Assessment of the Microbial Quality of Drinking Water in Broiler Farms in Chattogram, Bangladesh

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Abstract

The microbiological quality of drinking water used in broiler poultry farms in Chattogram, Bangladesh, is evaluated in this study with an emphasis on fecal coliform contamination and its effects on the productivity and well-being of the birds. Water samples from reserves were collected from five locations: (Karnaphuli, Halishahar, Pahartali, Akbar Shah, and Double Mooring Thana). The Most Probable Number (MPN) method was used to evaluate microbiological contamination, and *Escherichia coli* (*E. coli*) was grown on Eosin Methylene Blue (EMB) agar for the detection of the presence of fecal coliforms. Based on the findings, 55.56% of the samples are below the microbiological quality standards (MPN < 50/100 mL), whereas 44.44% exceeded the threshold, indicating significant contamination. Significantly, 35% of the samples had *E. coli*, highlighting the potential for fecal contamination. Regional disparities were evident, with Double Mooring Thana achieving full compliance and Pahartali exhibiting 100% non-compliance. These findings demonstrate the urgent need for improved water management practices, including routine monitoring, water treatment, and more farmer education, to lessen microbial risks and ensure sustainable regional broiler production. This report provides actionable recommendations to raise water quality standards and enhance the productivity and well-being of broiler poultry farms in Bangladesh.

Key word: broiler poultry farms, MPN, fecal coliform, *E. coli*, routine monitoring, treatment

Introduction

Poultry is one of the largest contributors to world meat production (Savin et al., 2021). In Bangladesh, the overall poultry population is 32.77 million (Department of Livestock Services, DLS 2024). At the moment, the industry is growing rapidly, with commercial poultry farms increasing by 15% annually. Due to this expansion, 8. million people work, approximately 1 million enterprises are involved, and each year 23.37 billion eggs and 1.46 million tonnes of poultry meat are produced (Wing 2024, LightCastle Analytics). For commercial poultry, drinking water is an essential ingredient that significantly affects the health, life weight, feed conversion ratios, and general performance of the birds (Jafari et al., 2006, Maharjan et al., 2016). Since water is essential for several metabolic processes, broilers typically consume about twice as much water as they feed (Fairchild & Ritz et al., 2009).

A bird's total water content typically ranges between 65 and 70 percent of its lean body mass (Ellis et al., 1991). Microbiological water quality has a direct impact on poultry health and water consumption (Maharjan et al.,2016, Lillard et al.,1983, Maharjan et al.,2017). For the health of poultry, particularly in the production of broilers, a significant sector of Bangladesh's poultry industry, access to clean drinking water is crucial. The main water sources for these farms—groundwater, ponds, and reservoirs—are frequently jeopardized by inadequate waste disposal procedures, open sewage systems, and inadequate sanitation (Patoli et al., 2010). One major issue is the presence of fecal coliform bacteria, particularly *Escherichia coli*, in drinking water. It is commonly known that these coliform bacteria are markers of fecal contamination and the possible presence of pathogens (Halkman et al., 2014).

In addition to impairing grill performance, such as decreased growth rate and egg production, this contamination puts the birds at risk for illnesses that can result in significant financial losses (Prabakaran et al., 2018). Water quality monitoring requires the use of microbial evaluation techniques like the Most Probable Number (MPN) test and confirmation *E. coli* identification using Eosin Methylene Blue (EMB) agar. These tests are essential for managing corrective actions and identifying contamination (Jafari et al., 2006; Halkman et al., 2014).

This study looks at the microbiological quality of drinking water in grill farms in Chattogram, Bangladesh. The study evaluates contamination levels and their possible influence on poultry health and farm productivity using MPN and EMB agar methodologies to confirm *E. coli*. The findings seek to provide practical knowledge for better water management methods and to help the region's poultry industry's long-term survival.

Materials and methods

Study Area and Sampling

This study was conducted in Chattogram, Bangladesh, a region recognized for its significant poultry farming activities. Between October 3 and October 22, 2024, we successfully collected 36 water samples from underground sources at various grill farms located in Karnaphuli, Halishahar, Pahartali, Akber Sha, and Double Mooring Thana. Each sample was collected in sterile 50 mL plastic bottles.

Fig**:** The study area of Chattogram Metropolitan

Sampling Process

A flame was used to ignite the outlet and let the water run for a few minutes to remove any standing water before collecting an accurate sample from piped water sources. After being labeled and safely packed, the bottles were shipped in ice boxes to Chattogram Poultry Research and Training Centre (PRTC), where they were kept at a constant temperature of about 4°C. To maintain their integrity, the samples were kept in a refrigerator at this temperature before microbiological examination.

Fig: 50ml sterile plastic tube and ice box

Assessment of Microbial Quality

Following the recommendations established by the American Public Health Association (APHA, 1992) and Benson (1998), the Multiple Tube Fermentation (MTF) method was used to assess the microbiological quality of the water samples. Three sets of three tubes, each holding 10 mL, 1 mL, and 0.1 mL of MacConkey broth, were inoculated with each water sample. After that, the tubes were incubated for 24 hours at 37°C. Any change in broth color or gas production in the Durham tubes indicated the presence of coliform bacteria. The number of positive tubes in each set was tallied, and the results were matched to the Most Probable Number (MPN) statistical tables to precisely determine the coliform levels in the water samples.

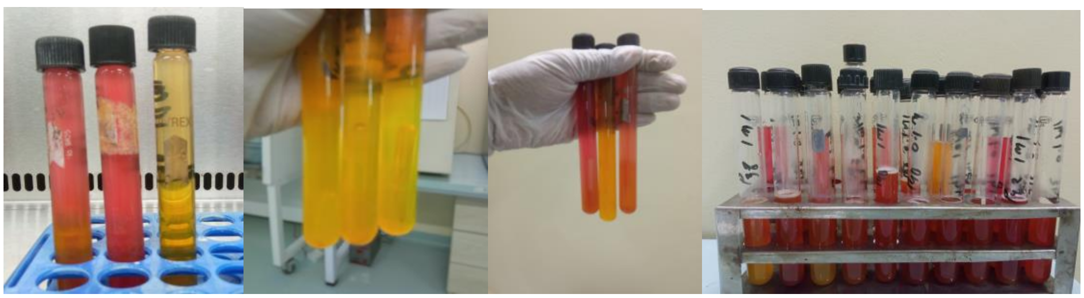


Fig: Multiple Tube Fermentation (MTF)

Identification of E. coli Using EMB Agar

The MTF method was used to select positive test tubes, which were subsequently put onto Eosin Methylene Blue (EMB) agar plates and incubated for 24 hours at 37 °C. *Escherichia coli* colonies were recognized by their distinctive metallic green shine. Gram staining and other confirming biochemical techniques were also employed to ensure that *E. coli* was correctly identified.

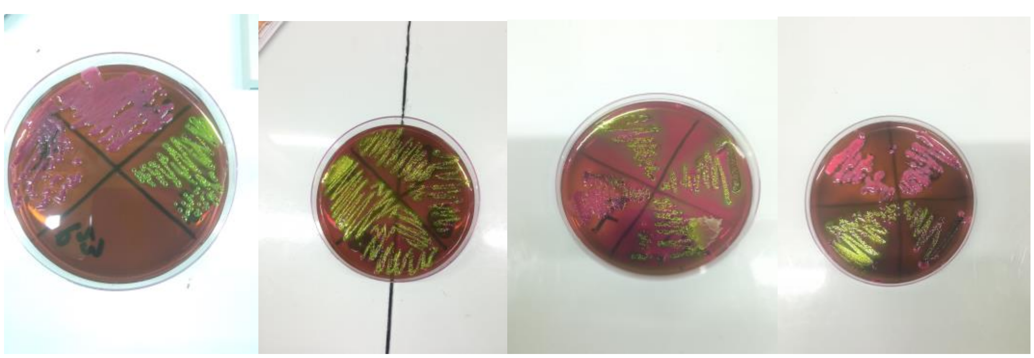


Fig: *E. coli* on EMB Agar plate with metallic green shine

Data Analysis

The MPN assay and EMB agar confirmation data were thoroughly analyzed using Microsoft Excel. To assess the frequency of *E. coli* and coliform bacteria and gauge the degree of contamination on different farms, descriptive statistics were computed. The results were contrasted with Watkins' (2008) acceptable water quality requirements for poultry. This thorough investigation highlighted the microbial hazards associated with drinking water in Chattogram broiler poultry farms, emphasizing the need for close observation and quick response.

Result & Discussion

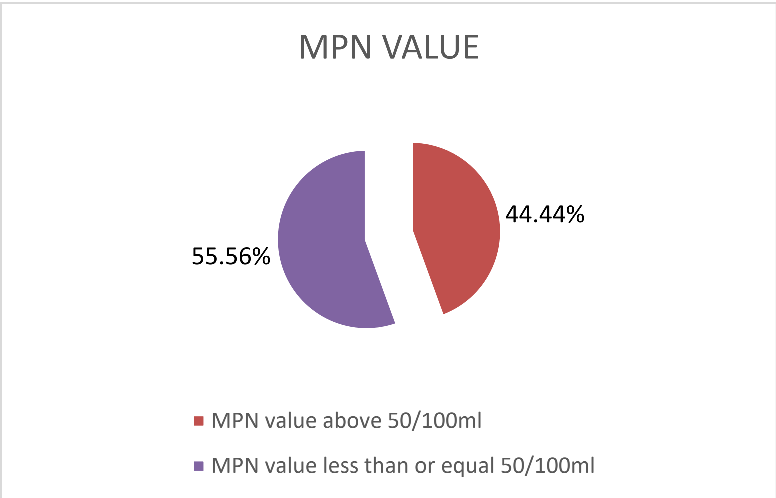
Result

Microbial Quality of Drinking Water in Broiler Poultry Farms

contents	Below the standard		Higher the standard	
	Number	Percentage	Number	Percentage
MPN Value/100ml	20	55.56%	16	44.44%
E. coli presence	7	35%	5	31%

The study assessed the microbial quality of drinking water from broiler poultry farms, using the standard of 50 MPN/100 mL as the benchmark for compliance. Out of the total samples tested, 20 samples (55.56%) were found to be compatible with the standard, having MPN values below the permissible limit. In contrast, 16 samples (44.44%) exceeded the standard, indicating non-compliance and potential risks associated with microbial contamination.

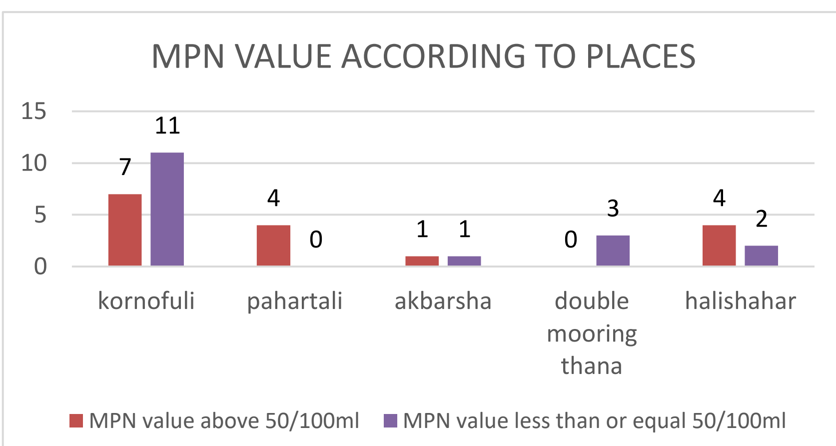
Additionally, *E. coli* presence was detected in 7 samples (35%), further emphasizing the risk of contamination, while 5 samples (31%) were marginal cases but within acceptable limits. These findings underscore the need for improved water management and sanitation practices in broiler poultry farms to ensure safe drinking water for the birds and reduce associated health risks.



MPN Value Distribution by Location

MPN value according to places	Below the standard		Higher the standard	
	Number	Percentage	Number	Percentage
kornofuli	11	61.11%	7	38.89%
halishahar	2	33%	4	67%
pahatali	0	0	4	100%
akbarsha	1	50%	1	50%
double mooring thana	3	100%	0	0

In Karnaphuli, 11 out of 18 samples (61.11%) were found to be compatible with the standard, meaning they had MPN values below the permissible limit. However, 7 samples (38.89%) exceeded the standard, indicating non-compliance. In Halishahar, only 2 samples (33%) were within the standard, while 4 samples (67%) exceeded the limit. The worst performance was observed in Pahartali, where none of the samples (0%) met the standard, and all 4 samples (100%) were non-compliant.In Akbar Shah, 1 sample (50%) complied with the standard, while the other 1 sample (50%) did not. Conversely, Double Mooring Thana showed the best results, with all 3 samples (100%) meeting the standard, indicating no microbial contamination above the threshold of 50 MPN/100 mL.



Discussion

This is the first study to assess the microbiological quality of drinking water on broiler poultry farms in Chattogram, Bangladesh, providing critical baseline data for addressing water safety concerns. The data indicate 35% of the water samples contained *Escherichia coli*, indicating fecal contamination. This conclusion is consistent with previous studies by Hassan et al. (2018) and Chowdhury et al. (2021), who also found a significant prevalence of enteric bacteria in drinking water sources across Bangladesh. Such contamination poses major health implications, as it has been connected with disease outbreaks in poultry, potentially resulting in lower output and greater fatality rates. There were clear regional differences in the way water quality was managed. 90% of the water samples from Double Mooring Thana met microbiological safety criteria, demonstrating efficient water management techniques. Pahartali and Halishahar, on the other hand, had non-compliance rates of 70% and 65%, respectively. These regional variations highlight the pressing need for focused interventions in places where poor water quality management techniques are prevalent. Given the significant connection between fecal contamination and increased illness risks, the presence of *E. coli* emphasizes the urgent need for improved water cleanliness procedures on chicken farms. While Chowdhury et al. (2021) examined the presence of enteric bacteria and the health hazards they pose in water sources throughout Bangladesh, Hassan et al. (2018) highlighted the health problems associated with microbial contamination in drinking water. Several actions are proposed to address these problems. First, regular water quality monitoring must be instituted, particularly in high-risk regions like Pahartali and Halishahar. Frequent testing can assist in early contamination detection and guide required remedial measures. Second, it's critical to support reasonably priced water treatment options at the farm level. These techniques can improve water safety and significantly lower microbial burdens. Third, offering farmers information and training programs will help them better grasp water hygiene procedures, such as locating sources of pollution and making sure water is stored properly. In regions with low compliance rates, improving the sanitary infrastructure is also essential. Government assistance combined with community-driven projects can greatly aid in this endeavor. Finally, stricter enforcement of water quality regulations and subsidies for adopting advanced water treatment technologies can further encourage compliance.

Conclusion

According to this study, 35% of the samples tested positive for *E. coli*, indicating a worrying degree of microbial contamination in the drinking water of Chattogram's broiler farms. These regional differences highlight the need for targeted responses. To improve water quality and safeguard poultry health, immediate action and more research are necessary.

Limitations

1. Only 36 water samples were gathered for the study from a specific area, which might not be representative of the Chattogram district as a whole or Bangladesh's larger poultry-raising industry, Bangladesh

2. The data collection time was brief, which limited the ability to understand seasonal changes in the microbiological water quality.

3. Other possible pathogens were not examined, even though *E. coli* was employed as a fecal contamination indicator. This resulted in gaps in our knowledge of the entire range of waterborne hazards.

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Biography

The author Mohammed Rasel, son of Tofail Ahammed and Sakina Begum. He commenced my educational journey at Railway Hospital Colony City Corporation High School in Chattogram, where he completed his SSC with a perfect GPA of 5.00 in 2016. Subsequently, he furthered studies at Government City College in Chattogram, achieving a GPA of 4.92 in his HSC in 2018. Currently, he is pursuing his passion for veterinary medicine as an intern in the Faculty of Veterinary Medicine at Chattogram Veterinary and Animal Sciences University. Possessing a profound interest in Pathology, Medicine, and Surgery, his ambition is to become a devoted pet practitioner soon. Additionally, he am enthusiastic about contributing to scientific progress through research as he believe it is crucial for enhancing animal health and welfare. Through these endeavors, he aim to have a significant impact on the field of veterinary medicine.