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Quality of Potable Jar Water in Selected Food Establishments in Shahbagh and Ramna, Dhaka, Bangladesh

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Water plays a vital role in maintaining the health, hygiene, and well-being of all living beings. The presence of harmful microorganisms and chemical pollutants in water can lead to severe health consequences. This study aimed to evaluate the physicochemical characteristics and microbiological quality of drinking jar water obtained from various hotels located in the Shahbag and Ramna areas of Dhaka city, Bangladesh. In this case, pH, temperature, carbon dioxide (CO2), alkalinity, hardness, color, iron (Fe), chloride (Cl-), and odor were measured and observed. Moreover, microbiological assessments of drinking water samples were carried out. For achieving the microbiological assessment, methods of total viable bacterial count (TVBC), total coliform count (TCC), and total fecal coliform (TFC) were used. Microbes were presumptively identified by microscopic and colony morphology with biochemical profiling. It was found that the pH of all samples ranged from 6.5 to 7.4, Fe recorded from 0.15- 0.427 mg/l, and the concentration of Cl- ions was within the 0.5-1.7 range. In addition, the hardness ranged from 0.15- 0.427 mg/l, alkalinity 2.13-9.4 mg/l, color from 20-52, and most of the water samples were odorless. All of the above-mentioned parameters fall within the marginal range for the majority of water samples. The highest total viable bacterial count was found in the water of the AA hotel sample (2.22×10^7 CFU/ml), also the highest fecal coliform count was found at the same hotel (30 CFU/100 ml), and the highest total coliform count was noted in the Ak hotel sample (30 CFU/100 ml). The detection of indicator microorganisms signifies potential fecal contamination and poses serious public health risks, thereby rendering the water unsafe for human consumption. The results emphasize the necessity of maintaining water quality for human consumption.

Keywords: Jar water, Physicochemical quality, Microbiological quality, Indicator organisms, Dhaka, Bangladesh

INTRODUCTION

Water is one of the most essential natural resources for sustaining life, with distinct physical, chemical, and biological characteristics that support human health, ecosystems, and socio-economic development (1, 2). In rural Asia and Africa, including Bangladesh, surface and groundwater serve as primary water sources (3). However, both natural processes and anthropogenic activities greatly influence the quality of groundwater. Assessing physicochemical and microbiological properties is therefore crucial for evaluating its safety and identifying potential public health risks (4).

Water quality is a pressing global concern since it directly impacts human well-being. In developing nations, contaminated drinking water remains a leading cause of waterborne illnesses and epidemics (5). Owing to its solvent nature, water is highly susceptible to contamination by diverse pollutants (6). According to the World Health Organization (WHO), safe drinking water is defined as water that poses no significant health risks throughout its consumption period. Despite this, WHO reports that nearly 80% of diseases in developing countries are attributable to biological contamination of water (7).

Diarrheal and other gastrointestinal disorders are closely associated with drinking water of low quality, contributing to an estimated 72 million disability-adjusted life years (DALYs) and 2.2 million deaths worldwide annually (8, 9). Numerous reports of tainted water supplies have identified pathogens like *Shigella, Salmonella, Escherichia coli,* and *Vibrio* that can cause widespread infectious diseases (10, 11). However, 90% of under-five child deaths in 42 developing nations were caused by contaminated water, with diarrheal infections accounting for 88% of these deaths (12,13). In addition to microbial contamination, water pollution from chemicals and heavy metals is a global problem, affecting nearly all nations to varying degrees (14, 15). Bangladesh, with its numerous rivers and dense population, is especially vulnerable to both organic and inorganic contamination from industrial effluents, agrochemicals, and household waste (16). Approximately 8.5% of deaths in Bangladesh are associated with unsafe water, poor sanitation, and inadequate hygiene (17).

Supplying safe drinking water is therefore at the forefront of improving health, productivity, and sustainable development (18, 19). Appropriate hygiene and sanitary measures are critical preventive

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interventions, but water safety monitoring is often limited to a few bacterial indicators such as *E. coli* and coliforms (20, 21). While coliforms may not necessarily cause disease, their presence is a sign of possible contamination. More critically, *E. coli* and fecal coliforms are certain markers of fecal pollution (22). In Bangladesh, it has frequently been shown by reports that coliforms, *E. coli, Pseudomonas* spp., and *Salmonella* spp. have been found in water samples (23).

In Dhaka and other cities where a sizeable portion of the population relies on roadside hotels and restaurants for daily meals, the potability of drinking water—generally provided through filtration units—must be critically addressed. The majority of hotels and restaurants employ filtered tap or ground water for serving patrons (24). But whether these filtration units are able to remove microbial and chemical contaminants effectively remains questionable in the absence of periodic monitoring and maintenance. Hence, water supplied in restaurants and hotels is still capable of carrying indicator bacteria and potential pathogens that may make water unsafe for human consumption.

Prominent water bodies in Dhaka city, like Gulshan Lake, Dhanmondi Lake, Ramna Lake, and Shahidullah Pond, affect the surrounding groundwater and supply networks (25). Among them, Ramna Lake is vital for draining the Shahbagh and Kakrail areas, home to many hotels and eateries. These places serve large groups of students, local residents, and commuters every day, making the safety of their filtered drinking water an important public health issue (26). Therefore, this study aimed to evaluate the safety of filtered drinking water from selected hotels and restaurants in the Ramna and Shahbagh areas of Dhaka, focusing on both physicochemical quality and microbial contamination.

MATERIALS AND METHODS

Sampling location and timeline: The sampling area of this study was two different areas, Shahbag and Ramna, within Dhaka city, Bangladesh, from November 24 to December 2024. From these selected areas, 8 different hotels have been selected for this study. A large number of people in these areas have their meals from these hotels. Therefore, the food and drink that are served in these hotels either directly or indirectly affect public health. The detailed information on the Sample ID, sampling location and timeline is summarized in Table 1.

Sample collection: Water samples were withdrawn from jars, which are typically 20-liter plastic containers having taps fitted and commonly used for drinking water supply and storage. Each jar was labeled with a unique sample number, date of collection, and place name for tracing. Approximately 500 ml of water was withdrawn from each jar in sterile 500 ml glass screw-topped bottles. Sterilization of caps and bottles by autoclaving at 121°C for 15 minutes was done before sampling in order to provide aseptic conditions. Water was pumped straight from the tap on the jar into the sterilized bottles without employing any intermediate containers (glasses) to minimize the chance of external contamination. Bottles were aseptically manipulated during sampling in a clean environment with caps open only at the filling point and immediately replaced after sampling. Insulated sampling boxes with ice packs were utilized to store filled bottles under constant transportation temperature before analysis. The samples were transported directly to the laboratory for subsequent microbiological analysis.

Evaluation of physicochemical parameters of water samples: The physicochemical parameters of the water samples were analyzed according to the standard procedures recommended by the manufacturers of the respective instruments and reagents. The pH of the samples was measured using a single electrode pH meter (EZ 00 pH 5011, Model PH-201, Lutron). The electrode was immersed directly into the sample, and the displayed value was recorded. Water hardness was determined by the EDTA titrimetric method. In this method, calcium and magnesium ions form complexes with EDTA while using Eriochrome Black T as the indicator. Dissolved CO_2 was measured through acid-base titration with standard NaOH, using phenolphthalein as the indicator and expressing the results in mg/l. Alkalinity was measured by titration with a standard acid solution (H_2SO_4 or HCl) and involved phenolphthalein and methyl orange (or bromocresol green) as indicators. This determined carbonate, bicarbonate, and hydroxide ions, with results expressed in mg/l as $CaCO_3$. Total iron was analyzed using the Ferrover method. Here, the Ferrover reagent reacts with soluble iron to create an orange-colored complex, and the intensity was measured spectrophotometrically, expressed in mg/l. Chloride content was determined through argentometric titration with silver nitrate and potassium chromate as the indicator. The apparent color of the samples was assessed using the Platinum-Cobalt (Pt-Co) standard method, which involved visual or spectrophotometric comparison with Pt-Co standards, and results were noted in true color units (TCU) (27).

Enumeration of total viable bacterial count (TVBC): To enumerate the total viable count of bacteria, a serial dilution was first done of each sample separately. Then, 0.1 ml from 10^{-4} dilution of each water sample was spread onto Nutrient Agar plates following the spread plate technique. For the total bacterial count, plates were incubated at 37°C for 24 hours (28).

Enumeration of total and fecal coliforms by membrane filtration method: Using the membrane filtration method, 100 ml of every water sample was subjected to total and fecal coliform counts. Sterile 0.45 µm nitrocellulose membranes were used to filter samples, which, upon incubation on selective agar media, were seeded on MacConkey agar (MAC) plates for the estimation of total coliforms and incubated at 37°C for 24 h. Lactose-fermenting coliform colonies on MAC were identified by the pink to red color, indicating acid production due to lactose fermentation. Non-fermenting lactose colonies were colorless or light-colored. For fecal coliforms, membranes were placed on Membrane Fecal Coliform (MFC) agar plates and incubated for 24 h at 45°C. Fecal coliform colonies were identified by lactose fermentation and aniline blue uptake characteristic blue coloration at elevated temperature, which promotes growth of thermotolerant coliform (29).

Identification and characterization of bacterial isolates: Microscopic observation, colony characteristics, and biochemical properties presumptively identified all the isolates detected from water samples. The microscopy analysis was done based on bacterial morphology with Gram staining using light microscopy. The isolates were first subjected to the Gram staining method before performing other biochemical experiments. Afterward, biochemical tests were performed, such as triple sugar iron test, citrate, catalase and oxidase test. The test results were noted and compared with the Bergey's manual of systematic bacteriology (30).

Table 1: Summary of sample ID, sampling location, and timeline of different hotels in the Shahbag and Ramna area.

Sample No.	Sample ID	Location	Date	Time
1	JR Hotel	Nawab Habibullah Rd, Shahbag	12/11/2024	9.30 AM
2	AK Hotel	Nawab Habibullah Rd, Shahbag	12/11/1024	10.11 AM
3	AA Hotel	Mymensingh Ln, Shahbagh	18/11/2024	9.40 AM
4	NI Hotel	Mymensingh Ln, Shahbagh	18/11/1024	10.11 AM
5	SH Hotel	Mymensingh Ln, Shahbagh	25/11/1024	10.00 AM
6	SR Hotel	Mymensingh Ln, Shahbagh	25/11/1024	10.15 AM
7	RN Hotel	Opposite side of Ramna Thana, Ramna	02/12/1024	10.15 AM
8	JD Hotel	Opposite side of Ramna Thana, Ramna	02/12/1024	10.35 AM

RESULTS

Physicochemical data analysis of water samples: Physicochemical parameters of water samples were analyzed using standard procedures and compared with the WHO and Bangladesh Standards (BDS). The pH values of water samples were within 6.3-7.4. The value of CO2 ranged from 24-34 mg/L, Fe was recorded from 0.15- 0.41 mg/L, the concentration of chloride Cl- ions in water samples was within the 0.5-1.7 mg/L range, the range of hardness as CaCO3 was between 24-179 mg/L, level of alkalinity was between 2.13-9.4 mg/L. All of the water samples were odorless, and the color ranged from 20-52 (Table 2).

Microbial Analysis of Water Samples:
Total viable bacterial count (TVBC): Among the sampling locations, the drinking water samples' total viable bacterial count (TVBC) differed greatly. SR Hotel had the lowest TVBC, 6.0 x 10^6 CFU/ml. At 2.22 x 10^7 CFU/ml, AA Hotel had the highest load. Other hotels—JR, AK, NI, SH, RN, and JD—also showed heavy bacterial counts ranging from 1.07 x 10^7 to 1.99 x 10^7 CFU/ml. Most of the tested water samples show evidence of severe microbial contamination.

Total coliform count (TCC): Most samples exhibited detectable levels of total coliform count (TCC), ranging from 0 to 30 CFU/100 ml. AK Hotel had the highest coliform contamination at 30 CFU/100 ml, closely followed by AA Hotel at 28 CFU/100 ml. SH, RN, and JD Hotels had moderate levels of 12–16 CFU/100 ml. At 8 CFU/100 ml, JR and NI Hotels registered lower values. SR Hotel was the only place free from coliforms.

Table 2: Physicochemical analysis of water quality in selected hotels in Shahbagh and Ramna.

Sample no.	Sample ID	pH	CO_2 (mg/L)	Alkalinity (mg/L)	Hardness as $CaCO_3$ (mg/L)	Colour Test *(Pt-Co)*	Iron Test (mg/L)	Chloride Test (mg/L)	Odour
1	JR Hotel	6.7	30	6.1	179	32	0.41	1	Odourless
2	AK Hotel	6.5	33	8.4	124	28	0.15	1.3	Odourless
3	AA Hotel	6.9	29	9.4	70	29	-	1.7	Odourless
4	NI Hotel	7.1	24	8.8	61	23	-	1.2	Odourless
5	SH Hotel	7.1	34	8.7	25	20	0.31	0.8	Odourless
6	SR Hotel	6.3	27	3.5	24	27	-	0.5	Odourless
7	RN Hotel	7.4	29	4.2	76	52	-	1.3	Odourless
8	JD Hotel	7.0	32	2.13	35	35	0.2	0.9	Odourless
1	WHO	6.5-8.5	15	200	200-500	15	0.3	250	Odourless
2	BDS	6.5-8.5	15	200	200-500	15	0.3-1	150-600	Odourless

Note: WHO (World Health Organization) (31), BDS (Bangladesh Standards) (32).

Table 3: Microbiological assessment of water quality in selected hotels in Shahbagh and Ramna.

Collection Sites	TVBC (CFU/ml)	TCC (CFU/100 ml)	TFC (CFU/100 ml)
JR Hotel	1.12 × 10^7 CFU/ml	8	0
AK Hotel	1.8 × 10^7 CFU/ml	30	2
AA Hotel	2.22 × 10^7 CFU/ml	28	30
NI Hotel	1.59 × 10^7 CFU/ml	8	6
SH Hotel	1.07× 10^7 CFU/ml	16	2
SR Hotel	6.0 × 10^6 CFU/ml	0	0
RN Hotel	1.74 × 10^7 CFU/ml	12	0
JD Hotel	1.99× 10^7 CFU/ml	12	24
WHO	Less than 100 to 500	0	0
BDS	Less than 1000	0	0

Note: WHO (World Health Organization) (31), BDS (Bangladesh Standards) (32).

Total fecal coliform (TFC): In some specimens, the total fecal coliform count (TFC) was lower but still there. AA Hotel had the maximum fecal coliform load found at 30 CFU/100 ml, followed by JD Hotel at 24 CFU/100 ml and NI Hotel at 6 CFU/100 ml. No fecal coliforms were discovered in the water samples gathered from JR, AK, SH, SR, and RN Hotels. The presence of fecal coliforms in particular locations points to possible fecal contamination and draws attention to possible health hazards for consumers (Table 3).

Presumptive identification of isolates: Morphological and biochemical examination of the isolates showed *Escherichia coli*, *Klebsiella* spp., *Enterobacter* spp., and *Citrobacter* spp. among the water samples (Table 4). Gram-negative rods exhibiting different colony morphologies on MacConkey agar defined all isolates.

E. coli was found to have flat, dry, pink colonies with an A/A reaction, gas generation, and a negative citrate test. *Klebsiella* spp. produced large, mucoid pink colonies with dispersed pigment and was citrate positive. Small mucoid pink colonies of *Enterobacter* spp. were also citrate positive and showed gas production. *Citrobacter* spp. created little, pale pink colonies and was citrate positive with an A/A response and gas production. These results show coliform bacteria are often linked to fecal contamination of water.

DISCUSSION

Waterborne diseases continue to be a major cause of illness and death worldwide each year (33). Any changes in the physicochemical or microbiological quality of water can greatly increase the spread of these diseases (34). To ensure safety, drinking water must meet all physicochemical standards and have enough essential minerals (35). Although most treated water is free from coliforms, finding total coliforms may point to inadequate treatment, disinfectant failure, contaminated water entering the supply, or bacterial regrowth within the distribution system (36). In Dhaka City, the lack of clean water sources and pollution pose a significant risk to the population from waterborne diseases (37). Given this situation, this study aimed to assess the physicochemical and microbiological quality of water supplied to various hotels in the Shahbag and Ramna areas of Dhaka city.

To identify the quality of drinking water supplied by hotels, eight physicochemical parameters were analyzed, which are listed in Table 1. The pH of all eight water samples collected from hotels in Shahbag and Ramna ranged from 6.3 to 7.4, indicating neutral conditions and meeting both the WHO (6.5–8.5) and Bangladesh drinking water standards (6.5–8.5). These findings are consistent with the study of Ahsan et al. (2022), where a pH value between 6.4 and 6.9 was found in drinking water in Dhaka city. The concentration of dissolved carbon dioxide (CO_2) in the analyzed samples ranged from 24 to 34 mg/l, which was higher than the permissible limit of 15 mg/l set by WHO and BDS norms. Elevated CO_2 levels may signal an acidic water condition and are typically associated with processes such as organic matter decomposition, bacterial regrowth, or heat perturbation, releasing dissolved gases (38).

Bangladesh's drinking water hardness is within the acceptable range of 200–500 mg/l (39). Hard water is harmless to human health, but with increased hardness, it reduces the effectiveness of soap and leads to scaling in utensils and boilers. In the present study, only the JR Hotel sample complied with the national standard of hardness, while other samples were less than that. Water color possesses an acceptable value of 0–15 Platinum Cobalt (Pt-Co) units according to WHO and BDS standards. Analysis revealed that all the samples that were above this threshold were unsafe for consumption as a beverage. Compared to this, Karmakar et al. (2024) also reported color values ranging from 0 to 15 Pt-Co in their study, which is in line with the established standards (40).

The iron content in the samples ranged from 0.15 to 0.41 mg/l. Of these, Shahbag samples of JR Hotel were within the WHO acceptable limit of 0.3 mg/l, while others were higher. All water samples were odorless, which indicates the absence of odor compounds and refers to good sensory quality. Overall, the results show that while some of the physicochemical parameters complied with national and international standards, the majority of the samples registered marginal to non-compliant values that represented a risk to the safety of hotel drinking water in areas under survey.

Microbial analysis was done to evaluate the potability of water samples taken. The standard for total viable bacterial count (TVBC) according to WHO is $\leq 1.0 \times 10^3$ CFU/ml. In the present study, TVBC in all samples was higher than the mentioned standard. The same findings were previously reported by Islam *et al*. (2021) in Noakhali district, where TVBC values ranged from 0.98×10^5 to 2.12×10^6 CFU/ml, well above the standard set by WHO (41). The same was recorded by Islam, M.A. *et al*. (2021) while observing a mean TVBC of 3.05×10^6 CFU/ml in drinking water from some restaurants (6). Elevated TVBC levels indicate elevated microbial loads, which can indicate potential contamination and inadequate treatment or maintenance of the water supply.

For coliform contamination, total coliforms were detected in seven of eight samples, and fecal coliforms in five samples. These findings are in accordance with Sathi *et al*. (2021), who reported contamination of all samples of supply and treated water of Dhaka city with total coliforms, and 10 among 16 samples (22) had fecal coliforms. Uddin *et al*. (2021) determined no detectable levels of *E. coli* and <1.8 MPN/100 ml total and fecal coliforms in tube-well and bottled water, proving microbiological safety in their tested samples (42).

Biochemical characterization in this research confirmed the existence of *E. coli, Klebsiella* spp., *Citrobacter* spp., and *Enterobacter* spp. in hotel water samples. The occurrence of these microorganisms provides evidence for fecal contamination and the possibility of pathogenic bacteria in the drinking water, a severe public health problem. Potential sources of contamination might include inadequate storage facilities for water, cross-contamination, and unsatisfactory handling of hygienic measures at the hotels. Having effective water treatment, complemented with continuous filtration as well as disinfection, is thus critical in maintaining microbiological safety and protecting consumers from waterborne diseases.

CONCLUSIONS

The findings of this study suggest that the overall Shahbag and Ramna drinking water quality in Dhaka is neither safe nor suitable for human intake. The most critical concerns are high microbiological burdens,

elevated CO_2 levels, hardness, color, and high iron levels. Detection of high viable bacteria concentrations, as well as total and fecal coliforms, is an unmistakable reference to the existence of pathogenic organisms that have the potential to create serious health risks among consumers. These results reinforce the urgency of stringent regulatory enforcement and continuous monitoring of water supply systems to ensure compliance with standards according to both WHO and Bangladesh Standards (BDS). Improving surveillance and promoting effective water treatment procedures are essential to safeguard public health and maintain safe drinking water quality.

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CONFLICTS OF INTEREST

There are no conflicts of interest.

REFERENCES

1. Adimalla N and Taloor AK. 2020. Hydrogeochemical investigation of groundwater quality in the hard rock terrain of South India using Geographic Information System (GIS) and groundwater quality index (GWQI) techniques. Groundwater for Sustainable Development, 10:100288.
2. Pranta JB, Chakraborty P and Hossain N. 2023. Experimental investigation of leaked potable water quality supplied by the leading water treatment plant in Bangladesh. Emerging Technologies in Applied and Environmental Microbiology, Elsevier:1-12.
3. Hassan GZ and Akhtar S. Valuing groundwater as a source of livelihood in Punjab Pakistan. [No year/journal details given].
4. Ahsan A, Ahmed T, Uddin MA, Al-Sulttani AO, Shafiquzzaman M, Islam MR, et al. 2023. Evaluation of water quality index (WQI) in and around Dhaka city using groundwater quality parameters. Water, 15(14):2666.
5. Sarker MKU, Majumder AK, Haque MZ, Hossain MS and Al Nayeem A. 2019. Assessment of inland water quality parameters of Dhaka City, Bangladesh. Environmental and Ecosystem Science, 3:13-16.
6. Islam M, Ema I, Usha K and Kabir S. 2021. Physico-chemical and microbiological assessment of drinking water of the selected restaurants in Mymensingh district of Bangladesh. Progressive Agriculture, 32(2):84-95.
7. World Health Organization. 2022. Guidelines for drinking-water quality: incorporating the first and second addenda. WHO.
8. Giri M, Behera MR, Behera D and Mishra B, Jena D. 2022. Water, Sanitation, and Hygiene Practices and Their Association With Childhood Diarrhoea in Rural Households of Mayurbhanj District, Odisha, India. Cureus, 14(10):e29888. doi:10.7759/cureus.29888.
9. World Health Organization. 2023. Burden of disease attributable to unsafe drinking-water, sanitation and hygiene, 2019 update. WHO, Geneva.
10. Mahbub K, Nahar A, Ahmed M and Chakraborty A. 2011. Quality analysis of Dhaka WASA drinking water. Journal of Environmental Science and Natural Resources, 4(2):41-49.
11. Ashbolt NJ. 2004. Microbial contamination of drinking water and disease outcomes in developing regions. Toxicology, 198(1-3):229-238.
12. Mebrahtom S, Worku A and Gage DJ. 2022. The risk of water, sanitation and hygiene on diarrhea-related infant mortality in eastern Ethiopia: a population-based nested case-control study. BMC Public Health, 22(1):343.
13. Prüss-Ustün A, Wolf J, Bartram J, Clasen T, Cumming O, Freeman MC, et al. 2019. Burden of disease from inadequate water, sanitation and hygiene for selected adverse health outcomes: An updated analysis with a focus on low- and middle-income countries. International Journal of Hygiene and Environmental Health, 222(5):765-777.
14. Singh A, Sharma A, Verma RK, Chopade RL, Pandit PP, Nagar V, et al. 2022. Heavy metal contamination of water and their toxic effect on living organisms. The Toxicity of Environmental Pollutants, IntechOpen.
15. Morin-Crini N, Lichtfouse E, Liu G, Balaram V, Ribeiro ARL, Lu Z, et al. 2022. Worldwide cases of water pollution by emerging contaminants: a review. Environmental Chemistry Letters, 20(4):2311-2338.
16. Parvin F, Haque MM and Tareq SM. 2022. Recent status of water quality in Bangladesh: a systematic review, meta-analysis and health risk assessment. Environmental Challenges, 6:100416.
17. Hasan MK, Shahriar A and Jim KU. 2019. Water pollution in Bangladesh and its impact on public health. Heliyon, 5(8):e02145.
18. Hutton G and Chase C. 2017. Water Supply, Sanitation, and Hygiene. In: Mock CN, Nugent R, Kobusingye O, et al. (eds). Injury Prevention and Environmental Health. 3rd edition. Washington (DC): World Bank. Chapter 9.
19. Dadebo D, Obura D and Kimera D. 2023. Hydraulic modeling and prediction of performance for a drinking water supply system towards the achievement of sustainable development goals (SDGs): A system case study from Uganda. Groundwater for Sustainable Development, 22:100951.
20. Talpur HA, Talpur SA, Mahar A, Rosatelli G, Baloch MYJ, Ahmed A, et al. 2024. Investigating drinking water quality, microbial pollution, and potential health risks in selected schools of Badin city, Pakistan. HydroResearch, 7:248-256.
21. Tambi A, Brighu U and Gupta A. 2023. Methods for detection and enumeration of coliforms in drinking water: a review. Water Supply, 23(10):4047-4058.
22. Holcomb DA and Stewart JR. 2020. Microbial Indicators of Fecal Pollution: Recent Progress and Challenges in Assessing Water Quality. Current Environmental Health Reports, 7(3):311-324.
23. Mahmud ZH, Islam MS, Imran KM, Hakim SAI, Worth M, Ahmed A, et al. 2019. Occurrence of Escherichia coli and faecal coliforms in drinking water at source and household point-of-use in Rohingya camps, Bangladesh. Gut Pathogens, 11:52.
24. Nasrin S. 2018. Microbiological quality of drinking water and their antibiogram at roadside restaurants in Dhaka city. Bangladesh Journal of Botany, 47:47-52.
25. Rahman SS and Hossain MM. 2019. Gulshan Lake, Dhaka City, Bangladesh, an onset of continuous pollution and its environmental impact: a literature review. Sustainable Water Resources Management, 5(2):767-777.
26. Majumder AK, Hossain MS & Nayeem A. 2019. Assessment of inland water quality parameters of Dhaka city, Bangladesh. Environment & Ecosystem Science, 3:13-16.
27. Priyanshi, Phiri TA, Prachi, Chhaya, Tomar S, Sagar S, et al. 2023. Assessment of physicochemical properties of water samples. Journal for Research in Applied Sciences and Biotechnology, 2:118-123. doi:10.55544/jrasb.2.2.17.
28. de Souza AC, Simões LA, Schwan RF and Dias DR. 2021. Enumerating Yeast in Foods and Water Using the Spread Plating Technique. Springer.
29. Kemper MA, Veenman C, Blaak H and Schets FM. 2023. A membrane filtration method for the enumeration of Escherichia coli in bathing water and other waters with high levels of background bacteria. Journal of Water and Health, 21(8):995. doi:10.2166/wh.2023.004.
30. Zerin T, Aktar K, Ahmed S, Rahman MM, Begum MA, Farjana NE. 2020. Water quality and distribution of drug-resistant bacteria in tap, well and surface water samples of randomly selected areas in Bangladesh. Journal of Microbiology and Experimentation, 8(6):193-199. doi:10.15406/jmen.2020.08.00308.
31. World Health Organization. 2011. Guidelines for drinking water quality. 4th Edn. World Health Organization; Geneva; 2011. Available: http://apps. who.int/iris/bitst ream/10665/44584/1/9789241548 151_eng.pdf (Accessed 22 Jan 2018).
32. Bangladesh Standards and Testing Institution (BSTI). 2018. List of Bangladesh standards (BDS) on agricultural and food products; 2018. Available: https://bsti.portal.gov.bd/sites/default/files/files/bsti.portal.gov.bd/page/b5ede8e7_aff6_4651_82a4_94ee498ca073/Updated%20BDS%20list%20_%202018.pdf.
33. Cissé G. 2019. Food-borne and water-borne diseases under climate change in low-and middle-income countries: Further efforts needed for reducing environmental health exposure risks. Acta Tropica, 194:181-188.
34. Zalifah C and Abdullah Sani N. 2007. Microbiological and physicochemical quality of drinking water. The Malaysian Journal of Analytical Sciences, 11.
35. Princela MA, Jose JMA, Gladis EE, Arthi D and Joseph J. 2021. Regional assessment of groundwater quality for drinking purpose. Materials Today: Proceedings, 45:2916-2920.
36. Obayomi OV, Olawoyin DC, Oguntimehin O, Mustapha LS, Kolade SO, Oladoye PO, et al. 2024. Exploring emerging water treatment technologies for the removal of microbial pathogens.

Current Research in Biotechnology, 8:100252.
37. Rahaman MA, Kalam A and Al-Mamun M. 2023. Unplanned urbanization and health risks of Dhaka City in Bangladesh: uncovering the associations between urban environment and public health. Frontiers in Public Health, 11:1269362.
38. Singh G, Singh A, Singh P, Shukla R, Tripathi S and Mishra VK. 2021. The fate of organic pollutants and their microbial degradation in water bodies. In: Pollutants and Water Management: Resources, Strategies and Scarcity:210-240.
39. Bhujel P. 2023. Assessment of ground water quality nearby Balaju industrial area. Tribhuvan University.
40. Karmakar P, Bari QH and Redwan SL. Assessment of drinking water quality in the storage containers of different restaurants near KUET campus. [No year/journal details].
41. Islam MA, Ghosh S, Alam AU, Islam MT, Kabir MR and Sultana M. 2021. Assessment of physico-chemical and microbiological quality of drinking water in three upazilas of Noakhali District in Bangladesh. Open Access Library Journal, 8(10):1-11.
42. Uddin MR, Khandaker MU, Abedin MJ, Akter N, Molla Jamal ASI, Sultana R, et al. 2021. Quality assessment of bottled and unbottled drinking water in Bangladesh. Water, 13(15):2026.