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Prevalence of *Escherichia coli* and *Salmonella* in drinking water around Sher-e-Bangla Agricultural University campus

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Abstract

Microbial contamination of drinking water poses a health threat for man and animals. The aim of this study was to detect *Escherichia coli (E. Coli)* and *Salmonella* in drinking water from the Sher-e-Bangla Agricultural University (SrAU) campus and its surrounding areas between January 2021 and August 2021. A total of 60 water samples were collected from dormitories, academic buildings and nearby shopping centres. Identification of bacteria was done using growth characteristics on selective media, staining, microscopic examination, and biochemical tests. The overall prevalence of contamination was 53.3%, with the highest rate (61.1%) in water from shopping centres. Drinking water in the SrAU campus and its vicinity is unsafe for drinking and household purposes. Sanitation programmes of the SrAU health centre need to be strengthen to mitigate health risks of the community. (*Bang. vet.* 2024. Vol. 41, No. 1 – 2, 1 – 6)

Introduction

Safe drinking water is crucial for a healthy lifestyle. Many people around the world still lack access to safe water for drinking and household use (Achar*jee et al*., 2014). Contamination of drinking water has become a serious global issue, contributing to the spread of numerous water-borne diseases (Majumder *et al*., 2011; Uddin, 2018). Poverty reduction and sustainable development can be helped by ensuring the availability of clean drinking water (Tekpor *et al*., 2017). A group of enteric bacterial is commonly found in soil, plants, and water, and in large quantities within the intestines and faeces of living organisms. The presence of coliform bacteria in drinking water suggests contamination by animal waste, faeces or sewage. These microbes can cause a variety of health issues such as diarrhoea, cramps, nausea, and headaches, posing long-term health risks to adults, young children, and infants. The most critical *Salmonella* species for human health are *S. typhimurium* and *S. typhi* (*Lan et al*., 2009). Typhoid fever caused by *S. typhi* remains a major public health concern various regions of Asia, Africa, and South America. Presence of these bacteria in water or food indicates faecal contamination (Levant*esi et* ., 2012). The objectives of the study were to

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detect *E. coli* and *Salmonella* from water along with determination of the prevalence of bacterial load in drinking water collected from around the SrAU campus.

Materials and Methods

The study was conducted for isolation and identification of *E. coli* and *Salmonella* from potable water from January 2021 to August 2021 in and around the SrAU campus.

Study specimen and design: A total of 60 samples (500 ml each sample) were collected in sterile vials from 20 sites. A longitudinal study design was followed.

Physical examination: Colour, odour, turbidity, pH (detected with paper strips), specific gravity & any foreign particles were examined in each sample.

Bacteriological observation

Cultural properties

Nutrient broth (NB), Peptone broth, Methyl-red and Voges-Proskauer broth (MR-VP) were used as liquid media. The solid media were Nutrient agar (NA), MacConkey (MC) agar, Salmonella-Shigella (SS) agar, and Eosin Methylene Blue (EMB) agar. The processed sample was inoculated into NB followed by solid media by spread plate technique (Caponi*gro et al*., 2010). In brief, the inoculated media were incubated at 37°C for 24 hours and examined twice daily. The cultural properties of the bacteria were observed. Gram's stain was done according to the established protocol (Caponi*gro et al*., 2010). The colonial morphology of the *E. coli* and *Salmonella* were observed under microscope.

Biochemical test

Catalase, Indole, Methyl Red, and Voges-Proskauer tests were used as described by Cowan (1974).

a). **Catalase Test**: Bacterial colonies were transferred to an agar plate using a sterile loop, and a drop of 3% H_2O_2 was added to a clean, sterile glass slide. A positive reaction was indicated by the formation of bubbles within a few seconds of adding H_2O_2.

b). **Methyl Red and Voges-Proskauer Tests:** Inoculums were placed in 5 ml test tubes, followed by incubation at 37°C for 72 hours. After incubation, one drop of methyl red solution was added. A red colour indicated a positive result, while yellow or no colour change indicated a negative result.

c). **Indole Test:** Organisms were cultured in 3 ml of peptone water containing tryptophan at 37°C for 48 hours. After incubation, 1 ml of diethyl ether was added, shaken, and allowed to stand until the ether rose to the top. Then, 0.5 ml of Kovac's reagent was gently added. A brilliant red ring forming between the medium and ether layer indicated a positive result (Cheesbrough, 2006).

Results and Discussion

Bacteriological examination

All the water samples cultured in nutrient broth showed turbidity after overnight incubation, indicating bacterial growth. The bacteriological characteristics of the isolated organisms are presented in Tables 1 and 2.

Table 1: The cultural, staining and biochemical properties of *E. coli*

Properties	Observation
Growth properties	Produced red to bright pink color colony in MC agar.
	Produced greenish red colour colony with faint metallic sheen in EMB agar.
Staining properties	Gram-negative.
Microscopic observation	Rod shaped, pink colored, single or paired arranged.
Biochemical test	Bubble formation gave positive result in catalase test.
	Produced red colour in positive result for MR test.
	No colour changed gave negative result for VP test.
	Produced bright red to pink colour ring in Indole test.

Table 2: The cultural, staining and biochemical properties of *Salmonella*

Properties	Observation
Growth properties	Produced black colonies in SS agar.
	Produced gray colonies in EMB agar.
Staining properties	Gram negative.
Microscopic observation	Small rod shaped, pink colour, arranged singly or paired.
Biochemical test	Bubble formation gave a positive indication in the catalase test.
	Produced red colour in a positive result for MR test.
	No colour change gave a negative result in VP test.
	No ring formation gave a negative result in Indole test.

The cultural, staining, microscopic and biochemical characteristics of the isolated *E. coli* and *Salmonella* closely align with the observations reported by Ronald (2015) and Mannan *et al*. (2023).

The occurrence of bacterial contamination in various food shops in and around the SrAU campus is presented in Table 3. A total of 18 drinking water samples were collected from six halls of residence: *E. coli* were detected in 2 and *Salmonella* in 5, and overall prevalence was 38.9%. Among the six halls, the highest prevalence (66.7%) was in Sheikh Hasina and Sheikh Sayera Khatun Halls. Both bacteria were present in

Sheikh Hasina and Sheikh Sayera Khatun students' Halls. The size and population density of these halls may explain the higher prevalence rates of contamination.

Six samples were collected from two faculty buildings. The overall prevalence of bacterial contamination was 50%, with *Salmonella* being the most frequently detected organism. The Agriculture Faculty Building had a higher prevalence (66.7%) compared to Sheikh Kamal Building (33.3%). The Agriculture Faculty Building is the oldest building, which could contribute to its higher microbial contamination. Concerned authority should regularly clean and disinfect the water reservoir tank and water taps. Leakage of water lines should be checked and if needed replaced or repaired.

Table 3: Prevalence of bacterial contamination of water samples in different study areas

Study areas		Total sample	Positive		Overall Prevalence (%)
			Salmonella	*E. coli*	
Students' Halls of residence	Shirajuddoula	3	0	0	0.00
	Sheikh Hasina	3	1 (33.3%)	1 (33.3%)	66.7
	Kabikazi Nazrul Islam	3	1 (33.3%)	0	33.3
	Fazilatunnesa Mujib	3	0	1 (33.3%)	33.3
	Sheikh Lutfur Rahman	3	1 (33.3%)	0	33.3
	Sheikh Sayera Khatun	3	2 (66.7%)	0	66.7
Total	**6**	**18**	**5**	**2**	**38.9**
Buildings	Agriculture Faculty Building	3	1 (33.3%)	1 (33.3%)	66.7
	Sheikh Kamal Building (Veterinary Faculty)	3	1 (33.3%)	0	33.3
Total	**2**	**6**	**2**	**1**	**50**
Shopping areas (Street Food shops)	College gate food shop	3	2 (66.7%)	1 (33.3%)	100
	Minimarket	3	1 (33.3%)	1 (33.3%)	66.7
	Food shop gate-2	3	1 (33.3%)	0	33.33
	Tea stall gate-2	3	1 (33.3%)	0	33.3
	Agargaon bazar	3	1 (33.3%)	1 (33.3%)	66.7
	Paka market	3	1 (33.3%)	1 (33.3%)	66.7
	Pitha store gate-1	3	1 (33.3%)	1 (33.3%)	66.7
	Food shop gate-1	3	1 (33.3%)	0	33.3
	Tea stall gate-1	3	1 (33.3%)	1 (33.3%)	66.7
	Jhalmuri shop	3	1 (33.3%)	1 (33.3%)	66.7
	Fuska shop	3	1 (33.3%)	1 (33.3%)	66.7
	Food shop gate-2	3	1 (33.3%)	1 (33.3%)	66.7
Total	**12**	**36**	**13**	**9**	**61.1**
Grand total	**20**	**60**	**20 (33.3%)**	**12 (20%)**	**53.3**

In shopping areas, 36 samples were collected from 12 street food shops where overall prevalence was 61.1%. The highest contamination was (100%) in the College Gate

food shops. Across all 60 samples collected from the SrAU campus and surrounding areas, 12 (20%) were positive for *E. coli*, while 20 (33.3%) were positive for *Salmonella*.

Salmonella is a common food-borne pathogen and a significant public health concern due to its role in food poisoning, which leads to considerable economic losses (Health Protection Agency, 2009). The highest contamination rates of *E. coli* and *Salmonella* were 20% and 33.3%, respectively (Table 3). The microbiological hazards posed by *Salmonella* species are a global concern for food safety. Mom*taz et* al. (2013) reported *E. coli* contamination (23.6%) and *Salmonella* (2.8%) of bottled water samples in Iran, which are consistent with this study. Similarly, Momba *et al.* (2006) found contamination of ground and surface waters in South Africa.

According to the World Health Organization (WHO) in 2011 and Centre for Affordable Water and Sanitation Technology (CAWST) in 2014, drinking water must be free from *E. coli* and *Salmonella* contamination. Their presence in potable water poses serious health threat as these pathogens causes hemorrhagic colitis, diarrhoea, nausea, stomach cramps, fever, and vomiting (K*err et al*., 1999). To mitigate these risks water purification (such as chlorination, filtration, sedimentation, and boiling) should be employed, and the microbiological quality of stored drinking water should be regularly monitored.

Conclusions

In this study *Salmonella* and *E. coli* were detected in water samples collected from three study areas. The highest contamination rate (61.1%) was found in the shopping (street food) areas around the SrAU campus. Overall, 53.3% of water samples were contaminated with pathogenic enteric bacteria, which are indicators of faecal contamination. Sanitation and hygienic measures need to be implemented to ensure the supply of safe potable water for the community people.

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References

Acharjee M, Rahman F, Jahan F, Noor R 2014: Bacterial proliferation in municipal water supplied in Mirpur locality of Dhaka city, Bangladesh. *Clean-Soil, Air, Water* **42** 434–441.

Caponigro V, Ventura M, Chiancone I, Amato L, Parente E, Piro F 2010: Variation of microbial load and visual quality of ready-to-eat salads by vegetable type, season, processor and retailer. *Food Microbiology* **27** 1071–1077.

CAWST (Center for affordable water and sanitation technology) 2014: Canada: Introduction to drinking water quality testing a CAWST training manual.

Cheesbrough M 2006: Medical laboratory manual for tropical countries. **2** 400-480.

Cowan ST 1974: Manual for the identification of medical bacteria. *Cambridge University Press*. 45-60.

Health Protection Agency 2009: Guidelines for assessing the microbiological safety of ready-to-eat foods.

Kerr M, Fitzgerald M, Sheridan J, McDowell D, Blair I 1999: Survival of Escherichia coli O157: H7 in bottled natural mineral water. *Journal of Applied Microbiology* **87** 833–841.

Lan R, Reeves PR, Octavia S 2009: Population structure, origins and evolution of major *Salmonella enterica* clones. *Infection, Genetics and Evolution* **9** 996–1005.

Levantesi C, Bonadonna L, Briancesco R, Grohmann E, Toze S, Tandoi V 2012: Salmonella in surface and drinking water: occurrence and water-mediated transmission. *Food Research International* **45** 587–602.

Majumder AK, Islam KN, Nite RN, Noor R 2011: Evaluation of microbiological quality of commercially available bottled water in the city of Dhaka, Bangladesh. *Stamford Journal of Microbiology* **1** 24–30.

Mannan MA, Rahman S, Adnan R, Saud B, Chowdhury S 2023: Detection of *Escherichia coli* and *Salmonella* species from vegetables salad in Dhaka City. *Journal of Sher-e-Bangla Agricultural University* **14** 1-7.

Momba MN, Malakate VK, Theron J 2006: Abundance of pathogenic *Escherichia coli, Salmonella typhimurium* and *Vibrio cholerae* in Nkonkobe drinking water sources. *Journal of water and health* **4** 289–296.

Momtaz H, Dehkordi FS, Rahimi E, Asgarifar A 2013: Detection of *Escherichia coli, Salmonella species*, and *Vibrio cholerae* in tap water and bottled drinking water in Isfahan, Iran. *BMC Public Health* **13** 1-7.

Ronald MA 2015: Principles of Microbiology, 2nd edn., Published by McGraw Hill Education (India) Private Limited.

Tekpor M, Akrong M, Asmah MH, Banu RA, Ansa EDO 2017: Bacteriological quality of drinking water in the Atebubu-Amantin district of the Brong-Ahafo region of Ghana. *Applied Water Sci*ence **7** 2571–2576.

Uddin MA 2018: Microbiological analysis of ready to eat foods collected from different places of Dhaka City, Bangladesh. *Stamford Journal of Microbiol*ogy **8** 30-33.

WHO (World Health Organization) 2011: Guidelines for drinking-water quality, Switzerland: WHO Library Cataloguing-in-Publication Data, Fourth.