ISSN: 0975-833X

Available online at http://www.journalcra.com

International Journal of Current Research
Vol. 9, Issue, 11, pp.61076-61083, November, 2017

INTERNATIONAL JOURNAL OF CURRENT RESEARCH

RESEARCH ARTICLE

PHYSICOCHEMICAL AND BACTERIOLOGICAL QUALITY OF WATER FROM THE NETWORKOF WATER SUPPLY IN ABOBO, ABIDJAN, CÔTE D'IVOIRE

[1,2]Yapo Ossey Bernard, *[1]Gnagne Agness Essoh Jean Yves Eudes, [3]Ohou Yao Marie-Jeanne Adelaide, [1]N'cho N'cho venance [4]Bouafou Eugene, [1]Gadji Alahou André Gabazé, [1]Ahoule dompe Ghislain, and [1,5]Okou Gnahoua Magloire

[1]Laboratoire des Sciences de l'Environnement (LSE), Unité de Formation et de Recherches en Sciences et Gestion de l'Environnement (UFR-SGE), Université Nangui Abrogoua, 02 BP 801 Abidjan 02, Côte d'Ivoire
[2]Laboratoire Central de l'Environnement du Centre Ivoirien Anti-pollution (LCE-CIAPOL), 20 BP 650 Abidjan 20, Côte d'Ivoire
[3]Unité de Formation et de Recherche en Environnement, Université Jean Lorougnon Guédé de Daloa, 12 BP V 25 Daloa, Côte d'Ivoire
[4]Office National de l'eau potable (ONEP), 04 BP 42 Abidjan 04, Côte d'Ivoire
[5]Laboratoire de Thermodynamique et Physico-Chimie du Milieu (LTPCM- SFA), Université Nangui Abrogoua, 02 BP 801 Abidjan 02, Côte d'Ivoire

ARTICLE INFO

Article History:
Received 20th August, 2017
Received in revised form
22nd September, 2017
Accepted 09th October, 2017
Published online 30th November, 2017

Key words:
Physico-chemical quality,
Hygienic quality,
Drinking water,
Côte d'Ivoire.

ABSTRACT

Potential source of life, drinking water must undergo various physical, chemical and bacteriological analyses that will assess its quality for human consumption avoiding any risk of contamination. This study aims to determine the physical, the chemical and the bacteriological quality of drinking water in Abobo (Abidjan Côte d'Ivoire). Ten (10) neighborhoods have been selected for the sampling from taps. A total of forty (40) water samples have been analyzed at a ratio of four (04) samples per neighborhood. Eleven (11) physical and chemical parameters and four (04) bacteriological parameters were analyzed on the basis of the French standards (AFNOR). According to the results, drinking water inten (10) neighborhoods ofAbobo has a good physico-chemical quality. However, two (2) samples out of forty (40)are unfit for human consumption because they are total coliforms contaminated. This may be due to the low rate of free chlorine in these samples *et al*so to the supply network quality.

Citation: Yapo Ossey Bernard, Gnagne Agnes Essoh Jean Eudes Yves, Ohou Yao Marie-Jeanne *et al.* 2017. "Physicochemical and bacteriological quality of water from the networkof water supply in abobo, abidjan, Côte d'ivoire", *International Journal of Current Research*, 9, (11), 61076-61083.

INTRODUCTION

Water is as important as air for human life. It is one of the key elements for country organization and development. Although it is unevenly distributed on the earth and sometimes in limited quantities, water remains a major environmental issue (Dovonon, 2011). Having sufficient water helps to keep healthy (Makoutode *et al*., 1999). Human environment depends on water, which in turn depends on global and local environmental dynamics. As a result, in the scientific research framework, as for decision-makers, water and environment are often associated (Sal, 2010).

***Corresponding author:* Gnagne Agness Essoh Jean Yves Eudes,**
Laboratoire des Sciences de l'Environnement (LSE), Unité de Formation et de Recherches en Sciences et Gestion de l'Environnement (UFR-SGE), Université Nangui Abrogoua, 02 BP 801 Abidjan 02, Côte d'Ivoire.

Population growth and rapid urbanization in Abidjan has led to an increase in water demand. This situation has consequently created aproliferation of drinking water supply networks. However, risks of contamination from this source remain important and act asa threat for both hygienic quality and physico-chemical characteristics of drinking water.Abobo is a township whose questions of the environment management are worrying. Environmental damages are widespread and increasing. One of the greatest difficulties encountered by municipal authorities is the collection of household waste and the disposal of waste water. These difficulties bring about the presence of a lot of uncontrolled urban waste deposits and the stagnation of both wastewater and storm water in many districts. The rates of household garbage collection rarely reach 50% (Nyassogbo, 2005). The low coverage rate of this important service results in a polluted and an unhealthy environment; a fact due to air, soiland subsoilpollution and the degradation of the living environment. Beyond the impact that this unhealthy environment could have on the water distributed by SODECI (water Distribution Company of Côte d'Ivoire)this study sheds light on the effectiveness of the treatment system and the drinking water treatment facilities used by SODECI.It also deals with the water canalization system. It is thus within this framework that this work aims to assess the quality of drinking water in Abobo, a township in Abidjan, through the analysis of physico-chemical and bacteriological parameters. These analyses will be done in accordance with the WHO standards of drinking water quality used in Côte d'Ivoire.

MATERIALS AND METHODS

Materials

Presentation of the study area

Locatedin the North of Abidjan (Ivory Coast), Abobo is the second most populated township of this city. It is bounded by Anyama in the North, by Williamsville, Adjamé and Deux-plateaux in the South, by Angré-Cocody in the East and in the West by the Banco forest (figure 1).Drinking water in Abobo comes from an underground sourcewhich is 98% from drillingwells(this water is distributed by SODECI) and 0.18 % from local wells (INS, 2014). The study area of this work covers ten (10) of the twenty-nine (29) neighborhoods of Abobo (Figure 1).

thermometer was used for pH and temperature measurement, a HQ conductivity meter for the measurement of electrical conductivity, a HQ 2700 turbidity meter for the measurement of turbidity, and a HACH-type chlorine meter for the measurement of free chlorine.Analyses using a molecular absorption spectrophotometer: NH_4^+, NO_3^-, PO_4^{3-}, SO_4^{2-}, and NO_2^- have been conducted in the laboratory. A Matashana autoclave was used for the sterilization of the culture mediumof the equipment to be used for measuring microbiological parameters. MEMERT ovens were used for the incubation of germs. A SATORUS filtration ramp was used for the filtration of samples to be used for fecal contamination germs.

METHODS

Water choice

According to INS (2014), Abobo is supplied by drilling water at 98%, water processed and distributed by SODECI and at 0.18% by wells. The sampling, essentially based on drilling water is due to the high use of drilling water distributed by SODECI in the households.

Neighborhoods Selection Criteria

The choice of the ten (10) neighborhoods was made on the basis of the density of the population and the availability of water in these neighborhoods.

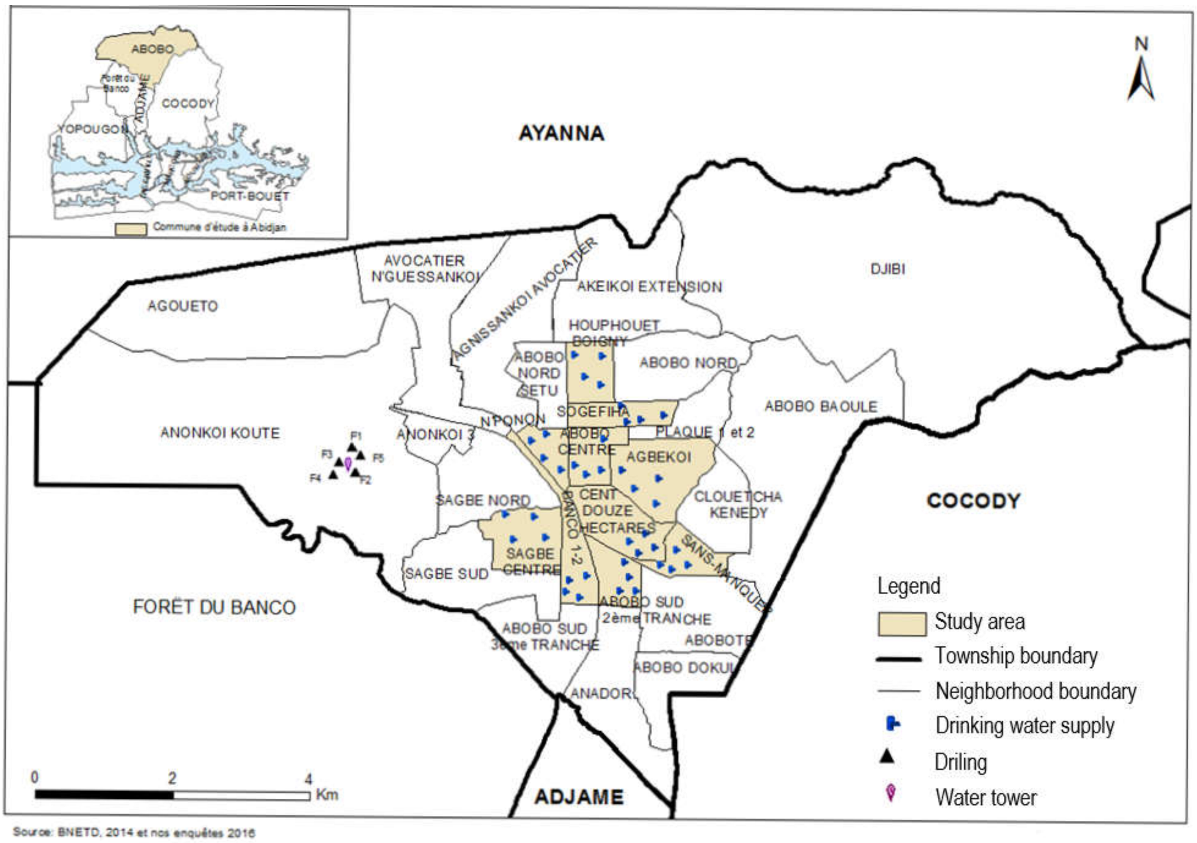


Figure 1. Map of the study area

Study Materials

The study material consists of drinking water from SODECI. It istap water fromten (10) neighborhoods in Abobo. For in-situ measurements, a HQ-type pH meter, coupled with a

These neighborhoods are: Sans Manquer ; Abobo Sud 2ème Tranche; Cent Douze Hectares; Sagbé Centre; Banco 1-2 ; Agbékoi ; M'Ponon ; Habitat Sogefiah ; Abobo Centre and Abobo Houphouët Boigny (Figure 1).

Sampling

Four (04) water samples were collected from four (04) households in each of the ten (10) chosen neighborhoods. The samples were randomly collected from four (04) households following the four cardinal points (North, South, East and West). The drinking water samples were taken in 1000 ml brown PET (polyethylene) bottles for physicochemical analyzes and in 500 ml transparent glass bottles for bacteriological analyzes. These samples were labeled and placed in a cooler container and stored at a temperature of 5 ± 3ºC. They were then sent to the laboratory for analyses. A total of forty (40) water samples were analyzed at a ratio of four (04) samples per neighborhood.

bacteriological parameters. Descriptive analyzes have therefore been carried out through arithmetic average and standard deviation. The results were represented by curves and histograms.

$$\overline{X}=\frac{1}{n}\sum_{i=1}^{n} x_i$$

$\overline{X}$: Arithmetic average

$$\sigma = \sqrt{\frac{1}{n}\sum_{i=1}^{n}(x_i - \overline{X})^2}$$

σ: standard deviation

Physicochemical sampling **Bacteriological sampling**

Figure 2. Water sampling Photographs

Table 1. Summary of the methods of analyses and references

Parameters	Method of analysis	References
pH	Electrometric measurement with glass electrode	NF T 90-008
Conductivity (µS/cm)	Electrometric measurement with electrode	NF EN 27888
Turbidity (NTU)	Formazin nephelometric methods	NF EN ISO 7027
Chlorine free (mg/L)	Colorimetric methods N, N-diethylphenylene-1,4-diamine (DPD)	HACH
Chlorides (mg/L)	Mohr's method	EN ISO 9297
Sulfates (mg/L)	Nephelometric method	NF T 90-210
Alkalinity (mg/L)	Titrimetric method	NF EN ISO 9963-1
Ammonium (mg/L)	Spectrophotometric method with indophenol blue	NF T 90-015-2
Nitrites (mg/L)	Ferrous sulfate reduction method	HACH
Nitrates (mg/L)	Spectrometric method with sulfosalicylic acid	EN ISO 7890-3
Ortophosphates (mg/L)	Ammonium molybdate spectrometry method	NF EN ISO 6878

Samples analysis

Physical and chemical parameters

The physico-chemical parameters analyzes were made on the basis of the French standards (AFNOR, 2001a) and HACH methods. Table 1 shows the methods of analysis and the references of the different physico-chemical and bacteriological parameters used in this work.

Statistical processing of data

The resulted data were submitted to statistical analyses to better account for, on the basis of WHO standards, the exceedance frequency, the physico-chemical and

RESULTS AND DISCUSSION

Physico-chemical quality of drinking water in (10) neighborhoods in Abobo

Physical parameters

Figure 3 shows the pH, the conductivity and the turbidity values of drinking water in ten (10) neighborhoods in Abobo. The pH values of these waters vary from 6.75 ± 0.10 in Abobo Sud 2ème tranche to 6.98 ± 0.14 in Habitat Sogefiah. Concerning the values of the conductivity, they oscillate between 104 ± 12,5 µS/cm and 164 ± 69 µS/cm, respectively in Abgékoi and M'ponon. As for the values of turbidity, they evolve between 0,44 ± 0.04 NTU in Abobo

Sud 2ème tranche to 0, 57 ± 0.14 NTU in Sans Manquer and Abobo Centre. These waters are quite transparent (colorless) and are fairly mineralized with an acid tendency (pH <7).

Chemical parameters

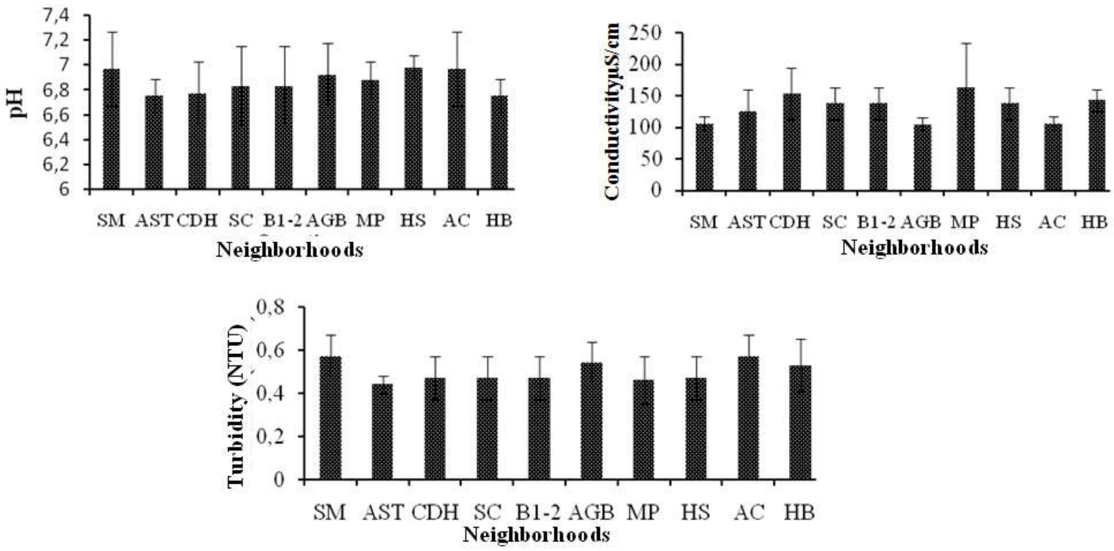
Nitrogen and phosphorus constituents

Figure 4 shows the average concentrations of nitrogen and phosphorus constituents in drinking water of Abobo. Indeed, the nitrogen concentrations of Abobo drinking waters evolve from 1.05 ± 0.38 mg / L in Abobo sud 2ème tranche to 2.83 ± 1 mg / L in Sans-Manquer and Abobo Centre.

As for the ammonium concentrations, they vary from 0.33 ± 0.14 mg / L in Abobo sud 2ème Tranche to 0.35 ± 0.15 mg / L in Abobo Centre. As far as the orthophosphate concentrations are concerned, they vary from 0.33 ± 0.14 mg / L in Abobo sud 2ème Tranche, in Cent Douze Hectares and in Banco 1 -2 to 0.74 ± 0.25 inSans Manquer.

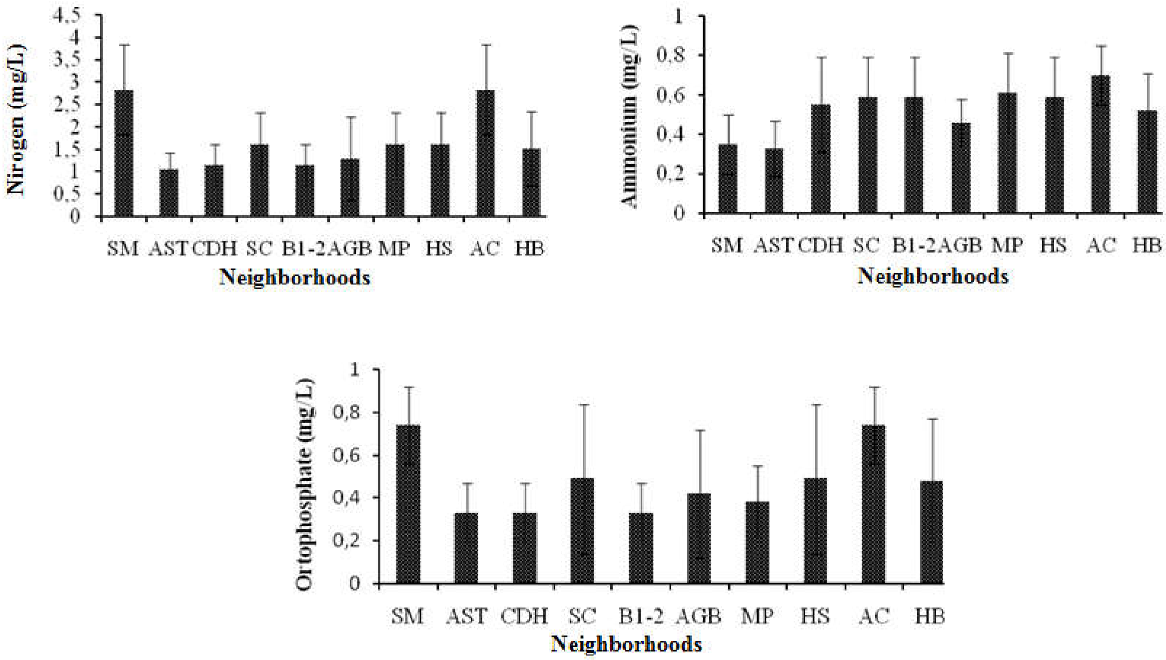
Some major ions

Figure 5 shows the sulfate ions, the chloride and the bicarbonate concentrations s of drinking water in ten (10) neighborhoods in Abobo. The sulfate concentrations evolve between of 0.33 ± 0.14 mg / L in M'Ponon and 0.70 ± 0.16 mg / L in Sans Manquer and Abobo Centre.



SM = Sans-Manquer ; AST = Abobo sud 2ème Tranche ; CDH = Cent Douze hectares; SC = Sagbé Centre ; B1-2 = Banco1-2 ; AGB = Agbekoi ; MP = M'ponon ; HS = Habitat Sogefiah ; AC = Abobo Centre ; HB = Abobo Houphouët Boigny

Figure 3. Average values of pH, conductivity and turbidity



SM = Sans-Manquer ; AST = Abobo sud 2ème Tranche ; CDH = Cent Douze hectares; SC = Sagbé Centre ; B1-2 = Banco1-2 ; AGB = Agbekoi ; MP = M'ponon ; HS = Habitat Sogefiah ; AC = Abobo Centre ; HB = Abobo Houphouët Boigny

Figure 4. Average concentrations of nitrogen, ammonium and orthophosphate of Abobo drinking water

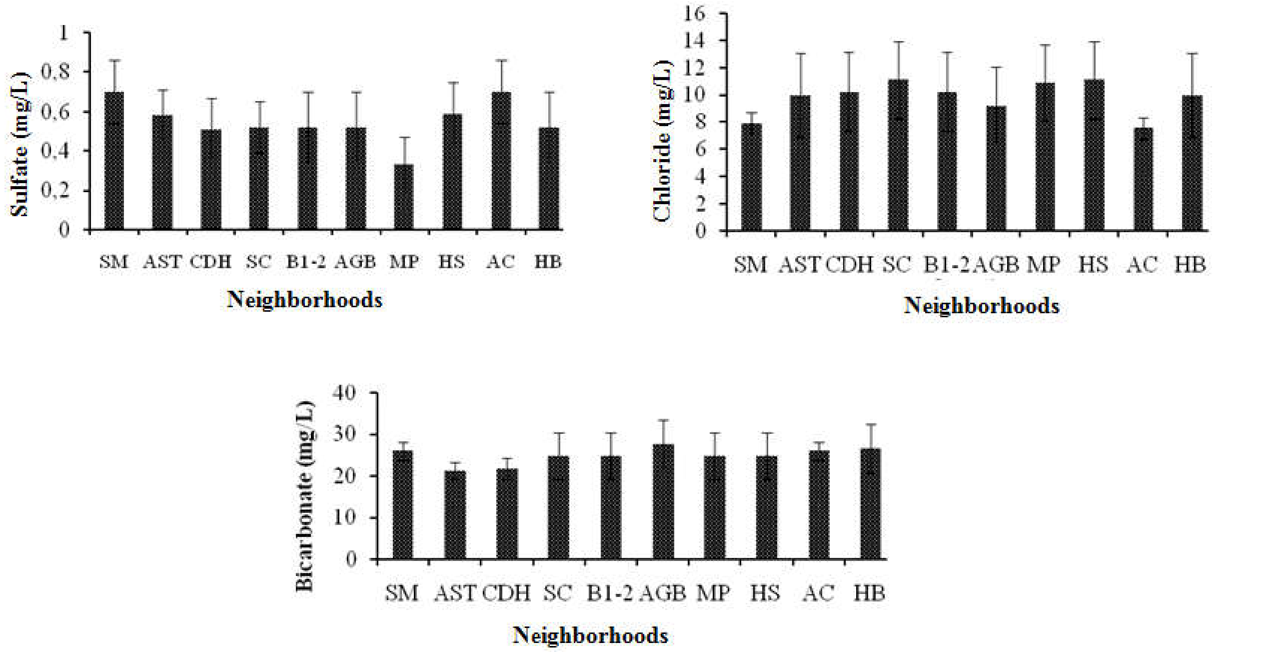
The chloride concentrations vary from 7.55 ± 0.81 mg / L in Abobo Centre to 24.7 ± 5.56 mg / L in Sagbé Centre, M'ponon and Habitat Sogefiah. As for the bicarbonate concentrations, they evolve between 21.2 ± 2 mg / L in Abobo Sud 2ème Tranche and 27.5 ± 5.91 mg / L in Agbekoi.

Free chlorine (Cl_2)

Figure 6 presents the average concentrations of free chlorine in drinking water of ten (10) neighborhoods of Abobo. These concentrations vary from 0.28 ± 0.04 mg / L in HouphouetBoigny and Abobo Sud 2ème Tranche to 0.32 ± 0.07 mg / L in Cent Douze Hectares, Sagbé Centre, Banco 1 -2, Agbekoi, M'Ponon and Habitat Sogefiah.

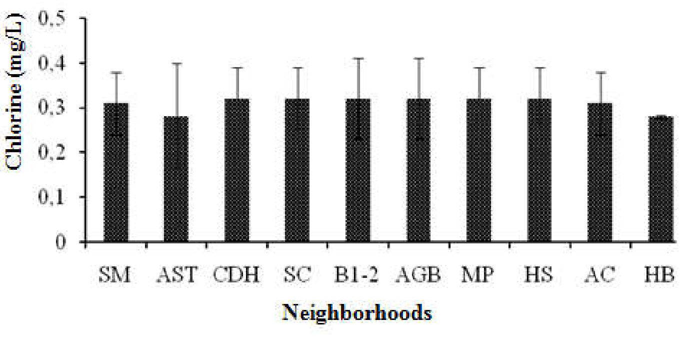
Table 2. Exceedance frequency of physicochemical and biological parameters

Parameters	WHO standards (2011)	Number of sample	exceedances Percentage (%)
pH	6.5 - 8.5	40	0
Conductivity	-	40	0
Turbidity	<5	40	0
Free chlorine	0.3 - 5	40	25
chlorides	250	40	0
sulfates	250	40	0
Bicarbonate	-	40	0
Ammonium	1.5	40	0
nitrates	50	40	0
phosphates	-	40	0



SM = Sans-Manquer ; AST = Abobo sud 2ème Tranche ; CDH = Cent Douze hectares; SC = Sagbé Centre ; B1-2 = Banco1-2 ; AGB = Agbekoi ; MP = M'ponon ; HS = Habitat Sogefiah; AC = Abobo Centre ; HB = Abobo Houphouët Boigny

Figure 5. Average concentrations of sulfate, chloride and bicarbonate of Abobo drinking water



SM = Sans-Manquer ; AST = Abobo sud 2ème Tranche ; CDH = Cent Douze hectares; SC = Sagbé Centre ; B1-2 = Banco1-2 ; AGB = Agbekoi ; MP = M'ponon ; HS = Habitat Sogefiah ; AC = Abobo Centre ; HB = Abobo Houphouët Boigny

Figure 6. Average concentrations of free chlorine of Abobo drinking water

Exceedance frequency of physicochemical parameters

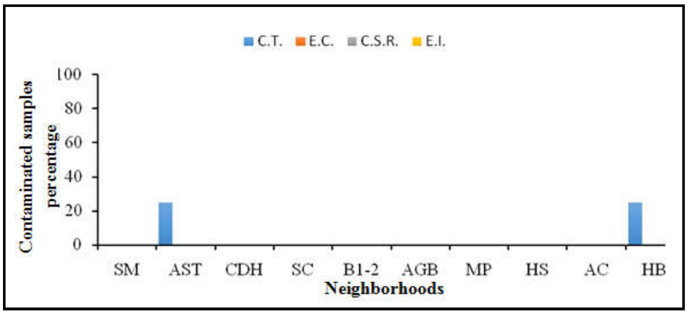
Table II presents the exceedance frequency of physicochemical parameters of forty (40) water samples collected in accordance with WHO standards (2011). Only one parameter out of eleven (11) has been questioned for non-compliance; namely the residual chlorine in 25% of the water samples (10 samples out of 40).

Bacteriological quality drinking water (10) neighborhoods of Abobo

Water fecal bacteria Contamination

Figure 7 displays the contamination by total coliforms - *Escherichia coli, sulfite-reducing clostridia* - and intestinal enterococci of water samples from ten (10) neighborhoods of

Abobo. It is a total coliforms contamination of only 25% of water samples from Abobo *Sud 2ème Tranche* and *Houphouët Boigny* .



CT = Total Coliforms ; EC = Escherichia coli ; CSR = sulfite-reducing clostridia; EI = Intestinal Enterococci SM = Sans-Manquer ; AST = Abobo sud 2ème Tranche ; CDH = Cent Douze hectares; SC = Sagbé Centre ; B1-2 = Banco1-2 ; AGB = Agbekoi ; MP = M'ponon ; HS = Habitat Sogefiah ; AC = Abobo Centre ; HB = Abobo Houphouët Boigny

Figure 7. Distribution of fecal bacteria contaminated samples in ten (10) neighborhoods of Abobo

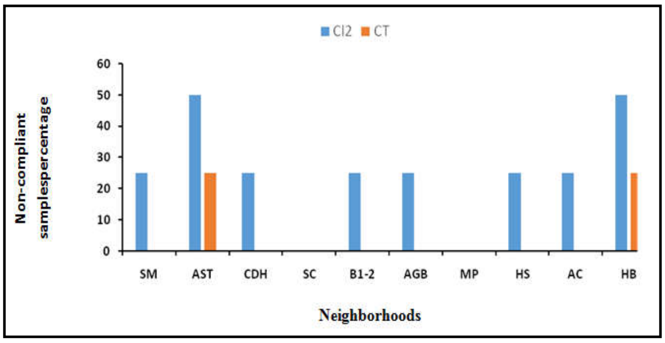
Exceedance frequency of bacteriological parameters

Table III shows the exceedance frequency of bacteriological parameters of forty (40) waters sampled according to the WHO standards (2011). Out of the four (4) bacteriological parameters, only fecal coliforms have been questionned. Here, it is 5% of the water samples; that is to say two (2) samples out of 40 contaminated by total coliforms.

Table 3. Exceedancefrequency of microbiological parameters

Parameters	WHO standards (2011)	Number of sample	Percentage of non-compliance (%)
total coliforms	0 UFC / 100 ml	40	5
Escherichia Coli	0 UFC / 100 ml	40	0
sulfite-reducing clostridia	0 UFC / 20 ml	40	0
intestinal enterococci	0 UFC / 100 ml	40	0

Physicochemistry and bacteriology Proportion of non-compliant samples



CT = Total Coliforms ; EC = Escherichia coli ; CSR = sulfite-reducing clostridia; EI = Intestinal Enterococci SM = Sans-Manquer ; AST = Abobo sud 2ème Tranche ; CDH = Cent Douze hectares; SC = Sagbé Centre ; B1-2 = Banco1-2 ; AGB = Agbekoi ; MP = M'ponon ; HS = Habitat Sogefiah ; AC = Abobo Centre ; HB = Abobo Houphouët Boigny

Figure 8. Distribution of non-compliant samples of ten (10) neighborhoods in Abobo

Figure 8 shows the distribution of non-compliant samples in ten (10) neighborhoods of Abobo. 25% (1/4) of water samples taken in Sans Manquer, Cent Douze Hectares, Banco1-2, Agbekoi, Habitat Sogefiah, and Abobo Centre and 50% (2/4) of water sampled in Abobo Sud 2ème tranche and Houphouet Boigny are not in accordance with the WHO standards. This non-conformity is due to the residual chlorine content. A half of 50% of residual chlorine non-compliant samples of Abobo Sud 2ème tranche and Houphouet Boigny, is total coliforms positive. Sagbé Centre and M'ponon samples are the only ones to show compliance with the WHO (2011) standards; regardless the analyzed physico-chemical and bacteriological parameters. These two neighborhoods - Sagbé Centre and M'ponon -are closer to the Abobo drinking water plant which is located in Andokoi (Figure 1).

DISCUSSION

Among the samples from the ten (10) neighborhoods of Abobo, residual chlorine and total coliforms are the only parameters, out of fifteen, which do not respect the WHO (2011) standards. Indeed, 25% of samples are residual chlorine non-compliant. This non-compliance is due to either a lake chlorinationof the sampled water, the frequent failures of pipes – ruptures or leakage – resulting from the unhealthy state of the neighborhoods environment. This result is lower than the one found by Amin *et al.* (2008) who worked on surface water and groundwater used by SODECI for drinking water of eight (8) cities in Côte d'Ivoire. The estimated non-compliance rate is 38.48% of residual chlorine. In fact, surface water is submitted to a high organic pollution. Water samples from Abgoville revealed a percentage of non-compliance in residual chlorine of more than 70%. As far as total coliforms are concerned, the non-compliance rate in this study is 5% of all the samples. These total coliforms contaminated samples are also non-compliant in residual chlorine contents according to the WHO standards (2011). This fact implies that these waters were insufficiently treated in chlorine or that the chlorine has been consumed during its passage through the distribution network which is full of organic matter. This result could also be accounted for as resulting from the frequent ruptures of water pipes, the non-compliance of drinking water supply network and technical standards or leakage.

This result is different from the one found by Amin *and al* (2008) which found out a rate of non-compliance of 1.9% as for the total coliforms in water supply samples from eight cities in Côte d'Ivoire. Using poorly chlorinated water, combined with a substandard hygienic level of the population would strongly contribute to an important rise of waterborne bacterial diseases (Amin *et al.*, 2008). The pH values of the studied waters are not that different to those obtained in Dassa by Gbohaida *et al.* (2016). Gbohaida *et al.* (2016) did the same study onSONEB (Benin National waters Company) water .These values meet the WHO standards (6.5-8.5). However, they differ from those of Cotonou water. Indeed, these authors showed that water they studied was acid. This observed acidity could be explained by the amount of lime used to treat it. Indeed, the well water used by SODECI is initially more or less acid. Thus, the lime concentration used to treat it, makes its pH reach a value which respects the WHO standards. The pH values of the studied water show that they do not contribute to the corrosion of the water supply network and plumbing. This fact consequently reduces metals release into the distributed water. For example, increasing the pH remains one of the most effective methods to minimize the levels of lead and iron in the distributed drinking water (Sante Canada, 2015). The mineral nitrogen (NO_3^- NO_2^-, NH_4^+) and phosphorous (PO_4^{3-}) compounds concentrations in the studied waters are below the WHO standards (2011). From a sanitary point of view, ingesting nitrates constitutes a potential health risk factor because, being reduced to nitrites, they bind to hemoglobin and cause breathing difficulties (asphyxia): it is methemoglobinemia (cyanosis) which affects mainly infants (born or in pregnancy) and constitutes a short-term risk. In adults, nitrates are reportedly converted into nitrites in the oral cavity, and then, into nitrosamines and nitroso-compound in the stomach (Öztürk and Bektaş, 2004). The mineral nitrogen and phosphorus compounds results of this study are similar to those of Tampo *et al.*(2014) conducted on the drilling water of the peri-urban neighborhoods of Lomé in Togo.The bicarbonate concentration of the studied waters could be, according to Mahamane and Guel (2015), from the dissolution of the carbonated compounds generated from lime-treatment according to the below equation: $CaCO_3 + H_2O \rightarrow 2 HCO_3^- + Ca^{2+}$.

The sulfate and chloride concentrations vary respectively from 0.33 to 0.70 mg/L and from 7.55 to 24.7 mg/L. They are almost insignificant as compared to the WHO standards (2011), which is estimated to 250 mg / L. These results are similair to those of Gbohaida *et al* (2016). As for the bacteriological parameters (*Escherichia coli, sulfite-reducing clostridia - and intestinal enterococci*), they generally meet the WHO standards. However total coliforms have been identified in 5% of samples from (10) neighborhoods in Abobo. This fact accounts for the level of water microbiological contamination from the water supply network. The consumption of these contaminated water samples could constitute a significant health risk.The degradation of water quality is observed in areas going from the production plant in Andokoi to the most remote neighborhoods; namely*Houphouet Boigny* (HB) and Abobo *Sud 2ème Tranche*. This fact implies that water at the production plant pipes is of good quality and the latter deteriorates during its conveyance through the distribution network. The Abobo drinking water supply network is the potential cradle of various sorts of degradation, which are responsible of the substandard water quality. Although the degradation risks are important, it is however necessary to pay special attention to factors such as disorder, the oldness of pipelines and materials which are in contact with water.Indeed, from mechanical, chemical or biological origins, the internal or external disorder factors participate in the pipes degradation and weaken the old conduits. Generally, old gray cast iron pipes and uncoated steel or steel pipes with damaged coating are affected by corrosion. As related to water quality, internal corrosion may be from pH, the dissolved oxygen rate, the calco-carbonic balance gap, and theferrous to ferric ions oxidation mainly with acid or deaerated fresh water.

The phenomenon generating red-colored water and deposits, is frequently observed in the drinking water supply network in Côte d'Ivoire; especially between water supply cutoff and restoration periods. This corrosion can result from the development of a bacterial biofilm which inevitably affects all types of pipes. A special attention should be paid to the risks of contamination when the biofilm develops or when a high consumption of chlorine is recorded.The more we move away from the production plant which houses the water tower, the more the free chlorine content decreases and the more we note the presence of microbiological contamination as is the case in*Houphouet Boigny* and *Abobo Sud 2ème Tranche* . Water from neighborhoods closer to the production plant has a higher level of free chlorine content; this water has no microbiological contamination. On the other hand, the level of free chlorine decreases in distant neighborhood; areas where water is exposed to a microbial contamination.According Loiseau and Juery (2002), treated water, produced in drinking water treatment plants, distributed through a buried distribution network, to users, is not sterile after chlorine disinfection. A number of microorganisms is introduced into the network because the conventional physicochemical processes of treatment do not allow complete elimination of the microorganisms. Inside the network, the bacteria which were only injured or stressed by water disinfection operations can regenerate; depending on parameters such as temperature and the nutrients in the pipelines. Moreover, in the network, some points, like pathways, favors contamination by microorganisms.

Network maintenance (repairs, connections..), leakage in case of depression, and accidents such as water return or pipes break may also be responsible for the introduction of microorganisms in the network.In fact, the neighborhoods which are distant from the production plant and the distribution points are more exposed to the disorder factors of the drinking water supply network in Abobo. The farther we are away from the production plant, the more the risk of water contamination increases. This fact is due to the decrease of free chlorine content and the increasing risks due to illegal connections and pipes repairs. Such situations can cause the development of biofilm on the pipes walls and affect the quality of water.

This situation consequently results indisinfectant oxidants (free chlorine) instability. Biofilm, increasing the demand for chlorine, can lead to problems of taste, smell and coloring and can release biological debris that affects the quality of drinking water.Drinking water is generally of quality because it meets the quality standards. However, despite all the measures in place to control its quality, it can sometimes be contaminated to varying degrees. We must then take temporary protective measures, such as sensitizing people to boil water before any use or not to consume it directly from taps. Drinking water may be contaminated in by microorganisms *(Escherichia coli* (E. coli), faecal coliforms or Enterococci) or by chemical ubstances (lead, trihalomethanes (THM)). That is why rules on drinking water quality set standards for drinking water contaminants that may pose a health risk. In Côte d'Ivoire, for lack of Ivorian standards for drinking water, those of WHO are used. SODECI, responsible for the distribution network is in charge of ensuring water drinking quality in compliance with the standards in force. The Ministry of Health supervises and monitors the rules enforcement.

Conclusion and perspectives

This study assessed the quality of drinking water which is distributed by the water distribution company in Côte d'Ivoire (SODECI) in ten (10) neighborhoods in Abobo. The results showed that, out of eleven (11) physicochemical parameters only residual chlorine is non-compliant as for 2 5% of the studied water samples. As for bacteriological parameters, it is only one (1) - total coliforms - out four (4) parameters, which, in 5% of the samples, displayed non-compliance to the WHO standards. Apart from these 5% of total coliform contaminated water sample, the other water samples are good for human consumption. In other words, the consumption of two (2) water samples, out of 40, could expose people to health risks. Thus, based on the studied parameters, water distributed by SODECI in the ten (10) neighborhoods of Abobo is generally of good quality. However, we may recommend SODECI to take every precaution to better chlorinate water in order to disinfect it completely and respect by extension the WHO standards in terms of residual chlorine. This study should be extended to other physicochemical parameters and micropollutants as well as other neighborhoods and townships of Abidjan to analyze the degrading factors and contamination of water consumed by populations. Studying the disorder factors of drinking water supply networks is required.

REFERENCES

AFNOR 2001a. Qualité de l'eau : Analyses organoleptiques, mesures physicochimiques, paramètres globaux, composés organiques. Aubenas ardèche, 6è Edition. 627 p.

AFNOR 2001b. Qualité de l'eau : Analyses biochimiques et biologiques, analyses microbiologiques. Aubenas Ardèche, 6è Edition. 695 p.

Amin N.C., Lekadou K.S., Attia A.R., Claon J.S., Agbessi k. et Kouadio K.L. 2008. Qualité physico-chimique et bactériologique des eaux d'adduction publique de huit communes en côte d'ivoire, *J.sci.pharm.bio*. Vol.9, n°1,. 22-31.

Dovonon L. 2011. Qualité chimique des eaux souterraines dans la commune de Dassa-Zoumé (Benin) : Impacts sanitaires des teneurs hors normes en fluorure et essais de traitement à l'os calciné de bovin, thèse de doctorat, FAST, Université d'Abomey-Calavi, 206 p.

Gbohaida V., Agbangnan P.D.C., Ngossanga M. B., Medoatinsa S. E., Dovonon L.F.C., Wotto V. D., Avlessi F., Sohounhloue D.C.K. 2016. Etude de la qualité physico-chimique de l'eau de boisson dans deux localités du Benin : Cotonou et Dassa.

INS (2014) : Recensement Général de la Population de l'Habitation (RGPH) 1998. Donnée socio-démographiques et économiques des localités, résultats définitifs par localités, région des lagunes, Vol III, Tome 1. 43 p.

Loiseau G., Juery C. 2002. La dégradation de la qualité de l'eau dans les réseaux, document FNDAE, Hors-série n°12, MAAPAR/DGFAR.

Mahamane A. A., Guel B. 2015. Caractérisations physico-chimiques des eaux souterraines de la localité de Yamtenga (Burkina Faso). *Int. J. Biol. Chem. Sci.,* 9 (1) : 517-533.

Makoutode M., Assani A. K., Ouendo E-M., Agueh V. D., et Diallo P., 1999. Qualité et mode de gestion de l'eau de puits en milieu rural au Bénin: cas de la sous-préfecture de Grand-Popo, *Médecine d'Afrique Noire,* 46 (11) : 528 – 534.

Nyassogbo Kwami Gabriel 2005. Accumulation d'ordures ménagères et dégradation de l'environnement urbain. Quelques pistes pour une viabilité environnementale dans le processus. Repenser le développement Africain : Au-delà de l'impasse. 11è assemblée générale du codestria, Maputo, Mozambique.

Öztürk N, Bektas T.E. 2004. Nitrate removal from aqueous solution by adsorption on to various materials. *Journal of Hazardous Materials*, 112 (1) : 155-162.

Sal M. 2010. Evaluation de la qualité microbiologique et physico-chimique de l'eau de l'adduction d'eau villageoise de Belefoungou-Centre (Djougou) p 47.

Santé Canada 2015 : Santé de l'environnement et du milieu de travail, le pH de l'eau potable, 17 p.

Tampoh L., Ayah M., Kodom T., Tchakala I., Boguido P., Bawa L., Djaneye B. 2014. Impact de la demande en chlore et de la chloration sur la désinfection des eaux de puits des quartiers de Lomé : cas des quartiers de Démakpoé et d'Abgalépédogan (Togo). *Journal of Applied Biosciences*, 75 : 6272-6281.

OMS, 2011. Directives OMS édition 2011 en vigueur. 28 p.

****