

Drinking Water Quality - A Study

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ABSTRACT

The present preliminary investigation was carried out to assess the degree of potability of drinking water from three different sources in the valley (viz. Dood Ganga, Alasteng, and bottled Mineral Water). The study was carried out by physico-chemical and bacteriological analysis during Summer, Spring and Winter. The average levels of pH, Chloride, D.O., Total hardness, and Magnesium for all water samples were found to be well within the limits prescribed for drinking water by W.H.O. (1993). However, Ca⁺⁺ content for Dood Ganga showed abnormally high value of 134.8 mg/l against 100mg/l as prescribed by W.H.O. (1993) and touching values were shown by Alasteng water sample while its values were normal for mineral water. Values of MPN/100ml of coliform bacteria indicated that all the three water samples crossed the drinking water limits of 0/100ml prescribed by W.H.O. (1993) and APHA (1998).

Keywords: Water quality, physico-chemical characteristics, bacterial count, coliform test.

Abbreviations : D.G. - Dood Ganga ; A.T. - Alasteng; M.W. - Mineral Water (bottled).

INTRODUCTION

Water is considered as one of the major component of living organisms and an elixir of life. This is evident from following Quranic Verse :

وَجَعَلْنَا مِنَ الْمَاءِ كُلَّ شَيْءٍ حَيٍّ

i.e., "And We made from water every living thing" (21:30)

In addition, water serves as the second best natural medium for the growth of microorganisms. But because of increased population and over exploitation of fresh water and waste water disposal, it directly or indirectly modifies and alters the physical, chemical and biological characteristics of water, which have profound and deleterious effects on human health by way of disease transmission and on the

environment as a whole. Incidence of typhoid fever, bacillary dysentery, hepatitis, cholera etc transmitted by water is still wide spread in some developing countries (W.H.O.,1997). Similarly, out break of gastro enteritis is because of sewage polluted water containing *E.coli* serotype 0126:1316 (Wernar *et al.*,1969). This indicates that the microorganisms and pollution are related in diverse ways as microorganisms may either directly indicate pollution or may be the cause therefore.

So, one can assume that drinking water is not only getting polluted but also becoming scarce commodity world wide. To assuage this scarcity, there is growing pressure to harness surface water sources like rivers and streams. But the extent to which we should interfere with aquatic systems is still a subject of some debate. Therefore, an attempt was made to investigate the status of three different sources of drinking water being supplied to the valley.

MATERIAL AND METHODS

Water samples were collected in 1 litre clear plastic bottles on seasonal basis (viz; Spring, Summer & Winter) in the morning hours after the tap water was allowed to run for a few minutes. Water samples to be tested for potability were drawn from:

Doodganga (D.G.) :- The samples were drawn from a residential house tap from Gogji Bagh locality which receives D.G. water supply and is in frequent use.

Alasteng (A.T.) :- The samples were drawn from the taps of University campus, Hazratbal, which receives A.T. supply and is in frequent use.

Mineral water (M.W.) :- A bottled mineral water (a local brand 'Kashmir Aqua') was used as sample. Moreover, it was used before its shown expiry date in three different seasons .

Chemical parameters were analyzed according to the standard methods given in Mackereth (1963), Welch (1948), and A.P.H.A.(1998). Parameters like D.O., chloride, total alkalinity, total hardness, Ca^{++} , and Mg^{--} were analyzed in the laboratory within 24 hrs. of sampling. pH was done on spot with the help of digital pH meter. This procedure was followed in two samples viz. D.G. and A.T. while as , in M.W. the chemical parameters were analyzed after procuring from the market.

Bacterial analysis was made by using dilution technique (MacFaddin, 1985; APHA,1998). After making serial dilutions , the samples were cultured using nutrient

agar medium (Koch, 1882) through spread plate technique (Taylor *et al.*, 1983; Kaper *et al.*, 1978) and Bacterial count was made after incubating the plates in an inverted position at 37°C for 24 hours. No. of bacteria/ml of water samples were counted using dilution formula $n \times 1/d$. While as coliform analysis was done by incubating water samples of three different dilutions (viz. 10ml, 1ml, 0.1ml) into McConkey's broth medium (c.f. APHA, 1998) then incubated for 48 hours at 37°C. Coliform count was done by calculating MPN of water samples using McCrady's probability table (McCrady, 1915).

RESULTS

Chemical Analysis:

Mean of the chemical parameters of three samples (viz. D.G., A.T., M.W.) as depicted in (Table 1), suggests that the pH was always in an alkaline range and did not fluctuate too much. Values being 7.86, 7.36 and 7.44 for A.T., M.W. and D.G. respectively. The amount of dissolved oxygen present in these water samples was good but maximum being for A.T. (12.8 mg/L) and minimum in M.W. (9.3 mg/L). Values of total alkalinity were 82.6 mg/L, 74.6 mg/L and 131 mg/L respectively for A.T., M.W. and D.G. Hardness values were quite high for all the three samples but being maximum for D.G. (199.6 mg/L), followed by A.T. (174.3 mg/L) and M.W. (174.6 mg/L). Appreciable amount of Ca^{++} was present in these samples, values being 134.8 mg/L for D.G., 99.7 mg/L for A.T. and 85.4 mg/L for M.W. Similar trend was followed by Mg^{++} , being maximum for A.T. (74.3 mg/L), then M.W. (67.6 mg/L) and D.G. (64.64 mg/L). Low Cl^- values were recorded for all the three samples, being 11.46 mg/L, 6.90 mg/L and 11.60 mg/L for A.T., M.W. and D.G. respectively.

Bacterial Analysis:

Plate Count :- Bacterial count made after 24hrs. showed substantial increase in number during summer and was low during winter for all the three water samples. Table 2 represents the bacteria no./ml of samples for three seasons. Number of bacterial count/ml during summer was 7.0×10^2 ml, 5.0×10^2 /ml and 7.2×10^2 /ml respectively for D.G., A.T. and M.W. and during winter number was 3.8×10^2 /ml, 4.0×10^2 /ml and 2.2×10^2 /ml respectively for D.G., A.T and M.W.

Coliform Count :- MPN/100ml for the three samples tested is depicted in Table 3. Positive coliform test for gas and acid production was recorded even for M.W. which is represented by MPN/100ml = 54/100ml. For A.T. all the tubes

showed gas as well as acid production. Therefore, MPN value was >181/100ml.
 For D.G. MPN value was = 161/100ml.

Table - 1. Mean of the parameters for three seasons and their comparison with W.H.O. standards.

S.No.	Parameters	Alasteng water	Mineral Water	Dood Ganga	W.H.O. Standards
1.	pH	7.86	7.36	7.44	6.5-9.2
2.	Cl ⁻ mg/l ⁻¹	11.46	6.90	11.60	250
3.	D.O. mg/l ⁻¹	12.80	9.30	11.00	2-3
4.	T. Alkalinity mg/l ⁻¹	82.60	74.60	131.00	-
5.	T.H. mg/l ⁻¹	174.30	153.30	199.60	500
6.	Ca ⁺⁺ mg/l ⁻¹	99.70	85.40	134.80	100
7.	Mg ⁺⁺ mg/l ⁻¹	74.30	67.60	64.64	150

Table - 2. No. of bacteria present per ml of water samples for three seasons.

Samples	Spring n x 1/d =	Summer n x 1/d =	Winter n x 1/d =
D. G.	5.9x10 ² /ml	7x10 ² /ml	3.6x10 ² /ml
A.T.	4.5x10 ² /ml	5.0x10 ² /ml	4.0x10 ² /ml
M.W.	5.3x10 ² /ml	7.2x10 ² /ml	2.2x10 ² /ml

Where n x 1/d = "d" is dilution factor
 "n" is no. of colonies on that plate.

Table - 3. Most Probable Number (MPN) /100ml of three water samples for a set of test tubes giving positive reaction.

Samples	No. of tubes giving +ve rxn.			MPN/100 ml
	1x50 ml	5x10 ml	5x1 ml	
A.T.	1	5	5	>181/100 ml
D.G.	1	5	4	=161/100 ml
M.W.	1	5	2	=54/100 ml

DISCUSSION

Chemical Analysis

Chemical analysis of three water samples gives an indication that these waters being supplied to common people are still worth to drink as all the chemical parameters investigated were found within the acceptable limits according to W.H.O. standards(1993) with the exception of calcium content for D.G. (Table 1).

Comparing the data on pH shows that all the three water samples were alkaline in nature throughout the year (2002). For drinking purposes alkaline nature of water is prescribed and values found in present study were within permissible limits of W.H.O (1993). Chloride content in all the water samples was significantly very low but is as per prescribed values by W.H.O (1993). Moreover, according to Hutchinson (1957) it is really a dominant anion in an open drainage system which is the case with the water samples under investigation. DO values suggest that these water sources contain appreciably good amount of oxygen and are in accordance with W.H.O standards (1993). Alkalinity present is due to bicarbonates and observed alkalinity values place them in hard water type of Moyle (1945). Also Freiser and Fernando (1966) state that when total alkalinity is high the bicarbonate system prevails and pH is usually on the alkaline side. This was also true for the water samples under investigation. Similarly mean values for hardness (for three samples), showed that they are within the limits what W.H.O (1993) has prescribed. According to Ohle (1934) these water samples are calcium rich, therefore, be classified into the polluted category. The high value of calcium may be due to sewage inflow or excessive use of bleaching powder at processing station for the purpose of disinfection. Also according to W.H.O (1993) D.G. is not potable as it crosses permissible limits of 100 mg l^{-1} for calcium (134.8 mg/l) and touching value was showed by A.T. (99.7 mg l^{-1}).

Bacterial Analysis

Bacterial analysis reveals that irrespective of seasonal changes colonies appeared though the number of colonies was much higher during summer as compared to winter. This can be attributed to temperature, nutrients, light, pH etc. Alvarez (1981), observed decline in bacterial count in winter with decreasing in pH and temperature in N.Florida. Similarly the presence of large number of bacterial colonies does not indicate any sort of contamination nor the low count. However, EEC, Directive 80/778 (Senior,1996)) sets 10 bact. /ml for tap water at 37°C . Therefore, D.G and A.T samples at 37°C have shown permissible values for potability. Similarly, Natural Mineral Water Regulation, 1985 (Senior,1996) sets 5 bacteria/ml at 37°C and

maximum permitted number of bacteria is 20/ml at 37°C. Therefore, for mineral water under investigation the number of bacteria per ml has remained within the maximum permitted limit at 37°C. Hence potability sustains.

For further assessing the degree of potability, water samples were tested for coliform group and all samples tested positive by gas and acid production. The MPN index observed for three water samples showed that they were crossing the permissible limit of W.H.O (1993) standards (0/100ml). Hence, water samples were suspected of being contaminated by organic material of humans or animal origin. Also, according to the drinking water classification by Ananthanaryan and Paniker, (1996) all the three samples tested were to be grouped under class IV, i.e. unsatisfactory category for drinking purposes on the basis of presumptive coliform count/100ml.

Since the present study is of preliminary nature more investigation in this direction will confirm the results.

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