

Microbiological Quality of Community and Animal Drinking Water in and around Mhow, Indore, Madhya Pradesh

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ABSTRACT

Microbial contamination of drinking water is a significant public health issue, particularly in developing regions where sufficient sanitation, hygiene, and water treatment are often lacking. This study aimed to assess the microbiological quality of drinking water from various sources with a focus on the presence of *Escherichia coli* as an indicator of fecal contamination. A total of 240 samples collected in and around Mhow, Indore (MP) (80 each community drinking, packaged water and animal drinking water), were analysed for microbiological quality by multiple tube technique, which displayed MPN (most probable number) indices from <3 to >1100 MPN/100 mL. Based on MPN count, water samples available for human drinking (both community and packaged water combined) were graded as satisfactory (63.75%), suspicious (6.25%) and unsatisfactory (30 %). However, only 0.98% samples graded satisfactory were positive for *E. coli*. Conversely, 30 % and 35.41% samples observed suspicious and unsatisfactory, respectively, showed the presence of *E. coli*. In source wise investigation of human drinking water samples, 27.50%, 12.50% and 60.00% community drinking water samples were observed as satisfactory, suspicious and unsatisfactory, respectively, wherein *E. coli* was detected in 4.54%, 30.00% and 35.41% samples, respectively. On the other hand, all the packaged water samples (100%) were found satisfactory for drinking without presence of *E. coli* in any of the sample. In the animal drinking water samples, presence of coliforms (100%) including *E. coli* (31.25 %) found was of considerable concern. High percentage of unsatisfactory water samples with presence of *E. coli* indicate likely sewage contamination and highlights the urgent need for immediate attention, and action to reduce the risk of water-borne diseases.

Key words: Drinking water, *E. coli*, Indicator, Microbiological quality, Most probable number (MPN).

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INTRODUCTION

The scenario of contamination in drinking water is not unusual, and the resultant disease epidemics are vastly common in the developing countries where sanitation, water treatment and hygiene practices are ignored (Ahmed *et al.*, 2013). The water-borne diseases, has contributed to 70-80% of health problems in developing countries (Jayana *et al.*, 2009) often transmitted through water contaminated with untreated sewage, discharged near water sources or distribution systems. Microbial contamination is one of the significant challenges in water-related health burdens (WHO, 2008). Hence, it is essential to check the quality of the drinking water from various sources (Mahajan *et al.*, 2018; Phyto *et al.*, 2019).

Analysis of water quality, assessing the presence of specific pathogens, is usually complex, expensive, and time consuming (Mahbub *et al.*, 2011). Additionally, the contaminants are often present in low quantities, which may result in their overlooking in the detection process (Ahmed *et al.*, 2013). Coliform bacteria especially *E. coli* are the natural commensal in the gut of animals and humans and usually enter water through the excreta of individuals, whether symptomatic or carriers, who inadvertently contaminate drinking water sources (Ahmed *et al.*, 2013). Thus their existence in drinking water signifies the likely presence of pathogens (Tharannum *et al.*, 2009). The assessment of

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coliform quantities helps in determining the possible health risks and hazards associated with contaminated drinking water (Goel *et al.*, 2007; Abera *et al.*, 2011). Therefore, the present study was undertaken with an aim to determine the concentration of coliforms using most probable number (MPN) technique and; to detect occurrence of *E. coli* in the drinking water available for consumption in the area.

MATERIALS AND METHODS

Sources of Samples

A total of 240 samples, comprising community drinking water (n=80), including tap water from public places such as eateries, offices and institutes, hospitals, households; packaged (branded) drinking water (n=80) and animal drinking water (n=80) from livestock and poultry farms and horse stables, in and around Mhow (DMS: 22° 33' 8.7732" N and 75° 45' 23.5116" E), Indore (MP, India), were collected aseptically in sterile screw capped bottles and transported to the laboratory in chilled condition in an icebox for further processing.

Presumptive Test

Most probable number (MPN) test, a quantitative method using multiple tube technique as described in US Food and Drug Administration's Bacteriological Analytical Manual was used to analyse water samples. The count was made by using the McCrady's table of probability according to the method described by FDA (2023) (Fig. 1).

Confirmed Test

Positive samples with the production of acid and gas in MacConkey lactose broth (the presumptive test) were selected and tested for the confirmation of presence of indicator bacteria, i.e., *E. coli* of faecal origin. One loopful inoculum from the positive test tubes of presumptive test was inoculated on eosin methylene blue (EMB) agar, incubated at 37°C for 24 h and observed for an appearance of distinctive blue-black colony with a green metallic sheen as a test of confirmation (Fig. 2).

Grading of Water Sample

Based on MPN count the human drinking water samples were categorised or graded as excellent, satisfactory, suspicious

and unsatisfactory (Table 1) as per the literature (Malathy *et al.*, 2017; Nyakundi *et al.*, 2020; Bano *et al.*, 2022). However for animal drinking water no such guideline for classification is available, hence only the coliform and *E. coli* positive samples were recorded.

Table 1: Classification of water quality based on coliform (MPN) count

Class	Grade	Presumptive coliform count (MPN/ 100 mL)	<i>E. coli</i> count/100 mL
I	Excellent	0	0
II	Satisfactory	1-3	0
III	Suspicious	4-10	0
IV	Unsatisfactory	>10	≥1

RESULTS AND DISCUSSION

As per FAO, the recommended MPN values for drinking water are 2/100 mL and the permissible limit is 10/100 mL (WHO, 2008; BIS, 2012; Satish *et al.*, 2018). The present study displayed a range of MPN indices from <3 to >1100 MPN/100 mL in community drinking water and animal drinking water. However, packaged drinking water revealed no coliform contamination. The present finding is in agreement with Roy *et al.* (2013) and Satish *et al.* (2018), who reported a range of MPN between 7.4 to >1100 and <3 to >1100 MPN/100 mL, respectively, indicating greater prevalence of faecal pollutants in drinking water.

Based on MPN count, out of 160 water samples intended for human consumption investigated in the present study, 63.75% (102/160) samples showed satisfactory results, whereas 6.25% (10/160) were found suspicious and the rest (30%; 48/160) were unsatisfactory. Source wise investigation, 27.50% (22/80) community drinking water samples were found satisfactory, 12.50% (10/80) were suspicious and

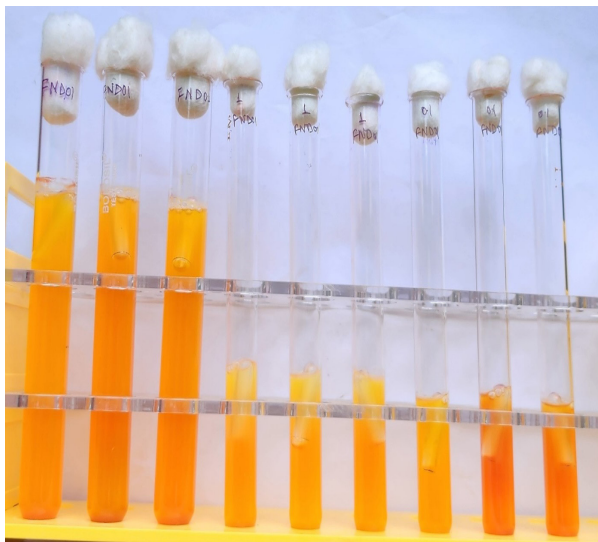


Fig. 1: MPN test showing acid and gas production

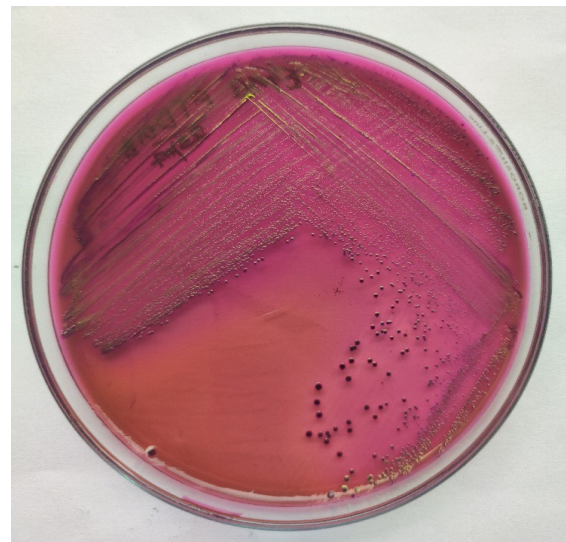


Fig. 2: Colonies of *E. coli* on EMB agar

Table 2: Quality of community and packaged drinking water samples [based on coliform (MPN) count]

Class	Grade (MPN/100 mL)	Community drinking water		Packaged drinking water		Combined result for human drinking water	
		Positive for coliforms	Positive for <i>E. coli</i>	Positive for coliforms	Positive for <i>E. coli</i>	Positive for coliforms	Positive for <i>E. coli</i>
I	Excellent (0)	-	-	-	-	-	-
II	Satisfactory (1-3)	27.50% (22/80)	4.54% (1/22)	100% (80/80)	-	63.75% (102/160)	0.98% (1/102)
III	Suspicious (4-10)	12.50% (10/80)	30.00% (3/10)	-	-	6.25% (10/160)	30.00% (3/10)
IV	Unsatisfactory (>10)	60.00% (48/80)	35.42% (17/48)	-	-	30.00% (48/160)	35.41% (17/48)

60.00% (48/80) were unsatisfactory (Table 2). Kumar *et al.* (2013), Mahajan *et al.* (2018) and Satish *et al.* (2018) graded 54.31%, 31.62% and 5.26% samples, respectively, in their studies, as unsatisfactory, which is lower than the present investigation (60.00%). This appears to be due to possible contamination with human and animal excreta (Mahajan *et al.*, 2018). However, the entire packaged drinking water sample *i.e.*, 100 % (80/80) was found satisfactory (MPN count between 1-3/100 mL) in the present investigation.

On the other hand, in animal drinking water, all 80 samples were found contaminated with coliforms in this study. This finding was also in agreement with other studies that reported occurrence of coliform bacteria in drinking water (Rizwan *et al.*, 2023; Soares *et al.*, 2023). Of the total 80 animal drinking water samples 31.25 % (25/80) were also positive for *E. coli* isolates.

Microbiological criteria for animal drinking water are not as clearly specified as those for human consumption (Munster and Kemper, 2024). Also, animals might have varying tolerances to water quality parameters unlike human. Therefore, it will not be customary to categorise or grade the samples like community drinking water in the present investigation. However, the presence of coliforms in animal drinking water, as observed in the present investigation, is an indicator of the likely presence of pathogenic microorganisms and indicates low microbiological quality. This presence of coliform in the sample may be due contamination of its source itself and lack of necessary treatments before use for livestock drinking (Rizwan *et al.*, 2023). Although, the established criteria for food and animal feed microbiology, especially pertaining to coliform levels, are relatable to ensuring water quality for animals, more insights on microbial quality of animal drinking water are required.

Further investigation for the presence of *E. coli* in drinking water revealed that, out of a total of 102 human drinking water samples categorized as satisfactory, only 0.98% (1/102) was found positive for *E. coli*. However, 30 % (3/10) samples categorized as suspicious, and 35.41 % (17/48) as unsatisfactory showed the presence of *E. coli*. When analysing community drinking water separately, *E. coli* was detected in 4.54% (1/22), 30.00% (3/10) and 35.41% (17/48) of satisfactory, suspicious and unsatisfactory drinking water, respectively. None of the packaged water sample showed presence of *E. coli*. These findings highlight the poor quality of drinking water available to the community. The presence of coliform and especially *E. coli* in all the categories indicates the possible faecal or sewage contamination and consumption of such water may lead to waterborne diseases, especially of intestinal pathogens (Satish *et al.*, 2018).

In conclusion, drinking water contaminated with pathogenic faecal microbes poses a serious health risk. The shockingly high number of contaminated water samples is alarming and serves as evidence of negligence, undermined action towards human and animal welfare. In order to improve the situation, an aggressive plan to prevent water

contamination is necessary along with practical initiatives to provide safe drinking water.

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