the quality of water has been strongly influenced by human actions, making it often unfit for consumption. It is estimated that 2 billion people worldwide use a source of water contaminated with faeces. **Objective**: this study aimed to analyze, through microbiological characterization, the quality of water destined for human consumption, of the inhabitants of the Sumidouroquilombo, located in the municipality of Padre Bernardo in Goiás. **Methodology**: Two methodologies were used: For the theoretical foundation, it was a systematic literature review was carried out from January to May 2020, in which scientific articles were consulted, selected by searching the Scielo and Pubmed databases. In addition for the research of total coliforms and *Escherichia* coli, the colilert kit methodology was used. **Results**: the results of the microbiological analyzes of the water samples showed that 9.7% were suitable for human consumption, while in 90.3% the presence of coliforms and the presence of *E. coli* was quantified. **Conclusion**: in view of the results obtained, it is necessary to implement educational measures, regarding obtaining appropriate water for use, as well as prophylactic measures to prevent diseases transmitted by waterborne pathogens, since the majority of people residing in that region little is known about the dangers of drinking this drink-free water with regard to disease transmission.

Keywords: Water; Water quality; Environmental monitoring; *Escherichia coli*..

INTRODUCTION

Water is an essential and irreplaceable substance at all stages of life, however, despite its importance, water supply for supply has proved to be one of the major public health concerns of the 21st century (Alves *et al.,* 2018). The quality of water has been strongly influenced by human actions, making it often unfit for consumption. Population development and the increase in unplanned homes have created health problems (Steffens *et al.,* 2015). It is estimated that 2 billion people worldwide use a source of water contaminated with faeces (WHO, 2018). The consumption of contaminated drinking water causes about 502 thousand diarrheal deaths per year (Glowacki *et al.,* 2019). The World Health Organization, to standardize and regulate water quality, points out international guidelines to be used as a basis worldwide, with the intention of providing public health protection (WHO, 2018). The presence of the bacteria in the aquatic environment is closely related to the release of untreated domestic sewage into water bodies or to the transport of soil particles exposed to animal feces. Alternatively, they can contaminate food, especially vegetables and fruits, through irrigation through these waters and / or through contact with animal excrement (Drumond *et al.,* 2018). Thus, the detection and quantification of bacteria of the coliform group present in the water is indicated, in which they serve as a parameter of water contamination by faeces (BRASIL, 2013). The genus Escherichia belongs to the family Enterobacteriaceae, whose most searched species worldwide is *Escherichia coli (E. coli)*, due to its importance for public health and its recurrence in gastroenteric diseases (Glowacki *et al.,* 2019). It is a Gram-negative bacterium, present in the intestinal tract of homeothermic animals, including humans. It is commensal, which is part of the intestinal microbiota, is not pathogenic and has an important physiological role for the functioning of the organism (Kuhnert *et al.,* 2000).

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There are six pathogenic categories of *E. coli* that cause intestinal infection in men and animals, being called diarrhogenic *E. coli* and differentiated by the presence of virulence factors and classified into: Enteropathogenic *E. coli* (EPEC), Enterotoxigenic *E. coli* (ETEC), Enteroinvasive *E. coli* (EIEC), enterohemorrhagic *E. coli* (EHEC) or Shiga toxin-producing *E. coli* (STEC), enteroaggregative *E. coli* (EAEC) and diffuse adherent *E. coli* (DAEC) (Drumond *et al.,* 2018). In view of the great risk of consuming contaminated water and developing waterborne diseases, the objective of the microbiological examination of water is to provide subsidies regarding its potability, that is, the absence of risk of ingesting disease-causing microorganisms, usually from contamination by human feces and other warm-blooded animals (BRASIL, 2013). Ordinance No. 2,914 / 2011 of the Ministry of Health (Ordinance of Potability) establishes that it is checked in water for human consumption to guarantee its potability, the absence of total coliforms and *Escherichia coli* and determine the count of heterotrophic bacteria (Kuhnert *et al.,* 2000). The same ordinance determines that the count must be performed as one of the parameters to assess the integrity of the distribution system (reservoir and network). The recommendation is that it should not exceed 500 Colony Forming Units per one milliliter of sample (Kuhnert *et al.,* 2000). For compliance with the microbiological standard of potability, the absence of total coliforms in 100 mL of sample is mandatory at the end of the treatment. However, according to Annex I of Ordinance MS No. 2.914 / 2011, the presence of total coliforms in only one monthly sample is accepted, for systems or collective solutions that supply less than 20,000 inhabitants and in 5% of monthly samples, in systems or collective solutions, which supply more than 20,000 inhabitants. It should be noted that in both situations, the presence of *Escherichia coli* is not allowed in water intended for human consumption (Kuhnert *et al.,* 2000). The importance of drinking water for human consumption is understood, which, if left untreated, has the capacity to spread various microbiological contaminants. Therefore, it is valuable to know if the water consumed is adequate to the drinking standards mentioned in

the legislation. Therefore, the purpose of this study was to evaluate the microbiological quality of the water in the SumidouroQuilombola community located in the municipality of Padre Bernardo - GO.

MATERIALS AND METHODS

Characterization of the determination site and delimitation of the samples

The municipality of Padre Bernardo is located between parallels 14º and 15º south latitude and meridians 47º and 48º west longitude of GWr, average altitude of 629 m and total area of 3,137.83 km² (Figure 1).

Fig. 1. Territorial area of the municipality of Padre Bernardo

The Sumidouroquilombola community is located in the municipality of Padre Bernardo, in the state of Goiás, between the geographical coordinates of latitude -15.1408472222222 and longitude -48.3536722222222. It presents 22.7% of households with adequate sanitation, 47.6% of urban households on public roads with afforestation and 11.6% of urban households on public roads with adequate urbanization (presence of manhole, sidewalk, pavement and curb) (BRASIL, 2013).

Collections and procedures

The collections were carried out from January to December 2019. The collections were carried out by point, in duplicate, totaling 64 water samples, and for each collection, sterile polypropylene flasks, with a volume of 500 mL, were used to transport the samples. Autoclave sterilized containers were used, so that there was no interference from any external microorganism other than those contained in the water. The container was placed against the water current and subsequently closed to avoid possible contamination. The material was transported in Styrofoam boxes, containing ice, to keep the samples refrigerated. The analyzes were processed within 24 hours after collection.

Techniques for water assessment

This study was carried out in two methodological steps:

For the research of total coliforms and *Escherichia coli (E. coli)*, the colilert kit methodology was used, following the kit protocol:

Initially, the 32 samples were collected directly from the tap, in glass bottles (500mL) with wide mouths, protected with laminated paper and previously sterilized in an autoclave at 121° C for 30 minutes, later they were sent to the Laboratory of the Federal University of Goiás , Campus Colemar Natal e Silva in a styrofoam box. Then, qualitative analyzes of Total Coliforms and *E. coli* were performed. This technique is based on the action of enzymes produced by Coliforms, through color change and the appearance of fluorescence without the need for confirmatory tests. This method is specific for target microorganisms, being fast and effective. For this purpose, Colilert reagent, Bunsen burner, 265nm wavelength UltraViolet lamp and incubator at 37 ° C were used. A 100 mL aliquot was removed from each sample and homogenized with a Colilert substrate ampoule, in a sterile bottle. It was homogenized and after 24 hours of incubation at 37 ° C (Figure 2), the results can be observed. According to Júnior and Pereira (2019), if the medium changes its color to yellow and does not show fluorescence under UV light, it indicates the presence of bacteria in the coliform group and the absence of *E. coli* in the sample. If the color of the medium is changed to yellow and it fluoresces under UV light, it means that bacteria from the coliform group and *E. coli* are present in the analyzed sample. For the theoretical basis, a systematic review of the literature was carried out, from January to May 2020, in which scientific articles were consulted, selected by searching the Scielo and Pubmed databases. The search in the databases was carried out as follows: the terms, *Escherichia coli*, water analysis, water microbiology, fecal coliforms, thermotolerants were applied. These were researched in Portuguese and English. All articles published in the Scielo and Pubmed databases until May 2020 were selected and articles that had the same keywords already mentioned were excluded, as they did not meet the criteria of the proposed study; however, that do not address the microorganism *Escherichia coli*.

Fig 2. Water samples in the incubator at 37ºC

RESULTS AND DISCUSSION

According to Silveira (2018), pollution is an ecological change, that is, a change in the relationship between living beings, caused by humans, which directly or indirectly damages their life or well-being. The general analysis of the data described in Table 1 allows to verify that, in all the collection points, the proliferation of total coliforms was observed in values above the limit proposed by the CONAMA resolution nº 357/2005(BRASIL, 2013).

Table 1. Results of total and fecal coliforms in the most probable number per 100 mL (NMP / 100 mL) of the thirty-two points analyzed

Samples	Total Coliforms	Fecal Coliforms - *Escherichia coli*	Samples	Total Coliforms	Coliformes fecais - *Escherichia coli*
Negative control	Absent	Absent	Negative control	Absent	Absent
SUM-01	9208	157,8	SUM-17	24200	59
SUM-02	5488	461,1	SUM-18	290,9	41,1
SUM-03	2046	129,1	SUM-19	866,4	2
SUM-04	12033	57,1	SUM-20	5172	435,2
SUM-05	613,1	Absent	SUM-21	9804	613,1
SUM-06	2755	Absent	SUM-22	7270	12,2
SUM-07	1553,1	123,6	SUM-23	238,2	Absent
SUM-08	2419,6	115,3	SUM-24	2419,6	2
SUM-09	906	111,2	SUM-25	24200	547,5
SUM-10	2247	284,1	SUM-26	10482	727
SUM-11	8701	13,1	SUM-27	17329	2909
SUM-12	5493	18,5	SUM-28	870,4	46,4
SUM-13	24200	4352	SUM-29	1732,9	9,6
SUM-14	24200	1956	SUM-30	1732,9	9,6
SUM-15	1299,7	113,9	SUM-31	24200	5794
SUM-16	275,5	25,3	SUM-32	24196	2419,6

Note the points SUM-13, SUM-14, SUM-17, SUM-25, SUM-31 and SUM-32 are above 20,000 / 100mL, being considered the most affected points with high concentrations of total coliforms. It is important to note that despite the low amount of *E. coli* found in points SUM-19 and SUM-24, they are considered unfit for human consumption. A similar situation was found by Scalize and collaborators (Scalize *et al.,* 2014), studying shallow wells in Canudos land reform settlements, observed that 100% (27 wells) of the samples were contaminated with thermotolerant coliforms, as well as other studies, which indicated contamination by coliforms in the water for human consumption (Araújo *et al., 2011;* Schmidt *et al.,* 2012; Almeida *et al., 2013*). These results are not in accordance with what is recommended by Ordinance 2914(BRASIL, 2011), which determines the absence of *E. coli* in water for human consumption, since its presence indicates fecal contamination and, consequently, the possibility of having pathogenic microorganisms , showing the precariousness of this type of supply source(BRASIL, 2013). Only points SUM-05, SUM-06 and SUM-23, representing 9.3% of the points analyzed, there was no proliferation of *E. coli*, being considered water suitable for human consumption. With the results obtained by the water analysis, there are strong indications of sewage discharge near the areas where water is collected for human consumption in this community. This pollution can be justified by channeling or direct dumping at the margins of the water source. Sewage consists of organic matter, serving as food for microorganisms, among which are bacteria, which will start to multiply in high quantity (Soares, Ferreira, 2017). According to Soares& Ferreira, pollution is more commonly observed in needy locations, as, as there is no sanitation in these places, most of the time, the population throws its waste in the open or in its own structures, but under conditions precarious.

In the case of the Quilombola Sumidouro community, as it is in the process of urbanization (in an unplanned way), it is subject to this type of pollution (Neves *et al.,* 2015), a fact that was observed during this study, especially at the collection points SUM -13, SUM-14, SUM-17, SUM-25, SUM-31 and SUM-32; due to its high levels of pollution, totally departing from the drinking standards established in Ordinance No. 2,914 / 2011 of the Ministry of Health (BRASIL, 2011). The water from these collected points, in addition to other applications, are used for human consumption, therefore, the sources of contamination must be observed and controlled.

Conclusion

Considering the results obtained, it is possible to state that only points SUM-05, SUM-06 and SUM-23, representing 9.3% of the points analyzed, there was no proliferation of *E. coli*, being considered water suitable for human consumption. In 90.7% of the samples analyzed from the QuilombolaSumidouro community were considered unfit for human consumption according to the microbiological standards established by Brazilian legislation (Ordinance No. 518/2011). The high levels of Total Coliforms and the presence of *Escherichia coli* may be associated with the inadequate discharge of sewage close to the water body. That said, it is necessary to implement public policies to improve water quality and raise awareness among the local population about the importance of water and its preservation.

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