Research & Reviews in Biotechnology & Biosciences **ISSN No: 2321-8681**
Website: www.biotechjournal.in **Research article**
Volume: 10, Issue: 2, Year: 2023 **PP: 81-87**
DOI: https://doi.org/10.5281/zenodo.10677399 **Peer Reviewed Refereed Journal**

Bacteriological Water testing in different regions of Ludhiana district, Punjab, India

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Article History

Received: 16/08/2023
Accepted: 24/09/2023

Article ID: RRBB/112

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Abstract

Drinking water is one of the basic needs of life and essential for survival. In this study, the microbiological examination of drinking water and water used for domestic purposes in Ludhiana district was carried out to ascertain their suitability for consumption, and presence of various microorganisms which are water borne. A total of forty (40) water samples were collected from the various regions of Ludhiana. All the areas of study showed 20-40% potability. The present findings provide an insight into the quality of drinking water in the areas of study and can be used by local water authority to ensure the supply of safe drinking water among population.

Keywords: Portability; Bacteriological analysis; Water quality; waterborne diseases

Introduction

Water is a fundamental resource on Earth, and is crucial for sustainability of human life, including the necessity for drinking water. Assessing the adequacy of drinking water, it is essential, in present and for the future as well (1). Access to clean water is a fundamental human right and an essential resource for the existence of man and other living things. Even, a minor loss of one per cent of body fluids can lead to dehydration in humans, while fluid loss reaching ten percent poses high risk of mortality (2). Nevertheless, the distribution of water resources is not uniform across the globe, with some areas being abundantly rich while others face scarcity. It is imperative to analyze the water resources of different regions individually. Public health faces significant challenges regarding the quality of drinking water and the treatment of waterborne diseases. Bacterial contamination poses the most prevalent health risk to drinking water sources. Water holds paramount importance for all life forms, playing an indispensable role in maintaining life on Earth and contributing to the composition and renewal of cells (3). Despite its critical role, humans continue to pollute water sources, leading to water-related illnesses. Diseases associated with contaminated drinking water impose a substantial burden on human health, with microbial contamination being the predominant health risk. Inadequate sanitation, polluted water, and water unavailability contribute to up to 80% of sickness and diseases globally. The microbiological quality of drinking water is a global concern due to its implications for public health (4). Community health relies heavily on safe and easily accessible water. Water, constituting about 70% of human body mass and 71% of the Earth's surface, is universally acknowledged as a crucial factor in

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determining the health and well-being of societies (5). Ensuring the good quality of drinking water is fundamental to guaranteeing public health, as it plays a significant role in human infection and diseases (6). Availability and accessibility of clean, potable water contribute to environmental protection, sustainable development, and poverty reduction. Poor water quality is considered a manifestation of poverty in developing countries, especially with the challenges posed by rapid population growth, urbanization, industrialization, and anthropogenic activities. Globally, water pollution rates are soaring, and approximately 1.1 billion people lack access to safe drinking water sources, with a majority in Asian and sub-Saharan African countries. WHO's 2030 agenda for sustainable development emphasizes the importance of water quality, stating that any deviation beyond permissible standards renders water polluted and unfit for its intended purposes(7). Therefore, regular monitoring and analysis of water are essential to assess its quality and degree of pollution.

In order to be deemed potable, water must adhere to specific physical, chemical, and microbiological criteria established to guarantee its palatability and safety for consumption[10]. Potable water is characterized as being devoid of disease-producing microorganisms and harmful chemical substances that could adversely affect health (8)

The health impact of inadequate water quality is staggering, with an estimated 37.7 million Indians suffering from waterborne diseases annually, resulting in the deaths of 1.5 million children due to diarrhea alone. Recognizing the significance of clean drinking water, the Constitution of India, under Article 47, places the responsibility on the states to ensure the provision of clean drinking water and enhance public health standards. Despite an expenditure of Rs.1,105 billion during the 10th plan on ensuring safe drinking water, the persistent lack of access to secure drinking water remains a substantial obstacle and imposes a significant economic burden on the nation (9).

Materials and Methods

Sample sites

This study was carried out at Ludhiana, centrally located city of Punjab, which is on the Grand Trunk
road from Delhi to Amritsar at latitude 30.55 nort h and longitude 75.54 East in Northern India (10) (Figure 1). Total 40 drinking water samples (Tap and filtered) and one control water sample were tested. Water samples were collected from some households of eight areas (Area 1- Area 8) of Ludhiana city viz. Chandigarh Road, Ferozpur Road, Civil Lines, Hambran Road, Pakhowal road, Jalandhar byepass, Gill road, Old City Area (Table 1). Boiled water sample was also tested and marked as Control.

Sample collection

These Samples for water analysis were collected in sterilized narrow mouthed bottles (Autoclavable) with stopper of 500ml capacity. The bottles were autoclaved before sampling for 20 minutes. Five random samples from each region were collected with utmost care to ensure that no contamination occurs at the time of collection and were labeled as S1 to S40 (Table 2) along with boiled water sample as Control. The water analysis was carried out within one hour of collection. These samples were subjected to potability analysis for bacteriological parameters.

Bacteriological Examination

Bacteriological water testing kits procured from Department of Microbiology, PAU, Ludhiana were used for bacteriological examination for detection of total coliforms, E. coli and emerging pathogens from drinking water. The kit is based on a defined substrate to detect presence or absence of total coliforms and emerging pathogens without need of confirmatory or

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complete tests .The aluminum seal of bacteriological water testing kit was cut open and the testing water was filled into the kit aseptically under laminar air flow cabinet. This was followed by rubber stopper replacement and kit was incubated up to 48 hours. Each sample bottle was examined at the end of 24 hours for color change and popping of lid (gas production) and if no change in color was observed, these were re-incubated for 24hours and examined again. Samples were observed for color change and gas production. No color change and absence of gas production constitutes negative test whereas color change from purple to yellow along with gas formation (if any) indicates positive test.

Result and Discussion

Microbiological Kit Analysis:

Twelve out of the 40 samples studied from eight different regions were found to be potable as per the result shown in Table 2; Figure 3. The non potability of water samples suggests the possibility for presence of coliform group and that the water may have been contaminated with faecal matter.

Conclusion

The findings from the aforementioned results revealed that nearly 70% (Figure 2) of the examined samples exhibited bacteriologically non-potable water. This aligns with the observations of Mahajan & Bhardwaj, 2017(11); Sahota et al., 2010(12), who also noted a high prevalence of non-potable water in these regions, emphasizing the contamination of water sources. The prevalence of bacteriologically non-potable water remains a significant concern. Given the susceptibility of the human population to waterborne diseases resulting from contaminated drinking water, it becomes imperative to conduct regular assessments of drinking water quality. Local water authorities must undertake essential measures to ensure the provision of safe drinking water to the population. Subsequent research is warranted to investigate potential associations between various health issues among individuals and the consumption of non-potable water. This could serve to draw the attention of relevant authorities towards addressing these concerns.

Authors Contribution

All the authors have contributed for the manuscript.

Acknowledgement

Authors are thankful to the host institution for providing necessary support to conduct the above mentioned research

Conflict of interest

Authors declare no conflict of interest

Figure1: Map of Ludhiana city, adapted from https://ludhiana.nic.in/ (13)

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Figure 2: Percentage of Potable and non-potable water samples

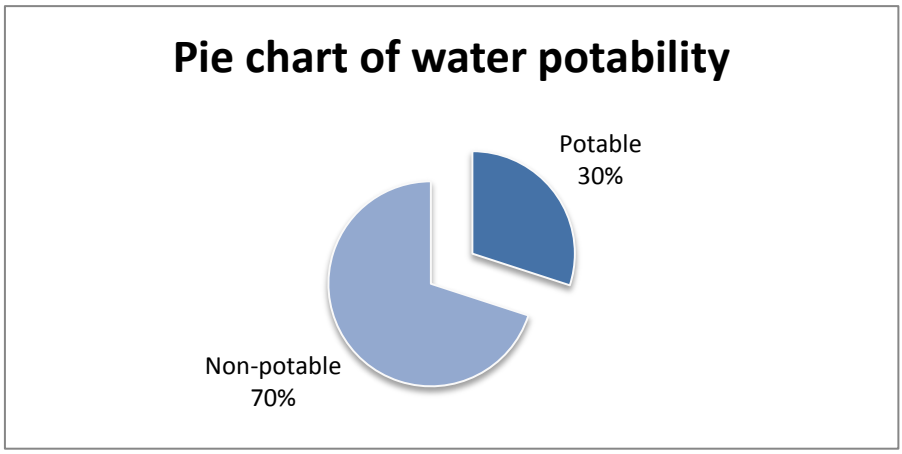
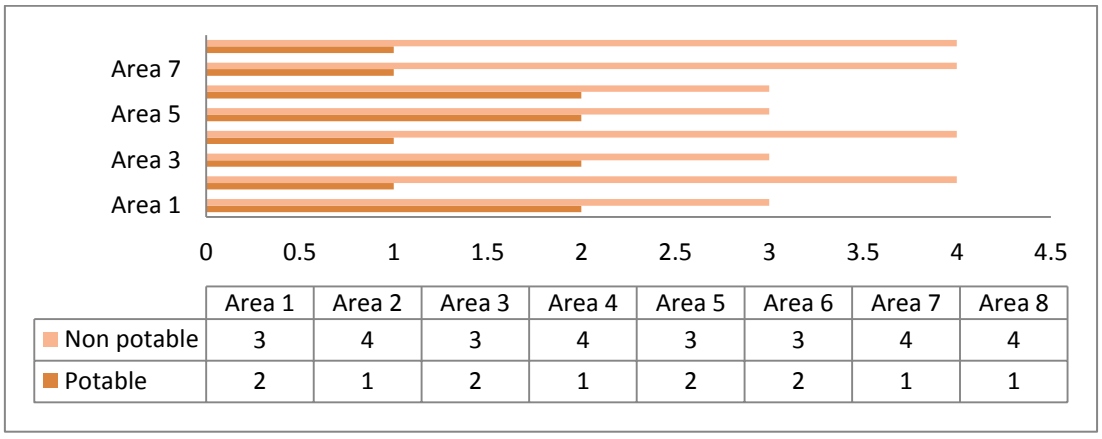


Figure 3: Distribution of potable and non-potable water samples in different areas of Ludhiana district



	Area 1	Area 2	Area 3	Area 4	Area 5	Area 6	Area 7	Area 8
Non potable	3	4	3	4	3	3	4	4
Potable	2	1	2	1	2	2	1	1

Figure 4: Observations after 24h of incubation for different water samples

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Table 1: List of various areas from Ludhiana district for water sample collection

S.no	Area	Name of Area
1	Area 1	Chandigarh Road
2	Area 2	Ferozpur Road
3	Area 3	Civil Lines
4	Area 4	Hambran Road
5	Area 5	Pakhowal road
6	Area 6	Jalandhar byepass
7	Area 7	Gill road
8	Area 8	Old City Area

Table 2: Results obtained through Microbiological water testing kit

S.No	Area	Sample number	Result	Inference
1	1 Chandigarh Road	S1	Positive	Non-potable
2		S2	Positive	Non-potable
3		S3	**Negative**	**Potable**
4		S4	**Negative**	**Potable**
5		S5	Positive	Non-potable
6	2 Ferozpur road	S6	Positive	Non-potable
7		S7	Positive	Non-potable
8		S8	Positive	Non-potable
9		S9	**Negative**	**Potable**
10		S10	Positive	Non-potable
11	3 Civil lines	S11	Positive	Non-potable
12		S12	Positive	Non-potable
13		S13	**Negative**	**Potable**
14		S14	Positive	Non-potable
15		S15	**Negative**	**Potable**
16	4 Hambran road	S16	Positive	Non-potable
17		S17	Positive	Non-potable
18		S18	Positive	Non-potable
19		S19	**Negative**	**Potable**
20		S20	Positive	Non-potable
21	5 Pakhowal road	S21	Positive	Non-potable
22		S22	**Negative**	**Potable**
23		S23	**Negative**	**Potable**
24		S24	Positive	Non-potable
25		S25	Positive	Non-potable
26	6 Jalandhar byepas	S26	Positive	Non-potable
27		S27	Positive	Non-potable
28		S28	Positive	Non-potable
29		S29	**Negative**	**Potable**
30		S30	**Negative**	**Potable**
31	7 Gill road	S31	Positive	Non-potable
32		S32	**Negative**	**Potable**
33		S33	Positive	Non-potable
34		S34	Positive	Non-potable
35		S35	Positive	Non-potable

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36	8 Old City area	S36	Positive	Non-potable
37		S37	Positive	Non-potable
38		S38	Positive	Non-potable
39		S39	Positive	Non-potable
40		S40	**Negative**	**Potable**

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ISSN No: 2321-8681
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