



RESEARCH ARTICLE

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## MICROBIOLOGICAL QUALITY OF WATER FOR HUMAN CONSUMPTION OF THE PALMARES SETTLEMENT IN ARAGUATINS, TOCANTINS

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### ABSTRACT

The importance of assessing water quality for human consumption is based on the fact that it is one of the main vehicles for infectious diseases. The objective of this research was to evaluate the quality of water for human consumption through the microbiological characterization of water from open and closed wells of Palmares, Araguatins (TO) settlement. The collections were carried out during the period from 16 to 20 October in two settlement wells. The results obtained were compared with the Ministry of Health Resolution No. 2,914 of 12/12/2011. The analyzed data from the Palmares settlement wells were positive for E. coli and did not fit the potability standards, indicating contamination by organic matter. Furthermore, it can be concluded that the families of the palm settlement are consuming water outside the potability standards stipulated by the Brazilian legislation and that the improvement of the offered water quality is due to the diffusion of sanitation technologies and the use of efficient methodologies for environmental education. of the residents of the settlements.

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### INTRODUCTION

Water is an essential element for the maintenance of life and human development, it is present in abundance on the planet, but much of this water is in the oceans and is unfit for consumption. Of the existing freshwater, most of it is deposited in the form of glaciers in the polar ice caps, and the second largest source of this water is groundwater. In the face of population growth accompanied by increasing environmental pollution, drinking water has become an increasingly scarce resource. In this scenario groundwater has assumed a relevant importance in the supply, generally have a high quality meeting the requirements for human consumption, without treatment to be consumed, but several anthropogenic and natural contamination have already been found in these waters. Allow to comply with the potability standard required by the relevant legislation (CASTRO, 2013). According to the Ministry of Health, Ordinance No. 2,914, of December 12, 2011, water from the public supply network is the starting point for obtaining purified water.

This, in turn, must be treated in a system that ensures the obtaining of water according to the specifications of the quality of water for human consumption and its potability standard. Its control should be periodic to ensure that the purification system is appropriate to the conditions of human use (BRASIL, 2011). Groundwater abstraction is any drilling through which we obtain water from an aquifer, called a well or borehole. There are several ways to classify them. According to the National Water Agency - ANA, they are widely used for ease of construction and lower costs. Among them we have the cacimba, shallow well, cistern and amazon, are built totally or partially by hand and do not need licensing or government authorization from the managing bodies (ANA 2013). Although groundwater is more protected from pollution than surface water, it is not immune to the action of man and his various activities; such as; disposal of human waste in landfills, intensive use of manure and pesticides in agricultural activities, landfill of animal waste resulting from activities livestock, improper construction of septic tanks and deposition of solid or liquid industrial waste and even through open-air

physiological disposal as they are dragged cause soil infiltration, contaminating the wells and causing the onset of waterborne diseases (ARAÚJO *et al.*, 2013). Today, a significant number of children die worldwide from illnesses directly related to poor water and sanitation conditions. These diseases, especially when associated with malnutrition, can weaken organic defenses to the point of contributing to disease and death from causes such as measles and pneumonia in addition to the various diseases transmitted via the fecal-oral route. This picture is closely related to poverty: the proportion of diseases related to water supply and sanitation in children under five in Africa, for example, is more than 240 times higher than in rich countries (PRUSS *et al.*, 2002). Data from the Health Surveillance Information System of Contaminated Soil Exposed Populations (SISSOLO) reveal, despite being provided by municipalities that provided information on contaminated areas in their territories, that approximately 30,000,000 people, ie The equivalent to 16% of the Brazilian population, estimated by the Brazilian Institute of Statistics and Geography (IBGE) in July 2014 at 202,768,562, are exposed or potentially exposed to the full range of harms generated by contaminated areas (BRASIL, 2011). From this perspective, water-borne diseases significantly reflect the expected quality of life and development in the life cycle. Knowledge of the risk factors that lead to the development of DVH's contributes to the adoption of preventive measures, such as water purification for human consumption, considerably reducing the occurrence of these diseases. However, information is very important for health promotion and prevention, in aspects involving water quality and the maintenance of human health (BERNARDIN, 2015).

Most of the water supply in the rural region of the municipality of Araguatins-TO is made from groundwater obtained from shallow or deep semiartesian wells built in collective land reform settlements, which are often not tested for water. Their quality and water from the public sector are only monitored for some parameters, and no complete analyzes are performed to check for contaminants such as metals and other elements, traces that may be present in the water, impairing its potability. Established since February 24, 2009, the Palmares settlement completed its occupation process in July of the same year. The anthropic action, especially the progressive implementation of economic activities and the disorderly population densification have been intensifying emerging environmental problems, such as the insufficiency of the sewage system, fast and intense waterproofing process without adequate drainage system (runoff and rainfall). ), resulting in reflections on the hydrological regime, with recognized consequences in terms of changes in the quality and quantity of water resources. At the beginning of the establishment of the settlement the peasant families had technical and financial support. However, they were not successful because the projects were developed through poor technical assistance and attention, some families eventually opted for projects whose productive activity could not meet their expectations and also because other families deviated in the purpose of the application of resources. With the installation of the Palmares settlement in Araguatins (TO), marginal areas are in the process of occupation, opening access roads, recording deforestation, increasing areas with soil exposure, accelerating erosion and modifying many of the natural processes where they interact. climate, relief, soil and vegetation cover, causing changes in the physical, chemical and microbiological characteristics of groundwater the main source of supply for families living in the community.

However, groundwater is a remarkable resource for the supply of regions with favorable conditions for exploitation. In addition, the state of Tocantins has severe drought from May to November, when surface waters may disappear during this period. Groundwater from fractures and compact rock faults has been the sole source of supply for small population nuclei. Within this context there is a need to identify risk factors that contaminate water and may be harmful to consumers. Since water is an essential element of life and indispensable on a daily basis, it also becomes a favorable means for the spread of diseases, when some conditions are present, including poor sanitation. Understanding that the socioeconomic characteristics of the families residing in the settlement are of low financial income and little access to municipal infrastructure (such as asphalt, piped water, sewage), it is necessary to identify as much as possible the risk that well water consumed without proper treatment can cause. The study will provide insight into the quality of water consumed by palmares settlement families.

## MATERIALS AND METHODS

The survey was conducted in Palmares settlements twenty-eight kilometers from the city of Araguatins, was created by the National Institute of Colonization and Agrarian Reform, INCRA, on February 24, 2009. It houses 50 families in 450 ha, and 67, 16 ha are reserve of the settlement. At the beginning of the establishment of the settlement the peasant families had technical and financial support. However they failed to succeed because the projects were developed through poor technical assistance and attention, some families eventually opted for projects whose productive activity failed to meet their expectations and also because other families deviated in the purpose of applying the resources. Overall many activities related to agricultural production and settlement creation are still being structured. Farmers are looking for ways to adapt to certain activities that suit them economically. In this way, the great majority of peasants work harder to devote themselves to producing products that have a safer commercial destination, such as cattle raising. Dairy farming is the main economic activity developed by the settlement families. The settlement faces difficulties in education and health, the school and the nearest health post is six kilometers away, in the Maringá settlement. The school that starts from literacy and goes until the fourth year of elementary school, making it difficult to complete the studies. The health care service, on the other hand, is developed in the Palmares settlement through the accompaniment of a Community Health Agent resident in the settlement itself and acts as directed by the Araguatins-TO municipal health secretary. Water distribution in the settlement was carried out by semiartesian wells (Figure 2) implanted in the settlement agrovila. This well is composed of a structure that involves an electric pump, water box, plumbing. This set of equipment constituted the water supply in the settlement agrovila. These water supply structures were established two years after the establishment of the settlement. Its operation and supply do not meet the needs of families. The well cannot serve the community well. The water has hardness, a fact that contributed to the families using cistern water (Figure, 3). Water supply structures were set up with federal government funding in 2010. According to the community, there is no maintenance or cleaning of the wells, repairs when necessary are made by the community. The settlement points of water in the settlement are the semiartesian well and the open well, both were made for this study.



Source – Author

**Figure 2.** Shows some details of the closed well

Partial view of the location of the closed (Semiartesian) Well in the Palmares settlement. Poor piping conservation can be observed.



Source- Author

**Figure 3.** Shows some details of the open well

General aspects of the open pit (cistern) in the Palmares settlement. It can be observed the natural vegetation in the background and the lack of preventive protection measures.

### Sample collection and preservation procedure

Water samples for physical, chemical and microbiological analyzes were collected in polyethylene bottles previously cleaned with 10% nitric acid for 48 hours, which were washed with distilled water and ultrapure water, and at the collection site. All samples were identified and packed in ice coolers for transport and refrigeration to the Aqua Microbiology laboratory, located in Imperatriz (Ma), 100 km from the collection site.

### Microbiological parameters

Libânio (2010) states that the biological characteristics of contaminated waters are constituted by several microorganisms capable of transmitting diseases and acting in the transformation of organic matter (biogeochemical cycles, nitrogen, for example). Faecal coliform bacteria are the main indicators of water contamination, characterizing how contaminated they are and the potential for disease transmission (WHITE 2010). The coliform group consists of bacteria found in the intestinal tract of homeothermic animals. Being classified as: total and thermo tolerant coliforms. These bacteria comprise several groups, belonging to different genera (Klebsiella, Escherichia, Serratia, Erwenia and Enterobacter), originating from the sewage and fecal mass produced. In order

for water to be contaminated by thermotolerant coliforms, there must be fecal matter nearby or nearby (BRANCO, 2010). MS Law No. 2,914 / 2011 establishes the procedures and responsibilities regarding the management and monitoring of drinking water potability standard, regulating that all good quality water shall meet the values allowed by the standard with water samples free of faecal coliforms. (BRAZIL, 2011).

**Total Coliforms:** Total fecal coliforms (COLtotals) are enterobacteria, gram-negative, non-sporulant, oxidase-negative, facultative anaerobic bacilli in culture medium containing bile and mobile salts. They are able to metabolize lactose by producing gas over a period of 24 to 48 hours at 35°C. In this group are bacteria originating from the human gastrointestinal tract and other endemic animals, such as *Escherichia coli*, as well as non-enteric bacteria, such as the genera *Citrobacter*, *Enterobacter*, *Klebsiella* and *Serratia*, among others (BRASIL, 2011), from the soil, from vegetables or other sources. This analysis is important to identify the presence of living organisms in water. Therefore its presence is tolerated for samples from wells, fountains, springs and other forms of untreated water supply, provided that the absence of *Escherichia coli* is analyzed. But in the case of water treatment systems, where there has already been complete disinfection of water, the presence of total coliform is an indication of external contamination during its distribution (BRASIL, 2004).

**Thermotolerant Coliforms (*E.coli*):** Thermo tolerant coliform bacteria (COLtermo) are a subgroup of total coliforms, characterized by metabolizing lactose within 24 hours at a temperature of 44.5 to 45.5 ° C, producing gas. They have as representative *Escherichia coli*, which is exclusively fecal in origin (humans, mammals and birds). But while the thermotolerant coliform group includes other non-fecal genera (*Klebsiella*, *Enterobacter*, and *Citrobacter*), it is the determination of *Escherichia coli* as the best method. Its use is acceptable and widely used to evaluate the microbiological quality of water and is also recommended by Brazilian legislation for surface water intended for supply, irrigation and industry. A faecal waste-receiving body of water may contain a variety of disease-transmitting agents, spread by pollutants possibly carrying pathogenic microorganisms. But this fact does not generate significant impact on aquatic biota, it only impairs the use of water for supply, recreation and irrigation (VON SPERLING, 2007).

## RESULTS AND DISCUSSION

Allied to the previous analyzes, and with the objective of conducting a survey of the sanitary conditions (potability) of the waters of the open and closed wells of the Palmares settlement, Araguatins (TO) the number of total coliforms and thermo tolerant bacteria (*E coli*) was determined. These results indicate that water from wells and springs may have been contaminated possibly with the contents of animal pits or manure. Inadequate management of animal waste or septic tanks can lead to water contamination by faecal microorganisms, *Escherichia coli* and enterococci, which may be carried from the ground to surface water sources such as streams and dams, or percolated, it can reach subsurface or shallow water levels, causing water contamination, especially in times of high rainfall (COGGER, 1988). In a study similar to the current one, a study developed by Colvara *et al.*, (2009), when assessing the groundwater quality of artesian wells in

southern Rio Grande do Sul, observed that 100% of the samples were contaminated by total coliforms and 70% of them had thermo-tolerant coliforms. The authors pointed out that several factors may be responsible for contamination: lack of reservoir maintenance; improper location of the well; and lack of care and hygiene with water prior to consumption. Similar result is reported by Amaral *et al.*, (2003) in a study carried out in the northeastern region of the state of São Paulo which, analyzing water for human consumption in rural properties, found that approximately 96% of the shallow well water samples analyzed were unfit for human consumption, representing a health risk factor, given the high concentrations found. The risk of outbreaks of waterborne diseases in rural areas is high, mainly due to the possibility of bacterial contamination of water, which is often captured in old, improperly sealed wells and near sources of contamination such as ditches and areas of pastures occupied by animals. In rural areas, the main sources of water supply are shallow wells and springs, sources very susceptible to contamination (RIGOBELLO *et al.*, 2017).

### Conclusion

The research undertaken in this work showed that the families of the palm settlement are consuming water outside the potability standards established by the Ministry of Health. It was observed that the settlement is not a model of environmental management, because there is no adoption of conservation and environmental practices. It was also found that the agricultural areas are poorly managed and the soil is naturally fragile and this posture generally favors erosion and consequently soil loss in the rainy season. Regarding the appreciation of the water quality of the open and closed wells studied in relation to Ordinance MS, the following can be verified:

According to Ordinance 2.914 / 11 / MS, the results obtained in this study for water are unfit for human consumption from a bacteriological point of view. The microbiological quality of the Palmares settlement groundwater is directly related to the sewage rate. Considering that water from wells is the sole source of supply for settlement families, raising the level of sewage is crucial in preventing the transmission of waterborne diseases and therefore in ensuring groundwater potability. Only with the systematic implementation of actions will the population become aware of the need to preserve water

resources and the risks that the consumption of low quality water may entail. The partnership with the secretary of health was very important, community agents will play an essential role in raising awareness of families living in rural areas.

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