Available online at www.elixirpublishers.com (Elixir International Journal)

Applied Chemistry

Elixir Appl. Chem. 136 (2019) 53881-53885

ISSN: 2229-712X

Evaluation of Physico-Chemical and Microbiological Qualities of Drinking Water of Benin Republic South Aquatic Cities

Mickael Vitus Martin Kpessou Saizonou, Leonce Firmin Comlan Dovonon, Magloire Acakpo Nonvignon Gbaguidi, Alassane Youssao Abdoul Karim, Daouda Mama and Nadège Kinigbe

Unit of Research in Ecotoxicology and Quality Study, Laboratory of Study and Research in Applied Chemistry, Polytechnical School of Abomev-Calavi. Universitv of Abomev-Calavi. 01 BP 2009 Cotonou. Benin.

ARTICLE INFO

Article history:
Received: 14 September 2018;
Received in revised form:
14 November 2019;
Accepted: 29 November 2019;

Keywords
Quality,
Water,
Hygiene,
Sanitation,
Benin.

ABSTRACT

This study focuses on Sô-Ava's population well-being regarding to drinking water quality especially in the villages of Ahomey- lokpo and Ahomey-ounmey. Samples of water were taken at three kinds of sites (bollard fountains, river Sô and shallows) and analysed for searching their physico-chemical and microbiogical characteristics. The differents parameters values obtained are sometimes higher than standards. Indeed for example the averages are ranged from 0.0264mg/L to 0.5247 mg/L for nitrites and from 0.73mg/L to 2.86 mg/L for total iron. Averages microbiological parameters also range in 0-19600 UFC/100mL for faecal coliforms and 42-560 UFC/100mL for total coliforms and finally 0-190 UFC/100mL for faecal streptococcus.

Introduction

Day after day the issue of water become a major challenge for global governance, one of the major political issues of the 21st century. The lack of drinking water is always a crucial concen for some populations. Several countries and especially developping countries as Benin republic for a long time higlight on getting water ressources without mind about their quality. But recently this vision change and all drinking water projects focus mainly on physico-chemical and microbiological qualities of water.

Despite Sô-Ava aquatic character, collection of undergroundwater constitute a major difficulty that people faces everyday. Due to their attachement to ancestors behaviors and insuffiscience of the SONEB[1] network throughout the municipality people, continue to consomme water from the castle and river.

To solve a little these concerns, hydraulics infrastructures such as modern wells, forrages, adduction water supplies are built on rare pieces of available lands. But because of their worse location, the water quality is often not according to standards. Also anthropics activities create insalubrity around water supplies points and cause bacterias presence in water. Indeed the ravaging of animals, defecation in nature, proliferation of garbage and other wastes near water points are all, factors of insalubrity. Also the castles that supplies the fountains bollards are not regularly washed and the river is cluttered by wastes and aquatic plants.

The villages of Ahomey-lokpo and Ahomey-ounmey (locations of the present study) are representative samples of the daily lives of the people of Sô-ava commune because of prevalency of diseases usually recorded in these areas.

This work aims population health risk prevention by physico-chemical and microbiological characterization of waater obtained from differents infrastrustures to propose sanitation.

Material and Methods

Description of study area

Water sampling are related to sites frequentations by populations and using of shallows and river's water sometimes by those, as drinking water. Three kinds of sites (river, shallows and fountain bollards) and two sites per village are prioritised.

Table 1 . Sites of sampling coordinates.

Village	Site	North coordinate	East coordinate
Ahomey -ounmey	Fountain bollard	06°33'49,41''	02°24'7,2108''
	River Sô	06°33'57,60204''	02°22'7,9992''
Ahomey-lokpo	Fountain bollard	06°34'49,2636''	02°23'51,3060''
	Shallow	06°34'48,3492''	02°23'42,1944''

Figure 1.Villages location.

[1] Benin's National Society of Water

Tele: (229) 95828180
E-mail address: kpessou67@hotmail.com

Before water sampling step, enquiries are made at populations level to evaluate wich kind of water supplies they use to use and differents water treatments practiced.

Table 2 . Percentage of households surveyed by village

Villages	Households surveyed	Total households	Percentages
Ahomey-lokpo	58	252	23%
Ahomey-ounmey	52	208	25%

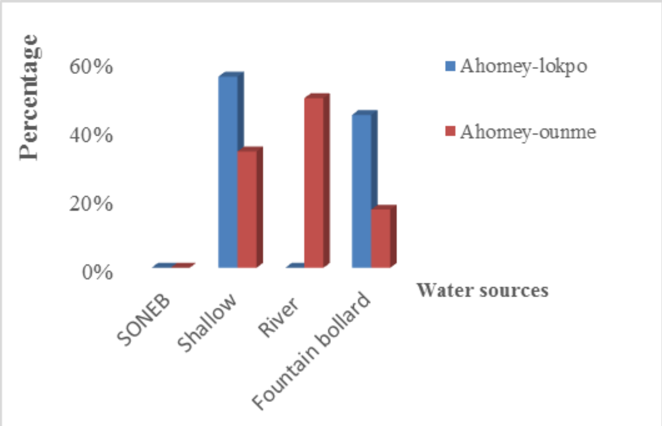

Figure 2 . Population percentage attending differents water sources

Ahomey-lokpo people take drinking water more from shallow (55,56%) in contrary to those from Ahomey-ounmey wich consume more river water (49,30%).

The population of these two villages believes that the water of the shallow has a very good taste unlike the fountain bollard water which would be tasteless and causes them irritation. However if for the population of Ahomey-lokpo, to consume the river water is not good, for those of Ahomey-ounmey, this presents no danger since the ancient parents did the same and would never had health problems related to such behavior.

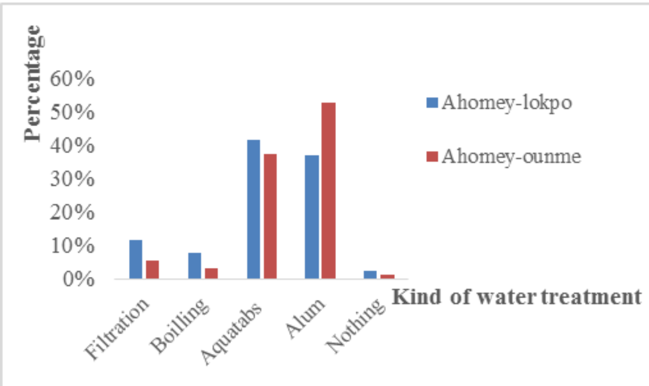

Figure 3 . Percentage of differents water treatments before consuming.

Two treatments are prioritised for water before drinking in Sô –ava. This is use of Aquatabs[2] (41,54% at Ahomey-lokpo and 37,89% at Ahomey-lokpo) and alum (36,93% at Ahomey-lokpo and 52,63% at Ahomey-lokpo).

[2] Troclososene sodium

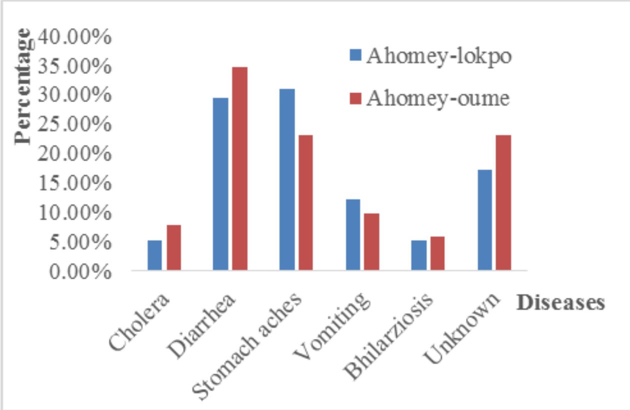

Figure 4 . Percentage of diseases prevalency.

Looking of previous figure make notice that people of these two villages suffer mainly of hydrics diseases.

Sampling collection

All the samples are taken in glasses bottles initially washed and rinsed with the water to be sampled. Especially for microbiological parameters, bottles are steriliased. For all parameters, bottles are completely filled, tightly closed and packed in aluminum paper to protect them from sunray. Bottles used for physico chemical parameters are without air bubble in contrary to those for microbiological ones because of bacteria breathing. In addition for in-situ measurements, 1.5L of water are sampled each time in bottle and rinsed 3 times with the water to be sampled before real water sampling. Water samples are afterwards conserved at a temperature of 4°C and analyzed in the laboratory within 48 hours after the sampling.

Analysis methods

Temperature, conductivity, pH are measured in situ while color and concentrations of nitrits, nitrats, chlorites, total iron, magnesium, calcium, total coliforms, streptococcus and coliform faecal are researched in water samples by standards methods according to methods of analysis recognized by the French Association for Standardization (AFNOR) [1].

Results and discussion

Analysis results are presented by following figures:

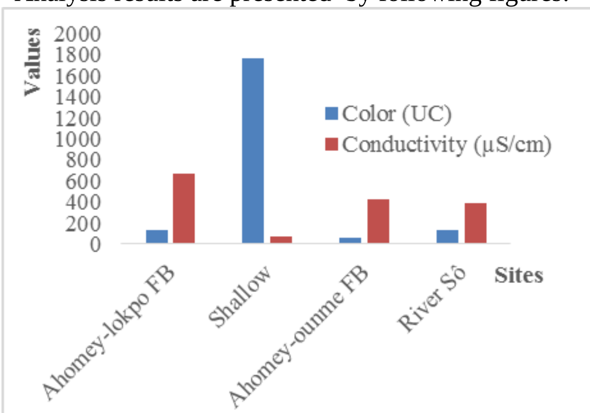

Figure 5 . Color and conductivity of water.

Color is considered to be one of the most important parameters of water quality, but all of water samples values of color are higher than WHO standards (15 UC) [2] and ones of Benin [3]. Black *and al* (1963) [4] argue that the color of drinking water may be due to the presence of colored organic substances, the presence of metals such as iron, manganese and copper, the presence of highly colored waste, the most common are the pasta and paper waste. So it is probably be considered that the state of surroundings of the sources explains the values of water color.

The values recorded are below standards (2000µs/cm) for conductivity. Despite the low values recorded for this parameter, it should be noted however a weak mineralization of these waters.

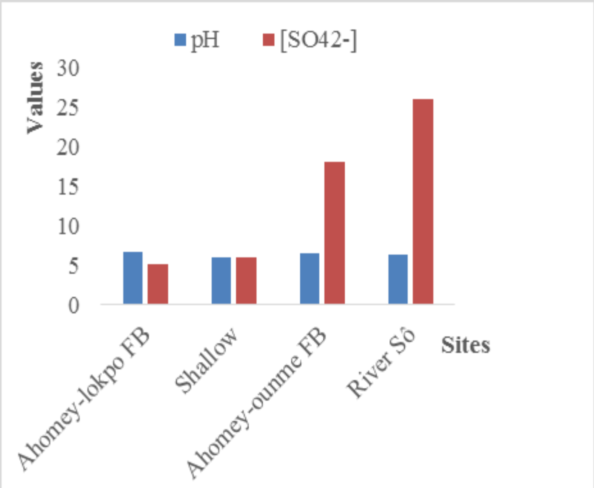

Figure 6. Water pH and sulfate values

According to figure 6 above, Ahomey-lokpo fountain bollard's water has a normal value according to the standards recommended by the WHO. It is also same for different values of sulfate recorded for all samples of water (< 500mg/L).

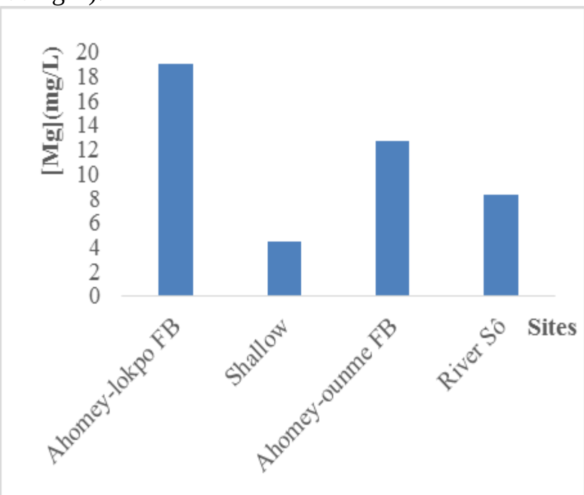

Figure 7. Magnesium concentration in water.

All of water samples have a magnesium concentration that meets the standards recommended by WHO guidelines.

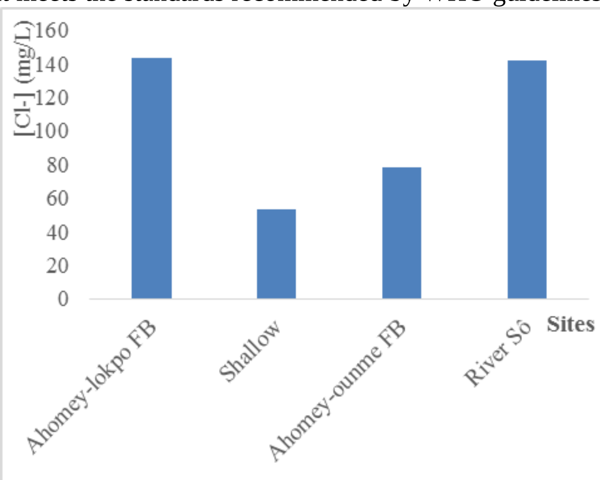

Figure 8 . Chloride ions concentration in water.

No collected water has a chloride ions concentration that exceeds the standards recommended by WHO guidelines.

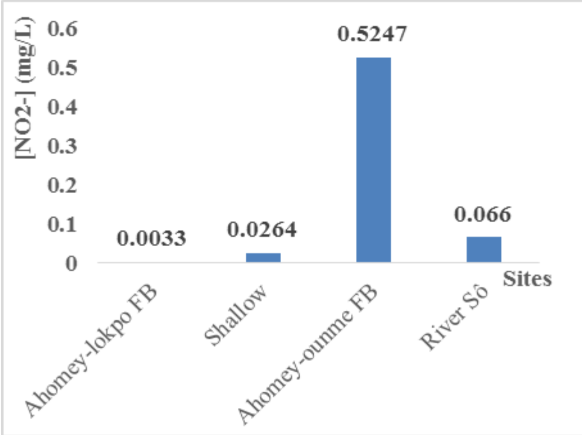

Figure 9. Nitrite concentrations in water.

WHO standards recommands 0.1 mg/L for nitrits contents in drinking water but concentrations recorded in samples analysed are all higher than this value.

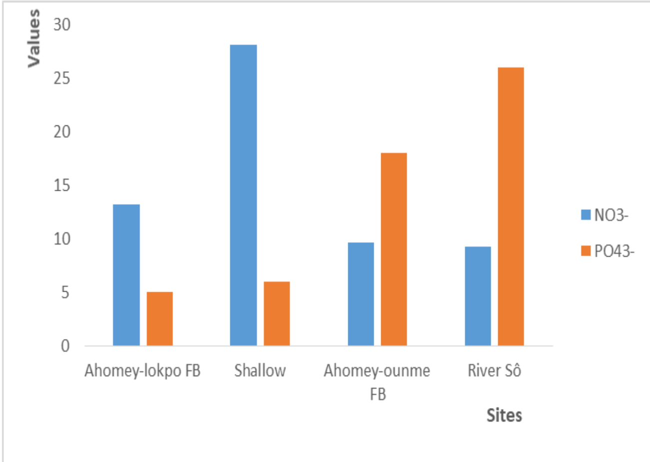

Figure 10. Nitrate and phosphate concentration in water

The figure 10 shows nitrate and sulfate values below WHO standards (respectively 45mg/L and 500mg/L), indicating no contamination regarding to these parameters for water consumed in the two villages.

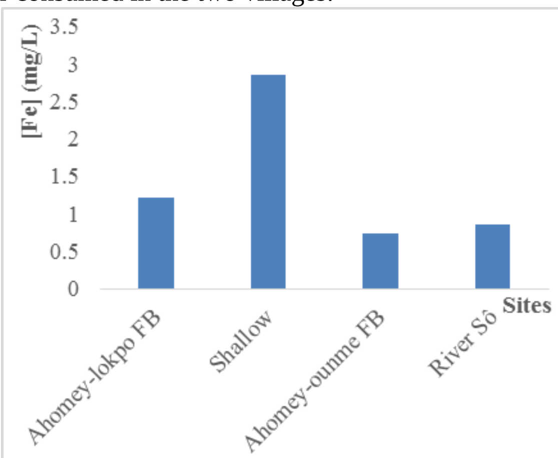

Figure 11 . Iron content in water

Iron concentrations recorded in water samples are all higher than 0.3 mg/L wich is recommanded as WHO standard , the water of the shallow remains the richest in iron. The origin of the iron in the waters could be explained by the nature of the crossed lands. Generally, iron does not present a danger for human health or for the environment but it brings to the water, inconveniences of an aesthetic and organoleptic nature. Indeed, the presence of iron in the water provocs rust that can stain laundry and sanitary. Iron also gives a metallic taste to the water making it unpleasant to consume.

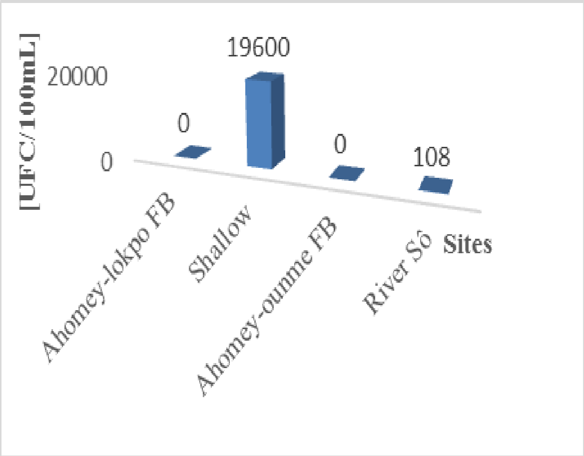

Figure 12. Fecal coliforms concentrations in water.

Only the waters of the shallow and the river are contaminated by fecal coliforms with very high contamination in the shallow since the standard is 00 UFC / 100mL.

Fecal coliforms are very sensitive controls of faecal contamination because of their large amount in the faeces, and completely because of their higher concentration in humans (Rodier, 2009). Compared to these bacteria of faecal origin, the germs contained in the sampled water have largely exceeded the norm of 0 UFC / 100mL recommended by the WHO and can then be responsible for the angina, otitis, meningitis and other equally serious affections .

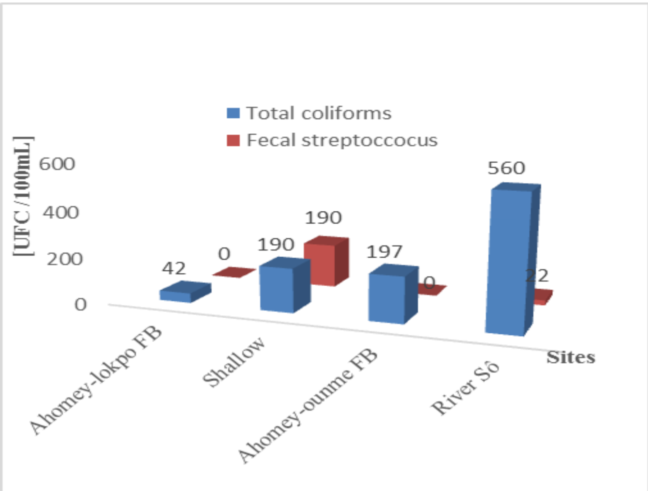

Figure 13 . Total coliforms and feacal streptococcus concentrations in water

Figure 13 shows that waters from all of the sites sampled are contaminated by total coliforms, since the standard is 10 CFU / 100mL and the concentrations recorded range from 42 to 500 CFU/100mL. Total coliforms indicate the ineffectiveness of a treatment. The same figure 13 shows that waters studied are contaminated also by faecal streptococcus. The values obtained range from 15 to 190 germs per 100 ml of water withdrawn. Only water from Ahomey-lokpo's fountain bollard is not contaminated by fecal streptococcus, since the standard is 00 CFU / 100mL. The presence of these germs in the drinking water is unacceptable according to bacteriological standards, because their presence indicates faecal contamination, confirming the infections and gastroenteritis that were identified during the survey. Indeed, the origin of faecal pollution is related to the quantitative ratio of faecal coliforms to faecal streptococcus (CF / SF). When this CF / SF ratio is greater than 4, the pollution is essentially human (Borrego *and al*, 1982). When less than 0.7, animal origin, especially livestock, and particularly sheep, seems to play a predominant role in water contamination (Larif, 2013). This ratio is 4.99 for the water at the river site and 103.15 for the shallow water, which means that all waters are contaminated by anthropogenic activities due to the presence of organic matter, lack of hygiene and sanitation around water points.

Table 3 summarizes the percentages of contaminated and uncontaminated waters by the various parameters.

Table 3 . Percentantage of water contamination based on various parameters.

Parameters	Contamined water percentage
pH	75%
Color	100%
Conductivity	0%
Nitrites	25%
Nitrates	0%
Iron	100%
Phosphates	0%
Sulfates	0%
Magnesium	0%
Chlorite	0%
Fecal coliforms	50%
Total coliforms	100%
Fecal streptococcus	75%

The results obtained show that seven (07) of the measured parameters have values that do not meet the standards recommended by WHO for drinking water and thus influence the quality of the drinking water in the different villages. These are pH, color, nitrites, iron, faecal streptococcus, faecal coliforms, total coliforms. At the three (03) sampling sites, the water nitrite concentrations range from 0.0264 to 0.524 mg / L. Only the water of the Ahomey-ounmey's fountain bollard is contaminated with nitrites, with a content of 0.524 mg / L. These results could be justified by the presence of piles of garbage noticed by place. Nitrites (NO_2^-) are naturally occurring ions in the environment. Their source is also attributed to anthropogenic activities through livestock, agriculture and others. They are the result of nitrification of the ammonium ion (NH_4^+), present in water and soil, which is oxidized to nitrites by bacteria of the genus nitrosomonas [7].

Conclusion

In short, all the waters of the different sampling sites do not have their physico-chemical parameters out of the standards. On the other hand, all waters are contaminated by coliforms and / or streptococcus. In addition, the shallow water is the most contaminated because of its very higher values of microbiological parameters. The high presence of these pollutants affects the health of the populations using these waters for consumption. These results led to the conclusion that the waters of the different sites do not meet the criteria for drinking water. To improve the conditions of access to good quality water, it is suggested to the populations to avoid the consumption of river water and shallow and to respect the rules of hygiene and sanitation around the castles of water and fountains they feed. All this will also have to pass by the education and the sensitization of the populations on the importance of the correct management of the solid wastes and on the risks of contamination of the surface waters and finally popularization of the most reliable and accessible methods of water treatment to the populations.

Bibliographical References

[1] N. Rodier, J. Legube, B. Merlet, Water Analysis. 9th Edition, DUNOD, Paris. (2009)

[2] World Health Organization: Guidelines for Drinking Water, 3rd Ed. (Vol1), Geneva 2004. 111p

[3] Decree n°2010-44 of November 24, 2010 setting standards of quality of drinking water in the Republic of Benin.

[4] A. Black, "Characteristic of colored surface waters", J.Am. Water works assoc.55:753p. 1963

[5] M. Larif, A. Soulaymani, M. Hnach, A. El midaoui. Spatio-temporal waterborne contamination of wadi Boufekrane in the region of Meknes-Tafilalt (Morocco) International Journal of Biological and Chemical Sciences 7(1):pp 172-184. (2013)

[6] World Health Organization: Guidelines for Drinking Water, 3rd Ed. (Vol1), Geneva 2004. 111p

[7] Health Canada. Nitrate and nitrite. Guidelines for Canadian Drinking Water Quality. Supporting documentation.(1992). [Online] Available on www.hcsc.gc.ca/ehp/dhm/catalogue/dpc_pubs/rqepdoc_appui/nitrate.pdf.