J. Health Biol Sci. 2021;9(1):1-7 doi: 10.12662/2317-3076jhbs.v9i1.4132.p1-7.2021

ORIGINAL ARTICLE

Microbiological quality of water from public drinking fountains in northwestern São Paulo, Brazil

Qualidade microbiológica da água de bebedouros públicos no noroeste de São Paulo, Brasil

Débora Regina Romualdo da Silva[1], Alessandra Alcantara de Almeida[2], Aparecida de Fátima Michelin[3,4], Teresa Marilene Bronharo[2], Camila Michele de Souza Hossotani[1], Bárbara Braga Ferreira Marta[2]

1. Doutoranda do Programa de pós-graduação em Ciência Animal da Faculdade de Medicina Veterinária de Araçatuba, Universidade Estadual Paulista (UNESP), São Paulo, Brasil. 2. Centro Regional de Laboratórios, Instituto Adolfo Lutz (IAL), Araçatuba I, SP, Brasil. 3. Docente do Instituto de Ciências da Saúde, campus Araçatuba, Universidade Paulista (UNIP), São Paulo, Brasil. 4. Estagiária de pós-doutorado no Programa de Ciência Animal da Faculdade de Medicina Veterinária de Araçatuba, Universidade Estadual Paulista (UNESP), São Paulo, Brasil.

Abstract

Objective: The present study aimed to evaluate the microbiological quality of the water and the maintenance and physical structure of public drinking fountains located in the city of Araçatuba – SP. **Methods**: To assess the presence or absence of *Escherichia coli* and total coliforms in the drinking water 41 samples were randomly collected. Thirteen samples were collected in the year 2018 and 28 samples in 2019. **Results**: All samples collected in the year 2018 showed no total coliforms and *E. coli*. However, the samples collected in the year 2019 showed coliforms in 10% (3/28). All the drinking fountains analyzed demonstrated to be inadequate in at least one of the qualitative criteria considered. **Conclusion**: Our results indicate that are necessary periodic maintenance of the public drinking fountains and the monitoring of its water since these parameters serve as indicators of the integrity of the drinking water distribution system.

Keywords: Drinking Water. Waterborne Diseases. Water Microbiology. *Escherichia coli.* Total Coliforms.

Resumo

Objetivo: O presente estudo teve como objetivo avaliar a qualidade microbiológica da água, a manutenção e estrutura física de bebedouros públicos localizados no município de Araçatuba - SP. **Métodos**: Para avaliar a presença ou ausência de *Escherichia coli* e coliformes totais na água de consumo, 41 amostras foram coletadas aleatoriamente. Treze amostras foram coletadas no ano de 2018 e 28 amostras em 2019. **Resultados**: Todas as amostras coletadas no ano de 2018 não apresentaram coliformes totais e *E. coli*. Porém, as amostras coletadas no ano de 2019 apresentaram coliformes em 10% (3/28). Todos os bebedouros analisados demonstraram ser inadequados em pelo menos um dos critérios qualitativos considerados. **Conclusão**: Nossos resultados indicam que são necessários a manutenção periódica dos bebedouros públicos e o monitoramento de sua água, visto que esses parâmetros servem como indicadores da integridade do sistema de distribuição de água potável.

Palavras-chave: Água Potável; Doenças Transmitidas pela Água; Microbiologia da Água; *Escherichia coli.* Coliformes Totais.

INTRODUCTION

Drinking water consumption is a basic human right and an essential component of life[1]. Drinking water mustn't present biological alterations and must be free from bacteria, viruses, protozoa, multicellular organisms, and other pathogens; and physical-chemical and organoleptic changes, such as color, odor, taste, and suspended materials[2-4].

In Brazil, diarrhea is the principal cause of death in children under five years old[2,3,5]. Microorganisms in water are transmitted via the fecal-oral route and can cause diseases like cholera, typhoid, amoebiasis, leptospirosis, giardiasis, infectious hepatitis, and acute diarrhea[6,7].

Total coliforms are a set of Gram-negative, rod-shaped bacteria belonging to the Enterobacteriaceae family, facultatively anaerobic, non-sporulated, lactose fermenting with gas formation at 35°C. The genus of bacteria belonging to this group is *Escherichia*, *Enterobacter*, *Citrobacter*, and *Klebsiella*. Among these, some are thermotolerant, which means that they ferment lactose with gas formation at 44 - 45°C. The main representative of this group is *E. coli*, considered an indicator of fecal contamination, revealing possible failures in filters, water disinfection, and the integrity of the distribution system[8].

Drinking fountains can become a public health problem because of the potential of transmitting bacteria and other microorganisms[9]. The users' infection occurs directly, through the ingestion of non-potable water, or indirectly, due to the users' lack of hygiene habits, location of drinking fountains close to restrooms, and environmental factors[10-12]. Thus, to

Correspondence: Débora Regina Romualdo da Silva. Address: R. Clóvis Pestana, 793- Dona Amélia. E-mail address: deboraregina1996@outlook.com
Conflict of interest: The authors declare that there is no conflict of interest.
Received: 2021 Out 17; Revised:2021 Nov 4; Accepted: 2021 Nov 10

prove the water potability and prevent the spread of diseases and outbreaks, microbiological analysis of the water and maintenance of the physical structure of public drinking fountains is essential[4].

Therefore, this study aimed to evaluate the microbiological quality of water and the maintenance and physical structure of public drinking fountains located in the city of Araçatuba - SP.

MATERIAL AND METHODS

Study Area

The study was conducted in the city Araçatuba located in the northwest region of São Paulo state, with an estimated population of 198,129 inhabitants, according to an estimate for 2020[13].

Sample collection

A total of 41 water samples were randomly collected from public drinking fountains. The drinking fountains were from several public places, as urban and interurban bus terminals, urban parks, cemeteries, and urban woodlands.

Thirteen samples were collected from September to November in 2018 and 28 samples from October to November in 2019. From the 2019 samples, 13 were collected from the same drinking fountains of 2018 and 15 from new ones. Furthermore, during the collection of water samples, an assessment of the maintenance and physical structure of the drinking fountains was carried out, following a previously elaborated checklist.

The collection of water samples was performed according to the "Manual de Coleta, Conservação e Transporte de Amostras de Água", of the Center for Sanitary Surveillance of the State of São Paulo[14]. Thus, faucet antisepsis with 70% alcohol was performed and the water was drained for three minutes, subsequently, 100 mL of water was collected in a sterile flask. The water samples were sent in isothermal boxes, under refrigeration, to the Regional Laboratory Center of the Adolfo Lutz Institute in Araçatuba-SP, where the microbiological analyzes were performed.

Research of total coliforms and *Escherichia coli*

The determination of the Presence or Absence of total coliforms and *E. coli* was performed using the enzymatic chromogenic defined substrate method (Colilert - Idexx Laboratories). The contents of the one pack (Colilert) were added to 100 mL of the sample, homogenized, and incubated at 35°C ± 1°C for 24 hours. After this period, the first reading was performed. The negative samples were re-incubated for up to 28 hours[15]. Water contaminated with *E. coli* strains was used as the positive control and sterile water as the negative control.

RESULTS

All samples (n=13) collected in 2018 revealed no coliforms and *E. coli*. In 2019 10.7% (3/28) of the samples revealed the presence of coliforms (Table 1, Figure 1) and no *E. coli* for all. Of the three samples positives for coliforms in 2019, 7.7% (1/28) correspond to a sample collected both years, and 13.33% (2/28) refer to those collected only in 2019.

The 13 public drinking fountains surveyed both in 2018 and in 2019 were evaluated for maintenance and physical structure, according to the previously elaborated checklist (Figure 2, Table 2).

Figure 1. Public drinking fountains: (A) Drinking fountain of water sample No. 10; (B) Drinking fountain of water sample No. 25; (C) Drinking fountain of water sample No. 28.

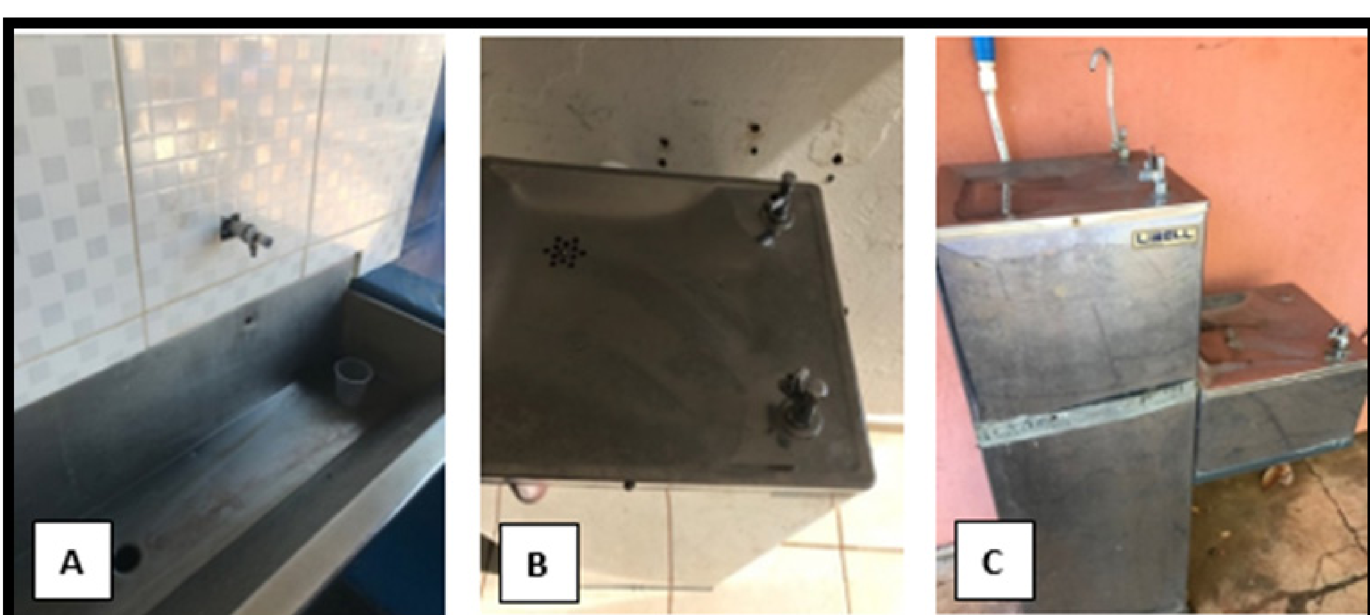

Table 1. Determination of the Presence or Absence of total coliforms and *E. coli* in the water from public drinking fountains in Araçatuba – SP, 2018 and 2019.

2018			2019		
Sample	Total coliforms 100 mL	*E. coli* 100 mL	Sample	Total coliforms 100 mL	*E. coli* 100 mL
1	Absence	Absence	1	Absence	Absence
2	Absence	Absence	2	Absence	Absence
3	Absence	Absence	3	Absence	Absence
4	Absence	Absence	4	Absence	Absence
5	Absence	Absence	5	Absence	Absence
6	Absence	Absence	6	Absence	Absence
7	Absence	Absence	7	Absence	Absence
8	Absence	Absence	8	Absence	Absence
9	Absence	Absence	9	Absence	Absence
10	Absence	Absence	10	**Presence**	Absence
11	Absence	Absence	11	Absence	Absence
12	Absence	Absence	12	Absence	Absence
13	Absence	Absence	13	Absence	Absence
			14	Absence	Absence
			15	Absence	Absence
			16	Absence	Absence
			17	Absence	Absence
			18	Absence	Absence
			19	Absence	Absence
			20	Absence	Absence
			21	Absence	Absence
			22	Absence	Absence
			23	Absence	Absence
			24	Absence	Absence
			25	**Presence**	Absence
			26	Absence	Absence
			27	Absence	Absence
			28	**Presence**	Absence

Source: Authors, 2021.

Figure 2. Public drinking fountains with maintenance and physical structure that were considered inadequate: (A) Drinking fountain with the presence of dirt (organic matter); (B) and (C) Drinking fountains with no maintenance and made of brick; (D) Drinking fountain with standing water; (E) Drinking fountain damaged with lateral water leakage and (F) Drinking fountain damaged.

Source: Authors, 2021.

Table 2. Assessment of maintenance and physical structure of public drinking water fountains in Araçatuba – SP, 2018 and 2019.

<table>
<tr><th rowspan="3">SAMPLES</th><th colspan="16">QUALITATIVE ASPECTS</th></tr>
<tr><th colspan="2">Does it have periodic maintenance?</th><th colspan="2">Is the spout/ faucet working?</th><th colspan="2">Is the physical structure of the drinking fountain damaged?</th><th colspan="2">Does it show evidence of vandalism?</th><th colspan="2">Does it have visible discoloration on the spout/ faucet?</th><th colspan="2">Does it have standing water?</th><th colspan="2">Has vegetable residue (sludge, plant...?)</th><th colspan="2">Does it have animal feces?</th></tr>
<tr><th>2018</th><th>2019</th><th>2018</th><th>2019</th><th>2018</th><th>2019</th><th>2018</th><th>2019</th><th>2018</th><th>2019</th><th>2018</th><th>2019</th><th>2018</th><th>2019</th><th>2018</th><th>2019</th></tr>
<tr><td>1</td><td colspan="2">yes</td><td colspan="2">yes</td><td colspan="2">no</td><td colspan="2">no</td><td colspan="2">no</td><td colspan="2">yes</td><td colspan="2">no</td><td colspan="2">no</td></tr>
<tr><td>2</td><td colspan="2">no</td><td colspan="2">yes</td><td colspan="2">no</td><td colspan="2">no</td><td colspan="2">no</td><td colspan="2">no</td><td colspan="2">no</td><td colspan="2">no</td></tr>
<tr><td>3</td><td colspan="2">no</td><td colspan="2">part</td><td>part</td><td>yes</td><td colspan="2">no</td><td>part</td><td>yes</td><td colspan="2">no</td><td colspan="2">yes</td><td colspan="2">yes</td></tr>
<tr><td>4</td><td colspan="2">no</td><td colspan="2">part</td><td colspan="2">part</td><td colspan="2">no</td><td colspan="2">part</td><td colspan="2">no</td><td colspan="2">no</td><td colspan="2">no</td></tr>
<tr><td>5</td><td colspan="2">no</td><td colspan="2">yes</td><td colspan="2">no</td><td colspan="2">yes</td><td colspan="2">no</td><td colspan="2">yes</td><td colspan="2">yes</td><td colspan="2">no</td></tr>
<tr><td>6</td><td colspan="2">no</td><td colspan="2">part</td><td colspan="2">yes</td><td colspan="2">no</td><td colspan="2">part</td><td colspan="2">no</td><td colspan="2">yes</td><td colspan="2">no</td></tr>
<tr><td>7</td><td colspan="2">no</td><td colspan="2">yes</td><td>part</td><td>yes</td><td colspan="2">no</td><td>part</td><td>yes</td><td colspan="2">no</td><td>no</td><td>yes</td><td colspan="2">no</td></tr>
<tr><td>8</td><td colspan="2">no</td><td colspan="2">yes</td><td colspan="2">yes</td><td colspan="2">no</td><td>yes</td><td>no</td><td colspan="2">no</td><td>yes</td><td>no</td><td colspan="2">no</td></tr>
<tr><td>9</td><td colspan="2">yes</td><td colspan="2">yes</td><td colspan="2">no</td><td colspan="2">no</td><td colspan="2">no</td><td colspan="2">no</td><td colspan="2">yes</td><td colspan="2">no</td></tr>
<tr><td>10</td><td>no</td><td>yes</td><td>part</td><td>yes</td><td>part</td><td>no</td><td colspan="2">no</td><td colspan="2">no</td><td colspan="2">no</td><td colspan="2">no</td><td colspan="2">no</td></tr>
<tr><td>11</td><td colspan="2">no</td><td colspan="2">yes</td><td colspan="2">yes</td><td colspan="2">no</td><td colspan="2">yes</td><td colspan="2">no</td><td colspan="2">yes</td><td colspan="2">yes</td></tr>
<tr><td>12</td><td colspan="2">no</td><td colspan="2">part</td><td colspan="2">yes</td><td colspan="2">no</td><td colspan="2">no</td><td colspan="2">no</td><td colspan="2">yes</td><td colspan="2">no</td></tr>
<tr><td>13</td><td colspan="2">no</td><td colspan="2">yes</td><td colspan="2">no</td><td colspan="2">no</td><td colspan="2">part</td><td colspan="2">no</td><td colspan="2">yes</td><td colspan="2">no</td></tr>
</table>

Obs: part represents qualitative aspects partially observed in drinking fountains.

Source: Authors, 2021.

DISCUSSION

In 2018, the samples revealed an absence of total coliforms and *E. coli*. In 2019 10.7% (3/28) of the samples revealed the presence of coliforms and showed no *E. coli* for all samples. Of the three samples positives for coliforms in 2019, 7.7% (1/28) correspond to a sample collected in 2018 and 2019, and 13.33% (2/28) refer to those collected only in 2019. According to Ordinance GM/MS 888 of 05/04/2021, drinking water samples must present absence of *E. coli* in all analyzed samples and absence of total coliforms in 95% of the samples analyzed in the month, in a distribution system of a municipality with more than 20,000 inhabitants[16]. Therefore, we can say that the presence of total coliforms in the analyzed samples must be evaluated as provided for in Annex 1 of Ordinance GM/MS No. 888, of 05/04/2021.

Contamination of water by these microorganisms can occur from the catchment point to the distribution network bridge. The reservoirs are important sources of contamination due to inadequate sealing and disinfection, and poor cleaning[17].

A research carried out in two public parks in Curitiba-PR analyzed two water samples from the faucet of the drinking fountains and two from the surface of the drinking fountains[18]. In another study in the ecological park of Águas Claras- DF, five samples were analyzed[19]. In both studies, the absence of total coliforms and *E. coli* was reported, using the multiple tube technique, corroborating our findings in the 2018 period.

On the other hand, these results differ from those found at a university in Guarapuava - PR that collected 47 samples from drinking fountains with water from wells. Four were positive for total coliforms and one positive for *E. coli*[20]. In the present study, 10.7% (3/28) of the samples were positive for total coliforms in 2019. These samples were treated water from the public distribution network and supplied to the population in aluminum and masonry drinking fountains.

Concerning drinking fountains located in universities, the absence of total coliforms and *E. coli* was also observed using the chromogenic enzyme substrate technique in 25 drinking fountains installed in a university in the state of Minas Gerais and 19 drinking fountains in a university in Paraná. Furthermore, the authors considered that the cleaning and maintenance techniques applied in the drinking fountains contributed to the satisfactory result obtained[21,22].

In 2018, only 15.38% (2/13) of drinking fountains analyzed had periodic maintenance, whereas 61.54% (8/13) of the spouts and faucets were in full operation and 38.46% (5/13) with partial working. Of the analyzed drinking fountains, 30.77% (4/13) were, totally damaged and the same proportion was observed for the partially damaged. The vandalism such as graffiti was evident in only 7.70% (1/13) of the drinking fountains, and the same drinking fountain remained graffiti in 2019. Total visible discoloration on the spout/faucet was identified in 15.38% (2/13) of the drinking fountains and partially in 38.46% (5/13). In 15.38% (2/13) of the drinking fountains, the presence of standing water and animal feces was evident, and 61.54% (8/13) had vegetal residue (sludge, plant).

Concerning in 2019, 23.08% (3/13) of the drinking fountains had periodic maintenance, 61.23% (9/13) of the spouts/faucets were in full operation, and 30.77% of it (4/13) were in partial working. The physical structure of the drinking fountains was totally damaged in 46.15% (6/13) and partially in 7.70% (1/13). The total visible discoloration in the spout/faucet was observed in 23.08% (3/13) the same percentage was also observed in drinking fountains with partial discoloration. In 15.38% (2/13) of the drinking fountains, standing water and animal feces were observed, and 61.54% (8/13) of them were identified as vegetable residues (sludge, plant).

According to Table 2, we can emphasize that the drinking fountains of water sample No. 3 (Figure 2a) worsened from 2018 to 2019. The physical structure of the drinking fountain was partially damaged and had partially visible discoloration in the spout/faucet in 2018, and in 2019 a pipe was placed in the faucet water outlet. The same happened with the drinking fountain of water sample No. 7 (Figure 2c) in which the presence of vegetable residue (sludge) was also seen in 2019, characterizing the lack of maintenance in these drinking fountains.

An improvement was evidenced in the drinking fountain of sample No. 8 that had vegetable residue in 2018 and showed a clean appearance until the time of collection of the consecutive year, and it also had a replacement of the faucet that showed visible discoloration. In the drinking fountain sample No. 10 (Figure 1b), there was also an improvement in the functioning of the spouts, physical structure of the drinking fountain, and maintenance, whose filter was changed and was within the expiration date. However, this same drinking fountain showed positivity for total coliforms in 2019.

It is important to point out that 2/3 of the drinking fountains whose water samples were positive for total coliforms had periodic maintenance. This positivity can be an indication of the presence of dirt in the water tank. Although the results were negative for *E. coli*, the principal indicator of water quality, it is essential to emphasize the constant need for sanitation, cleaning, and maintenance of the reservoirs, since their incorrect sealing, as well as the lack of cleaning and disinfection, represent important sources of contamination[23].

A study that surveyed public drinking fountains reported that 46.7% (21/45) of the drinking fountain had discoloration around the faucet's spout and the presence of some algae growth suggesting the need for improvements physical structure and cleaning of drinking fountains[24]. A survey conducted in California revealed that 90% of the drinking fountains analyzed were fully operational. Nevertheless, about 30% of the drinking fountains were classified as unclean and 20% as clogged, suggesting that although the drinking fountains are working, they couldn't indeed be used very often because many were dirty or clogged or both[25].

In the drinking fountains referring to samples No. 1 and No. 5 (Figure 2d), we noticed the presence of standing water in 2018, which perpetuated until the time of collection in 2019, serving as a probable source for breeding sites of the *Aedes aegypti* mosquito, vector of arboviruses such as Dengue, Zika, and Chikungunya. It is noteworthy that the municipality of Araçatuba – SP is endemic for Dengue, according to epidemiological records and a recent study on the occurrence of this arbovirus, in which 15,249 notifications of suspected dengue cases were reported between 2012 and 2017[26].

The periodic control of the quality of the water distributed in public drinking fountains and the cleaning and maintenance of the tanks, spouts, faucets, and other equipment can compromise the potability of water[27]. Therefore, monitoring the physical structure and the quality of water of the drinking fountains is essential to ensure the health of the consumers.

It is significant to carry out a new collection of water samples in all drinking fountains researched and expand the number of samples through the active search for other drinking fountains in public places. Monitoring the quality of water offered in public drinking fountains is of paramount importance for promoting the health and safety of the population.

CONCLUSION

Our results showed the need for periodic maintenance of drinking fountains in public places, in addition to water monitoring, since these parameters serve as indicators of the integrity of the drinking water distribution system for human consumption. Thus, the need for periodic microbiological monitoring of water and the maintenance of drinking fountains is suggested to ensure the health safety of the consumers.

REFERENCES

1. Hossain MZ. Water: the most precious resource of our life, GJAR, 2015, 9: 1436–1445. [cited 2021 Aug 10]. Available: http://gjar.org/publishpaper/vol2issue9/d325r35.pdf.

2. Meira IA, Silva TC, Fortuna JL. Pesquisa de coliformes em água de cozinhas e bebedouros de creches da rede municipal de ensino de Teixeira de Freitas-BA. Hig. Alimente; 2018 Mar-Apr; 32(278/279): 92-96.

3. Dutra MTD, Silva JL, Oliveira CR, Lyra MRCC, Montenegro SMGL. Relações entre condições ambientais e doenças de veiculação hídrica em áreas do assentamento rural Serra Grande, Vitória de Santo Antão, PE, Brasil. Rev Bras Geog Fís. 2016; 9(6): 1677-1689. doi: https://doi.org/10.26848/rbgf.v9.6.p1677-1689.

4. Martins AAM, Michelone TP, Santos NND, Alvarenga L, Eugênio MAM, Bueno R. Análise da qualidade microbiológica da água e da superfície de bebedouros de um parque localizado na região de Sorocaba - São Paulo: há riscos à saúde? RMS. 2020; 2(4): 01-12.

5. Fundação Nacional de Saúde. Manual Prático de Análise de Água. 4. ed. Brasília, DF: FUNASA; 2013. p. 150.

6. Scuracchio PA, Farache A Filho. Qualidade da água utilizada para consumo em escolas e creches no município de São Carlos–SP. Alimentos e Nutrição. 2011 Oct-Dec; 22(4): 641-647.

7. Ashbolt NJ. Microbial contamination of drinking water and disease outcomes in developing regions. 2004 May 20; 198(1): 229–238 [cited 2021 Nov 09]. Available: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7126529/.

8. Hunt ME, Brodsky MH, Degnan AJ, Dichter G, Farmer JJ, Feng P. Differentiation of Coliform Bacteria: 9225 A. In. Baird RB, Eaton AD, Rice EW, editors. Standard Methods for the Examination of Water and Waste water. 23 ed. Washington: APHA, AWWA, WEF; 2017.

9. Silva CA, Yamanaka EHU, Monteiro CS. Monitoramento microbiológico da água de bicas em parques públicos de Curitiba (PR). Eng. Sanit. Ambient. 2017 Mar-Apr; 22(2): 271-275. doi: https://doi.org/10.1590/S1413-41522016158283.

10. Alessio CE, Pinto FGS, Moura AC. Avaliação Microbiológica das Águas das Principais Fontes de Praças e Parques de Cascavel PR. UNOPAR Cient., Ciênc Biol Saúde. 2009; 11(2): 41-4. doi: https://doi.org/10.17921/2447-8938.2009v11n2p%25p.

11. Silva JR, Lemes EO, Vargem DS, Oliveira DP, Arcanjo IRB, Mata LCE. Analise da Presença de Bactérias em Bebedouros de uma Instituição de Ensino Superior do Município de Anápolis - Goiás. Ensaios Ciênc, Ciênc. Biol. Agrár. Saúde. 2016 [cited 2021 Jan 10]; 20(1): 11-15. Available: https://www.redalyc.org/pdf/260/26045778002.pdf.

12. Del'Arcos T, Santos MN, GonçalveS MGS, Villanoeva CNBC, Dell'Isola ATP. Avaliação higiênico-sanitária da água, bebedouros e manipuladores de alimentos em escola municipal. Revista UFG. 2020; 20: e20.62608. doi: https://doi.org/10.5216/revufg.v20.62608.

13. Instituto Brasileiro de Geografia e Estatística. Araçatuba. Rio de Janeiro: IBGE; 2020 [cited 2021 Jul 12]. Available: https://cidades.ibge.gov.br/brasil/sp/aracatuba/panorama.

14. Centro de Vigilância Sanitária do estado de São Paulo. Manual de Coleta, Conservação e Transporte de Amostras de Água. São Paulo: Centro de Vigilância Sanitária; 2004 [cited 2021 Set 03]. Available: https://wp.ufpel.edu.br/ccz/files/2016/05/Manual-de-Coleta-e-amostras-de-agua_CVS.pdf.

15. Best J, Cockerel BLJR, Dichter G, Hall NH, Northeimer WW, Reynolds V, et al. Enzyme Substrate Test: Selection 9223 B. In. Baird RB, Eaton AD, Rice EW, editor. Standard Methods for the Examination of Water and Wastewater. 23. ed. Washington: APHA, AWWA, WEF; 2017. Part 9000.

16. Ministério da Saúde (BR). Portaria GM/MS nº 888, de 4 de maio de 2021. Altera o Anexo XX da Portaria de Consolidação GM/MS nº 5, de 28 de setembro de 2017, para dispor sobre os procedimentos de controle e de vigilância da qualidade da água para consumo humano e seu padrão de potabilidade. Diário Oficial da União. 2021 May 5 [cited 2021 Jul 01]. OPA: https://www.in.gov.br/en/web/dou/-/portaria-gm/ms-n-888-de-4-de-maio-de-2021-318461562.

17. Yamaguchi UM, Cortez LER, Ottoni LCC, Oyama J. Qualidade microbiológica da água para consumo humano em instituição de ensino de Maringá-PR. Mundo da Saúde. 2013; 37(3): 312-320.

18. Reis F, Dias CR, Abrahão WM, Murakami FS. Avaliação da qualidade microbiológica de águas e superfícies de bebedouros de parques de Curitiba –

PR. Visão Acadêmica. 2012 Jan May; 13(1): 55-70.

19. Alves SGS, Ataide CDG, Silva JX. Análise microbiológica de coliformes totais e termotolerantes em água de bebedouros de um parque público de Brasília, Distrito Federal. Rev. Cient. Sena Aires. 2018 Jan-Jun; 7(1): 12-7.

20. Zulpo DL, Peretti J, Ono LM, Garcia JL. Avaliação microbiológica da água consumida nos bebedouros da Universidade Estadual do Centro-Oeste, Guarapuava, Paraná, Brasil. Semina: Ciências Agrárias. 2006; 27(1): 107-110.

21. Mello CN, Resende JCP. Análise microbiológica da água dos bebedouros da Pontifícia Universidade Católica de Minas Gerais campus Betim. Sinapse Múltipla. 2015; 4(1): 16-28.

22. Seco BMS, Burgos TN, Pelayo JS. Avaliação bacteriológica das águas de bebedouros do campus da Universidade Estadual de Londrina –PR. Semina: Ciências Biológicas e da Saúde. 2012 Jul-Dec; 33(2): 193-200.

23. Silva DRR, Maciel MOS, Marta BBF, Bronharo TM, Michelin AF. Qualidade da água em escolas públicas municipais: análise microbiológica e teor de nitrato em Araçatuba, estado de São Paulo – Brasil. Rev Inst Adolfo Lutz. 2018; 77: e1740.

24. Wilson N, Signal L, Thomson G. Surveying all public drinking water fountains in a city: outdoor field observations and Google Street View. Aust N Z J Public Health. 2017; 42(1): 83–85. doi: 10.1111/1753-6405.12730.

25. Avery D, Smith C. Access to public drinking water fountains in Berkeley, California: A geospatial analysis. BMC Public Health. 2018;18. doi: 10.1186/s12889-018-5087-4.

26. Salesse TS, Sanches ACS, Gobbo LEM, Michelin AF. Ocorrência de dengue no município de Araçatuba–SP. J Health Sci Inst, 2019; 37(3):208-12.

27. Pezente AW. Análise microbiológica, física e química da água dos bebedouros e torneiras consumida na E.E.B Timbé do Sul, localizada no centro do munícipio de Timbé do Sul-SC [Trabalho de Conclusão de Curso]. Criciúma (SC): Universidade do Extremo Sul Catarinense-UNESC; 2009.

How to cite this article/Como citar este artigo:

Silva DRR, Almeida AA, Michelin AF, Bronharo TM, Hossatani CMS, Marta BBF. Microbiological quality of water from public drinking fountains in northwestern São Paulo, Brazil J Health Biol Sci. 2021; 9(1):1-7.