Determination of Physicochemical properties and Escherichia Coli in water

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Abstract

The contamination of processed or unprocessed drinking water by fecal coli form bacteria has been reported worldwide. Despite a high incidence of waterborne diseases, entero- Escherichia Coli is an under acknowledged pathogen of concern to public health in India. Although the presence of EHEC is recorded in surface water resources of India, drinking water sources are yet to be investigated.The drinking water quality with respect to bacteriological examination by quantitative determination of total coli form and fecal coli form count (MPN) and presence or absence for E.coli were done for 21 numbers of drinking water (well, T.E. supply, pond and tube well)samples Hunagund and Badami taluka of Bagalkot district Karnataka areas where cases of dysentery and diarrhea were found to be maximum. Standard methods were used for analysis of total coli form and fecal Coli form bacteria.

KEYWORDS: Bacteriological quality, drinking water, Bagalkot district.

Introduction

Escherichia coli are present in the intestinal tracts of both humans and animals, are released into the environment through fecal material and is therefore used as an indicator of fecal contamination [1]. E.coliis also a reservoir for antibiotic resistance genes [2]. In the natural environment the resistant bacteria and resistance genes from animal or environmental origin might transfer to humans [3]. Use of antibiotics is one of the factors contributing to resistance [4]. Among the antibiotics commonly used both in human and veterinary medicine are the fluoroquinolones [5, 6], with ciprofloxacin being the most consumed fluoroquinolone worldwide [7]. As a consequence of this, bacterial fluoroquinolone resistance has been reported both in humans and animals [8].When we are sick and take antibiotics, the goal is to kill the "bad" bacteria that have caused the disease.With no bacteria, the planet would be covered with dead plants and animals. They make it possible for ruminant animals (cows, sheep, and goats) to digest plant cellulose and for some plants, (soybean, and peas, alfalfa) to convert nitrogen to a more usable form [9].

Water is the most important in shaping the land and regulating the climate. It is one of the most important compounds that profoundly influence life. The quality of water usually described according to its physical, chemical and biological characteristics. Rapid industrialization and indiscriminate use of chemical fertilizers and pesticides in agriculture are causing heavy and varied pollution in aquatic environment leading to deterioration of water quality and depletion of aquatic biota. Due to use of contaminated water, human population suffers from water born diseases. It is therefore to check the water quality at regular interval of time. Water is one of the most important compounds to the ecosystem. Better quality of water

described by its physical, chemical and biological characteristics. But some correlation was possible among these parameters and the significant one would be useful to indicate quality of water. Due to increased human population, industrialization, use of fertilizers in agriculture and man-made activity. The natural aquatic resources are causing heavy and varied pollution in aquatic environment leading to water quality and depletion of aquatic biota. It is therefore necessary that the quality of drinking water should be checked at regular time interval because due to use of contaminated drinking water, human population suffers from a variety of water borne diseases. It is difficult to understand the biological phenomena fully because the chemistry of water reveals much about the metabolism of the ecosystem and explain the general hydro biological relationship.

Occurrence of pathogens in water is due to deficiency in plumbing lines, inadequately laid plumbing lines, cross-connections, treatment deficiency, bio film growth problems, leakage point or gap in the piping system with high external pressure, low-pressure conditions in the distribution system that allow a flow reversal or back flow of non-potable water, hydraulic disturbances that allow bio film material on pipe surfaces or sediments to enter the bulk water and integrated problems. The Bureau of Indian Standards (BIS, 10500: 1991) is responsible for drafting of the standards pertaining to drinking water quality and monitoring of drinking water quality supplies. WHO has its own standards and there is a difference in the standards and permissible limits between the two. A common surveillance tool for waterborne pathogens is needed to reduce public health emergencies by standardizing methodologies and validation at international level. Conventional methods for detection and enumeration of bacterial pathogens are based on the use of selective culture and biochemical methods, requiring 4–7 days to perform, and are costly.

Typically, methods for isolating any target bacteria from water involve concentration, enrichment, and identification in a well-established laboratory. Due to these difficulties, examination of water samples for emerging pathogens is normally not performed during routine microbiological assessment of water quality, hence creating the potential for public infection [10].The U.S. Environmental Protection Agency (EPA) requires all drinking water systems to monitor for total coli forms in distribution systems. The EPA states that no more than 5.0% of samples can test positive for total coli form in a month. (For water systems that collect fewer than 40 routine samples per month, no more than one sample can be total coli form-positive).Coli form bacteria are the standard used for bacterial quality in drinking water. Coli form bacteria is not a single bacteria species, rather it is a grouping of several different bacterial species. The presence of coli form bacteria in water sources indicates that sewage or some type of surface water is entering and contaminating the water supply. Along with coli form bacteria, other disease causing organisms may be present, and these can cause diseases such as dysentery, typhoid and hepatitis. A water source contaminated with coli form bacteria requires immediate attention. Coli form bacteria are often used as indicator of sanitary quality of foods and water. Coli form bacteria are defined as rod-shaped Gram negative organisms which ferment lactose with the production of gas when incubated8 at 35º C.

These organisms are normally found in the aquatic environment and on vegetation. The presence of coli form bacteria in drinking water indicates that the water was not properly treated to eliminate pathogens, or that it got contaminated somewhere in the distribution system. Escherichia coli, a member of the coli form group can ferment lactose at 44º C as well. The origin of Escherichia coli is almost exclusively of fecal origin, thus, if it is found in water or food, it indicates fecal

contamination, and an imminent health danger, as other fecal pathogens such as virus's or parasites may be also present. The majority of test for bacteria depend on using three indicator bacterial types. They are the total coli form group; the fecal coli form group, and E. coli.

Material and methodology:

Sampling and analysis technique

Drinking water samples were collected from available water at residential level and total 21 water samples were collected from different areas of Badami and Hunagund taluka of Bagalkot district. All the water samples were collected using one liter plastic canes before sample collection canes were washed with dilute nitric acid and rinsed with water to be analysed. The samples were collected in early morning 5.30 to 6.00 A.M and pH of water samples was determined during sample collection at sampling sites. Collected water samples were brought to the laboratories for determination of physicochemical and microbial parameters. Drinking water samples were analysed for various water quality parameters as per standard procedures. The drinking water samples collected were analysed for the various water quality parameters. The bacteriological examination of water was performed within 24 hrs of water collection using test kits by Rakiro Biotech Bombay. The important parameters analysed includes EC, Salinity, Turbidity, Sulphate, DO, BOD, COD and E.Coliform bacteria. The results obtained were compared with drinking water quality standards set by CPHEEO as shown in Table 1.

Table 1:

The physicochemical parameters and E.Coli in water resources of the Badami and Hunagund

S.No	Taluq	Source at	pH	E.C.	T.D.S.	Salinity	Turb	Sulphate	D.O.	B.O.D	C.O.D.	E. Coli
1	Badami	Parvati kere water near guledgudda	7.5	786	471.6	0.9	14	72	4.1	8.8	14.3	ND
2	Badami	Mahakuta honda water	4	178	106.8	0.0	12	6	4.3	7.7	16.7	ND
3	Badami	Lake water guledgudda	8.5	248	148.8	0.0	10	7	3.9	13.9	28.6	10^1
4	Badami	Agasanakoppa well water (drinking water)	9	759	455.4	0.9	16	35	2.9	17.6	32.6	10^3
5	Badami	Banashankari temple honda water	7.2	365	219	0.2	10	74	5.1	13.8	20.4	ND
6	Badami	Halakurki kere water	9	2374	1424	3.7	8	13	4.7	11.9	18.5	ND
7	Badami	Hungaragi kere water	8.5	828	496.8	1.1	16	50	3.7	16.7	31.6	10^4
8	Badami	Agasanakoppa mathad well water	9	1699	1019	2.5	7	131	4.7	8.9	15.4	ND
9	Badami	Banashankari Saraswati stream water	6.5	185	111	0.0	13	18	4.6	8.4	17.8	ND
10	Badami	Augastha teertha honda water	6.5	469	281.4	0.4	14	20	2.7	25.6	40.1	10^1
11	Badami	Kendur kere water	4.5	141	84.6	0.0	15	18	3.1	22.6	36.6	10^2
12	Badami	Malaprabha river water near	9	832	499.2	1.0	16	69	3.5	23.4	33.7	10^4

		Cholachagudd										
13	Hunagund	Aiholi Mallikarjuna temple honda water (Pushakrni)	9.5	3320	1992	5.5	14	218	3.2	25.1	45.8	10^1
14	Hunagund	Gudur borewell water	7.5	1022	613.2	1.4	16	20	4.1	16.7	39.4	10^2
15	Hunagund	Rangasamudra Chikka dam water	9	309	185.4	0.1	18	9	3.5	17.8	32.6	10^1
16	Hunagund	Ilkal kere water	9	265	159	0.1	18	10	3.6	18.6	33.9	10^5
17	Hunagund	Durga temple pushakrni water Aiholi	8.5	1698	1018	2.5	10	125	4.3	15.1	20.3	ND
18	Hunagund	Sulebhavi kere water	7.8	1169	701.4	1.6	14	80	4.2	32.2	52.7	10^1
19	Hunagund	Siddanakolla stream water near Kelur	4.5	221	132.6	0	8	14	3.9	17.3	31.8	ND
20	Hunagund	Gorjanal madar voni drinking well water	7.9	1115	669	1.5	12	22	2.6	28.5	48.9	10^1
21	Hunagund	Gorjanal well	5.6	982	560	1.2	15	12	4.6	13.5	22.0	10^3

ND- Not Detected

Result and discussion:

The pH is of major importance in determining the corrosives of water. In general, the lower the pH, higher the level of corrosion. pH of water samples ranged from 4.5 to 9.5 . Since the electrical conductivity is a measure to the capacity of water to conduct electrical current, it is directly related to the concentration of salts dissolved in water, and therefore to the Total Dissolved Solids (TDS). Salts dissolve into positively charged ions and negatively charged ions, which conduct electricity. EC of water samples varied from 178 to 3320 µS/cm. The electrical conductivity of water is actually a measure of salinity. Excessively high salinity can affect plants in the following ways:

1. Specific toxicity of a particular ion (such as Sodium)
2. Higher osmotic pressure around the roots prevents an efficient water absorption by the plant.

Some plants are more susceptible to the electrical conductivity than others and each species has an electrical conductivity threshold, beyond which yield is decreased. The TDS ranged from 84.6 to 1992. The US Environmental Protection Agency standard for safe drinking water required the TDS of this water to be equal to or less than 500 mg/L.As a secondary drinking water contaminant, TDS does not pose substantial health risks at drinking water concentrations. Na_2SO_4 concentrations above 250 mg/L may produce a laxative effect. Excess sodium may affect those restricted to low-sodium diets or pregnant women suffering from toxemia. TDS concentrations above the SMCL may impart an objectionable taste, odor, and color to drinking water. Other aesthetic concerns include an indicator of corrosives, scaling, and limiting the

effectiveness of detergents.TDS values in lakes and streams are typically found to be in the range of 50 to 250 mg/L. In areas of especially hard water or high salinity, TDS values may be as high as 500 mg/L. Drinking water will tend to be 25 to 500 mg/L TDS United States Drinking Water Standards. Salinity varied from 0.1 to 5.5mg/l. Salinity is an indication of the concentration of dissolved salts in a body of water. Turbidity varied from 7 to 16 NTU. Turbidity is the measure of relative clarity of a liquid. Excessive turbidity, or cloudiness, in drinking water is aesthetically unappealing, and may also represent a health concern. Turbidity can provide food and shelter for pathogens. If not removed, turbidity can promote re growth of pathogens in the distribution system, leading to waterborne disease outbreaks, which have caused significant cases of gastroenteritis throughout the United States and the world. Although turbidity is not a direct indicator of health risk, numerous studies show a strong relationship between removal of turbidity and removal of protozoa. The particles of turbidity provide "shelter" for microbes by reducing their exposure to attack by disinfectants. Microbial attachment to particulate material has been considered to aid in microbe survival. Sulphate of water samples ranged from 6 to 218mg/l. Sulphate present above 500 mg/L in water may affect the taste of water. At levels above 1000 mg/L, sulphate in drinking water can have a laxative effect, although these levels are not normally found in drinking water. Sulphate minerals in drinking water can increase corrosion of plumbing and well materials. Sulphur bacteria may produce a dark slime or deposits of metal oxides that develop as a result of the corrosion of metal pipes. The slime or deposits can clog plumbing and stain clothing.

DO of water ranged from 2.6 to 5.1mg/l. DO is produced by photosynthesis and consumed by breathing and decomposition of organic compounds in water. A saturated amount of DO in fresh-water is 9.1 mg/l at 1Pa, $20C^0$ [12]. The higher DO value is, the lower the water pollution is. Water that has low dissolved oxygen sometimes smells badly because of various pollutants in the water and waste product produced by organism that live in such low oxygen environment. Very low dissolved oxygen concentration can result in mobilization of trace metals [13]. Dissolved oxygen is therefore one of the best indicators of the health of a particular water ecosystem and a very important indicator of a water body’s ability to support aquatic life. The test for biochemical oxygen demand (BOD) is a bioassay procedure that measures the oxygen consumed by bacteria from the decomposition of organic matter. BOD is an indicator parameter to know the presence of biodegradable matter in waste and express degree of contamination [14]. Determination of BOD from sewage waste is very useful in identifying an appropriate methodology for waste water treatment and also to design facilities for disposal and reuse of sludge on land.COD values ranged from 14.3 to 48.9mg/l. Chemical oxygen demand (COD) is a synthetic indicator that represents the degree of organic pollution in water. Both of them reflect the pollution degree of the water, and are the comprehensive index of the relative content of organics. As the main comprehensive index of the organic pollution, COD and BOD5 are important in the control of the total con-tent of pollution and the management of water environment. However, no relaxation of COD is given BIS standards, as it indicate the organic pollution of water body. In the conjunction with the BOD test, the COD test is helpful in indicating toxic conditions and the presence of biologically resistant organic substances [15]. During present study in most of the samples 20 stations have the high COD, concentrate ion was more than the limit set up WHO (20.0 mg/l) in drinking water. Similar observation was noticed by

Viravaghavan and Warnock (1975).concentration of E.Coli in water samples ranged from 10^1 to10^4/100ml. Diarrheal diseases are the major cause of death in children under 5 years of age in resource-poor countries, resulting in approximately 2.5 million deaths each year worldwide [16]. Among the bacterial pathogens, diarrheagenic E.coli ***(***DEC) are most frequently implicated in cases of epidemic and endemic diarrhea worldwide[17]. The presence of fecal contamination is an indicator that a potential health risk exists for individuals exposed to this water.

Conclusion:

The overall water quality of Badami and Hunagund taluka showed that out of 21 water samples from villages 45% drinking water samples were suitable for drinking purposes 55% drinking water samples were unsuitable for drinking purposes and on the basis of physico-chemical parameter study and Water Quality Index for drinking and domestic purpose. But bacteriological studies attributed river water was not fit for drinking purposes due to higher coli forms counts, which require continuous monitoring and treatment process if the water is to be used for drinking purposes. Some steps and awareness programs must need to educate local villagers to safeguard the Precious River and its surrounding.

Acknowledgements
Authors are also thankful to Management and Staff of chemistry dept for valuable assistance during project work. Authors are thankful to UGC for financial assistance.

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