

**EVALUATION OF
MICROBIOLOGICAL
AND PARASITOLOGICAL
PARAMETERS OF
WATER AND SAND IN
BEACH AT COASTAL
ZONE OF ISLAND
OF SÃO LUÍS-MA: A
HEALTH PERSPECTIVE**

Danielle do Nascimento Lopes

<http://lattes.cnpq.br/1246284904241173>

MariaVictory Lima Almeida

<http://lattes.cnpq.br/7441132955583566>

Valdemiro Freitas Neto

freittastralhos@gmail.com

Ana Clara de Almeida Mendes

<http://lattes.cnpq.br/7791561509998204>

Romulo Diego Marinho Siqueira

<http://lattes.cnpq.br/8438969060111444>

Ingrid Albuquerque Araujo Gomes Self

<http://lattes.cnpq.br/1114437012742458>

Gabriela Coutinho Amorim Carneiro

<http://lattes.cnpq.br/2751300259103868>

Elias Victor Figueiredo dos Santos

<http://lattes.cnpq.br/6611296301428106>

Darlan Ferreira da Silva

<http://lattes.cnpq.br/6804115819693791>

All content in this magazine is licensed under a Creative Commons Attribution License. Attribution-Non-Commercial-Non-Derivatives 4.0 International (CC BY-NC-ND 4.0).



Rosangela Rodrigues Alencar

<http://lattes.cnpq.br/6401096152367990>

Wellyson da Cunha Araújo Firmo

<http://lattes.cnpq.br/2261911621272178>

Maria Raimundo Chagas Silva

<http://lattes.cnpq.br/5681082851141570>

Abstract: Brazil has considered the quality of water, regarding contamination by total and fecal coliforms, present a great risk to health, currently, studies are being carried out on the beaches of the coastal zone of São Luís due to the growth of contamination by pathogenic microorganisms, which can affect the health of bathers. parasitology, microbiology and physical-chemical parameters of water and beaches on the coastal zone of the island of São Luís. The collection was carried out at 3 points on São Marcos beach and 3 points on Araçagi beach. MacConkey Agar (MC) by the serial dilution method. In parasitology, the analysis was performed using the Hoffman method to identify eggs and cysts and the physical chemistry used the APHA method, 2012. The results obtained showed that the physical-chemical parameters comply with the legislation, except for Nitrate and Nitrite on both beaches. The results of the bacteriological analyzes of the beaches presented values higher than those acceptable by the legislation, the parasites found were, *Ascaris Lumbricoides*, *Trichuris Trichuriuria*, *Entamoebaco* and *Entamoebahystolytica*.

Keywords: Pollution, Beach, Microbiology

INTRODUCTION

The beach is considered a natural leisure, which offers free places for recreation, rest and enjoyment. However, the quality of water and sand is very important when considering popular use. (ISLA, 2013; B et al., 2015)

The care with the quality of the beach has increased because it treats the proximity with the population from the primary contact with the sand to the contact with the water, it is notorious that the subjects that deal with the sand are currently little discussed in relation to the various literatures that surround the subject of sea pollution. (ALMEIDA et al, 2018).

Due to the risks to which bathers and

fishermen may be exposed in these more remote areas of the island of São Luís, this work carried out the monitoring of the seawater quality of the most isolated beaches, such as those in the Itaquí Bacanga area, this research was carried out in accordance with CONAMA resolution 274.

Bathing is defined as the quality of water intended for primary contact recreation, which is understood as direct contact and prolonged with water (swimming, diving, water skiing, etc.), in which the possibility of ingesting quantities appreciable in water is high. (CETESB, 2011).

More research is needed on the beaches in this region, as the interest in studying this subject in this area is still small, as is the concern about how its characteristics are going. This concern today encompasses not only the scientific society and government organizations, but also the general population, who are concerned about the environment in which they live.

Sand is an important marker of environmental pollution, however, with little concern in relation to sea monitoring studies. There is a way to know the risks that one may be exposed to. There are reports that confirm that sewage dumped directly into the sand that flows towards the tide is in a denomination "black tongue" that results in poor quality of the environment (CETESB, 2014; SARAIVA, 2017).

The contamination by parasites is related to the sewage that is dumped directly on the beach, which comes mainly from homes that are located around it, which becomes very serious, because in Brazil there is a very big lack when it comes to health education. Contamination is more common in children, as they are the most susceptible to ingestion of eggs and cysts of these parasites (OLIVEIRA; SILVA; MONTEIRO, 2007).

Studies show that pathogenic bacteria survive in sand for longer, one of the

reasons being abiotic factors, as they favor the resistance of these microorganisms (ABDALLA et al, 2005; ELMANAMA et al, 2005).

CONAMA Resolution 274/2000 uses enterococcus, a genus of bacteria belonging to the faecal streptococci group, as a quality standard. Enterococcus has a great advantage over another indicator of faecal contamination, which would be *Escherichia coli*, as the bacteria are more resistant to environments with higher levels of salinity and chlorine.

Therefore, bathing plays an extremely important role in the control and knowledge of the population about the problems that they can acquire if they are not warned in advance (ANDRADE; et al. 2012).

Considering that these problems are common in society, this study aims to provide information on the types of contamination from pathogenic and anthropic agents, and the main objective of this research is to evaluate the physical-chemical, microbiological and parasitological parameters of the water and sand of beaches in the coastal area of the island of São Luís-MA.

MATERIALS AND METHODS

LOCATION AND CHARACTERIZATION OF STUDY AREA

The collection of water and sand was carried out on two beaches in the coastal zone of the Island of São Luís: Praia de São Marcos and Praia do Araçagy, with three collection points. On the beach in São Marcos, the points are represented by P1 Estrela D'alva, P2 Parquinho, P3 Landruá. Na praia do Araçagy P1 entrance to the beach, P2 in the middle of the beach and P3 Igarapé from the beach and river. During the dry and rainy season in the months of March and July and September 2019 to January 2020. Figure 1 shows the location map of the beaches of São Luís with the three distinct sampling points.

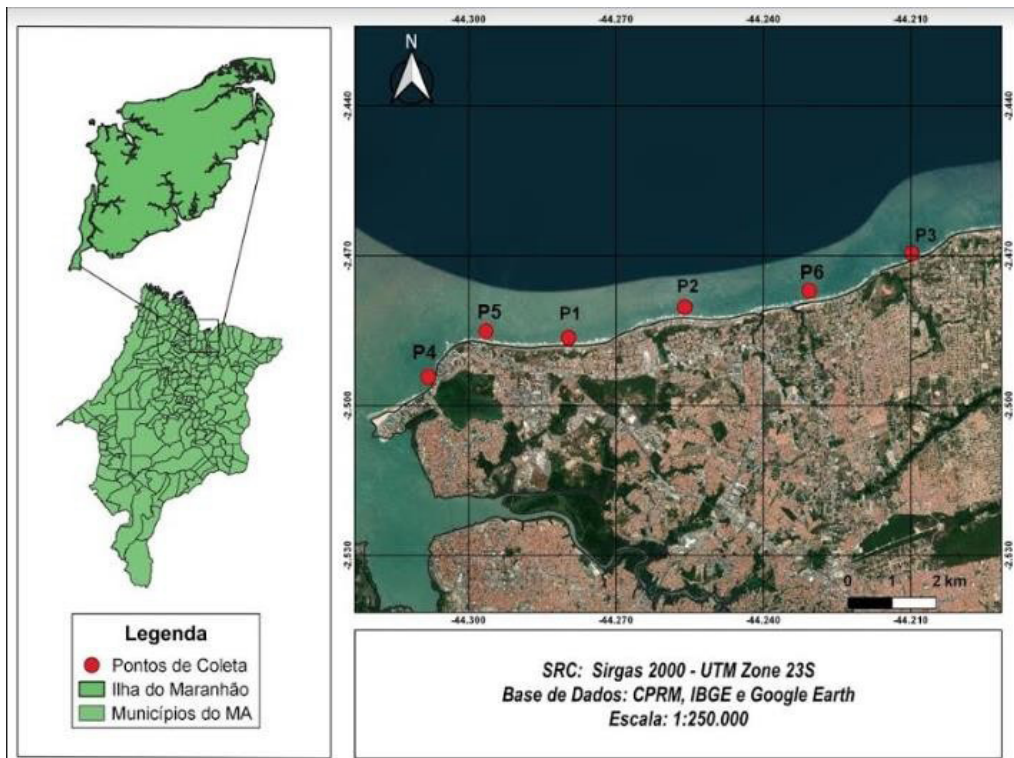


Figure 1. Location of area in study 2020.



Figure 2. Beach of Araçagy (P1, P2, P3). Source: author, 2020.



Figure 3. BeachAreFrames(P1, P2, P3). Source: furauthor, 2020.

COLLECT OF SAMPLES

The water samples were all collected in separate polyethylene bottles for each point to determine the measurements. To obtain the measurements in the physical-chemical analysis, the parameters analyzed were: PH, Turbidity, TDS, by the method (APHA, 2012).

The water and sand samples were collected in polyethylene bottles and in plastic bags for microbiological, parasitological and physical-chemical analysis. of Environmental Sciences at Ceuma University.

PARAMETERSPHYSICO-CHEMICALS

The variables analyzed followed the methodology (APHA/ 2012), for the following parameters it was used: pH (Hanna pH meter), turbidity (Hanna portable turbidimeter), electrical conductivity, total dissolved solids and salinity (in the tactile multiparameter meter of the brand AK88) the nutrients by the (Spectrophotometer Hanna).

MICROBIOLOGY OF THE WATER

For the microbiological analysis of the water, the Colitest was chosen, which consists of simultaneously evaluating total and fecal coliforms. The test is performed in a sterile flask in which a sachet will be placed in the sample and shaken close to the Bunsen burner to avoid contamination, then it is incubated at 37° for 24 hours. This test is used to determine total fecal coliforms when *Escherichia Coli* is present (TEBALDI, 2011).

After the sample is removed, the results were analyzed by changing the color, which varies according to the pH of the medium that fermenting lactose and reaches the yellow color. two drops of kovacs reagent are placed in a tube together with the sample, and if there is a formation of a red halo on the surface of the tube, it means positive and if it is yellowish, it is negative.

MICROBIOLOGY OF THE SAND

The technique used for microbiological analysis was serial dilution, which consists of counting the number of microorganisms that will form in the culture media, later originating through colony-forming units.

Inoculated is too large, there may be colony overlap which makes counting impossible. Therefore, the sample must be diluted in 10-1, 10-2, 10-3. For the results, the number of colonies formed from the diluted sample is multiplied by the dilution volume.

PARASITOLOGY

Parasitological analysis is performed using the Hoffman method, which consists of searching for helminth eggs and protozoa.

In a container, place water and the sample and wait 2 to 24 hours for sedimentation, after that time, remove a portion of the sediment with the aid of a pipette, add a drop of lugol and analyze it under a microscope. However, this method was adapted where centrifugation was performed to enhance the sedimentation of this sample (ScireSalutis, 2013).

RESULT AND DISCUSSION

The results of the studies of the analyzed physicochemical parameters of the water quality of the beaches of São Marcos and Araçagy are presented in tables 1 and 2, and of the bacteriological analyzes are presented in table 3.

The periods chosen for analysis were divided into dry period (September) and rainy period (January) where this climate variance can influence the results to be analyzed, in which the pH at the three points of Araçagy beach differs from 8.0 to 7.2 in the rainy season.

All the parameters analyzed from the samples of Araçagy beach at the three points in all collections, both in the month of June

Spots	pH	turbidity UNT	Salinitymg/L	TDS (mg/L)	Conductivity (μ S/cm)	Nitrate(mg/L)	Nitrite(mg/L)
P1							
June(2019)	7.6	6.99	16.1	13.9	279	4.0	0.66
January(2020)	8.0	5.66	21.5	18.0	363	3.1	0.31
P2							
June(2019)	7.6	01.21	15.2	126	252	4.0	1.02
January(2020)	7.7	19.58	24.3	20.3	406	1.1	0.29
P3							
June(2019)	7.4	3.78	15.3	13.2	261	4.2	0.66
January(2020)	7.2	5.21	25.1	20.9	471	0.15	0.29
CONAMA 274 and 357.	6.0 The 9.0	100	<30mg/L	1000 mg/L	>500(μ S/cm)	0.40 mg/L	0.07 mg/L

Table 1. Determination of parameters physico-chemical of the beach of Araçagy in the year in 2019 and 2020.

Source: Data of the search (2020).

(2019) and January (2020) showed values that meet the current legislation for bathing (CONAMA 274/2000), within the reference values, such as (pH- 6.0 to 9, 0), including nitrate and nitrite (CONAMA 357/2005) where this climatic variance can have a very strong influence in the rainy season.

Although the turbidity values are all within the standards of the CONAMA 375\05 legislation, it was possible to observe that in the study by Lima Neto (2019) in which his research evaluated the turbidity of beach water, he observed a discrepancy at Point 1 with 41.3UNT being low and at Point 6 with 89.8 UNT being high and this indicates the variation there is at each point, but still within the 100 UNT limit.

However, when we talk about salinity, it can be considered that an amount of salt is clearly found in the beach water, because it is saline waters, but these values, when exceeded, can be caused by factors that, according to Marinho et al. (2006), the high

concentrations of salinity can favor the increase of carbohydrates and decrease the amount of proteins in the nasal gasses.

Electrical conductivity showed positive values in relation to the legislation of CONAMA 357, since Brazil (2011) states that CONAMA 357 does not establish a limit for the value of conductivity, but it must obey a value in the range of 10 to 100 μ S/cm, but for polluted environments this value can reach 1000 μ S/cm.

According to Araújo et al. (2019), who carried out a survey in the port of Outeiro (island of Caratateua), the TDS value was 273.69 ml/l. This was due to the rainfall present in the river beds, causing a high concentration of solids to be visible in the water.

Nitrate is not within the standards in the dry season at the three collection points, however, in the rainy season, all values are within the standards according to CONAMA 357/05, which indicate the value of 0.40mg/L, so, nitrate is directly linked to sewage and

Spots	Ph	Turbidity UNT	Salinitymg/L	TDS (mg/L)	Conductivity (μ S/cm)	Nitrate (mg/L)	Nitrite (mg/L)
P1							
September(2019)	7.5	7.15	14.1	2.2	244	16.2	0.32
January (2020)	6.8	8.26	26.1	21.7	434	1.2	0.07
P2							
September(2019)	7.4	6.8	13.6	11.9	237	4.4	1.01
January(2020)	6.9	7.81	24.6	20.6	41	1.1	0.15
P3							
September(2019)	7.2	11.12	14.1	12.3	245	7.0	1.14
January(2020)	7.4	17.54	25.6	21.7	431	1.13	1.09
CONAMA 274 and 357.	6.0 to 9.0	100	<30mg/L	1000 mg/L	>500 (μ S/cm)	0.40 mg/L	0.07 mg/L

Table 2. Determination of parameters physico-chemical of the beach in San Marcos in the year in 2019 and 2020.

Source: Data of the Search (2020).

organic matter located in the sea. However, nitrite is correlated to pathogenic organisms such as bacteria and the results are varied between the standards of CONAMA 274/00 which establishes 0.07 mg/L denitrite in water.

For Vasco et al. (2010) Nitrite in high concentrations can be toxic to the life of aquatic beings, many species do not survive in concentrations above 5mg/L.

All parameters analyzed from the São Marcos beach samples at the three points in all collections, both in September (2019) and January (2020) presented values that meet the current legislation for bathing (CONAMA274/2000), within the reference values, such as (Ph- 6.0 to 9.0) including nitrate and nitrite (CONAMA 357/2005) where this climatic variance can influence a lot of water in the rainy season.

The values of electrical conductivity in the dry and rainy seasons are all within the CONAMA standard, so in their research Lima and Cardoso (2012) carried out a study that showed a variance in the average conductivity

in the rainy season, which was 22 μ S/cm near the bronchodry period, reaching 41.1 μ S / cm paraiba de Guajar.

According to Esteves (2011), he states that the electrical conductivity can be altered by seasonality, especially in the rainy period, in which the ion dilution factor expresses a high increase.

Regarding turbidity, the values are within the parameters on both beaches, therefore, in his study, Silva Juniores et al. (2012) states that there are several sources that generate turbidity, either by debris or clays that are aggregating and being transported to the surface through the flow process. The TDS values are within the reference standards for both the dry and rainy months. In accordance with Ordinance Number 2,914 (BRAZIL, 2011), the acceptable number for the concentration of TDS in water is 1000mg/l, but it may be lower according to its use.

Observing the results of nitrate and nitrite, it was possible to verify an increase in the results mainly in the dry period, however

Beach		AND.coliCFU / mL	CONAMA274 /00 2000 CFU/mL
P1	S/C	2.65x10 ³ /2.20x10 ³	Improper
P2	S/C	4.05x10 ³ / 1.4x10 ³	Improper
P3	S/C	1.95x10 ³ /1.70x10 ³	Improper
Beach of Araçagy			
P1	S/C	4.85x10 ³ /4.00x10 ³	Improper
P2	S/C	3.70x10 ³ /2.00x10 ³	Improper
P3	S/C	3.70x10 ³ /1.00x10 ³	Improper

Table 3. Values of bacteriological analysis of the sandy beaches of Araçagy and São Marcos in the dry and wet period.

S/C(Dry/Rainy). Source: Data of the research, 2020.

the values of the rainy period are above the reference values, according to Sodré (2007) states that almost all waters have traces of Nitrate, the high concentrations are due to human pollution or by leaching processes.

However, for Scorsfavaetal. (2010) the high concentrations of nitrite can make the environment in which it is present toxic and cause diseases such as methemoglobinemia (blue baby syndrome) and can also convert to nitrosamines, and nitrosamides which are carcinogenic, considered a high risk to human health.

Castro (2016) carried out a study in which the value of nitrite in the rainy season was below 0.03 mg/l, and in the dry season this value increased at Point 2 with 0.09 mg/l, showing a variation between the periods seasonal. In the study carried out by Coelho (2012), the salinity value was average, equal to 34.64%, this can be explained by the lack of a floodgate system, which allows the flow and reflux of seawater.

Table 3 determines the values of bacteria in the sands of the Araçagy and São Marcos beaches in dry and rainy periods in 2019 and 2020. And figures 4, they show the Gram negative morphology.

The presence of fecal or thermo tolerant coliforms on São Marcos beach varied in the period with the three points (1.95x10³ to 4.85x10³CFU/mL) and in the rainy season they were (1.70x10³ to 2.20x10³CFU/mL), noting that the growth occurred more in P2, due to this location having a lot of waste and feces, in addition to the lack of care of the responsible bathers and the organs. All points above are permitted according to current legislation (1000 UFC/ 100ml CONAMA No. 274/2000).

On the other hand, in Praiado Araçagy, the presence of fecal or thermotolerant coliforms varied in the dry period at the three points (3.70x10³/ to 4.05x10³ CFU/mL) and in the rainy period from (1.00x10³ to 24.00x10³CFU/ mL). All points are above what is permitted

according to the current legislation (800UFC/100ml CONAMA n°274/2000). Araçagy beach is still very rustic, with bars, and on the sands there are many dogs, which spreads diseases from parasites in the feces of animals and many times the human ones too, therefore, the values are above the legislation. It is also observed that both the dry and rainy seasons are very significant in terms of values.

Ngah et al. (2012) states that the high concentrations of fecal coliforms found in beach waters is due to human activities and warm-blooded animals. For Rego, Barros and Santos (2010), the presence of large amounts of thermotolerant coliforms shows a danger of contamination for bathers by pathogenic microorganisms that colonize the intestine of human beings.

Comparing the values of fecal coliforms from the research with Santos (2017), in the coastal area of São Luís, we observed that they are very similar with values of (3060 and 1740 CFU/mL) in Guia beach, (840 and 1060 CFU/mL) p2 at Praia do Amor

and (1120 and 2640 CFU/mL) at Praia do Boqueirão, establishing the beaches in the category of unsuitable for bathing in the rainy season (January 2017) in accordance with current legislation. CONAMA No. 274 (BRAZIL, 2000). The analysis carried out on the beaches of Araçagy and São Marcos, are classified as unsuitable for bathing due to the high number of coliforms found in these waters, according to CONAMA resolution n°357/2005 (BRASIL, 2005).

However, in the rainy season, on both beaches it is necessary to monitor the legislation to verify that physical-chemical and microbiological parameters are periodically carried out on the beaches, since the variation of agents that can cause imbalances in the environment and the aquatic environment are diverse, which shows the importance of this analysis for the prevention of both bathers and tourists.

All points were made Gram negative, figure 1 is only representing the morphology of E-coli bacteria.

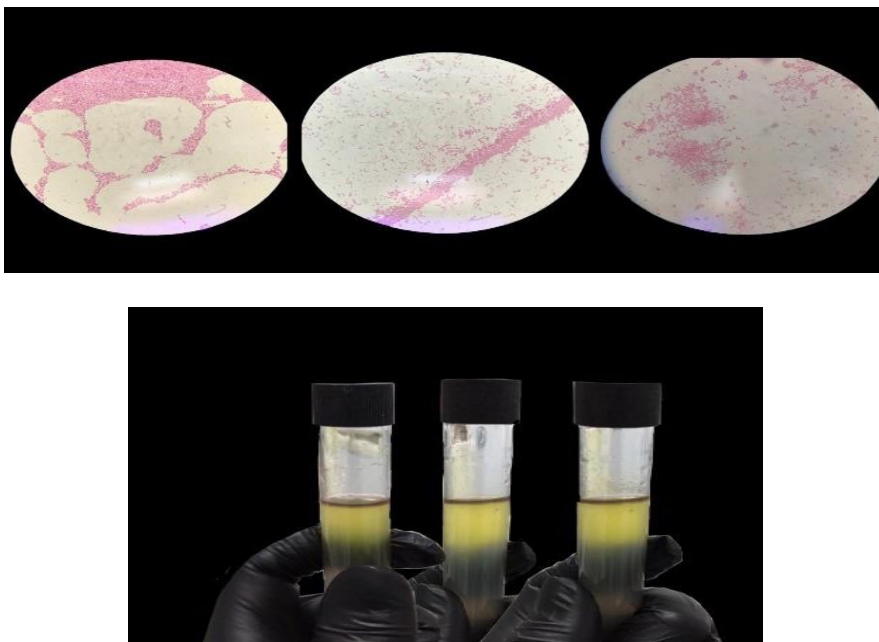


Figure 4: microscopic observation of the morphology of Gram negative (A) and fecal coliforms using thekovacs(B)in the three spots.Sources:data ofsearch,2020

Regarding the analysis of the microbiology of the water, all 6 points had their color changed, shown in figure 4 image (A), which is confirmatory of total coliforms, so all beaches tested positive for total coliforms, then in image (B) we obtained confirmation of fecal coliforms using the kovacs reagent where it indicates positivity for the *Escherichacoli* bacterium.

Sousa (2017), in his study, says that water is an essential element for all living organisms to maintain their survival, since from it they extract all the important nutrients that maintain their stability of life, but there are pathogenic microorganisms that use water as a form of transmission of disease to humans, causing infections, depending on their amount.

E.coli is a pathogenic microorganism, belonging to the “coliform” group, and normally inhabits the human intestine, in high amounts it can cause diarrhea and even invasive disease depending on its pathogenicity. Its presence in water is an indication of fecal coliforms parasitizing the human intestine.

Table 4 depicts positivity for *Entamoebacoli*, *Entamoebahistolytica*,

Trichuris trichiuria, on Araçagy beach during the dry and rainy season, all parasites found are correlated with sewage from houses that are thrown directly into the sea. According to Patz et al., (2012) *Trichuris trichiura*, it is a helminth that can affect people of any kind.

According to Silva (2018), similar results were obtained at Praia da Pinheira, where, even if mild, in 8% of cases, the presence of whipworms was found, where it is considered an important parasite of zoonotic origin.

Other results, as by Villela et al., (2009), carried out a study at Praia do Laranjal, Pelotas-RS, and 6.3% of the samples that were analyzed were contaminated. Leite et al. (2006) also obtained a positive result in Meia-praia, Itapema-SC, which showed a prevalence of 2 %give *Trichuris*.

In addition to helminths, there was the presence of protozoa such as *Entamoebahistolytica*, where according to Pritsch IC, (2016); Oliveira Filho (2011) carried out a study and found similar results, regarding the presence of *Entamoeba histolytica*, this was important to highlight the degree of contamination and that many people who frequent the beach are exposed to this parasite. without causing very serious

Beach Araçagy	Parasites Helminths	Protozoa
P1	<i>Trichuristrichiura</i>	-
S/C		
Beach of Araçagy		
P1	<i>Trichuristrichiura</i>	-
S/C		
P3		<i>Entamoebacoli</i>
S/C		<i>Entamoebahistolytica</i>

Table 4. Presence of protozoan cysts according to the species collected in the sands of the beach of São Marcos and Araçagy.

Source: Data of the search(2020)dry (s)andrainy (C).

harm to the human being it can be a risk to be contracted, however. In his work, Santos (2010) covers that even though *E. coli* is not considered pathogenic, being harmful to the intestine, but its presence on beaches is an alert indicator for the population that are being exposed to these parasites.

CONCLUSION

The values were significant in the physicochemical parameters analyzed, except in the concentrations of nitrate and nitrite where there was an increase. The pH parameter showed acceptable values (between 6.0 and 9.0) in all points collected from the beaches of São Marcos and Araçagy, according to CONAMA resolution 274/2000.

REFERENCES

- ABDALLAH, S.A.; ELMANAMA, A. A.; FAHD, M. I.; AFIFI, S. **Microbiológica Beach Sand Quality in the Gaza Strip in Comparison to Seawater.** *Polish Journal of Environment Studies*, v. 14, n. 6, p. 841-850, 2005.
- ANDRADE, M. P et al. **Avaliação da Balneabilidade das praias do Município de Santos/SP nos últimos dez anos**, Revista Ceciliana Jun 4(1):55-59, 2012.
- APHA, 2012. **Standard methods for the examination of water and wastewater**, 22nd edition edited by E. W. Rice, R. B. Baird, A. D. Eaton and L. S. Clesceri. American Public Health Association (APHA), American Water Works Association (AWWA) and Water Environment Federation (WEF), Washington, D.C., USA.
- ARAÚJO, V. E. S. et al. **Análise de parâmetros de qualidade da água em decorrência de efeitos da precipitação na baía de Guajará – Belém – PA.** *Revista Brasileira de Geografia Física*, v.12, n. 2, p. 661-680, mar. 2019.
- BOTERO, C. PEREIRA, C.; TOSIC, M.; MANJARREZ. **Design of an index for monitoring the environment quality of tourist beaches from a holistic approach.** *Ocean & Coastal Management*, v. 108, p. 65-73, 2015.
- BRASIL. Lei nº 7.661, de 16 de maio de 1988. **Plano Nacional de Gerenciamento Costeiro e dá outras providências.** Brasília, DF, 1988. Disponível em: <http://www.planalto.gov.br/ccivil_03/Leis/L7661.htm>. Acesso em: 19 maio 2017.
- BRASIL. Ministério da Saúde. Portaria nº 2.914 de 12 de dezembro de 2011. **Dispõe sobre os procedimentos de controle e de vigilância da qualidade da água para consumo humano e Seu padrão de potabilidade.** http://bvsms.saude.gov.br/bvs/saudelegis/gm/2011/prt2914_12_12_2011.html Acesso em: 15 dez. 2016
- CETESB. **Relatório de qualidade das praias litorâneas no estado de São Paulo.** São Paulo: CETESB, 2011.
- COELHO, Fábio Reis. **Caracterização da qualidade das águas dos canais de Santos (São Paulo, Brasil).** *UNISANTA BioScience*, v. 1, n. 2, p. 54-59, 2012.
- CONAMA nº 274 (Brasil) de 29 de novembro de 2000 Publicada no DOU no 18, **Define os critérios de balneabilidade em águas brasileiras** de 25 de janeiro de 2001, Seção 1, p. 70- 71.

CONAMA nº 357, de 17 de março de 2005 **Dispõe sobre a classificação dos corpos de água e diretrizes ambientais para o seu enquadramento, bem como estabelece as condições e padrões de lançamento de efluentes, e dá outras providências.** Publicada no DOU nº 053, págs. 58-63 de março de 2005.

DE ALMEIDA, Alessandro Alves et al. **Determinação quantitativa de coliformes fecais na areia das praias de Santos (São Paulo, Brasil).** Anuais do Encontro Nacional de Pós Graduação, v. 2, n. 1, p. 204-209, 2018.

ELMANAMA, Abdelraouf A. et al. **Microbiological beach sand quality in Gaza Strip in comparison to seawater quality.** Environmental research, v. 99, n. 1, p. 1-10, 2005.

ESTEVEES, F. A. **Fundamentos de Limnologia.** 3. ed. Rio de Janeiro: Interciência, 2011. 790 p.

ISLA, F.I. **From touristic villages to coastal cities: the costs of the big step in Buenos Aires.** Ocean & Coastal Management, v. 77, p. 59-65, 2013.]

LIMA NETO, Rudli dos Santos. **Avaliação físico-química da Praia do Amor na ilha de Caratateua – Belém/PA.** Orientador: Lúcio Cardoso de Medeiros Filho. 2019. 62 f. Trabalho de Conclusão de Curso (Graduação em Engenharia Ambiental e Energias Renováveis) – Universidade Federal Rural da Amazônia, Campus Belém, PA, 2019.

LIMA, R. F.; CARDOSO, R. N. C. **avaliação das características físicoquímicas da baía do guajará nas imediações do porto de belémpará.** In: XXXIII Congresso Interamericano de Engenharia Sanitária e Ambiental - AIDIS, 2012, SALVADOR. XXXIII Congresso Interamericano de Engenharia Sanitária e Ambiental - AIDIS, 2012.

LUÍS, M. A. qualidade da água do rio jaguarema no município de são josé de ribamar- ma. 2016

MARINHO-SORIANO, E.; FONSECA, P. C.; CARNEIRO, M. A.; MOREIRA, W. S. **Seasonal variation in the chemical composition of two tropical seaweeds.** Bioresource Technology, England, v.97, n.18, p.2402-2406, 2006.

NGAH, M. S. Y. C. et al. **Marine Pollution Trend Analysis of Tourism Beach in Peninsular Malaysia World Applied Sciences Journal,** 2012.

OLIVEIRA, Camila Belmonte; DA SILVA, Aleksandro Schafer; MONTEIRO, Silvia Gonzalez. **Ocorrência de parasitas em solos de praças infantis nas creches municipais de Santa Maria–RS, Brasil.** Revista da FZVA, v. 14, n. 1, 2007.

OLIVEIRA Filho AA, Fernandes HMB, Alcântara NDF, Assis TJCF, Freitas FIS. **Frequência de enteroparasitas nas areias das praias da Paraíba.** RevBiolFam.2011;6(2):10813. <http://arquivosmedicos.fcmsantacasasp.edu.br/index.php/MASCSP/article/view/43/32>

PATZ, J.A. et al. NGAH, M. S. Y. C. et al. **Marine Pollution Trend Analysis of Tourism Beach in Peninsular Malaysia World Applied Sciences Journal,** 2012. International Journal of Parasitology, v. 30, n. 30, p. 1395-1405, 2002.

PRITSCH IC, Frighetto M. **Ocorrência de geohelmintos em areia de locais públicos municipais de Videira e Itá SC, Brasil.** Rev Saúde Pública Santa Catarina 2016; 9(1):37- 44.11.

REGO, Neylor Alves Calasans; BARROS, Sizinio Rosa; SANTOS, José Wildes Barbosa dos. **Avaliação espaço-temporal da concentração de coliformes termotolerantes na Lagoa Encatada, Ilhéus, Bahia, Brasil.** REDE-Revista Eletrônica do PRODEMA, v. 4, n. 1, 2010.

SÃO PAULO. Governo do estado de São Paulo. Companhia Ambiental do Estado de São Paulo (CETESB). **Qualidade das praias litorâneas no estado de São Paulo** 2013. São Paulo, 2014, 213 p.

SANT'ANNA, Lorena Mota Lopes; DE JESUS OLIVEIRA, Fernanda; DE MELO, Cláudia Moura. **Estudo comparativo de técnicas parasitológicas baseada no princípio de sedimentação espontânea (Hoffman) e Parasitokit®.** Scire Salutis, v. 3, n. 1, p. 6-15, 2013.

SANTOS, Simone Aparecida dos; MERLINI, Luiz Sérgio. **Prevalência de enteroparasitoses na população do município de Maria Helena, Paraná.** Ciênc. saúde coletiva, Rio de Janeiro, v.15, n.3, p.899-905, May 2010.

SANTOS, W.A; SILVA, MRC. **Balneabilidade de praias na região portuária da área Itaqui Bacanga São Luís – MA.** 20 f. (Monografia). Coordenação de Engenharia Ambiental.Universidade Ceuma. São Luís-MA

SARAIVA, HARIANE LOPES. **avaliação do risco microbiológico nas areias da praia do atalaia, salinópolis-pa.** 2017

SCORSARAVA, M. A. et al. **Avaliação físico-química da qualidade de água de poços e minas destinada ao consumo humano.** Instituto Adolfo Lutz. São Paulo, v. 69, n. 2, p. 229- 232, maio. 2010..

SILVA Junior, V. et al. **Calibração de Turbidímetro para estimativa da concentração de sedimento em suspensão como parâmetro de qualidade.** In: 11a SIMPÓSIO DE RECURSOS HÍDRICOS DO NORDESTE. 2012, João Pessoa. Anais. Paraíba, XI Simpósio de Recursos Hídricos do Nordeste. 2012.

SILVA, Alice da et al. **Contaminação por parasitas de importância zoonótica em amostras fecais na praia da Pinheira Palhoça-SC,** Brasil. 2018.

SODRÉ, Silvana do Socorro Veloso. **Hidroquímica dos lagos Bolonha e Água Preta mananciais de Belém-Pará.** 2007. 144 f. Dissertação (Mestrado em Ciências Ambientais) – Programa de Pós-Graduação em Ciências Ambientais, Instituto de Geociências, UFPA, Museu Paraense Emílio Goeldi e EMBRAPA, Belém, 2007.

SOUSA, Tony Markus Rodrigues Rego de et al. **Análise microbiológica e físico-química das águas da praia de Atalaia na cidade de Luís Correia-PI.** 2017.

TEBALDI R **Avaliação bacteriológica de águas minerais sem gás e gaseificadas artificialmente comercializadas em garrafas individuais.** [dissertação] Araraquara: Universidade Estadual Paulista “Júlio Mesquita Filho, Faculdade de Ciências Farmacêuticas; 2011.

VASCO, A. N.; MELLO JUNIOR, A. V.; SANTOS, A. C. da S.; RIBEIRO, D. O.; TAVARES, E. D.; NOGUEIRA, L. C. **Qualidade da água que entra no estuário do rio Vaza Barris pelo principal fluxo de contribuição de água doce.** Scientia Plena. 6(9): 102401-1. 2010

VILLELA, M.M.; PEPE,M.S.;FERRAZ,M.L.;MORAIS, N.C.M.; ARAÚJO,A.B.; RUAS,J.L.; MÜLLER, G.;BERNE,M.E.A. **Contaminação ambiental da Orla da Laguna dos Patos (Pelotas, RS, Brasil), por parasitos com potencial zoonótico.**