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ASSESSMENT OF BIOCHEMICAL AND MICROBIOLOGICAL PARAMETERS IN DIFFERENT SOURCES OF PORTABLE WATER IN WESTERN U.P.

Kanchan Chauhan	Postgraduate student, Dept. of Biochemistry, Subharti Medical College, Meerut, U.P., India.
Jaskiran Kaur	Professor & Head, Dept. of Biochemistry, Subharti Medical College, Meerut, U.P., India
Surbhi Tyagi	Tutor, Dept. of Biochemistry, Subharti Medical College, Meerut, U.P., India.
Anita Pandey	Professor & Head, Dept. of Microbiology, Subharti Medical College, Meerut, U.P., India.
Charul Tyagi	Postgraduate student, Dept. of Microbiology, Subharti Medical College, Meerut, U.P., India.

ABSTRACT **Background-** Water is the basis of life and vastly required for drinking along with other purposes, the suitability of water must be checked before use. **Aim & Objective-** The aim of this study was to analyse the quality of portable water from different regions in western U.P, by checking biochemical and microbiological parameters. **Material & Method-** A total of 60 samples were collected from bore well, hand pumps, and municipal tap water supplies of the different areas as mentioned and examined for bio-chemical and microbiological parameters. **Result-** In this study 33% sample have hardness above the acceptable limit, 29% have high TDS, 19% have high dissolved ammonia and 5% have crossed the permissible limit of fluoride. For microbiological analysis, the multiple tube fermentation (MTF) method was used. 20 samples were found to be contaminated with coliform bacteria. **Conclusion-** Water quality analysis revealed that the quality of water of some regions does not fall within the standard limits as per Bureau of Indian Standards (BIS).

KEYWORDS : Portable water, Water Quality Index, Total Dissolve Solids(TDS), Hardness, Coliform bacteria, Most Probable Number(MPN), Multiple-tube fermentation (MTF)

INTRODUCTION

Water touches every aspect of life. Water makes up on average 60% of an adult's body weight every process in our body directly or indirectly depends on water. Safe, clean, and easily available drinking water is a fundamental necessity of all humankind. Groundwater is regarded as the safest source of drinking water but due to rapid urbanization, high population growth rate, and various anthropogenic activities, water resources are getting highly contaminated with several harmful pollutants. According to World Health Organization (WHO), consumption of contaminated water causes 80% of diseases directly or indirectly in the world. Contaminated water and poor sanitation are linked to transmission of diseases such as cholera, diarrhoea, dysentery, hepatitis A, typhoid etc. Absent, inadequate, or inappropriately managed water and sanitation services expose individuals to preventable health risks.1 According to UNICEF less than 50 percent of the population in India has access to safely managed drinking water.2 There are limited number of studies which determine biochemical and microbiological water quality in Western Uttar Pradesh hence the present study was done to know the water quality from different sources of Western Uttar Pradesh.

MATERIALS AND METHODS

The study was conducted in the Department of Biochemistry in collaboration with the Department of Microbiology at Subharti Medical College, Meerut, after taking the approval from the Institutional ethical and research committee of Subharti Medical College.

Sample size -

A total of 60 water samples were collected from bore well, hand pumps, and municipal tap water supplies of the different areas of western Uttar Pradesh via a random sampling method in a sterilized container to analyse water`s biochemical and microbiological quality.

Method used for estimation

In order to determine the suitability of groundwater for drinking purposes, the samples were examined for physio-chemical and biological parameters.

For biochemical analysis the Water Quality Index developed by the Bureau of Indian Standards (BSI) was used3, the biochemical parameter was analysed are- pH, Total Dissolve Solids (TDS), Total hardness, chloride, fluoride and total ammonia method and desirable limits of these parameters is given below in table-1.

For microbiological analysis multiple-tube fermentation (MTF) method was used to detect coliform bacteria. Coliform bacteria are rod-shaped gram-negative bacteria which belong to the Enterobacteriaceae family and used as a biological indicator of water pollution. MTF method consists of inoculating a series of tubes with appropriate dilutions of the water sample. Fermentation tubes containing lactose broth (are inoculated with measured volumes of water samples; the coliform bacteria present in the water sample multiply and are detected by the formation of acid and gas. From the number with a positive reaction, the most probable number (MPN) of bacteria present in the original water sample can be determined statistically[4].

Table-1

S.NO	Parameter	Acceptable Limit	Permissible Limit	Method of Test
1	pH	6.5- 8.5	Relaxation	pH Meter
2	Total Dissolve solids	500mg/l	2000mg/l	Gravimetric Method
3	Total Hardness	200 mg/l	600mg/l	EDTA Method
4	Chloride	250 mg/l	1000mg/l	Argentometric Method
5	Fluoride	1mg/l	1.5 mg/l	Titrimetric Method

6	Total Ammonia	0.5 mg/l	No Relaxation	Titrimetric Method

RESULT

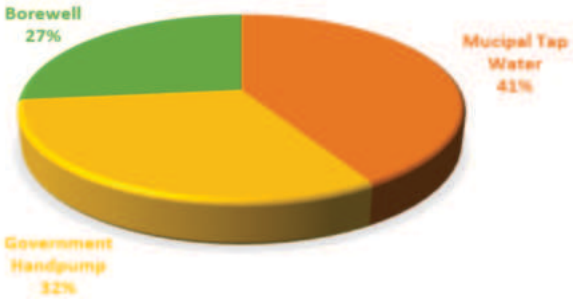

Figure. (1): Percentage Wise Distribution of Drinking Water Sample

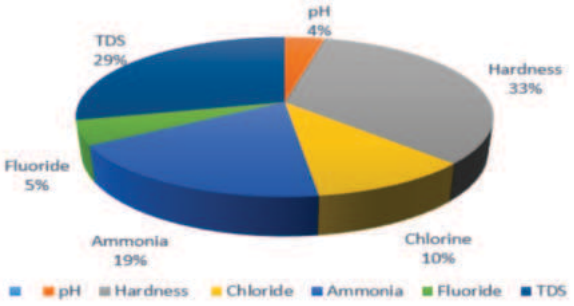

Figure-2 Analysis of chemical parameter of water sample

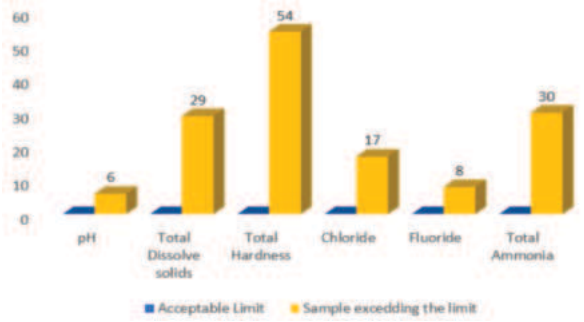

Figure-3 No. of sample exceeding the limit

Table-2 Microbiological Analysis of water sample

Source of water sample	Total No. of Water Sample	No. of unsatisfactory sample	Escherichia coli	Pseudomonas Sp.	Klebsiella Sp.
Municipal Tap Water	25	10	2	5	3
Government Hand pump	19	8	1	4	3
Bore well	16	2	-	-	2

Figure 4- Microbiological contamination in different type sample

A total of 60 drinking water samples were analysed. Out of which-
Total drinking water samples collected from Municipal Tap Water -25(41%).
Total drinking water sample collected from Government Hand Pump -19 (32%).
Total drinking water sample collected from Bore well - 16 (27%). (Figure-1)

As per chemical analysis, six samples (i.e.4%) have pH above 8.5, 54 samples (i.e.33%) have hardness above the acceptable limit out of which 30 samples have a hardness level above 400-600 mg/dl, 14 samples have hardness between200-400mg/dl,10 samples have hardness above 600mg/dl, while only 6 samples have a hardness level below an acceptable level. 46 (i.e.29%) have high TDS. High dissolve ammonia level was detected in 30(i.e.19%) samples. Out of 60 samples 8 (i.e. 5%) have crossed the permissible limit of fluoride, while no sample crossed the permissible limit of chlorine but 17(i.e.10%) have chlorine above the acceptable limit(Figure2). For microbiological analysis, the most probable number (MPN) method was used. Out of 60 samples, 20 samples have coliform bacteria. (Table-2). The organisms were identified as *Escherichia coli, Pseudomonas Sp.,* and *Klebsiella sp.* Municipal tap water samples have the highest number of coliform bacteria while bore well samples have minimal coliform bacteria.

DISCUSSION

Biochemical Parameters

The pH of any solution gives the strength of the solution and an idea of whether the solution is acidic or alkaline. Safe ranges of pH for drinking water are from 6.5 to 8.5 for domestic use and living organisms needs. As per our finding 4% of samples are alkaline The high levels of either acidity or alkalinity in water may be an indication of industrial or chemical pollution. The pH has no direct impact on the health of the human being but too much alkalinity disturbs the body's normal pH, leading to metabolic alkalosis[5].The presence of huge concentrations of potassium, chloride, and sodium ions, causes high levels of Total Dissolve Solids (TDS). Out of sixty, forty- six samples have high TDS. According to Deswal et.al Increase in TDS may be due to saline water infiltration and increase in salt like bicarbonate, sulphate, calcium, chloride, sodium, potassium, and other ions during rainy seasons[6]. High TDS value reduces utility for drinking and agriclutre[7]. Drinking water with a high TDS level for an extended period of time can lead to chronic health problems such as kidney stones, hair fall, skin disorders, atopic eczema. In our study, we found that only six samples have hardness below an acceptable limit. These findings were in accordance with the finding of Krishna Gopal et.al. who found that fluoride and hardness were high in most of the samples[8]. Fluoride ions in the drinking water in modest amounts are beneficial for tooth health but excess fluoride causes dental fluorosis, skeletal fluorosis, hyper parathyroidism, and skin, cardiovascular, and reproductive problems. Hence it is desire to maintain the optimal concentration of fluoride in drinking water. Ammonia (NH3) is a clear gas with a distinct odour. Ammonia forms a weak base when it reacts with water. Water contaminated with sewage, animal wastes, or fertilizer runoff may contain excessive quantities of ammonia. In our study high dissolve ammonia level was detected in thirty samples these findings were supported by Chaudhary Veena et.al who state that heavy nitrogenous fertilizer application and open dumping of animal waste were responsible for groundwater nitrate contamination in Western Up[9].

Ammonia poisoning can be caused by drinking water with high levels of ammonia, which can cause nausea, vomiting, severe stomach discomfort, difficulty breathing, burning eyes, temporary blindness, acidosis, and elevated blood pressure.

Microbiological Parameters

Microorganisms are found everywhere in nature. Water contains millions of bacteria per millilitre, the majority of which are harmless. Coliform bacteria indicate that the water has been contaminated by human or other warm-blooded animal feces. In our study, we find out that 10 samples out of 60 from municipal tap water have highest number of coliform bacteria the similar result was found by *Deepesh Kumar* et.al[10]. The presence of coliform bacteria in water indicates faecal contamination or may be due to contamination during storage and distribution through water pipelines.

As per our analysis water from municipal samples and hand pumps is not suitable for drinking purposes. These findings were supported by *Haroon Sajjad et.al*.[9] who state that the water quality is not up to the mark but tube well samples are better than the hand pump water samples the ground water drawn from deep water table through tube wells was found to be without any contamination. According to *Neelam Nigam et.al*. high concentration of various elements in groundwater render it unsuitable for domestic and other uses whereas its long term use may lead to a variety of diseases and may even prove fatal[11].

CONCLUSION

Water quality analyses reveal that the quality of water of some regions does not fall within the standard limits as per BIS. Water is vital for life clean, and safe drinking water is a fundamental necessity for all humans. The water for human consumption must be free from chemical, and microbiological contamination. The distribution system of water supply should be closely monitored from pump houses to consumer ends. To maintain proper water quality parameters corroded and old water pipelines should be renovated, leaking joints and cross connections between water supply pipes and sewage drainage pipes should be checked properly.

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