Evaluation of Coliform in Tap Water of Forty one Town of Ten Districts of Kashmir Valley

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Abstract

The coliform group has been used extensively as an indicator of water quality and has historically led to the public health protection concept. The aim of the study was to evaluate the status of tap water of Kashmir valley, and to monitor coliforms through multiple tube method- Most Probable Number (MPN). MPN proved highly successful when it was used to detect faecal pollution and to monitor water quality during outbreaks of water borne hepatitis A & E infection in the valley. Total forty one towns of ten districts of three subdivisions were studied. The coliform count of tap water of Kashmir valley varied greatly. District Srinagar shows lowest level of MPN ? 2/100ml of tap water. However bacterial count of tap water of majority of the towns exceeded the recommended permissible level of WHO. Introduction of sewage into the drinking water system was the main reason for the bacterial contamination. The sewage water recycling was necessary to minimize the water borne diseases. During the study it was found that tap water of Kashmir valley except Srinagar is not fit for human consumption and other similar use.

Introduction

In many countries, microbiologically safe drinking water is considered a fundamental human right. About 80% of communicable diseases in the world are waterborne. According to WHO estimate about 80% of water pollution in developing country, like India is carried by domestic waste. In India 70% of the water is seriously polluted and 75% of illness and 80% of the child mortality is attributed to water pollution. The improper management of water systems may cause serious problems in availability and quality of water. The major pathogenic bacteria responsible for water borne disease are spread by the faeco-oral route, in which water may play an intermediate role.

Faecal Coliform is by far the most important microbial indicator from water quality point of view because of its direct health significance. Coliform bacteria are often referred to as “indicator organisms” because they indicate the potential presence of disease causing bacteria in water. The presence of coliform bacteria in water does not guarantee that the water will cause an illness. Rather, their presence indicates that a contamination pathway exists between a source of bacteria (septic system, animal waste, etc.) and the water supply. Disease causing bacteria may use this pathway to enter the water supply and thereby human system.

The multiple tube method was introduced by McCrady and has been widely used for estimating numbers of particular organisms in water and other public health specimens. The MPN method of coliform bacteria testing that rely on color changes also provide an estimate of the number of bacteria present, which use a statistical relationship to estimate the number of bacteria in water sample based on color changes in multiple test tubes. The higher the level of indicator bacteria, the higher the level of faecal contamination and the greater the risk of water borne diseases.

The purpose of this study was to investigate and analyze microbial coliform contamination in the tap water system of forty one major towns of ten districts of Kashmir valley, to assess the effectiveness of tap water system. The data of this study may provide some important information about public health risks associated with water quality in this region.

Materials and Methods

For bacteriological study of water total forty one towns of ten districts of Kashmir valley were studied. Minimum five samples were taken from each town. Only tap water was used for the study. Samples were taken from the consumer points and all possible care was taken to collect the samples from the taps used by the major population of the area. Water was allowed to run for five minutes before filling the bottle. The study was carried out from January 2011 to December 2011. Samples were collected in sterilized glass bottles of 500ml capacity and were sealed to avoid contamination if any. Sterile gloves were used to avoid contamination of sample. They were stored in ice box and transported to lab within 24 hours and processed within 36 hours.

MacConkey broth (single strength) and MacConkey broth (double strength) was prepared by adding 40mg
and 80mg of MacConkey broth (single strength) and MacConkey broth (double strength) powder to 1000ml of distilled water separately respectively. The content of both the mixtures were stirred and shaken well before heating for one hour. For MPN values 50ml & 10ml of MacConkey broth (double strength) was added one 150ml fermentation tube and five 30ml fermentation tubes respectively. Similarly 10ml of MacConkey broth (single strength) was added to five 20ml fermentation tubes. One Durham’s vial was added to each fermentation tube in an inverted condition. All the eleven tubes were plugged with cotton and sterilized in an autoclave at 15 albs for 15 minutes. After autoclaving water samples of one 50ml, five 10ml and five 1ml were added to one 150ml, five 30ml and five 20ml fermentation tubes respectively with measuring cylinder and pipettes. Fermentation tubes were shook vigorously and incubated at 37°C for 48 hours. After 48 hours each tube was examined carefully for gas production. The tubes showing gas were compared with McCrady’s statistical table and results were recorded.

The following classification of water samples based on MPN coliform count test was used

Excellent- MPN count is Zero
Satisfactory- MPN count is 1-3/100ml
Suspicious- MPN count is 4-10/100ml
Unsatisfactory- MPN count is >10/100ml

Results and Discussion

The MPN coliform count of tap water of four districts namely Anantnag, Kulgam, Shopian and Pulwama of South Kashmir shows presence of coliform ranges from 1-180/100ml of tap water (Fig 1). Among the twelve towns of the three districts of South Kashmir, no towns show MPN 0/100ml. The least polluted town i.e., Qazigund shows MPN 1/100ml followed by both Awantipora and Pampore MPN 10/100ml. The towns Palhalgam, Anantnag, Bijbehara and Pulwama show MPN of 54, 92, 92, 161/100ml respectively. The tap water of Kokernag, Kulgam, Shopian, Keller and Tral shows MPN of 180/100ml.

The MPN coliform count of three districts namely Budgam, Ganderbal and Srinagar of Central Kashmir differs greatly (Fig. 2). Amrikadal, Batamaloo, Habbakadal, Khanyar, Sonwar and Zadibal areas of Srinagar district shows MPN 0/100ml of water, followed by Hazratbal, Iddgha and Sonamarg MPN 2/100ml. Khan Sahib, Budgam, Magam, Beerwah and Chari-Sharief show 54, 92, 92, 161, 161/100ml respectively. Chadoora, Ganderbal and Kangan shows MPN 180/100ml each.

Similarly MPN coliform count of Bandipora, Baramulla and Kupwara shows great diversity (Fig. 3). Among the Twelve towns of North Kashmir Gulmarg shows lowest MPN 4/100ml followed by Bandipora 10/100ml. Tangdar, Handwara, Sumbal, Sopore and Pattan shows 35, 43, 54, 92 and 161/100ml respectively. All other towns namely Hajan, Baramulla, Uri, Kupwara and Lolab show highest MPN of 180/100ml each.

Similarly data of district headquarters is also represent in fig. 4. Srinagar shows lowest MPN i.e. 0/100ml followed by Bandipora 10/100ml. Anantnag and Budgam both shows 92/100ml, Pulwama 161/100ml. Baramulla, Ganderbal, Kulgam, Kupwara and Shopian shows MPN 180/100ml. Our results are in accordance with Punam Sharma et al.11 who recorded highest MPN 135/100ml during summer from Dal lake. According to our analysis the tap water of these districts are polluted with faecal coliforms and only tap water of Srinagar is fit for human consumption.

In Kashmir valley, inadequate sewage disposal and water treatment facility are primary cause of waterborne infectious diseases. With the increase in population water resources of this region are being polluted at an alarming rate which decreases the availability of potable water. We are exploiting our water resources with great speed, which once seemed endlessly renewable when our population was limited. Today very rare or no river has been spared from domestic discharge in valley. This untreated domestic discharge increases the water pollutants and makes the water unfit for human consumption. If this trend continues then in the next twenty to twenty five years our water sources will become sewage channels. Many authors have reported waterborne disease outbreaks in water.12,13,14 Outbreak of viral hepatitis A & E has been reported frequently in the valley.15,16,17 The incidence is generally more than one outbreak per month which is related to water contamination. Tap water is the source of faecal pollution that causes the outbreak. Also, the infectious disease caused by pathogenic bacteria, viruses and parasites (e.g. Protozoa and Helminths) are the most common and widespread health risks associated with water in rural habitation.

The reason for high MPN coliform is due to inadequate maintenance of water reservoirs and pipe lines, and the percolation of sewage into water bodies. The desirable limit of coliform in water is 10 MPN/100ml.
(ISI). The total coliform in the water of Srinagar district was within the permissible level (?2MPN/100ml). The same results of total coliforms were also observed in Qazigund, Sonamarg and Gulmarg towns of Kashmir valley. The remaining water samples exceeded the desirable limit. Similar results were also reported in other water bodies. The reasons for the high number of total coliforms were due to the discharge of human and animal faces into the water bodies. The results of the present study draw support from the findings of Radha & Seenayya and Sood et al. According to Pujari et al., the onsite sanitation that is increasingly adopted in India is possibly responsible for high levels of nitrates and bacterial contamination in water sources. In rural areas, people prefer to eliminate night soils in open places especially in agriculture fields and river banks. In such conditions, there are more possibilities of contamination of open water resources through rainwater runoff mechanism.

The inadequate availability of potable water, poor quality of water at source, lack of water treatment facility, ill-maintained water pipelines and sewer lines, faulty water supply system, direct distribution of water from high altitude streams (which gets contaminated by herds raised by shepherds) in hilly terrain, lack of sewage treatment plants, direct sewage disposal into water bodies, open air defecation, lack of disposal of human, animal (cow dung) and household wastes, open latrines, unhygienic environment, unawareness about good sanitation etc. are some key factors responsible for poor water quality in Kashmir valley.

The bacteriological analysis of water determines its potability. Water of Kashmir valley except for district Srinagar, were found unsuitable for domestic use because the bacterial parameters exceeded the standard limit. Therefore boiling of water is essential before consumption by the people living in Kashmir valley. The sewage water must be treated and then disposed of into the environment for avoiding health hazards. Similarly water must be treated scientifically before supplying to consumers.

Conclusion

This study indicated that tap water of Kashmir valley is infected with coliform bacteria. The MPN count of different localities varies greatly. The data clearly suggests that people of this region are under severe threat of water related diseases and health risks. The continuous consumption of such polluted water could pose serious health risks especially in infants.

References

Illustrations

Illustration 1

Graph1

![Graph1](image)

Illustration 2

Graph2

![Graph2](image)
Illustration 3

Graph3

Illustration 4

Graph4
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