ANALYSIS OF THE POTABILITY OF MINERAL WATERS CONSUMED BY THE POPULATION OF JARAGUÁ DO SUL/BRAZIL

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Water, a natural resource of the Earth, is considered fundamental for human beings and must be following the quality parameters to be used for several purposes. However, billions of people in the world do not have access to treated water, causing health problems. Therefore, this work aimed to evaluate the potability of still mineral water consumed by the population of Jaraguá do Sul, Santa Catarina, making a comparison with water samples from the distribution network and river water. Microbiological, parasitological, physical-chemical, and phytotoxicity tests were carried out on all samples. Given the results obtained, it was concluded that the samples of still mineral water consumed by the population of Jaraguá do Sul are suitable for human consumption and use, unlike the water in the distribution network and the river water, which showed significant divergences in several stages of the analyzes. For more accurate results and values, new tests and analyzes must be carried out, as well as the monitoring and inspection of the waters used by the population, to make a better diagnosis regarding their potability.

KEYWORD: WATER, WATER POTABILITY, PUBLIC HEALTH.

INTRODUCTION

Water, a natural resource of the Earth, is considered fundamental for humans and represents about 70% and its mass, acting in several functions of the body, such as maintaining temperature and as a vehicle for various reactions. This resource must be by the quality parameters to be used, such as in food preparation, personal hygiene, electricity production, in industries, agriculture, and other activities (SOUZA *et al.*, 2018).

According to the Brazilian legislation, water for human consumption can be defined as "drinking water for the ingestion, preparation and production of food and personal hygiene, regardless of its origin" and also, "water that meet the potability standard established in this Ordinance and that does not offer health risks" (BRASIL, 2011).

In cases where the quality of the water is outside the standards defined by the legislation, there is a risk of transmission of many diseases, mainly through the ingestion of water, which can be caused by several interferents present in it, such as bacteria, viruses, parasites, toxins, chemicals, pesticides, and heavy metals. The most common symptoms related to illnesses caused by drinking contaminated water are diarrhea, nausea, vomiting, abdominal cramps, and fever. Among those that manifest with diarrhea are the enteroviruses, most frequently caused by rotaviruses, parasites (giardiasis, amoebiasis), and those caused by bacteria such as *Escherichia coli* (AGUIAR, 2019), for example, which can progress to severe conditions and even lead to death, especially in children, pregnant women and the elderly.

Water is an indispensable public good for life, however, billions of people around the world do not have access to treated water, among which 35 million live in Brazil, thus causing a public health problem (GARCIA; FERREIRA, 2017).

Thus, the control of water quality for human consumption represents a very important tool that can assist in the management of water resources, ensuring that it does not represent a risk to human health and contributing to the improvement in the quality of public supply (BRASIL, 2006)

Therefore, this work aimed to evaluate the potability of bottled mineral water consumed by the population of Jaraguá do Sul, Santa Catarina, comparing it with water samples from the water distribution system and from water sources.

MATERIALS AND METHODS

For this investigation, three samples of six (same manufacturing lot) different bottled mineral waters typical of those consumed by the population of Jaraguá do Sul, State of Santa Catarina/Brazil, were purchased and microbiological, parasitological, physical-chemical and phytotoxicological analyzes were performed. Bottles (500 and 510 mL) of all samples were disinfected using 70% alcohol. For comparison purposes with bottled mineral waters (MW), water samples from the water distribution system (TapW) and water collected from Jaraguá River and Itapocú River (RW) were also analyzed. All analyzes were performed in triplicates and evaluated according to the parameters required expressed by the Brazilian Legislation (218/2004/Ministry of Health/RDC 274/2005 (BRASIL, 2005)

500 mL Duhram flasks were sterilized and used for the collection. For the tap water, the tap was disinfected with 70% alcohol, opened, and run for 2-3 min to eliminate any disinfectant residue from the system, closed, and identified. For the superficial waters, the flasks were filled horizontally and care was taken to maintain a space in the bottle for later homogenization.

The Acquaplus I® (Newprov/Brazil) Kit for microbiological water control was used for quantification of Total and Thermotolerant Coliforms, following the instructions according to the protocols described in the user manual. The methodology is based on the presence or absence of coliforms. After 48 hours of incubation at 37 °C, the flasks were observed. If there was a change in the initial (colorless) color to a bluish green-blue, the sample was positive for Total Coliforms. In this case, the flask was subjected to observation under ultraviolet (UV) light of long length (365 nm) in a dark environment. The fluorescence observed indicated the presence of Thermotolerant Coliforms in the sample. If the sample, after 48 hours of incubation, only turned green and did not show fluorescence, it was concluded that there were only Thermotolerant coliforms and absence of feces. If the sample did not acquire green color, that is, it was clear or even cloudy, there was no evidence of the presence of Thermotolerant Coliforms.

For the parasitological analyses, the Faust Method (Zinc sulfate centrifugal flotation technique) was followed. (FAUST et al., 1938). Briefly, Falcon® Conical Centrifuge Tubes containing 10 mL of water samples were centrifuged at 2.500 rpm for 5 min. The supernatant liquid was discarded and the pellet was resuspended with a 33% zinc sulfate solution and centrifuged again at 2.500 rpm for 5 min. With the help of a platinum loop, the surface film formed by the zinc sulfate with the material sample was removed and placed on a microscope slide with Lugol´s drop and covered with a coverslip.

For the Physico-chemical water parameters such as Total Alkalinity, Free Carbon Dioxide and Total Hardness by the titration technique, according to protocols described in the Practical Water Analysis Manual **(**BRASIL, 2013).

For the Phytotoxicity testing of the water samples, the lettuce method (adapted) was used by the growth response of lettuce seeds (CUNHA, 2012). Identified Petri dishes were used for the growth of lettuce seeds on filter paper About 30 lettuce seeds (PRIAC et al., 2017) (*Lactuca sativa*) were place in each Petri dish with 4 ml of the water sample, well distributed on the moistened filter paper and covered with PVC film to avoid moisture loss, and plates were incubated at 22 ° C for 7 days.

All experiments were conducted in replicates and standard deviation (SD) was calculated using Microsoft Excel 2010. Differences between phytotoxicity tests were assessed using One Factor Analysis of Variance (ANOVA) using Minitab package version 20.1 for Windows 7 to determine significant differences. Significance levels were quoted at 95% confidence ($p < 0.05$).

RESULTS AND DISCUSSION

The results obtained from microbiological analyzes performed on samples of bottled mineral water (MW), water samples from the water distribution system (TapW), and water collected from Jaraguá River and Itapocú River (RW) are shown in Table 1.

TABLE 1 - MICROBIOLOGICAL ANALYZES FOR BOTTLED MINERAL WATER (MW), WATER DISTRIBUTION SYSTEM (TAPW) AND WATER SAMPLES FROM JARAGUÁ RIVER AND ITAPOCÚ RIVER (RW).

Samples	Results		
	1	2	3
MW– A	Colorless	Colorless	Colorless
MW – B	Colorless	Colorless	Colorless
MW – C	Colorless	Colorless	Colorless
MW – D	Colorless	Colorless	Colorless
MW – E	Colorless	Colorless	Colorless
MW – F	Colorless	Colorless	Colorless
TapW – G	Colorless	Colorless	Colorless
TapW – H	Colorless	Colorless	Colorless
TapW – I	Colorless	Colorless	Colorless
TapW – J	Colorless	Colorless	Colorless
TapW – K	Slightly cloudy and bluish green	Slightly cloudy and bluish green	Slightly cloudy and bluish green
TapW – L	bluish green	bluish green	bluish green
RW – M	Fluorescent bluish green	Fluorescent bluish green	Fluorescent bluish green
RW – N	Fluorescent bluish green	Fluorescent bluish green	Fluorescent bluish green

MW= water samples from the bottled mineral water (MW); TapW = water samples from the water distribution system; RW = water collected from Jaragua River and Itapocú River.

According to Table 1, the presence of fecal and thermotolerant coliforms was not detected in the bottled mineral water, characterizing a water suitable for human consumption, which according to Siqueira (2011) must be colorless, odorless and tasteless, and must not contain impurities.

However, other studies showed the presence of thermotolerant and fecal coliforms in mineral waters commercialized in Brazil. SANT´ANA *et al.* (2003) revealed that 25% of the total samples of mineral waters commercialized in the city of Vassouras (State of Rio de Janeiro) presented thermotolerant and fecal coliforms, which differed from our results. ALVES; ODORIZZI; GOULART (2002) reported the presence of thermotolerant in mineral and water collected from the distribution system in the city of Marilia (State of São Paulo), and CUNHA; LIMA; BRITO (2012) also reported that the mineral water commercialized in the city of Macapá (State of Amapá) was not in accordance with the legislation. Another study conducted by PANTOJA *et al.*, 2020) showed that mineral water commercialized in Belém (State of Pará) was not in accordance with microbiological standards established by the Brazilian legislation. The presence of thermotolerant and fecal coliforms in bottled mineral water indicates that there are flaws in disinfection and handling procedures for natural mineral water. In the water samples from the water distribution system, four of them were free from fecal and thermotolerant coliforms and two others (RD - K and RD - L) revealed the presence of thermotolerant coliforms, which were considered unfit for consumption, according to the Brazilian legislation (BRASIL, 2011).

In Brazil, drinking water for human consumption is currently regulated in Ordinance 05/17 (BRASIL, 2017). Thus, for water to be considered potable, it must meet the standards established for physical parameters (Color and Turbidity), chemical (Free Chlorine and pH), microbiological (Heterotrophic Bacteria Count, Total Coliforms and *Escherichia coli*), sensorial (Flavor, Odor and Aspect), cyanobacteria/cyanotoxins and radioactivity. The presence of coliforms is often associated with infections, which can cause damage to human health, causing illnesses that vary in intensity and range from gastroenteritis to serious illnesses, some even fatal (MORAIS; SALEH; ALVES, 2016). However, the presence of thermotolerant coliforms do not characterize fecal contamination but is an indicator of non-compliance with sanitary conditions in the filling process. MORAIS; SALEH; ALVES (2016) reported that the water distributed for public supply in the city of Rio Verde (Goiás State) met the physicochemical and bacteriological parameters. ALVES; ODORIZZI; GOULART, 2002) also reported the presence of thermotolerant coliforms in water from the distribution system in the city of Marília (São Paulo State).

Water samples collected from two different sources of superficial waters (Jaraguá River and Itapocú River) indicated the presence of fecal and thermotolerant coliforms, characterizing water of inadequate quality, thus needing to undergo a previous treatment, to ensure that it does not represent a risk to human health and collaborating to the improvement in the quality of public supply (BRASIL, 2006). Jaraguá do Sul has four effluent treatment plants and in 2020 the sanitary sewage coverage reached 90% of the urban area, according to the Municipal Autonomous Water and Sewage Service (SAMAE, 2020), which is much higher than the average of sewage treatment for the South Region (45,44%) and the national average is only 46% according to the National Sanitation Information System (SNIS, 2018). Although the low number of samples collected from the superficial waters; the results found in this study once again confirm the need for full coverage of sewage treatment. Other studies reported the presence of thermotolerant coliforms in raw water collected before treatment, which might be related to the economic activity, level of preservation of these water sources, or the way in which the sewage is discharged in the rivers used to collect water (STANCARI; CORREIA, 2010).

The results obtained from parasitological analyzes performed on samples of bottled mineral water (MW), water from water distribution system (TapW) and water collected from Jaraguá River, and Itapocú River (RW) are shown in Table 2.

TABLE 2 - PARASITOLOGICAL ANALYZES OF BOTTLED MINERAL WATER, WATER FROM DISTRIBUTION SYSTEM AND THE WATER SAMPLES FROM JARAGUA RIVER AND ITAPOCÚ RIVER (RW).

Samples	Results		
	1	2	3
MW – A	Negative	Negative	Negative
MW – B	Negative	Negative	Negative
MW – C	Negative	Negative	Negative
MW – D	Negative	Negative	Negative
MW – E	Negative	Negative	Negative
MW – F	Negative	Negative	Negative
TapW – G	Negative	Negative	Negative
TapW – H	Negative	Negative	Negative
TapW – I	Negative	Negative	Negative
TapW - J	Negative	Negative	Negative
TapW – K	Negative	Negative	Negative
TapW – L	Negative	Negative	Negative
RW – M	Negative	Negative	Trofozoíte (*Balantidium coli*)
RW – N	Negative	Negative	Negative

MW= water samples from the bottled mineral water (MW); TapW = water samples from the water distribution system; RW = water collected from Jaragua River and Itapocú River.

In the parasitological analysis carried out on the bottled mineral water samples, no parasites were found, once again confirming the quality of the commercialized water, being suitable for human consumption, as well as the tap water, which also did not present parasitological findings, ensuring what the legislation prescribes, that the water must be free from the presence of pathogenic microorganisms (BRASIL, 2013). Also, HANDAM;,SANTOS;MORAES NETO, 2020 reported poor quality of tap and river waters, which presented high levels of *Escherichia coli* in residences in the city of Manguinhos (State of Rio de Janeiro).

One of the water sample collected from the river (RW - M) revealed the presence of a parasitological finding characterized as a trophozoite from *Balantidium coli,* which can cause clinical manifestations ranging from asymptomatic cases to cases of severe gastroenteritis with episodes of dysentery, which can lead to death (BARBOSA, 2016). GROTT et al. (2016) reported the presence of cysts of *Giardia spp*., oocysts of *Cryptosporidium* spp. in untreated water collected from water treatment plants in Blumenau, Santa Catarina State (Brazil) which was also contaminated with *E.coli.*

In this case, the water treatment process, more specifically chlorination, represents an indisputable health benefit, so that chlorine is a disinfectant capable of destroying and inactivating most pathogenic organisms transmitted by water, such as some parasites, for example. (FREGONESI *et al.*, 2012)

A study by SALAZAR (1982), who performed a parasitological analysis on different brands of mineral water, proved to be free from the presence of parasites, a result similar to that found in all samples of mineral water in this study. Another study conducted by SILVA et al., (2017) reported that the drinking water supplied for the population of Nova Serrana (State of Minas Gerais) did not present risks of parasitological contamination, although the authors reported the presence of *Ascaris lumbricoides* in samples collected from Pará River and captured raw monitoring protozoa and other parasites in water supplied for the population in vital to human health, since the transmission of parasites by water can easily reach the population and cause outbreaks. STANCARI; CORREIA, (2010) reported the occurrence of *Giardia* cysts in one sample of raw water collected from Water Treatment Plant from one municipality of Bauru (State of São Paulo). The authors pointed out the importance of the treatment of the water, and indicating that the process used was not efficient enough to eliminate the protozoa. PÓVOAS *et al.*, 2020 reported the presence of parasites such as *Entamoeba coli*, *Strongyloides* sp, *Entamoeba histolytica* among others from samples collected from Cachoeira River (State of Bahia).

TABLE 3 – PHYSICO-CHEMICAL ANALYSES OF BOTTLED MINERAL WATER, WATER FROM DISTRIBUTION SYSTEM AND THE WATER SAMPLES FROM JARAGUÁ RIVER AND ITAPOCÚ RIVER (RW). STANDARD DEVIATION (DP) IN PARENTHESIS.

Samples	Results			
	pH	Alkalinity mg L^{-1}	Free carbon Dioxide (CO_2) mg L^{-1}	Total Hardeness mg L^{-1}
AM – A	7,70 (±0,04)	2,00 (±0)	5,33 (±0,06)	766,67 (±0,06)
AM – B	9,89 (±0,01)	91,33 (±1,16)	0,00 (±0)	633,33 (±0,06)
AM – C	7,21 (±0,22)	26,67 (±0,15)	11,67 (±0,12)	533,33 (±0,06)
AM – D	7,34 (±0,28)	7,33 (±0,06)	5,33 (±0,06)	700,00 (±0,06)
AM – E	7,17 (±0,13)	22,00 (±0,10)	4,67 (±0,06)	1300,00 (±0,06)
AM – F	7,12 (±0,02)	17,33 (±0,06)	5,67 (±0,06)	700,00 (±0,10)
RD – G	7,11 (±0,03)	8,67 (±0,06)	3,67 (±0,06)	766,67 (±0,06)
RD – H	7,09 (±0,02)	9,33 (±0,06)	3,33 (±0,06)	633,33 (±0,06)
RD – I	7,16 (±0,03)	7,33 (±0,06)	1,33 (±0,06)	533,33 (±0,06)
RD – J	7,17 (±0,02)	8,67 (±0,06)	3,00 (±0)	700,00 (±0)
RD – K	7,08 (±0,07)	34,67 (±0,06)	3,67 (±0,06)	1300,00 (±0,10)
RD – L	7,38 (±0,02)	6,67 (±0,06)	3,33 (±0,06)	700,00 (±0,10)
AMA – M	7,33 (±0,04)	30,67 (±0,06)	3,33 (±0,06)	1033,33 (±0,06)
AMA – N	7,39 (±0,07)	78,67 (±0,06)	6,67 (±0,06)	866,67 (±0,06)

MW= water samples from the bottled mineral water (MW); TapW = water samples from the water distribution system; RW = water collected from Jaraguá River and Itapocú River.

In the physico-chemical analysis carried out on the bottled mineral water, several pH values were obtained, differing from sample to sample, so that the values found were in accordance with the legislation, which describes that the pH values must be situated in the range of 6.0 to 9.5 (BRASIL, 2004). Except for the MW - B sample, which had a pH of 9.89, since it is an alkaline mineral water and fits the values expressed by the manufacturer. The pH values of the water in the distribution system were also within the required parameters, ranging from 6.0 to 9.5 (BRASIL, 2004). Similar results were found by MORAIS; SALEH; ALVES, W. S., 2016 which analyzed drinking water distributed for public supply in Rio Verde (State of Goiás). pH may be considered as one of the most important parameters of water quality, since an acidic water may cause corrosion of metal pipes and plumping systems while alkaline water may indicate disinfection in water (RAHMANIAN *et al.*, 2015) and possibility of formation of incrustation in the pipeline. Besides that, waters with extremely low or high pH values may cause irritation to the skin or eyes of individuals who come into contact with them (MORAIS; SALEH; ALVES, W. S., 2016).

In the physico-chemical analysis carried out on the bottled mineral water, several pH values were obtained, differing from sample to sample, so that the values found were by the legislation, which describes that the pH values must be situated in the range of 6.0 to 9.5 (BRASIL, 2004). Except for the MW - B sample, which had a pH of 9.89, since it is alkaline mineral water and fits the values expressed by the manufacturer. The pH values of the water in the distribution system were also within the required parameters, ranging from 6.0 to 9.5 (BRASIL, 2004). Similar results were found by MORAIS; SALEH; ALVES, W. S., 2016 which analyzed drinking water distributed for public supply in Rio Verde (State of Goiás). pH may be considered as one of the most important parameters of water quality, since acidic water may cause corrosion of metal pipes and plumping systems while alkaline water may indicate disinfection in water (RAHMANIAN et al., 2015) and the possibility of formation of incrustation in the pipeline. Besides that, waters with extremely low or high pH values may irritate the skin or eyes of individuals who come into contact with them (MORAIS; SALEH; ALVES, W. S., 2016).

The water samples from the river revealed acceptable pH values, as required by legislation that accepts pH values between 6.0 to 9.0 (COELHO, 2015). Other studies also observed a great variation among pH values. CUNHA; LIMA; BRITO (2012) reported that although the 20L bottled mineral water analyzed were within the Brazilian legislation, there were great variation among the brands and along the time analyzed, which was about 2 years. The authors pointed out that acidic waters are more acceptable by the consumers than the alkaline ones, furthermore, also suggested that these waters are not mineralized enough.

In the analysis of total alkalinity, which comprises the total measure of the substances present in the medium, such as hydroxides, carbonates, and bicarbonate, capable of neutralizing acids without significant change in pH, the values found ranged from 2.0 to 91.33, according to the type of water analyzed. Such value does not present any risk or noticeable change, according to other studies (SILVA NETO, 2013). The maximum amount of total alkalinity allowed, according to the MS Ordinance No. 2914/2011 is 250 mg / L of water (BRASIL, 2011). Alkalinity is an important parameter since it shows the water's ability to neutralize acids in it and it is fundamental during the process of water treatment, as it is depending on its content that the dosage of chemical products used is established (BRASIL, 2013).

In the analysis of free carbon dioxide, which represents the total acidity of the water, values between 0.00 and 11.67 were found, which varied according to the water sample. Samples that comprised values up to 10 mg / L are by the legislation, however, one sample of mineral water (MW-C) showed a value of 11.67, which is not by the legislation (SILVA NETO, 2013.

Total hardness is defined as the sum of the concentrations of calcium and magnesium ions in water, expressed as calcium carbonate (BRASIL, 2013) All samples analyzed, bottled mineral water (MW), water from the distribution system (TapW) and water from the river (RW) proved to be outside the required standard, presenting results greater than 500 mg / L, an ideal value determined by the current legislation for all water sources (BRASIL, 2004). According to the WHO Guidelines for Drinking-water Quality (WHO, 1996), there does not appear to be any convincing evidence that water hardness causes adverse health effects in humans. However, the available data of epidemiological studies are inadequate to prove any causal association. Furthermore, the health effects of hard water are mainly due to the effects of the salts dissolved in it, primarily calcium and magnesium, and it has been suggested that very hard water, could provide an important supplementary contribution to total calcium and magnesium intake (GALAN et al., 2002), especially for those who are marginal for calcium and magnesium intake (SENGUPTA, 2013). Also, there is some evidence from epidemiological studies for a protective effect of magnesium or hardness on cardiovascular mortality, however, the evidence is being debated and does not prove causality. On the other hand, some laxative effects might occur when drinking water in which both magnesium and sulfate are present in high concentrations (~250 mg/l each) (SENGUPTA, 2013).

TABLE 4 - PHYTOTOXICITY TESTS CARRIED OUT ON BOTTLED MINERAL WATER (MW), WATER FROM WATER DISTRIBUTION SYSTEM (TAPW) AND WATER COLLECTED FROM JARAGUÁ RIVER AND ITAPOCÚ RIVER (RW).

Samples	Média (cm)	D.P
MW – A	$1,6^{e}$	0,10±
MW – B	$1,8^{e}$	0,10±
MW – C	$2,0^{e}$	0,10±
MW – D	$1,5^{e}$	0,20±
MW – E	$1,7^{e}$	0,26±
MW – F	$1,9^{e}$	0,20±
TapW – G	2,8d*	0,20±
TapW – H	2,6d*	0,21±
TapW – I	$3,4^{cd*}$	0,15±
TapW – J	$2,8^{bcd*}$	0,25±
TapW – K	$3,1^{bc*}$	0,25±
TapW – L	$3,5^{b*}$	0,15±
RW– M	$3,7^{ab**}$	0,15±
RW – N	$4,1^{a**}$	0,25±

MW= water samples from the bottled mineral water (MW); TapW = water samples from the water distribution system; RW = water collected from Jaragua River and Itapocú River.

The results obtained from phytotoxicity tests carried out on samples of bottled mineral water (MW), water from water distribution system (TapW) and water collected from Jaragua River and Itapocú River (RW) are shown in Table 4.

Means that do not share a letter are significantly different. * Significantly different from mineral and river water samples. ** Significantly different from all samples.

Bioassays are widely carried out using organisms for ecotoxicological biomonitoring such as bacterial biomarkers (DAMS *et al.*, 2011);(CORDOVA-ROSA *et al.*, 2009); SINCLAIR et al., 1999), algae (RADI et al., 2017) and aquatic invertebrates (CHARLES et al., 2014). Phytotoxicity testing using seed germination are simple, inexpensive, and only requires a relatively small amount of sample (PRIAC; BADOT; CRINI, 2017) and the lettuce *Lactuca sativa L.* is one of the species recommended by the US Environmental Protection Agency (EPA, 1996) and the US Food and Drug Administration (FDA, 1987). Several studies have used *L.sativa* as a bioindicator for phytotoxicity testing (GRYCZAK *et al.*, 2018; MACENA *et al.*, 2017; GUEVARA *et al.*, 2019; RODRIGUES *et al.*, 2013).

The growth of 30 lettuce seeds was observed and their measurement reached values ranging from 1.5 to 2.0 cm in length. In the water samples from the distribution system, it was possible to observe the appearance of about 35 lettuce seeds, reaching values of 2.6 to 3.5 cm in length. There was a significant difference in length among samples from mineral water and the tap water and the river water ($p<0.05$). In the water samples from the river, 40 seeds appeared, on average, ranging from 3.8 to 4.2 cm in length.

The samples obtained from the river (RW-M and RW- N) had the greatest growth in cm when compared with the other samples ($p <0.05$). Therefore, the results indicated that the greater development of these seeds can be explained due to the action of organic matter, which can be defined as any material of plant or animal origin produced in the aquatic environment itself, and that when it undergoes a decomposition process, it implies consumption of oxygen in the medium. Thus, with the decomposition of organic matter, nutrients are released into the environment, which will consequently be used by algae and higher plants for their growth (CETESB, 2020).

In addition, the water from the distribution system showed significantly higher growth than the mineral water samples ($p < 0.05$). This finding may be due to the presence of minerals in the bottled mineral water which might have influenced the growth of lettuce seeds. For instance, CRUZ et al. (2006) observed that salinity (NaCl) had a deleterious effect on height, leaf number, leaf area, and dry mass of all parts of yellow passion fruit plants.

Although there was no significant difference among the mineral water samples ($p > 0.05$), all of them had a significant reduction in the growth of the seeds when compared with the tap water and water from the river. Furthermore, the fact that growth was not affected] by water from the river might suggest that these waters are free of high concentration of mineral ions or other contaminants which affect growth and germination of *L. sativa*. Studies have shown that waters with high salinity and high concentration of ions such as chloride cause inhibition of growth and germination of *L. sativa* (ANDRADE; DAVIDE; GEDRAITE, 2010; RODRIGUES *et al.*, 2013).

CONCLUSIONS

Through the results obtained with this research it was concluded that the samples of mineral water consumed by the population of Jaraguá do Sul are suitable for human consumption and use, therefore, they are considered drinking water.

Further studies on the quality and potability of mineral water and human consumption are necessary, in addition to monitoring the quality control of mineral water factories, as well as monitoring and inspection of the water used by the population, to guarantee water of quality and a better diagnosis regarding its potability.

RESUMO

A água, recurso natural da Terra, é considerada fundamental para o ser humano e deve estar de acordo com os parâmetros de qualidade para ser utilizada em diversas finalidades, porém bilhões de pessoas no mundo não têm acesso à água tratada, causando problemas de saúde. Portanto, este trabalho teve como objetivo avaliar a potabilidade da água mineral sem gás consumida pela população de Jaraguá do Sul, Santa Catarina, fazendo uma comparação com amostras de água da rede de distribuição e água de rio. Em todas as amostras foram realizados testes microbiológicos, parasitológicos, físico-químicos e de fitotoxicidade. Diante dos resultados obtidos, concluiu-se que as amostras de água mineral sem gás consumidas pela população de Jaraguá do Sul são adequadas para consumo e uso humano, ao contrário da água da rede de distribuição e da água do rio, que apresentaram divergências significativas nas várias etapas das análises. Para resultados e valores mais precisos, novos testes e análises devem ser realizados, bem como o monitoramento e fiscalização das águas utilizadas pela população, a fim de se fazer um melhor diagnóstico quanto à sua potabilidade.

PALAVRAS-CHAVE: *ÁGUA, POTABILIDADE DA ÁGUA, SAÚDE PÚBLICA.*

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