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Short Communication

Assessment of Bacteriological Quality of Water in Kolhapur City of Maharashtra, India

Nakade D.B.
Associate Professor in Microbiology, Govt. Rajaram College, Kolhapur, MS, INDIA

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Abstract

The microbiological quality of drinking water is a concern to consumers, water suppliers, regulators and public health authorities. The greatest risk from microbes in water is associated with consumption of drinking water which is focally contaminated. Although other sources are also significant. The potential of drinking water to transport microbial pathogens to great numbers of people causing subsequent illness is well known. The pathogens that are transmitted through water are diverse and is a major concern of consumers. The water is usually treated with disinfectant before it is distributed however, sometimes insufficient dose of disinfectant or leakage of distribution pipelines may gain the entry of pathogens in to drinking water and become a major cause of outbreaks. The number of outbreaks that has been reported throughout the world indicates that transmission of pathogens by drinking water remains a significant cause of illness. By considering this in the present study bacteriological analysis was carried out for indicator organisms i.e. total coliform and fecal coliform (E.coli) by MPN method and using Endo agar and IMViC tests. A total of 60 samples were collected from six different sites from a period of May 2010 to October 2010 five sites from consumer's tap of A B C D and E ward and one from water reservoir at Balinga lifting site. Results indicated that all samples were found contaminated with total coliforms as well as fecal coliforms in the month of June, July and August. Sample from E ward showed positive results throughout the study period and also the counts were higher in E ward samples. The present study indicated the need for improvement in water treatment plant and or distribution pipeline system.

Keywords: Coliforms, Fecal coliforms, total coliforms, E.coli, contamination.

Introduction

Water is the most abundant chemical in the human body and plays a central role in the regulation of nutrient transport, toxic waste removal, thermal regulation, digestion, organ functioning and metabolic activities. However, if water is fecally polluted it spreads diseases in consumers to a great number of peoples.

The pathogens that are transmitted through fecally polluted water are bacteria mainly Enteropathogenic and Enterotoxigenic *Escherichia coli*, *Salmonella* species, *Shigella* species, *Proteus* spp, Vibrio spp. Viruses that spread through water are *Adenovirus, Enterovirus, Hepatitis* A,C,D,E, *Noroviruses* and *Rotavirus*. Protozoa and Helminths that spreads through water are *Acanthamoeba, Giardia, Cryptosporodium, Cyclospora, Toxoplasma, Schistosoma*, *Dracunculus*. The pathogens that are transmitted by the faecal-oral route, drinking water is the only vehicle of transmission. Contamination of foods, hands, utensils and clothing can also play a role particularly when domestic hygiene is poor. The outbreak of Cryptosporidiosis in Milwaukee, Wisconsin in the United States provides a good example[1]. Subsequent reports also suggested the same[2]. Water borne diseases account for one third of the intestinal infections World-wide[3]. The diseases most frequently associated with water are enteric infections such as diarrhea, Gastroenteritis, Giardiasis. Several waterborne pathogens such as *Vibro cholerae*, *Hepatitis* E virus, Enteropathogenic *E.coli* and Salmonella have a high mortality and may lead to outbreaks[4].

In a drinking water system, HACCP is a source to tap system. Microbial safety is safeguarded through the knowledge of the quality of the source of water, control of the treatment process and integrity of the distribution or storage system. Pathogen testing can be a useful tool for sanitary surveys of catchment areas for setting treatment goals for laboratory or pilot scale demonstration of the efficacy of existing or new water treatments and for investigation of outbreaks. Waste water discharges in freshwater is a major source of fecal organisms including pathogens[5-8].

Total coliform bacteria describe a group of enteric bacteria that includes *E.coli, Klebsiella* species, *Enterobacter* and *Citrobacter* species[9]. They are gram negative, facultative anaerobic, non spore forming motile rods, capable of fermenting lactose with acid and gas at 37^{O}C within 48 hours[10]. Although they are generally not harmful themselves, they indicate the possible presence of other pathogenic bacteria, viruses and protozoans[11]. *E.coli* is a taxonomically well defined member of the family enterobacteriaceae and is characterized by possessing enzymes B-galacosidase, grows at 44^{O}C on complex media like

Endo or EMB agar, ferments lactose with production of acid and gas at 44^{O}C within 24-48 hours.

E. coli is widely use as index of fecal pollution of water because it is easily detected, it is present in abundance as compared to other organisms, it survives for longer period and its sourse is exclusively human and animal intestine. Therefore its detection is a indication of fecal pollution and its presense in drinking water indirectly indicates presense of other members of family enterobacteriaceae such as, *Salmonella, Shigella, Vibrio, Proteus, Pseudomonas, Enterobacter*, *Streptococci, Clostridium*.

Kolhapur city is situated on the bank of river Panchganga, which is a major source of drinking water of Kolhapur city. However, two streams Jayanti and Dudhali also flows through the city and are becoming a major source of fecal contamination and put a major risk for microbial pathogens in drinking water.

By considering this in the present study, investigation of raw and drinking water samples from Kolhapur city were analyzed for presence of Coliforms and other members of Enterobacteriaceae.

Material and Methods

Collection of samples: A total of 60 tap water samples were collected monthly during the period May 2010 to October 2010 from six different sites A,B,C,D,E ward and R as raw water reservoir from Balinga water lifting point. The taps were sprayed with 95 % ethanol and were then flushed at maximum capacity for three minutes immediately prior to sample collections. Samples from raw water reservoir were directly collected. A total 300 ml sample was collected in 500 ml screw top bottles. Each sample was sealed immediately after the sample was collected and was then placed in ice cold box.

Bacteriological analysis: Enumeration of total and fecal coliforms: Bacteriological analysis was carried out for indicator organisms i.e. total and fecal coliform (***E.coli***) by most probable number (MPN) method[12,13]. 15 tubes of MacConkeys broth (Hi media Mumbai) arranged in three rows. First row containing 10 ml double strength MacConkeys broth was inoculated with 10 ml of water sample. Second and third row containing 10 ml single strength MacConkeys broth medium was inoculated with 1 ml and 0.1 ml water sample respectively. After incubation at 44^{O} C for 24 hours coliform number was determined by the following formula.

$$MPN/\ 100m1 = \frac{\text{No. of } + \text{ ve tubes } * 100}{\sqrt{(\text{ml of water sample in all tubes}) * (\text{ml of water sample in} - \text{ve tubes})}}$$

Fecal coliform (*E.coli*) was enumerated by SPC technique using Endo agar as a selective and differential medium for E. coli.

Qualitative analysis: A loopful suspension from positive MPN tube was streaked on Endo agar for confirmation of fecal coliform and IMViC test was performed to confirm presensce of E.coli. Simultaneously a loopful was streaked on Wilson and Blair medium for Salmonella species, TCBS agar for Vibrio and Peptone water for Shigella species.

Statistical analysis: The average geometric mean of coliform bacteria per 100 ml was calculated in each month.

Results and Discussion

Table 1 and 2 indicates average geometric mean of Most Probable Number (MPN) of coliform bacteria and fecal coliforms.

Table-1
Average geometric mean of Most Probable Number (MPN) of coliform bacteria

Area	Geometric Mean ($100\ ml^{-1}$)	S.D.	Range
A ward	1.05	1.26	6-10
B ward	1.5	1.29	8-18
C ward	1.9	1.68	10-35
D ward	1.06	1.41	6-11
E ward	4.6	2.70	30-140
R (Reservior)	$5*10^4$	6.8	+2400

Table-2
Average geometric mean of Fecal coliform (*E. coli*.)

Area	Average Geometric Mean (SPC $ml^{-1}*10^4$)	S.D.
A ward	0.3	0.5
B ward	0.3	0.5
C ward	0.4	0.7
D ward	0.2	0.3
E ward	0.8	1.2
R (Reservior)	3.0	4.1

The data indicated all the samples from five wards showed presence of *E.coli*. and this failed to meet the WHO drinking standards of zero coliforms per 100 ml making the water unsuitable for drinking purposes. The MPN number was very high in water reservoir (R) site indicating the the original source of water itself is contaminated with fecal coliforms from human and animal sources. The presence of Salmonella was found especially in the month of July and August. *Vibrio* species were found to be completely absent in all the samples throughout the analysis. *Shigella* was detected in water samples from E ward and D ward in the month of July. Pathogens were completely absent in the month of May, June, September and October. Investigation of the tap drinking water was carried out in Quebec city of Canada showed that 36% and 28% of water samples were contaminated by at least one pathogenic bacteria[14]. My results indicated that all the samples showed presence of *E.coli*. this may be ineffectiveness or malfunctioning of the treatment process employed for the treatment of water or it may be due to

inadequate sanitation and unhygienic conditions of distribution system and pipelines of distribution system.It was also found that water samples from Srikurmam and Ghatprabha showed presence of total coliform beyond the permissible limit[15,16]. It was indicated unhygienic conditions of pipelines and leakage with domestic sewage is a major source of microbial contamination of any potable water[17]. This could be a reason for the presence of *E. coli.* in all the season in drinking water.

The microbial contamination of drinking water and its control constitutes a major issue worldwide, because it is still a major source of infection and can cause mortality especially in the childrens, hence it is necessary to check sources of contamination and more need to concentrate on the treatment procedures.

Conclusion

i. Detection of coliforms and *E.coli* in water reservoir itself is an indication of fecal contamination of water from original source. ii. Presence of Coliforms in household tap water may be due to ineffectiveness or malfunctioning of the treatment process or treatment plant. It needs further investigation. iii. There may be leakage of distribution pipelines with domestic waste. iv. Water especially from E ward showed highest MPN number therefore, it needs more emphasis, chlorination process may be made effective and treated water must be checked for residual chlorine before it is distributed for drinking purposes. Authorities may also check randomly samples at all levels to ensure the supply of safe drinking water.

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