Quality of water from springs in the administrative region of Brazlândia, located in the Descoberto River micro hydrographic basin, Federal District, Brazil

Qualidade da água dos mananciais da Região administrativa de Brazlândia, situada na micro bacia hidrográfica do Rio Descoberto, Distrito Federal, Brasil

Calidad del agua de los manantiales de la región administrativa de Brazlândia, ubicada en la microcuenca hidrográfica del Río Descoberto, Distrito Federal, Brasil

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Abstract

Water is essential for life and used for multiple purposes such as human consumption, agriculture and recreation. In this way, it must present physical-chemical characteristics adequate to the quality standards, without risk to human health. This study aimed to verify the water quality of the springs, in the municipality of the Regional city of Brazlândia, DF, Brazil, in the year 2021. The research was carried out in May and the water samples were collected in eleven points of springs and from Córrego de Brazlândia, in Veredinhas Park, from each sampling point, three liters of water were collected randomly and separately, for the investigation of enteroparasites, using the spontaneous sedimentation method. For the analysis of thermotolerant coliforms and *Escherichia coli*, three samples (100 ml) were collected and analyzed using the Colilert method. The organoleptic characteristics, pH, and presence of solid residues were verified in addition to observing the existence of the gallery forest. All areas analyzed had the presence of solid residues and most of the collection points had water with a cloudy appearance, unpleasant odor, and pH 6. All samples were positive for thermotolerant coliforms and presented at least one evolutionary form of intestinal parasite. Water sources in Brazlândia, DF, Brazil, are contaminated with potentially pathogenic microorganisms for humans. Thus, measures must be taken to minimize this situation, in addition to guidance and work with the community, to help in the recovery of these sources.
Keywords: Water; Veredinhas Park; Thermotolerant Coliforms; *Escherichia coli*; Enteroparasites; Springs.

Resumo

A água é essencial para a vida e utilizada para múltiplos fins, como consumo humano, agricultura e recreação. Desta forma, deve apresentar características físico-químicas adequadas aos padrões de qualidade, sem riscos à saúde humana. Este estudo teve como objetivo verificar a qualidade da água das nascentes, no município de Regional Brazlândia, DF,

Brasil, no ano de 2021. A pesquisa foi realizada no mês de maio e as amostras de água foram coletadas em onze pontos de nascentes e do Córrego de Brazlândia, no Parque das Veredinhas. Em cada ponto de amostragem foram coletados aleatoriamente e separadamente três litros de água, para pesquisa de enteroparasitos, pelo método de sedimentação espontânea. Para a análise de coliformes termotolerantes e *Escherichia coli*, três amostras (100 ml) foram coletadas e analisadas pelo método Colilert. Foram verificadas as características organolépticas, pH e presença de resíduos sólidos nas amostras de água, além de observar a existência de mata ciliar do local de amostragem. Todas as áreas analisadas apresentaram presença de resíduos sólidos e a maioria dos pontos de coleta apresentou água com aspecto turvo, odor desagradável e pH 6. Todas as amostras foram positivas para coliformes termotolerantes e apresentaram pelo menos uma forma evolutiva do parasito intestinal. As fontes de água de Brazlândia, DF, Brasil, estão contaminadas com microrganismos potencialmente patogênicos para o homem. Assim, medidas devem ser tomadas para minimizar essa situação, além de orientações e trabalho junto à comunidade, para ajudar na recuperação dessas fontes.
Palavras-chave: Água; Parque das Veredinhas; Coliformes termotolerantes; *Escherichia coli*; Enteroparasitos; Nascentes.

Resumen
El agua es esencial para la vida y se utiliza para múltiples propósitos, como el consumo humano, la agricultura y la recreación. De esta forma, debe presentar características fisicoquímicas adecuadas a los estándares de calidad, sin riesgo para la salud humana. Este estudio tuvo como objetivo verificar la calidad del agua de los manantiales en el municipio de Regional Brazlândia, DF, Brasil, en el año 2021. El levantamiento se realizó en mayo y se recolectaron muestras de agua en once puntos de manantiales y el Córrego de Brazlândia, en Parque das Veredinhas, de cada punto de muestreo, tres litros de agua fueron recolectados al azar y por separado, para la investigación de enteroparásitos, utilizando el método de sedimentación espontánea. Para el análisis de coliformes termotolerantes y *Escherichia coli*, se recolectaron tres muestras (100 ml) y se analizaron por el método Colilert. Se verificaron las características organolépticas, pH y presencia de residuos sólidos, además de observar la existencia de vegetación de ribera. Todas las áreas analizadas mostraron la presencia de residuos sólidos y la mayoría de los puntos de recolección tenían agua de aspecto turbio, olor desagradable y pH 6. Todas las muestras fueron positivas para coliformes termotolerantes y mostraron al menos una forma evolutiva del parásito intestinal. Las fuentes de agua en Brazlândia, DF, Brasil, están contaminadas con microorganismos potencialmente patógenos para los humanos. Por lo tanto, se deben tomar medidas para minimizar esta situación, además de lineamientos y trabajo con la comunidad, para ayudar a recuperar estas fuentes.
Palabras clave: Agua; Parque Veredinhas; Coliformes termotolerantes; *Escherichia coli*; Enteroparásitos; Manantiales.

1. Introduction

Water is a natural resource, an integral part of the planet, which acts on the functional dynamics of nature. Its availability is one of the most important factors that shape and sustain ecosystems, being the main constituent of all living organisms (Pielou, 1998; Moraes & Jordan, 2002; Popkin et al., 2010). Water is used for multiple purposes, including human consumption, agriculture, energy generation, sports and recreation, so its quality must comply with the standards required by authorities and not pose a risk to human health (Araújo et al., 2011; CONAMA, 2005).

The advance of urbanization on the floodplains, the suppression of riparian forests, the growth of the population and, mainly, the deterioration of the watercourses are problems that are directly linked to the disordered demographic growth and the lack of cities planning. As consequence, the rivers and lakes have become the main destinations of the liquid and solid effluents, both industrial and domestic. Regardless of the type of effluent, the fact is the deterioration and pollution of these waterways cause serious illness (Tundisi 2003; Vasconcelos & Souza, 2011; Machado & Torres, 2013). Such information shows the importance of scientific research on water quality and the formation of an environmental monitoring database. This approach enables the development of management plans and strategies that guarantee the conservation and recovery of impacted natural environments (Buzelli & Cunha-Santino, 2013). It is important to highlight that most microorganisms found in natural waters are generally harmless to human health. However, contamination resulting from sanitary sewage can introduce microorganisms that have the potential to be detrimental to human health. Pathogenic microorganisms encompass viruses, bacteria, as well as intestinal parasites such as protozoa and helminths (FUNASA, 2013).

Diseases associated with the contamination of drinking water pose a significant public health concern. The primary health risk arises from consuming water that has been contaminated with feces containing pathogens responsible for infectious diseases such as cholera, diarrheal diseases, dysentery, and enteric fevers (WHO, 2011). The impact of water-related diseases varies depending on the circumstances, with the greatest burden observed in low-income environments where diarrhea continues to be a leading cause of child mortality (Liu et al., 2012; Bain et al., 2014). There are already specific norms and legislations that help to grant the quality and availability of water resources, such as the National Water Resources Policy and the resolutions of the National Environment Council (CONAMA) n°. 274/00 and 357/05 that provide guidelines for the quality of water intended for consumption.

The management of water resources and environmental sanitation are of great importance because they have a direct relationship with public health (Libânio et al., 2005; Lin et al., 2022). The World Health Organization (WHO) has established widely recognized Guidelines for Drinking-water Quality, which include criteria for assessing health risks and establishing targets for improving water safety (WHO, 2011). While directly measuring pathogens can be complex, techniques for evaluating fecal contamination using fecal indicator bacteria have been well-established and widely utilized. The WHO recommends the use of *Escherichia coli*, or the use of thermotolerant coliforms for assessing fecal contamination in water (WHO, 2011). In Brazil, the Ministry of Health's Potability Ordinance (Ordinance nº 2.914/2011) aligns with the WHO guidelines by specifying that the absence of total coliforms and *Escherichia coli* must be confirmed in water intended for human consumption. To prioritize interventions, the WHO suggests employing a risk classification based on the levels of indicator organisms, as higher concentrations generally indicate greater fecal contamination. This classification categorizes samples based on the number of indicator organisms per 100 ml, including: <1 as "very low risk," 1–10 as "low risk," 10–100 as "medium risk," and >100 as "high risk" or "very high risk" (Lloyd & Bartram, 1991; Bain et al., 2014). However, it is important to note that this analysis is imperfect, and the presence of indicator organisms does not always equate to a specific level of risk (Gleeson & Gray, 1996). Water quality can vary over time and space, and occasional sampling may not accurately reflect actual exposure.

The administrative region of Brazlândia is in the western area of the Federal District (DF), which is the most populous region and with the highest population density, including the administrative regions of Brazlândia, Ceilândia, Taguatinga, and Samambaia. (CODEPLAN, 2020). The cities grew along the Veredinha stream, and in 1992 the Veredinha Ecological Park was created with the aim of protecting the springs and the riparian forest of the stream (CODEPLAN, 2020), which today is the main tributary of the Lake, a postcard of the city of Brazlândia. This region is one of the main producers of vegetables in the Federal District, and the largest producer of strawberries in the Midwest (CODEPLAN, 2020). This vegetable production depends on local springs for irrigation and production. The Descoberto River supplies 60% of water for the population of the DF (Lima, 2004) and is located within Brazlândia, but does not supply this city (Lima et al., 2018).

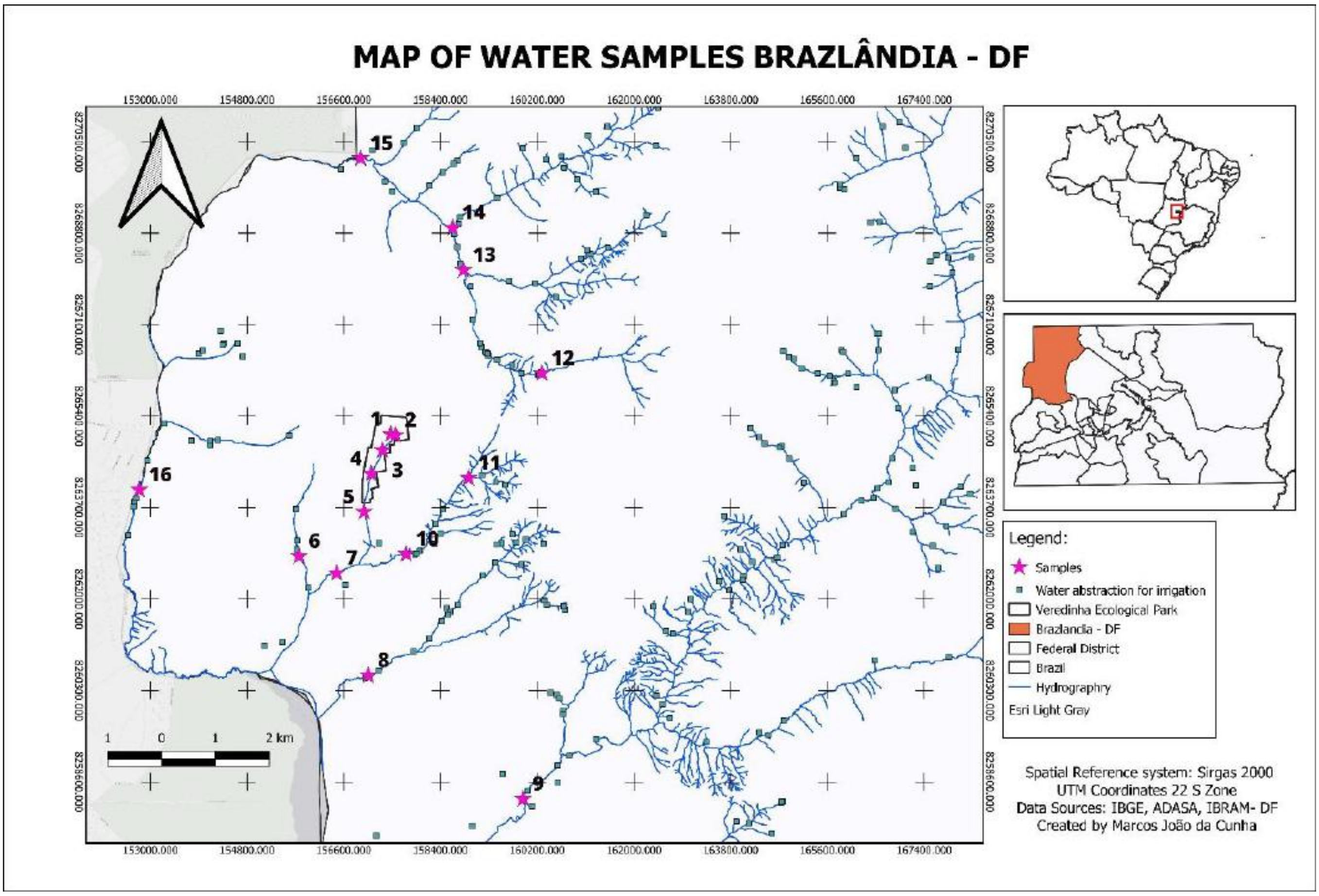
Once this region has great importance for the water supply system for the entire Federal District and for the local agriculture, especially for growing vegetables and fruits, due to the presence of the Descoberto River, these local needs greater attention in monitoring the quality and preservation of existing water bodies in this area. Therefore, the objective of the study was to verify the water quality of eleven the springs of the Regional City of Brazlândia, Federal District, Brazil, during the month of May 2021.

2. Methodology

2.1 Area of study

The study was conducted in the administrative region of Brazlândia, located between the geographical coordinates of South latitude of 15°36'37"S, West longitude 48°7'12"W and altitude of 1.0134 m (SEMA/DF-SISDIA, 2022). The climate of the region, according to the Köppen classification, features dry winters and hot, rainy summers. During the dry period, the mean values of maximum, minimum, and average temperature were 28.4 ºC and 17.1 ºC, respectively. (Lima et al., 2018; ICMBio, 2014). Samples were harvested during the month of May 2021, in the afternoon, between 12 pm and 1 pm. Sixteen points were chosen for the collection of water samples, as shown in Figure 1 and Table 1.

Figure 1 - Map of the administrative region of Brazlândia indicating the collection points of water of the study.



Souce: Authors.

Figure 1 shows the collection points of the study. The pink stars located on the map are the collection points in the rural area of the administrative region of Brazlândia, and inside the Veredinha Ecological Park, DF, in May 2021.

Table 1 - Locations of water sample collection points in the springs located in the administrative region of Brazlândia, DF, in May 2021.

Sampling points	Local	Coordinates (UTM) Zone 22	Characteristics
1	Round spring	X 800725,691 AND 8265655,408	Spring inside the Veredinha Park.
2	Spring stream Veredinha Park	X 800811,379 AND 8265636,758	Well after small waterfall inside the Park.
3	Bridge over creek Veredinha Park	X 800561,973 AND 8265363,185	Under bridge of the creek Veredinha, pedestrian crossing.
4	Quadra 5 walkway inside the Veredinha Park	X 800338,834 AND 8264932,563	Well after the old crossing inside the Park

5	Lake Veredinha Park	X 800186,138 AND 8264227,575	Green lake near the mouth of the stream.
6	VC 541 X Beautiful Waters under Bridge	X 798955,501 AND 8263438,553	Under bridge next to encroachment and construction area.
7	Chapadinha stream next to BR 080.	X 799645,122 AND 8263106,256	Creek bed near the entrance to the city.
8	Pottery vs. Indian Stream Bridge under BR 080	X 800179,376 AND 8261186,633	Stream bed next to the bridge, near the monitoring station (CAESB)
9	Rodeador Creek bridge under 080	X 802149,539 AND 8258809,193	Upstream of the bridge under Br 080, near the lake of Descoberto.
10	Jumping Creek under gravel bridge	X 800948,77 AND 8263421,752	Upstream of the bridge on a dirt road, near block 1 South.
11	Pulador Creek	X 802149,539 AND 8264801,382	Bridge under the entrance of a farm producing vegetables.
12	Water abstraction (CAESB) of the Capão da Onça Stream (FLONA/APM)	X 803566,03 AND 8268668,697	Direct collection from the catchment lake (CAESB)
13	Córrego Capão da Onça bridge under DF 445 (APM)	X 802162,764 AND 8268668,697	Under dirt road bridge, collect in the bed of the stream.
14	Water abstraction (CAESB/APM), Córrego Barrocão.	X 801985,632 AND 8269454,994	Direct collection from the catchment lake (CAESB)
15	Descoberto River, Ponte Divisa DF/GO BR 080	X 800308,686 AND 8270797,705	Under bridge Br 080 of the Rio Descoberto, near Vendinha/GO
16	Descoberto Border River, DF/GO, Padre Lúcio.	X 796020,377 AND 8264755,388	Road Brazlândia / Águas lindas, near Padre Lúcio / GO.

Souce: Authors.

2.2 Collection and analyses of samples

From each sampling point (Figure 1, Table 1), three liters of water were collected in plastic bottles (1L), previously cleaned and dried. These samples were used in the evaluation of the presence of evolutionary forms of intestinal parasites. From those points, three water samples were also collected in 50 ml Falcon tubes, which were used in the microbiological analyses for the detection of total coliforms and the bacterium *Escherichia coli*, as described in section *2.2.1*.

The samples were transported to the Microbiology Laboratory of the Anhanguera College of Brasília – Taguatinga Unit (FAB-UT), where the determination of pH the evaluation of the presence of enteroparasites, and the color characteristics (von Sperling, 2005). The coloration of water can be caused by organic and inorganic substance. The turbidity is due to the presence of suspended solids, of organic and inorganic origin, of total and thermotolerant coliforms, and *Escherichia coli* is the main indicator of the presence of fecal contamination in the water body.

The samples were analyzed by the parasitological method of Spontaneous Sedimentation (Hoffmann et al., 1934). Each water sample was divided into four sedimentation calyces and left to rest for 24 hours. Then the supernatants were discarded, and the sediments (20 ml) were placed in 15 ml Falcon tubes, which were centrifuged at room temperature for 5 minutes at 2,500 rpm. The supernatants were discarded, and the sediments were resuspended in 1 ml of distilled water and analyzed by microscopy until the exhaustion of the entire sample, the analyses were made using optical microscopy, with objectives of 10x and 40x.

The samples were considered positive when evolutionary forms were detected. The identifications were made by comparison, using photos presenting morphological structures, in Medical Parasitology books (Rey, 2008; Neves et al., 2005), Veterinary (Urquhart et al., 1998) and Atlas of Parasitology (Neves et al., 2005). Due to the similarities between man's intestinal parasites and the intestinal parasites of domestic and wild animals, most of parasites has been identified up to the genus. The number of evolutionary forms of intestinal parasites detected in the total volume of water examined was given using the positive sign (+), being: one (+), one to five (1-5) evolutionary forms of enteroparasites, two (++), six to ten (6-10), three (+++), 11 to 15 and four (++++), 16 or more, as indicated in Table 2.

2.2.1 Bacteriological analysis of water samples

For the analysis in the detection of bacteria, from each sampling point, 3 samples of 50 ml were collected. As a negative control of the analyses, we used samples of filtered water, sterile water, and tap water. The samples were transferred to sterile 250 ml Erlenmeyer vials. For the diagnosis of total coliforms and *Escherichia coli*, the Colilert method was used, following the recommendations of the Manufacturer (IDEXX Laboratories, Inc., Maine, USA). A capsule of the Colilert reagent was added to each sample, which was homogenized manually and placed in an oven for incubation at 35 ± 0.5 °C for 24 hours. Then the samples were placed in a laminar flow chapel and analyzed using ultraviolet (UV) light. In the presence of UV light, samples negative for total coliforms and *Escherichia coli* do not change color or have a light-yellow coloration, samples positive for total coliforms showed intense-yellow coloration, and samples positive for *Escherichia coli* present fluorescent staining.

The selection of this group of bacteria as an indicator of water contamination is based on several factors, (i) these bacteria are commonly found in the feces of warm-blooded animals, including humans, (ii) they can be easily detected and quantified using simple and cost-effective techniques, making them applicable to various types of water, (iii) their concentration in contaminated water directly correlates with the degree of fecal contamination. Additionally, these bacteria have a longer survival time in water compared to intestinal pathogenic bacteria, as they have lower nutritional requirements and are unable to multiply or multiply at a slower rate in aquatic environments. Lastly, they exhibit greater resistance to surfactants and disinfectants.

To meet the microbiological standard for drinking water safety, it is essential to have the absence of total coliforms in a 100 ml sample after treatment. However, there are specific provisions outlined in Appendix I of Ministry of Health Ordinance No. 2.914/2011. In the case of collective systems or solutions serving fewer than 20,000 individuals, the presence of total coliforms is permissible in only one monthly sample. For collective systems or solutions supplying more than 20,000 individuals, the presence of total coliforms is allowed in up to 5% of monthly samples. It is important to emphasize that regardless of these allowances, the presence of *Escherichia coli* in water intended for human consumption is strictly prohibited (Ministério da Saúde, 2011).

3. Results

Samples were collected from 16 different points (three samples from each sampling point) in the city of Brazlândia (Figure 1, Table 1). In the sites, only remaining areas of riparian forest remained on the banks of the Veredinha stream, located in this park, but with the presence and accumulation of solid waste and the other springs and streams were also polluted and with little vegetation on the banks. The appearance of the water in most of the sampling points was cloudy (Figure 2), with an unpleasant odor and a pH of 6.0. From the results (Figure 2, Table 2), it can be concluded that the characteristics of turbidity and color are outside the potability standard.

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Figure 2 - Sample collection points. A: point 13, B: point 7. C: point 11 and D: point 7.

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Figure 2 (A, B, C, and D) shows some of the points chosen for the collection (Figure 1, Table 1) of samples for the analysis of the water quality of the springs of the administrative region of Brazlândia.

A total of 48 samples were analyzed, three samples per collection point. All samples analyzed were positive for some type of enteroparasites (Table 2), and *Entamoeba coli* cysts were the most abundant in the samples. Cysts of *Entamoeba* sp. were also detected (+++), *Entamoeba coli* (+++), *Giardia* sp. (++), and larvae and eggs of helminths: filarioid larvae of Nematoda (+++), *Strongyloides* sp. (+++), and eggs of: *Ascaris* sp. (++) and *Toxocara* sp. (++).

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Table 2 - Distribution of parasites and commensals detected in water samples collected in springs located in the city of Brazlândia, DF, in May 2021.

PARASITES	**WATER SAMPLE COLLECTION POINTS**															
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**
HELMINTHS																
Ascaris sp. Eggs	–	++	–	–	+	–	–	–	–	+	–	–	+	–	–	–
Nematoda sp. Filarioid larvae	+++	+	+	+	+++	++	–	++++	+	++	++++	++	++++	+++	+++	+
Nematoda sp. Eggs	++	+	–	+	++	+	–	+	–	+	–	++	+	+	–	+
Strongyloides sp. Filarioid larvae	–	++	–	–	+	–	+	–	–	+	+	+++	++	++	++	–
Toxocara sp. Eggs	++	–	–	–	+	–	+	+	–	–	–	–	–	–	+	–
PROTOZOA																
Entamoeba sp. Cysts	–	+++	–	–	–	–	–	–	–	+++	++	++	+	++	++	+
Entamoeba coli Cysts	+	++	–	–	++	+++	++	++	++++	++	+++	+++	++++	+++	+++	++
Giardia sp. Cysts	–	–	+	–	++	–	–	–	+		+	–	–	–	–	–

Souce: Authors.

All samples collected from the sampling points were contaminated with fecal coliforms and *Eschericha coli*, as shown in Table 3.

Table 3 - Distribution of water samples collected at different points of water courses in the administrative region of Brazlândia and control water samples regarding the presence of total coliforms and *Eschericha coli*, in 2021.

Water sample collection points	**Total coliforms**	*Eschericha coli*
Filtered water (Drinker)	-	-
Sterile water	-	-
Tap water (Treated)	-	-
Round spring	+	+
Spring stream veredinha	+	+
Bridge over creek Veredinha	+	+
Quadra 5 walkway	+	+
Lake Veredinha	+	+
VC 541 X Waters under Bridge	+	+
Chapadinha stream next to BR 080	+	+
Stream Pottery x Indian Bridge under BR 080	+	+
Rodeador Creek bridge under BR 080	+	+
Jumping Creek under gravel bridge	+	+
Pulador Creek	+	+
Water abstraction (CAESB) of the Capão da Onça Stream (FLONA/APM)	+	+
Córrego Capão da Onça bridge under DF 445 (APM)	+	+
Water abstraction (CAESB/APM) Córrego Barrocão.	+	+
Descoberto River, Ponte Divisa DF/GO BR 080	+	+
Descoberto Border River, DF/GO, Padre Lúcio.	+	+

Souce: Authors.

As shown in the data above, 100% of the collected samples were contaminated with total coliforms and *Escherichia coli*, showing total disagreement with the guidelines imposed by Ordinance No. 2914/2011 of the Ministry of Health, where the presence of *Escherichia coli* is not allowed in water for human consumption.

4. Discussion

The present study showed that 100% of the water samples evaluated were positive for some enteroparasite. The detection of fecal coliforms confirms that the water used by the population and for irrigation in the cultivation fields for fruits and vegetables, which are grown in the city of Brazlândia, was contaminated at the moment of this study. Data from the literature corroborate these findings, as they show that total coliforms and *Escherichia coli* (Souza et al., 1983; Silva et al., 2006; Marques et al., 2020) are often found in water and food and, when ingested by the population, can cause diseases and, in severe cases, can generate morbidity and even lead to death (Santos et al., 2017; Correa et al., 2020).

The collection points were chosen aleatory by convenience in order to cover as much as possible the area of the Administrative Region of Brazlândia, considering the location of the irrigation grant points provided by ADASA, this information is public and is found in SISDIA (District System of Environmental Information).

The detection of high bacterial levels is often associated with high levels of pathogens in humans. Fecal coliforms, represented mainly by *Escherichia coli*, have been extensively used in the monitoring of water quality and are considered the most specific indicators of the quality of water destined for potability and breathability (Alm et al., 2003; Nogueira et al., 2003). In addition, *Escherichia coli* is considered one of the main pathogens responsible for gastroenteritis in children in Brazil and is especially associated with enteric infections caused by contaminated water (Vieira et al., 2010). The detection of this microorganism indicates the possibility of fecal, animal or human contamination, and potential health risks due to association with other enteric pathogens, meaning lack of hygiene (Prüss-Ustün et al., 2014; Chard et al., 2020). As shown in the Table 1, all water samples collected in the park area were contaminated by helminths, protozoa, coliforms, and *Escherichia coli*.

This fact can be explained by the topography and location of the park, which is in the middle of the city of Brazlândia, where all the water collected by the rain drainage system comes from the newest part of the city and directed to the interior of the park (Neto et al., 2016). A study using the Colilert method to analyze the microbiological water quality of springs in the urban area of Piracicaba, SP, verified that 100% of the samples were contaminated by total coliforms. They related that the period of higher rainfall had more positive samples for *Escherichia coli*, which leads to believe that the springs may be suffering contamination through rainwater (Garboggini & Gallo, 1998). Our results corroborate these data. Probably, in the rainy season, along with the rainwater carried all the garbage is present in the streets, so the area is extremely polluted with solid waste. Another fact that should be taken into consideration is related to the constant leaks in the sewage collection network around the park, where the effluent is thrown, by gravity, into the rainwater network. Consequently, sewage is released at various points in the Veredinha stream, thus contaminating the stream water with evolutionary forms of enteroparasites, and fecal coliforms and *Escherichia coli*.

It is important to highlight, as mentioned earlier, the supply of the city of Brazlândia depends exclusively on the existing springs nearby, points 12 and 14 are the places of capture for supplying the city. These points are in the Capão da Onça and Barrocão streams, even though they are protected by the Springs Protection Area (Área de Proteção de Nascentes-APN, in portuguese). These areas near the springs and along the course of these water bodies have several uses and occupations, especially the production of vegetables, the main economic activity of the region. A monitoring study conducted in the area (Araújo et al., 2011) showed the presence of chloride in the samples collected in this region. Chloride is indicative of possible contamination by sanitary sewage that corroborates with our results that point out the presence of intestinal parasites, potentially pathogenic found in the water samples.

The other points evaluated, which are in the urban area, are in the vicinity of concession points for surface water abstraction. This information is important because it can establish a connection between the results found for enteroparasites and their importance in the water quality of neighboring water bodies that are used in the production of fruits and vegetables (Takayanagui et al., 2006). Thus, there is a possibility that the contamination of the water of these analyzed springs comes from vegetable residues that are grown near the streams and springs. Normally, in the places where horticulture exists, animals such as birds, cattle, dogs, cats, and pigs also circulate, which can be carriers of enteroparasites and bacteria, which release in the feces cysts, oocysts of pathogenic protozoa or commensals, helminth eggs and in the rainy periods end up being carried to the water courses, contaminating them.

Data from the literature show that *Giardia* sp. circulates among different wild animals (Cunha, 2013), and in domestic animals such as cattle (Oliveira et al., 2007), dogs (Bartmann & Araújo, 2004), cats (Thompson et al., 2008), and pigs (Matos et al., 2016). Another pathogenic protozoan that can contaminate water is *Balantidium coli*. Usually, *B. coli* is found primarily in pigs (Rodrigues, 2014), in these animals are rare cases of manifestation of the disease, another important fact that happens in Brazil and also in Brazlândia is that the feces of pigs can be used as organic fertilizer in vegetable crops, and can then contaminate the soil, and be dragged with rain to the springs, contaminating them and/or contaminating fruits and vegetables (Silva et al., 2014; Machado et al. 2018; Maldonade et al., 2019).

Infections with intestinal parasites do not begin with fecal-oral contact by ingestion of water and/or food contaminated with feces, by direct infection of larvae (Andrade et al., 2010; Dos Santos Carvalho et al., 2002), but also by sexual contact (anal and oral) (Andrade et al., 2010; Sousa et al., 2017). Results already presented in the literature show that vegetables such as lettuce (Maciel et al., 2014; Machado et al., 2018; Maldonade et al., 2019) and fruits, such as strawberries, are highly contaminated with *Balantidium coli* cysts (Silva et al., 2014), *Entamoeba* sp, *Giardia* sp. (Silva et al., 2014), larvae of helminths, hookworms, *Strongyloides* sp., and eggs of different Nematodes such as *Ascaris lumbricoides* and *A. suum* (Silva et al., 2014), hookworms (Silva et al., 2014), *Toxocara* sp. (Oliveira & Germano, 1992; Dall'agnol et al., 2010; Ferraz, et al., 2020). and commensals such as *Entamoeba coli* and *Endolimax nana* (Maciel et al., 2014; Silva et al., 2014; Burlin & Sa, 2020).

Another group of enteroparasites detected in this study that circulate in man and among different groups of animals such as birds (Souza et al., 2019), dogs (Zanetti et al., 2021), cats (Dall'agnol et al., 2010), pigs (Coutinho & Rabello, 1958; Burlin & Sa, 2020) are the commensal protozoa *Entamoeba coli*, *Entamoeba* sp and *Endolimax nana*. Even in the case of non-pathogenic protozoa, their detection in water or in fruits and vegetables indicates that feces are being released into the soil and springs, that is, they are indicators of water potability and possible contamination by pathogenic parasites, since the source of contamination and transmission are the same.

It is noteworthy that the lack of criteria for the use and occupation of the banks of streams, which are environmentally sensitive areas, causes serious impacts on public health and the environment, changing the dynamics of the watercourse and causing various imbalances, such as the intensification of erosive processes, silting of the bed of springs.

The main limitation of this study was the impossibility of performing the techniques of quantification of the organisms found in the collected samples. In this way, we hope to carry out a more in-depth study with qualitative and quantitative molecular methods and more robust statistical tests to obtain more accurate results to infer for other regions.

5. Final Considerations

It is concluded that the combination of several factors contributed to the microbiological contamination and degradation of the spring's areas and streams in the Administrative Region of Brazlândia, DF, Brazil. Among them, the inadequacy of urban management models, which resulted in the absence of riparian forest, with exacerbated presence of solid waste, as well as water with cloudy appearance and unpleasant odor, indicating the presence of substances originated from residential sewage or from the vegetables cultivation field that were released into those springs, which is a public health problem. In general, the local Government has deficiencies in terms of human and financial resources, emphasizing that the lack of criteria and supervision of the use and occupation of the banks of streams, environmentally sensitive areas, causes serious impacts on the environment. These impacts substantially change the dynamics of the watercourse and cause various imbalances, such as the intensification of erosive processes, silting of the bed of springs. We can also add the lack of integration between provisions of environmental and urban legislation and the lack of information from society about the importance of protecting these areas.

The evaluation of water quality is extremely important and relevant to the health of the population. The commitment to water quality must begin with the preservation of water sources and reservoirs, ensuring the presence of riparian forests, and supervising the dumping of domestic, agricultural, and industrial sewage. Thus, it is necessary to adopt mitigating measures and management of these water bodies the district government in order to ensure the health of both the environment and the population. In addition, measures to raise awareness of the local population, through environmental education programs or projects, can be important in helping these water resources.

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