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Physico-chemical and microbiological study of some waters of Comoros

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ABSTRACT

The problem of water is a vital issue for Small Island Developing States such as the Comoros where social protection remains largely underdeveloped and covers less than 20% of the population. The sanitation emergency only increases this generalized water shortage. Meeting the targets set by the international community in the area of water and sanitation is an essential step (Sustainable Development Goals SDGs 1, 3 and 6) towards the goal of providing all populations with safe drinking water and adequate sanitation services. In this study, we showed the different cases of waterborne diseases observed in the study districts, and we analyzed some physicochemical and then bacteriological parameters of some water sources used by the population of Anjouan and Grande Comore. Our work presented that the vast majority of the population does not have access to drinking water, although there are numerous water sources identified in abundance that can be exploited to overcome this challenge. The results of this study showed that the water consumed did not meet the standards of potability (especially bacteriological). This would explain the persistent presence of these waterborne diseases identified in these localities. As a result, the population is exposed to serious problems related to the use of untreated water, especially since the vast majority of the population lives in remote areas where access to drinking water is difficult.

Key words: Contaminated water, treatment, Grand-Comore, Anjouan, Population

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INTRODUCTION

Over the past decades, significant progress has been made in providing populations with safe drinking water and adequate sanitation services [1]. But much remains to be done in the coming decades to provide these essential services to those who still lack them, the vast majority of whom live in poverty. In countries such as Comoros and Madagascar, the provision of clean water to people in rural and small remote districts is an increasingly serious problem and is holding back development [2]. The problem of water is part of a context linked to the health emergency, but it also remains inherent to the existence of the population, especially the vulnerable communities. Studies have shown, for example, that more than half of these populations do not have access to drinking water. For Small Island Developing States like Comoros, where poverty is a major challenge, access to water can mean the difference between life and death, between prosperity and poverty. In Comoros, water problems take various forms: variability of water resources, difficult access to these resources and their vulnerability (low rainfall in some regions, negative impacts of human activities, poor waste management, poor maintenance of water infrastructure, traditional practices that generate biological contamination, salinization of wells by rising water, ...) [3 4]. With an estimated population of 902,348 and a growth rate of 2.42% in 2022 [5], the supply of drinking water in the Comoros remains a social problem in urban and rural areas. Limited financial resources and inadequate sanitation infrastructure expose the archipelago to serious consequences, including diseases caused by water contaminated by human, animal or chemical waste [6]. These include cholera, typhoid, polio, meningitis, hepatitis A and E, and diarrhea, among others. Surface water generally contains micro-organisms (bacteria, viruses, protozoa) and chemical substances (e.g. benzene, lead) that can affect human health [7, 8]. But also industry, agriculture, mining and forestry can significantly alter water quality, among other things by discharging pesticides, metals and toxic products. Food-borne illnesses, caused indirectly by contaminated water, could also be more frequent. The main reason for this catastrophic situation is poverty. The production of drinking water is too expensive, nor even the care that these affections require, the medical infrastructures not being sufficient [6]. However, with simple water quality hygiene measures, the problems could be reduced. Ensuring access to water and sanitation is also fundamental to achieving the other development goals set out in the Millennium Declaration, such as: reducing poverty, hunger and malnutrition; reducing child mortality; increasing educational opportunities; and achieving environmental sustainability [2]. It is in this perspective of sanitation that our study is based on water treatment for a good care of the population of Comoros.

The Comoros Archipelago

The Comoros archipelago is located at the northern entrance of the Mozambique Channel, halfway between the East Coast of Africa and the North-West of Madagascar. It occupies a total area of 2 236 km², unequally divided into four main islands bordered by some deserted islets. The four main islands of the Archipelago are, from North to South, NGAZIDJA (Grande Comore), MWALI (Mohéli), NDZUWANI (Anjouan) and MAORE (Mayotte). It has a young population with an average age of 24.1 years and a proportion of young people under 29 years old representing 51.6% of the total. The proportion of people under five years of age represents 14.8% of the population as against 22.34% for the 15-24 age group [4, 9].

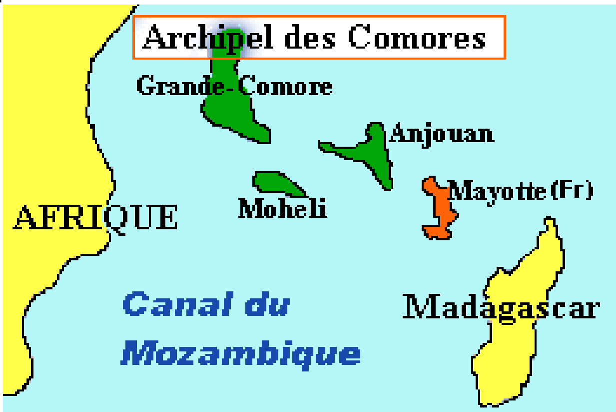

Fig. 1 Map of the Comoros Archipelago

Comoros are part of the group of least developed countries (LDCs). The average monthly per capita income in Comoros is \$117, either \$1,400 per capita per year, with a gross domestic product (GDP) of 2.2 in 2019 and a particularly low growth rate. With a human development index of 0.411, Comoros ranks 156th out of 189 countries ranked by the UNDP in 2019. The "multi-insularity" that characterizes the country constitutes both its wealth (through diversity) and a major obstacle to its development (through the cost and constraints related to inter-island trade and trade with the rest of the world [10].

The four large slopes (north, northwest, east and southwest) exposed to the winds constitute orographic barriers against which the air flows. These moving humid air masses are forced to rise. This rise causes expansion, cooling and condensation [11]. On the other hand, in well-winded regions, with no obstacles to the passage of winds, precipitation is quite low.

Study framework (survey and research on population, resources and water quality).

The demographic structure of the Comoros is also marked by the weight of young people, who in 2003 represented 53% of the population for those under 20 years of age and 42% for those under 15 years of age (table 1) [9].

Table -1 Population projection by residence and gender

Year	Total population	Urban	Rural	Males	females
2003	575660	160865	414795	255705	289955
2010	687052	192717	494335	342686	344366
2015	788445	220412	564333	392607	392138
2020	897219	252035	645184	450043	447176
2025	1019861	286175	733686	512676	507185

Source : RGPH 2003 – CGP

From the National Water Vision 2025 studies, the potential of mobilized water resources is detailed in the table 2 below.

Table -2 Evolution of water demand for the years 2002 and 2025

Island	2002			2025		
	Population	Supply L/d	Demand L/d	Population	Supply L/d	Demand L/d
Ngazidja	297440	11 000 000	39 500 000	532 232	11 000 000	70 680 000
Ndzouani	240240	7 500 000	15 000 000	437 988	7 500 000	27 347 000
Mwali	34320	1 500 000	2 500 000	64 245	1 500 000	4 680 000
TOTAL	57200	20 000 000	57 000 000	1 034 465	20 000 000	103 085 000

Source: (DREA: Regional Water and Sanitation Department)

Drinking water supply in Comoros

Water supply in Grande Comore is provided, on the one hand, by modern adduction of groundwater extracted by pumping (recent wells) and, on the other hand, by rainwater collection through a traditional system of tanks. In 1989, 80% of the population of Grande Comore relied on mainly communal cisterns. These large capacity tanks (100-200m^3) are intended for dry season supply. The risks of accidental pollution from these systems are significant [9]. However, these emergency tanks are not always sufficient, and it is then necessary to resort to supplying water to these areas by truck from the Moroni region, a system that entails costs for users [6, 7]. In contrast, in Anjouan and Moheli, surface water and springs are sufficient for water supply, with the exception of the Wanani region in Moheli. In this region, a "drilling" program is underway and should provide water to the people and M'ramani Anjouan. The village community obtains its water from rainwater collected in a large open dam during the rainy season. It is often stored for a long time so that the community can use it during the dry season. The major problem is that the water used for drinking is not treated to make it potable [6, 12, 13].

Evolution of waterborne diseases

Diarrhoeal diseases of water and food are the leading causes of morbidity and mortality, especially in less developed countries. Surface water generally contains micro-organisms (bacteria, viruses, protozoa) and chemical substances (e.g. benzene, lead) that can affect human health. Food-borne illnesses, caused indirectly by contaminated water, may also be more common. Limited financial resources and inadequate sanitation infrastructure expose the archipelago to serious consequences, including diseases caused by water contaminated by human, animal or chemical waste. These include cholera, typhoïd, polio, meningitis, hepatitis A and E, and diarrhea among others... [7].

Case of Grand Comore

Some informations of diseases were indicated in tables 3 and 4.

Table -3 Index of the ratio of the population to the number of cases in each health district (HD)

Health District of Ngazidja	Diarrhea (2011)	Typhoïd (2012)	Diarrhea (2012)	Diarrhea (2014)
HD of Moroni-Bambao Center	42.2	39.2	34.1	451.3
HD of Hambou	128.1	90.5	54.2	981.0
HD of Oichili-Dimani	210.3	325.0	157.1	744.8
HD of Mitsamihouli-Mboudé	189.7	226.9	109.8	154.8
Hamahamet-Boinkou HD	81.0	105.7	84.0	1612.6
East Mbadjini HD	163.9	161.6	99.8	4805.0
HD of Mbadjini West	71.2	207.0	33.2	432.6

Table -4 Summary of typhoid fever cases from 2009 to 2011 in Anjouan

Year	Month	Number of events	Year	Month	Number of events	Year	Month	Number of events
2009	Jan	65	2010	Jan	46	2011	Jan	181
	Feb	68		Feb	87		Feb	88
	Mar	74		Mar	109		Mar	106
	Apr	64		Apr	97		Apr	140
	May	64		May	91		May	124
	Jun	38		Jun	117		Jun	75
	Jul	78		Jul	39		Jul	65
	Aug	85		Aug	67		Aug	70
	Sept	56		Sept	88		Sept	97
	Oct	74		Oct	65		Oct	168
	Nov	55		Nov	100		Nov	105
	Dec	153		Dec	78		Dec	84

Experimental-Methods

All our tests were carried out with water samples taken in different localities of the archipelago. It should be noted that these samples are taken during the rainy season.

During our work, we studied some samples of water taken on Anjouan and Grande-Comore to determine the quality of the water we consume since it is not subject to any treatment.

To do this, we made field visits to see the physical condition of some sources and their management.

Sites where the water was studied

Samples from Ndzouani Island

Among the sites visited, two are those of a drinking water supply project financed by the French Development Agency (AFD). They are Mromhou and Konimroni and concern the villages of the Sima peninsula, located on the ridge line (roughly oriented East-West) between the +400 mark and the sea. These are, starting from the high point towards the sea, the villages of : Boungweni, Sima, Kavani, Milembéni, Mirongani and Bimbini (photo 2 and 3).

The catchment is envisaged immediately downstream of the confluence of the 2 tributaries that drain the upper part of the catchment area (BV) at a height of about 280 m. As the 1/50 000 scale extract attests and as we observed on site, this basin is cultivated in its upper part and on its transverse ridge lines (cassava). There are some dwellings and livestock, including in the forest.

During our visits to these different sites, we took some samples for physico-chemical and bacteriological analyses. The latter were carried out in different laboratories in order to determine the degree of water pollution.

- Physico-chemical and bacteriological analyses of samples taken in Anjouan are carried out at the water treatment laboratory of the Coca Cola Comoros Company (COMCO) and/or the water quality control laboratory of the University of the Comoros.
- The physico-chemical analyses of the samples taken at Grande Comore are carried out in the laboratory of JIRAMA Mandroseza and the bacteriological analyses in the laboratory (LHAE) at the Institut Pasteur de Madagascar in Antanarivo.

Photo 1: Capture of Mromhou

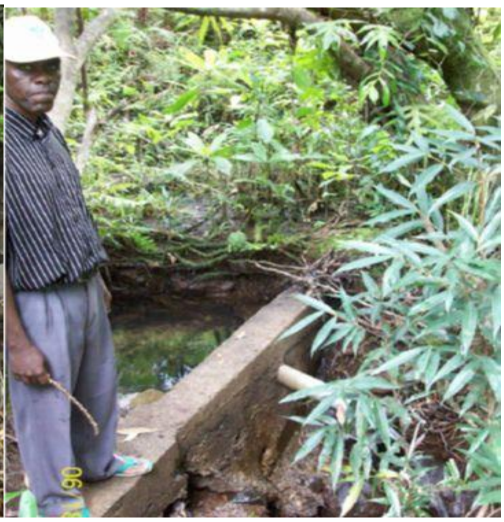

Photo 2: Konimroni capture

Physico-chemical analyses

In the catchments visited, we took two samples of which some characteristics were analyzed: ionic composition; measurements of temperature, electrical conductivity of water and pH [14-16].

Samples of Ngazidja Island

On the ground in Ngazidja, we visited three sites.

Water from the Moroni standpipe

Operating intermittently, and despite their dilapidated state, the Moroni standpipes are the most modern on the island. They distribute water to every corner of the city.

Water from the Hahaya standpipe

The city of Hahaya currently populated by 4 260 inhabitants is located 20 kilometers from Moroni in the northwest of the island. It is among the localities of Grande Comore that enjoys continuous access to brackish groundwater [9].

Photo 3: Moroni fire hydrant

Photo 4: Hahaya fountain

Dimadjou Hamahamé collective rainwater tank.

Collective tanks refer to tanks that do not belong to an individual, and whose use is reserved for the entire community, subject to certain rules published by the community itself [4].

Photo 5: Dimadjou collective cistern

Physico-chemical analyses made it possible to determine the quantity of elements contained in the water such as: mineral compounds, organic compounds, organoleptic compounds, radioactive compounds and parameters such as: temperature, turbidity, pH, conductivity, etc. [14-16]

Three samples are taken and analyzed:

Sample 1 :

Photo 6 : Water from the Moroni standpipe

Sample 2 :

Photo 7 : Water from the Hahaya standpipe

Sample 3 :

Photo 8 : Water from the collective cistern of *Dimadjou (rainwater)*

These analyses were carried out at the JIRAMA laboratory in Madagascar and made it possible to determine the physico-chemical parameters of these samples taken.

Bacteriological analyses

Microbiological analyses of water make it possible to determine the presence of animal or human faecal pollution; They are also an excellent way to monitor the effectiveness of protective measures or treatment. These samples are analyzed at the Food and Water Hygiene Laboratory of the Institut Pasteur in Madagascar [14-15].

RESULTS AND DISCUSSION

According to population projections (Table 1), the three Comorian islands will be populated at 2025 by 1 019 861 inhabitants, which means that its population is expected to double almost every 25 years. Rapid population growth is distorting the use of already limited resources threatened by climate instability, leading to a high incidence of poverty and malnutrition, especially in rural areas.

Indeed, drinking water tends to become scarce, although the percentage of the population with easy access to it is only 30% in Grande Comore and 15% in Anjouan, but 80% in Mohéli [6-8]. The analysis of Table 2 shows us that, assuming that supply remains the same, specific consumption per capita increases from 35 litres per day in 2002 to 28 litres per day in 2012, i.e. below 50 litres per day used as the necessary average for basic current needs by the WHO. In 2025, the average consumption per capita will fall by 19 liters per day if the supply remains the same. Information obtained on waterborne diseases (tables 3 and 4) showed that for the period from November to January the number of typhoid cases in these areas is increasing. It reaches the number of 180 cases during this rainy period. This is due to the dumping of feces (faeces) in rivers and in the vicinity of springs and lakes, and which goes directly into the distribution system without undergoing any control or treatment [17].

During our work, we were able to determine some important parameters in water treatment (measurement of temperature, electrical conductivity of water and pH). These physico-chemical analyses confirmed what was suggested by the measurement of the electrical conductivity of the water, i.e. the low mineralization of the water sampled. That is consistent with the geological context of the island, formed by relatively insoluble volcanic terrains [18]. The results obtained after analysis are recorded in the following tables.

Table -5 Physico-chemical parameters of the Konimroni and Mromhou samples

Catchment or source	pH	T°C	Turbidity	Conductivity	Mineralization	Iron
Konimroni catchment	7.9	22.2	1.5	97	89.312 mg/L	0.03 mg/L
Catchment of Mromhou	7.3	21.1	1.7	102	94.218 mg/L	0.08 mg/L

Source : UCEA

Table -6 Concentration (mg/L) of ions analyzed from Konimroni and Mromhou sites

Catchment or source	pH	T°C	Conductivity	Mineralization	Iron	Ca^{2+}	Mg^{2+}
Konimroni catchment	8.0	22	94	86.635 mg/L	0.209	2.30	1.45 mg/L
Catchment of Mromhou	7.0	21	100	92.165 mg/L	0.23	2.10	1.26 mg/L

Source : UCEA

Bacteriology analyses

Moulds grow in the form of velvety or cottony colonies or in the form of whitish buffers, but yeasts have a smooth surface. For these samples, we counted moulds, yeasts and coliforms.

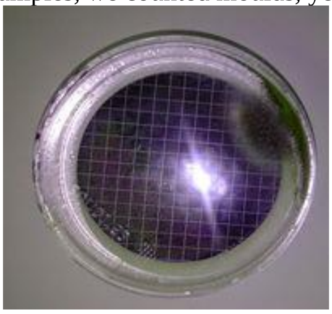

Photo 9 : Yeasts and mould of sample 1

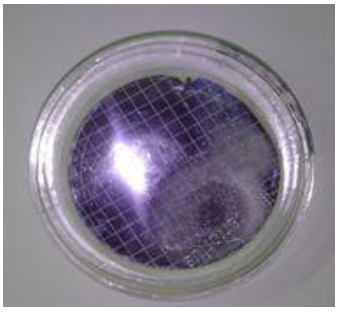

Photo 10 : Yeasts and mould of sample 2

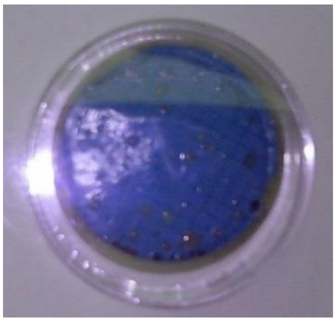

Photo 11 : Total coliforms of sample 1

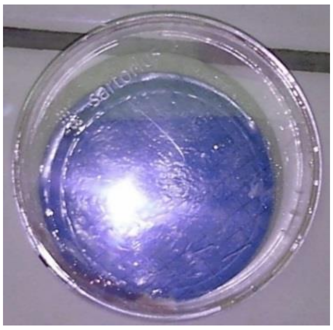

Photo 12 : Total coliforms of sample 2

During bacteriological analyses [14, 16] carried out at the Coca Cola Comoros Water Quality Monitoring Laboratory (COMCO) on samples taken in the study areas, we note in photo n°9 and n°10 the presence of moulds in both samples

but no yeast is observed. On the other hand, in photos n°11 and n°12, we observe the presence of coliforms in these two samples. This shows that these samples do not correspond to the bacteriological standards of drinking water.
The analyses carried out at the JIRAMA laboratory in Madagascar made it possible to determine the physico-chemical parameters of these samples taken [16]. The results of the three samples taken in Ngazidja are recorded in table 7.

Table -7 Results of physico-chemical parameters of samples taken in Ngazidja

	Water from the Moroni standpipe	**Water from the fountain of HAHAYA**	**Water from the collective cistern of Dimadjou (rainwater)**	**STANDARDS**
	07/11/2012	**07/11/2012**	**07/11/2012**	
Bulletin No.	9	8	10	
Temperature °C	22.8	22.9	23.1	25°C
NTU turbidity	1.25	2.4	1.37	< 5 NTU
Ph	7.43	7.23	7.18	6.5 à 9
Conductivity µs/cm	372	1857	82.1	< 3000
Mineralization mg/L	324	1609	71	
Total hardness °f	3.5	24	4.5	< 50
Calcium hardness °f	1.7	5.2	4.2	
Alkalimetric strength °f	0	0	0	
Full alkalimetric strength °F	4	8.4	4.5	
Organic matter mg/L	1.06	1.18	0.64	< 2
Calcium mg/L	6.8	20.8	16.8	
Magnesium	4.374	45.684	0.729	
Sodium	66.52	335.03	3.6	
Total iron mg/L	0.02	0.03	0.03	< 0.5
Bicarbonate	48.8	102.48	54.9	
Chlorides mg/L	96.56	**499.84**	7.81	< 250
Sulphates mg/L	16.34	92.12	3.46	< 250
Nitrite mg/L	0	0.23	0	< 0.1
Nitrates mg/L	2.04	1.54	4.21	< 50
OBSERVATION	RAS	**Brackish water**	RAS	
RAS: NOTHING TO REPORT				

The results show that for the physico-chemical parameters of these samples, only the sample taken at Hahaya (sample 2) has a chloride level that exceeds the limit value of the standards, since it is an underground source whose abstraction is carried out at the seaside, but the remaining parameters meet the standards of drinking water.

Experimental results of microbiological analyses
These samples are submitted by the 0.45 µm membrane filtration method, and total coliforms, enterococci, ASR, pseudomonas and staphylococci were counted [14, 15]. The results are reported in table 8.

Table -8 Microbiological results of parameters

Microbiological parameters	Sample 1	Sample 2	Sample 3
Total coliforms	28	Unaccountable, 2 types colonies: bulging and bottom	2 types 6 yellow and 1 orange colony
Enterococci	0	100	0
ASR	01	00	2527
Pseudomonase	28	0	44
Staphylococcus	2 types of colonies, 11 yellow, 1 orange	100	2 types of colonies, 16 yellow, 12 oranges
M.A 36° + 1°C	13	60	20

For enterococci

Enterococci are germs indicative of contamination of faecal origin. Indeed, no colonies were observed in samples 1 and 3. However, 100 colonies were counted in sample 2 and a confirmatory test was performed. After transferring the membrane into the BEA and incubated it for 24 hours at 44 ° C, no black colonies appeared. The result is less than 1/100 mL, so it is not intestinal enterococci or feces.

For pseudomonas

Pseudomonas aeruginosa usually form blue colonies 1 to 2mm in diameter with a blue halo. Thus for the sample (2), the result is less than 1, on the other hand for samples (1) and (3) we successively have 28 and 44/100 mL. This blue color observed in photo 14 shows the presence of Pseudomonas.

Photo 13: Enterococci results sample 2

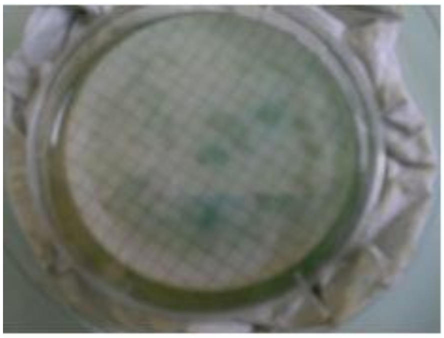

Photo 14: Results of Pseudomonas sample 3

For ASRs

Sulphite-reducing anaerobes (SRCs) are germs capable of reproducing and remaining in water for a very long time in a vegetative form. Their presence in the water, in the absence of faecal germs, can be interpreted as a defect in protecting the slick against the presence of foreign bacterial flora. For those in our samples, we have the following result:

<u>For the sample (1)</u>

1st reading: zero colonies

2nd reading: there is a colony pushed (Photo 15).

<u>For the sample (2)</u>

1st reading and 2nd reading: zero colonies

<u>For the sample (3)</u>

1st reading: 25 colonies

2nd reading: 27 colonies grown (photo 16).

Photo 15: ASR results sample 1

Photo 16: ASR results sample 3

It is noted that only collective cistern water has a worrying value of ASR germs.
For aerobic microorganisms (MA)
They are present in food thanks to a time / temperature couple favorable to their growth. These germs develop in the presence of air (aerobic) at medium temperature (mesophilic: 25-30 ° C).

The sample (1), 13 colonies grown
The sample (2), there are 60 colonies
The sample (3), 20 colonies grown.

Staphylococci
Staphylococcus aureus form colonies whose color varies between golden yellow and orange with a yellow halo.

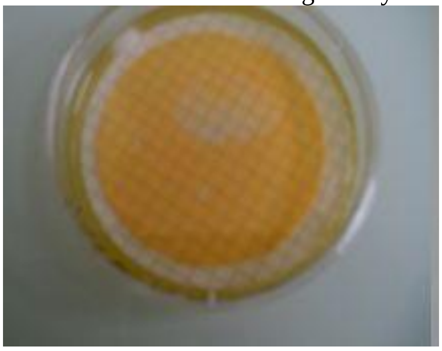

Photo 17: Staphylococci result

Here we notice these types of colonies grown in our samples, but it is necessary to perform a confirmatory test which is gram staining.

Gram stain test:
For the sample (2), there is presence of gram-positive coccus in cluster, but for the other two samples, we did not examine coccus grams (+) in cluster.
The operation is continued using the coagula test and BHI using the research protocol [19, 20] with laboratory modifications.
With the BHI and the coagula test at 37°C for 24 h, we noticed a coagulass tube (+) positive among the ten tubes of the sample (2) and the remaining nine are coagula (-) negative, so we have as result for the sample (2).
Result: *1/100 mL staphylococcal number*. On the other hand for the other two samples (1) and (3), all the tubes are coagula (-) negative.
Result: 0*/100 mL staphylococcus number*. So absence of intestinal staphylococci (See tables 10 and 11)

Table -9 Staphylococcus number (Sample 1)

Sample 1	**Yellow colonies 11**			**Orange colonies 1**
	1	2	3	1
BHI coagula test	-	-	-	-

Table -10 Staphylococcus number (Sample 2)

Sample 2	**Yellow colonies 100**									
	1	2	3	4	5	6	7	8	9	10
BHI and coagula test	-	-	-	+	-	-	-	-	-	-

Table -11 Staphylococcus number (Sample 3)

Sample 3	**Yellow colonies 16**			**Orange colonies 12**		
	1	2	3	1	2	3
BHI coagula test	-	-	-	-	-	-

For total coliforms on membrane
Total coliforms are a group of bacteria that are commonly found in the environment, such as soil or vegetation, and in the intestines of mammals, including humans. Total coliforms generally do not cause disease, but their presence indicates that a water supply may be contaminated with more harmful microorganisms [20].
Escherichia coli is the only member of the total coliform group found exclusively in the intestines of mammals, including humans. The presence of *E. coli* in water indicates recent contamination with feces, and may indicate the possible presence of disease-causing pathogens such as bacteria, viruses and parasites.
We have carried out the manipulations, the interest of which varies according to the case:

- after reading, we transplanted respectively 10 suspicious colonies of coliforms on tryptone casein soy agar (TCS) in petri dishes. Incubate the agar at 36 + 2 ° C for 21h + 2h;
- search for oxidase: we took with a Pasteur pipete a part of the chosen colony and spread it on an oxidase paper impregnated with a few drops of distilled water. In the presence of oxidase, a purple coloration appeared immediately after 15s. A positive oxidase reaction that is excellent and transplant colonies considered negative oxidase on urea broth. We incubated at 44°C for 24 h and 0.2 to 0.3 mL of Kovacs reagent.

Considering all oxidase (-), urea (-) and indole (+) colonies as *Escherichia coli*, we have the following results:
Sample (1) : For 10 transplanted colonies we have 4 are oxidases (-) with TBX and indole urea, absence of positive oxidase. The coliform number is 4 so there is no *E. coli*.
Sample (2) : For 10 transplanted colonies there are 6 oxidases (-) with TBX and indole urea at 44 °C - 24h. For the revelation of indole (3 drops) of Kocvachs in urea, we have only one tube that is turned red (+) so number of *Escherichia coli* is 1.
Sample (3) : Out of 7 transplanted colonies, 3 are oxidase (-) but with the revelation of indole we have a negative result so absence of *E. coli*.

Table -12 Oxidase test of samples 1, 2 and 3 for the determination of *E coli*.

	Sample 1	Sample2	Sample 3
Total coliforms	28	unaccountable	7
Number of colonies transplanted	10	10	7
Number of coliform	4	6	3
Number of *E. Coli*	0	1	0

The results of microbiological analyses of sample 1, 2 and 3 do not meet standards. This is proven by the presence of germs in these three samples. However, for physico-chemical analyses, the values do not exceed the standards of potability drinking water. This allows us to conclude that the water consumed in these different localities is not microbiologically drinkable. This justifies the presence of waterborne diseases in health districts [19, 20].

Conclusion

In order to contribute to the search for solutions to the problems related to the supply of drinking water in the Comoros, we have focused this work on the physicochemical and microbiological aspects of water.
We began by using statistical data on waterborne diseases in the various islands of the archipelago that were collected from the institutions concerned. These data show that these diseases persist throughout the year and peak during the rainy season. We also examined the condition of water abstraction and storage sources. We then carried out field trips to take samples of water actually consumed, with or without treatment in order to find out the reason that could explain the persistence of waterborne diseases. Water samples were collected from different sites and analyzed for drinkability. Physicochemical and Bacteriological samples are carried out and the results show that the water consumed in these localities does not meet the standards of bacteriological potability. These results concern both areas where water is consumed without prior treatment, and certain areas with water collection and treatment facilities. This helps explain the persistent presence of these waterborne diseases identified in these localities.
We make a suggestion of a method of improving the situation by proposing a technique that is simple, reliable, less expensive and well adapted to the living conditions of the population. This method serves to treat water at home using simple means and that the construction material of the device is on site.

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