American Journal of Food and Nutrition, 2025, Vol. 13, No. 4, 154-157
Available online at http://pubs.sciepub.com/ajfn/13/4/4
Published by Science and Education Publishing
DOI:10.12691/ajfn-13-4-4

Quality Control of Drinking Water Supply in the Goh, Loh-Djiboua, and Nawa Regions (Côte d'Ivoire)

KPAIBE Sawa André[1,2,*], Agbessi Therese[1,2], GBAGBO Tchapé Aubin[2], Essé Amoin[1], Bakayoko Aminata[2], He Linda[1], AMIN N'cho Christophe[1],

[1]Département des Sciences Analytiques et Santé Publique, UFR des Sciences Pharmaceutiques, Université Félix Houphouët-Boigny, Côte d'Ivoire
[2]Laboratoire d'Hygiène, Institut Nationale d'Hygiène Publique, Côte d'Ivoire
*Corresponding author: andresawa@yahoo.fr

Received June 25, 2025; Revised July 27, 2025; Accepted August 03, 2025

Abstract This study was conducted to evaluate the quality of public water supplies in the Gôh, Lôh-Djiboua, and Nawa regions, with a focus on the localities of Diégonéfla, Divo, Gagnoa, Guibéroua, Lakota, Oumé, and Soubré. A total of forty (40) water samples were collected and subjected to physicochemical and bacteriological analyses. In parallel, a consumer survey was carried out to assess perception of water quality. Survey responses indicated that the majority of the population regarded the water supply as satisfactory. However, laboratory findings revealed non-compliance with national standards for several physicochemical parameters, including residual chlorine, turbidity, iron, manganese, aluminum, and pH levels. From a bacteriological perspective, the presence of microorganisms such as total coliforms, Escherichia coli, and Enterococcus faecalis was detected in some samples, suggesting potential risks to public health.

Keywords: *Water supply, Quality control, Physicochemistry, Bacteriology*

Cite This Article: KPAIBE Sawa André, Agbessi Therese, GBAGBO Tchapé Aubin, Essé Amoin, Bakayoko Aminata, He Linda, and AMIN N'cho Christophe, "Quality Control of Drinking Water Supply in the Goh, Loh-Djiboua, and Nawa Regions (Côte d'Ivoire)." *American Journal of Food and Nutrition*, vol. 13, no. 4 (2025): 154-157. doi: 10.12691/ajfn-13-4-4.

1. Introduction

Water is a vital resource, essential for sustaining life and central to human activities. It serves as one of the key drivers of territorial development [1]. However, both the quantity and quality of available water resources present increasingly complex challenges, particularly in developing countries [2]. Collected water may contain various contaminants that pose health risks, including pathogenic microorganisms, undesirable substances, and toxic compounds.

According to the World Health Organization (WHO), over two million children under the age of five die annually in developing countries from diarrheal diseases, with 90% of these deaths linked to poor drinking water quality as of 2017 [3,4]. In Africa, the situation remains critical: two out of five individuals lack access to safe drinking water, resulting in approximately 4,000 child deaths each day, as reported by the United Nations [5,6]. In Côte d'Ivoire, potable water services reach 79.96% of the urban population but only 57.03% of the rural population. Several studies of drinking water distribution networks have identified significant health risks [7,8,9].

In this context, the present study seeks to monitor and evaluate the quality of water supplied in the Gôh, Lôh-Djiboua, and Nawa regions.

2. Materials and Methods

2.1. Equipment and Supplies

The equipment used in this study included: a photometer (Wagtech® 7100 se, UK); a pH meter with probe (Hach®, France); a turbidimeter (Hach®, France); a conductivity meter with probe (Hach®, France); a filtration manifold (Sartorius®, Germany); a water bath (J.P. Selecta®, Barcelona); a uv sterilizer; a benchtop autoclave (J.P. Selecta®, Barcelona). Ice packs, 47 mm diameter filtration membranes, petri dishes, standard laboratory glassware was also used.

2.2. Reagents

All reagents used were of analytical grade. The chemical reagents from the Wagtech® brand (United Kingdom) included reagent tablets for nitrates, nitrites, ammonium, chlorides, residual chlorine; manganese, aluminum, fluorides, organic matter and iron. EDTA, NET, Sulfuric Acid, Phenolphthalein of Sigma-Aldrich® (US) and Distilled Water were used . The microbiological reagents consisted of the following culture media:

Rapid'E.coli 2 Agar (Bio-Rad®, France), Bile Esculin Azide (Bio-Rad®, France), and Thiosulfate Neomycin Agar (Bio-Rad®, France).

2.3. Sampling

Sampling was carried out randomly. A total of 40 water samples were collected across the different localities. At each water point, two types of samples were collected: one 1000 mL sample for physicochemical analysis, and one 500 mL sample for microbiological analysis. The water samples were stored in a cooler with ice packs (maintained at 4°C to 8°C) and kept away from light during transport [10].

2.4. Methods

The physicochemical parameters of the water samples, including pH, electrical conductivity, and turbidity, were analyzed according to standardized AFNOR protocols [11,12,13].

The nitrates, nitrites, ammonium, chlorides, manganese, Aluminium, Fluorides, Organic Matter and iron were analyzed as follows. For each compound tested, a 10 mL aliquot of the water sample was collected and transferred into an analysis tube. A reagent tablet specific to the compound of interest was then added to the sample. The tablet was thoroughly crushed and mixed using a glass stirring rod to ensure complete dissolution. The prepared sample was subsequently placed in a photometer. The program corresponding to the target compound was selected, and the absorbance measurement was taken at a wavelength of 520 nm. The total hardness and alkalinity was determined by titrimetry. Total coliforms, Thermotolerant coliforms, Escherichia coli, Enterococcus faecalis, and sulfite-reducing anaerobes were analyzed . The water filtration procedure for microbiological analysis includes several steps, starting with the filtration of the water sample through a membrane, followed by the transfer to a culture medium. The media were then incubated for 18 to 24 hours, and the bacteria were counted [14,15]. Statistical analyses were carried out [15].

3. Résultats

The quality control focused on the analysis of physicochemical and microbiological parameters, as well as the analysis of non-conformities. The results of the physicochemical and microbiological analyses of the drinking water are presented in Table 1. In terms of physicochemistry, the drinking water is mildly mineralized, with an average conductivity of 137.25 ± 122.67 µS/cm and an average acidic pH of 5.99 ± 0.80. The parameters exceeding the limit values set by the Ivorian standard were pH, turbidity, residual chlorine, and iron. Microbiologically, analyses of the tap water revealed the presence of germs such as coliforms, enterococci, and Aerobic spore-forming bacteria. These microorganisms reached maximum concentrations of 1200 CFU/100ml for total coliforms, 170 CFU/100ml for E. coli, 200 CFU/100ml for E. faecalis, and 10 CFU/100ml for ASR.

All the samples analyzed from the Goh, Loh-Djiboua, and Nawa regions were found to be non-compliant with Ivorian standards. The physicochemical and microbiological parameters responsible for the non-conformities included turbidity, pH, residual chlorine, total iron, magnesium, and aluminum (Figure 1).

Table 1. Results of the physicochemical and bacteriological parameters of tap water from the regions of Goh, Loh-Djiboua, and Nawa

Parameter	Unit	Min	Mean ± SD	Max	Norme
Turbidity	NTU	0.12	2.39 ± 2.76	10.8	≤1
Conductivity	µS/cm	56	137.25 ± 122.67	739.5	1000
Temperature	°C	26.4	28.42 ± 0.93	31.7	25
pH	-	4.6	5.99 ± 0.80	7.0	6,5-8,5
Nitrates	mg/L	0.14	4.12 ± 4.75	24	≤50
Nitrites	mg/L	0	0.012 ± 0.01	0.06	≤3
Ammonium	mg/L	0.01	0.08 ± 0.06	0.24	≤1,5
Organic Matter	mg/L	0.28	1.27 ± 0.99	4.66	≤5
Chlorides	mg/L	0.4	14.59 ± 7.57	37	≤200
Total Hardness	mg/L $CaCO_3$	5	36.38 ± 29.02	125	≤500
Alkalinity	mg/L HCO_3^-	5	68.63 ± 56.88	235	-
Residual Chlorine	mg/L	0.02	1.19 ± 1.55	6.1	0,2-1
Iron	mg/L	0	0.06 ± 0.08	0.3	≤0,3
Manganese	mg/L	0	0.01 ± 0.01	0.041	≤50
Aluminium	mg/L	0.01	0.13 ± 0.11	0.42	≤0,1
Fluorides	mg/L	0	0.59 ± 0.23	1.19	≤1,5
Total coliforms (TC)	CFU/100 mL	0	31.48 ± 189.56	1200	0
Thermotolerant coliforms (TTC)	CFU/100 mL	0	4.25 ± 26.88	170	0
Escherichia coli	CFU/100 mL	0	4.25 ± 26.88	170	0
Enterococcus faecalis	CFU/100 mL	0	5 ± 31.62	200	0
Sulfite-reducing anaerobes (SRA)	CFU/100 mL	0	0.25 ± 1.58	10	0

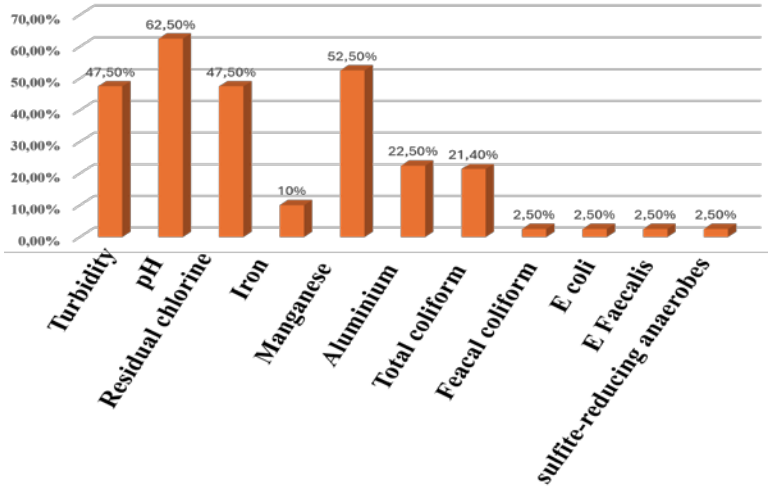

Figure 1. percentage of non-conformities per parameter studied

4. Discussion

The results of this study reveal multiple physicochemical and microbiological non-conformities in tap water from the Goh, Loh-Djiboua, and Nawa regions, highlighting deficiencies in both treatment and distribution processes that compromise its potability.

Water temperatures in the analyzed samples exceeded the Ivorian regulatory threshold of 25°C. This observation aligns with WHO findings, which recognize the difficulty of maintaining such limits in West Africa, where water temperatures frequently approach 30°C [16,17]. Although elevated temperatures do not pose an immediate health risk, they may encourage microbial proliferation and diminish chlorination efficacy.

Acidity presented a high non-compliance rate (62.5%). While acidic water typically does not result in direct health concerns, it can accelerate corrosion in metallic pipes, thereby increasing the risk of heavy metal release—such as lead and copper—into the water supply [18]. Turbidity was another significant issue, with 47.5% of samples failing to meet the standards. Elevated turbidity often reflects the presence of suspended organic and inorganic particulates, which can interfere with disinfection and shield pathogenic microorganisms, ultimately reducing microbiological safety [19].

Residual chlorine was found in 47.5% of public water samples, potentially indicating overdosing in certain areas or rapid degradation due to organic matter, which limits chlorine's effectiveness throughout the distribution system. Non-compliance related to metals—specifically iron (10%) and aluminum (22.5%)—suggests shortcomings in filtration and sedimentation during water treatment. Iron contamination may result from pipe corrosion or insufficient treatment, while elevated aluminum concentrations are typically linked to improper dosing of aluminum sulfate used in coagulation processes [20,21,22].

Microbiological analyses raise particular concern. The detection of total coliforms, thermo-tolerant coliforms, *E. coli*, *E. faecalis*, and sulfite-reducing anaerobic spores in varying proportions suggests both recent and historical fecal contamination. A non-compliance rate of 21.4% for coliforms and 2.5% for *E. faecalis* confirms that the supplied water is not entirely free from microbial risk, thus exposing local populations to potential waterborne illnesses.

These findings underscore the urgent need to strengthen the operational capacities of wastewater treatment plants, ensure regular maintenance of distribution infrastructure, and enforce systematic monitoring of water quality throughout all stages. Furthermore, appropriate disinfection measures for stored water must be implemented to ensure compliance with national and international standards and safeguard public health [15,23,24].

5. Conclusion

This study evaluated the physicochemical and microbiological quality of public water supplies in the Gôh, Lôh-Djiboua, and Nawa regions. The findings revealed that 92% of the 49 treated water samples failed to comply with Ivorian drinking water standards, underscoring serious concerns about treatment efficacy. To mitigate potential public health risks, it is essential to enhance water treatment processes by adopting suitable technologies and equipment that ensure effective purification.

References

[1] Lanjri AF, El Cadi A, Lalilti A, Brigui J. Physico-chemical and bacteriological specification of groundwater in Tangier. *J Life Sci*. 2014; 8(8).

[2] Sintondji L, Awoye H, Agbossou K. Modélisation du bilan hydrologique du bassin versant du Klou au Centre-Bénin : contribution à la gestion durable des ressources en eau. *Bull Rech Agron Bénin*. 2008; 59: 35-48.

[3] Kouassi WF, Mangoua J, Kouassi KA, Kouadio ZA, Alle PH, Goula BTA. Caractéristiques hydrogéochimiques des aquifères fissurés de la région d'Odienné, nord-ouest de la Côte d'Ivoire. *Afr Sci*. 2017; 13(3): 30-42.

[4] UNICEF. *190 million children at risk from water-related crises: triple threat of water scarcity, inadequate WASH services, and climate change* [Internet]. New York: United Nations Children's Fund; 2023 [cited 2025 May 14].

[5] WHO/UNICEF. *Progress on drinking water and sanitation*. Geneva: World Health Organization; 2014.

[6] UNICEF, WHO. *Progress on drinking water, sanitation and hygiene in Africa: 2000–2020 – Five years into the SDGs* [Internet]. New York: UNICEF and WHO; 2023 [cited 2025 May 14].

[7] Amin N, Lekadou K, Attia A, Claon J, Agbessi K. Qualité physico-chimique et bactériologique des eaux d'adduction publique de huit communes en Côte d'Ivoire. *J Sci Pharm Biol*. 2008; 9(1): 22-31.

[8] Kambiré B, Ymba M. L'accès à l'eau potable dans les villes secondaires ivoiriennes : le cas de Gagnoa (sud-ouest de la Côte d'Ivoire). *Sci Environ*. 2017; 1(14): 121-44.

[9] Amin NC, N'kousse AB, Kpaibe SAP, Seki TO, Degny GS, Gbagbo TAG. Households' perception of the quality of public tap water in Côte d'Ivoire. *Bull Public Health Côte d'Ivoire*. 2024;2(3):30–38.

[10] AFNOR. *FD T90-520: Water quality – Technical guide for sampling for sanitary monitoring in application of the Public Health Code* [Internet]. Saint-Denis La Plaine: French Standardization Association; 2005 [cited 2025 May 14].

[11] AFNOR. *NF T90-008: Water quality – Determination of pH* [Internet]. Saint-Denis La Plaine: French Standardization Association; 2001 [cited 2025 May 14].

[12] AFNOR. *NF EN 27888: Water quality – Determination of electrical conductivity* [Internet]. Saint-Denis La Plaine: French Standardization Association; 1994 [cited 2025 May 14].

[13] AFNOR. *NF EN ISO 7027-1: Water quality – Determination of turbidity – Part 1: Quantitative methods* [Internet]. Saint-Denis La Plaine: French Standardization Association; 2016 [cited 2025 May 14].

[14] Seki TO, Yapo TW, Kpaibe SAP, et al. Caractérisation physicochimique et microbiologique des eaux de puits à usage de boisson à Aboisso (sud-est de la Côte d'Ivoire). *Int J Biol Chem Sci*. 2024; 18(1): 311–25.

[15] Gbagbo GAT, Bakayoko AB, Agbessi TK, et al. Physicochemical and bacteriological characterisation of domestic drinking water sources in M'pody village (Côte d'Ivoire) during the four seasons of 2020. *Int J Water Res Environ Eng*. 2025; 17(2): 27–39.

[16] WHO. Guidelines for drinking-water quality. *WHO Chron*. 2011; 38(4): 104-8.

[17] Orou K, Coulibaly KJ, Tanoh A, et al. Qualité et vulnérabilité des eaux d'aquifère d'altérites dans les sous-préfectures de Grand-Morié et d'Azaguié (Côte d'Ivoire). *Rev Ivoir Sci Technol*. 2016; 28: 243-72.

[18] Eblin S, Sombo A, Soro G, et al. Hydrochimie des eaux de surface de la région d'Adiaké (sud-est côtier de la Côte d'Ivoire). *J Appl Biosci*. 2014; 75: 6259-71.

[19] Batool A, Aziz S, Imad S, et al. Physico-chemical quality of drinking water and human health: a study of Salt Range (Pakistan). *Int J Hydrol*. 2018; 2(6): 668-77.

[20] Tchotsoua M, Esoh E, Mohamadou G, Ngana J. Diagnostic de l'état de l'environnement de Ngaoundéré et contribution pour une approche de gestion. *Ann Fac Arts Lett Sci Hum Univ Ngaoundéré*. 1998; 1: 99-144.

[21] Rondeau V, Commenges D, Jacqmin-Gadda H, Dartigues JF. Relation between aluminum concentrations in drinking water and Alzheimer's disease: an 8-year follow-up study. *Am J Epidemiol*. 2000; 152(1): 59-66.

[22] Rondeau V, Jacqmin-Gadda H, Commenges D, et al. Aluminum and silica in drinking water and risk of Alzheimer's or cognitive decline: 15-year follow-up of the PAQUID cohort. *Am J Epidemiol*. 2009; 169(4): 489-96.

[23] OMS. *Directives de qualité pour l'eau de boisson* (3e éd). Genève: Organisation Mondiale de la Santé; 2004.

[24] Temgoua E, Ngnikam E, Ndongson B. Drinking water quality: stakes of control and sanitation in Dschang (Cameroon). *Int J Biol Chem Sci*. 2009; 3(3).

[25] Yapo TW, Meless FRD, Gbagbo GAT, et al. Physico-chemical and bacteriological characterization of surface waters for domestic use: case of river waters in M'pody village (Anyama, Côte d'Ivoire). *Int J Biol Chem Sci*. 2023; 17(2): 735–42.