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# Bacterial Contamination of Drinking Water in Tehsil Oghi, Mansehra Pakistan

**SAEED AHMED[*1], ZIA-UR-RAHMAN[1], SALMA KHALID[2], TARIQ KHAN[1], ARSHAD IQBAL[3] & ZAMARUD SHAH**

*[1]Department of Environmental Sciences, University of Haripur*
*[2]Prime Institute of Public Health, Riphah International University, Islamabad*
*[3] Islamia College Peshawar*
*4 Department of Biotechnology, University of Science and Technology, Bannu*

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***Corresponding Author:**

Saeed Ahmed
*Email:*
*saeed.hu24@gmail.com*

**ABSTRACT**

To analyze the microbiological quality of drinking water from different sources (tap water, open wells, stream water, spring water and water supply networks such as municipal main storage tank) in rural communities of the Oghi; a total of 175 water samples were collected from the study area with 35 samples from each source. All the samples were analyzed for microbial contamination by pour plate method, membrane filtration technique and MacConkey agar for the isolation of Enterobacteriaceae. Different identification tests have been carried out by using various selective and differential media (MacConkey agar, Eosine & Methylene Blue agar) for isolation and identification of microorganisms.Water samples showed the presence of faecal contamination; especially coliform bacteria which is a risk for the health of local community. Salmonella spp. was detected in 7.42 % of water samples having range 1-20 CFU $100ml^{-1}$, while *E.coli* was detected in 91.4% of water samples having colonial population between 1-40 CFU/100ml. According to this study, 98 % of the water sources of study area did not meet the safe limits for drinking water of the country as well as the WHO guidelines. Conclusively it was declared that water quality is unacceptable for human consumption. It is therefore recommended that the authorities should take every possible measure to provide safe and clean water to household especially drinking water. Filtration plants, proper chlorination and awareness program should be carried out for safe drinking water.

**Key Words:** Drinking water, Microbial contamination, waste management.

## INTRODUCTION

Water being the basic requirement of people, is used for drinking, domestic consumption and in agriculture activities (Sulehria *et al*., 2013). Globally, contaminated drinking water is responsible for the death of 1.6 million toddlers per annum with majority in the rural areas (Hisam *et al*., 2014). According to World Health Organization (WHO) a large group of people in the developing world are devoid of clean and potable water (Sulehria et al., 2013). Also polluted water is one of the most important contributors to health issues in Pakistan (Hisam *et al*., 2014). Some of the responsible factors for microbial contamination are poor waste management, use of polluted water and poor level of awareness (Nabeela *et al.,* 2014).

World Health Organization has claimed that 80 % of human health problems in the emerging nations are due to biological contamination of drinking water. Pakistan has been ranked at 80th position among 122 nations regarding poor potable water quality. According to the studies of Bhutta *et al.,* 2002), drinking water in densely populated cities of Pakistan like Karachi, Lahore, Rawalpindi, Peshawar, Faisalabad, Qasur, Sialkot and Gujrat is polluted due to various human activities and cannot be recommended for human consumption. Among various sources of contamination, microbial contamination is of prime importance which is due to improper disposal of faecal matter. This bacterial contamination has been reported to be the alarming issue throughout the country including urban and rural areas (PCRWR, 2005). Most of the bacterial pathogens are transmitted through drinking water to human body and the presence of coliforms indicates faecal contamination in the water (Sulehria *et al*., 2013). A research conducted by Pakistan Council for Research in Water Resources (PCRWR), have analyzed the water quality of rural areas in 64 tehsils of four provinces with the findings of

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microbial contamination of drinking water (Hisam *et al*., 2014). The outbreaks of gastroenteritis and waterborne disease have become common in urban areas. Annually more than 3 million citizens are affected from which 0.1 million do not survive (Haydar, 2009). In Pakistan, water borne diseases especially diarrhea is the leading cause of infant and children death affecting every fifth citizen (Haydar, 2009).

Providing safe and consumable drinking water is an important public health concern. Ignorance of potential risks and inappropriate trainings, faulty water drinking management systems result in unnecessary outbreaks of water borne diseases (Ashbolt, 2015).

In cities of Peshawar, Mardan, Charsada and Nowshehra of Khyber Pakhtunkhwa, more than 50 % of the total population have no access to clean drinking water. They use the drinking water from tube wells andshallow wells that are liable to be contaminated with biological pollutants from the surrounding sources such as toilets, underground damaged sewerage lines and seepage/percolation of contaminated surface water (Khan *et al*., 2013). Therefore, the present study aimed to achieve the objectives of water quality investigation through; Analysis of water samples for biological contamination and to identify the reasons for such pathogenic contamination.

## MATERIALS AND METHODS

Water samples were collected for bacteriological analysis from different villages of Oghi i.e. Jalalabad, Bazargay, Manchora, Rasheeda, Belasyedabad, Kathai and Shamdarain duly sterilized bottles of one liter as per APHA guidelines of 2005 for drinking water.Water samples were collected from tap water, distribution network water, open well water, stream water and spring water.

For microbial study, growth mediums like selective and differential medium were used. Furthermore, for determining microbial quality of water sources, Coliform indicator was used. Generally, all Gram-negative bacteria which are able to conduct lactose fermentation and gas production and grow for 48 hours between 32 to $37^0$C are considered Coliform. Counting and presence of Coliforms were carried out by MacConkey agar growth medium. Growth medium was placed in incubator at temperature of 37 $^0$C for 24 hours. Water samples were grown in positive lactose growth medium such as Eosine Methylene Blue (E.M.B) and MacConkey agar (M.C.) for confirmation test. In case of bacterial contamination such as Escherichia coli and Enterobacter, pink colonies (showing positive lactose) were observed after 24 hours of incubation at 37 $^0$C on mentioned growth media.

Water microbiological tests were carried out by Pour plate method, Membrane filtration method**,** MacConkey broth/agar for the isolation of enterobacteracea/coliforms and identification test by using different selective and differential media.

To assess the impacts of water sanitation with relation to water borne diseases, a cross sectional study through self-administrative questioner was conducted among the local community of the study area. Different parameters like water handling practices, water channels safety, use of toilets, domestic waste water discharge into streams and open water sources were kept under consideration to check sanitation levels of different studied areas. Random House to house visits were conducted in which one person from each house was interviewed. After filling the questionnaire from respondents, analyses were done through Microsoft excel.

## RESULT AND DISCUSSION

Microbiological analysis of water samples from the five sources (spring, well, distribution network, stream and tap water) in seven sites of Tehsil Oghi showed that all water sources were positive for total coliforms and faecal coliform in two rounds of triplicate sampling except a few samples of well water. Shegilla and Pseudomonas spp. were found in very few samples. Salmonella were randomly found in different samples. Staph.aureus spp. were not found in most of the samples of Tehsil Oghi (Fig.,1).

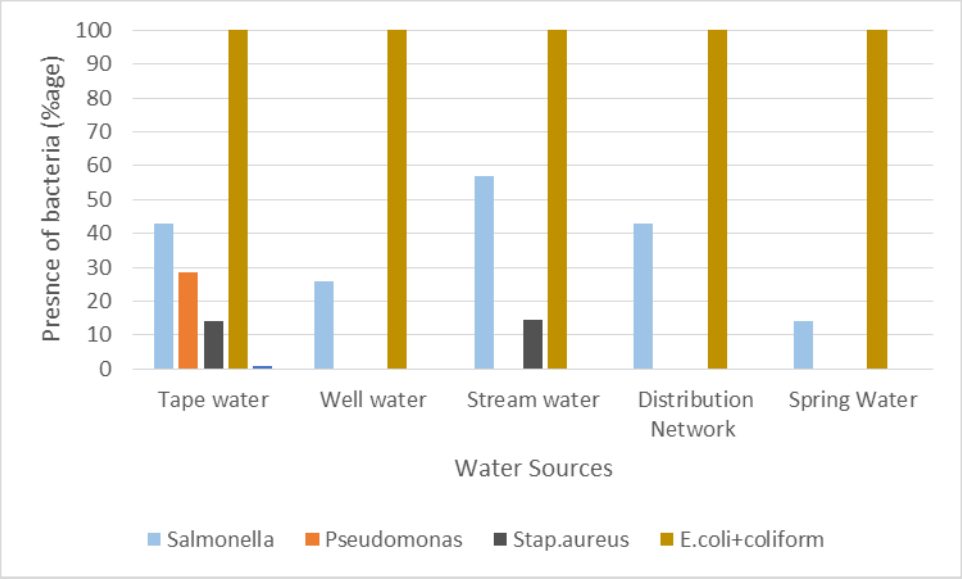


**Fig., 1:** Microbiological contamination in different sources of water samples

Sanitation measures were found by survey method with the help of a cross sectional self-administrative questionnaire. Different parameters like water handling practices, water channels safety, use of toilets, domestic waste water discharge into streams and open water sources were kept under consideration to check sanitation levels of different studied areas.

There are three main water sources on which tehsil Oghi citizens are dependent and are using it for drinking purpose. One is scheme water including tap and distribution network water while the second one is open well water and other includes spring water. Analysis showed that 66.6% of the total population living in Jalal Abad use scheme water while other user of scheme water are 46.6 % in Bazargay, 40% in Manchora, 26.6% in Rasheeda, 33.3% in Bela Syed Abad while 20% and 60 % in Kathai and Shamdhara respectively. Survey shows that open well users are highest in Rasheeda (53.3%) while they are minimum in Bela Syed Abad where they are 26.6%. Other water sources are highly used in Kathai (53.3%) while in Jalal Abad and Shamdhara no one uses other water sources.

It can be seen from table (1) that 100 percent samples were heavily contaminated with E. coli and the presence of coliform indicates the low sanitary measures and lack of awareness about disposing sewerage lines into safe manner. This kind of contamination is an evidence of mixing of sewerage line with drinking water. It was either because of open defecation practice or discharge of sewerage line into water source.

**Table I. Microbiological analysis of water samples in different villages of district Oghi.**

**(A) TAP WATER**

| Bacteria | Villages | | | | | | |
|---|---|---|---|---|---|---|---|
| | Jalalabad | Bazargay | Manchora | Rasheeda | Belasyedabad | Kathai | Shamdara |
| Salmonella | - | - | + | + | - | + | - |
| Shigella | - | - | - | - | - | - | - |
| Pseudomonas | - | - | - | - | - | - | - |
| Stap.aureus | - | - | - | - | - | - | - |
| E.coli+coliform | + | + | + | + | + | + | ++ |

**(B) WELL WATER**

| Bacteria | Villages | | | | | | |
|---|---|---|---|---|---|---|---|
| | Jalalabad | Bazargay | Manchora | Rasheeda | Belasyedabad | Kathai | Shamdara |
| Salmonella | - | - | + | - | - | - | + |
| Shigella | - | - | - | - | - | - | - |
| Pseudomonas | - | - | - | - | - | - | - |
| Stap.aureus | - | - | - | - | - | - | - |
| E.coli+coliform | + | + | + | + | + | + | + |

**(C) STREAM WATER**

| Bacteria | Villages | | | | | | |
|---|---|---|---|---|---|---|---|
| | Jalalabad | Bazargay | Manchora | Rasheeda | Belasyedabad | Kathai | Shamdara |
| Salmonella | + | - | - | + | + | - | + |
| Shigella | - | - | - | - | - | - | - |
| Pseudomonas | - | - | - | - | - | - | - |
| Stap.aureus | - | - | - | + | - | - | - |
| E.coli+coliform | + | + | + | + | + | + | + |

**(D) DISTRIBUTION NETWORK**

| Bacteria | Villages | | | | | | |
|---|---|---|---|---|---|---|---|
| | Jalalabad | Bazargay | Manchora | Rasheeda | Belasyedabad | Kathai | Shamdara |
| Salmonella | - | - | + | - | - | + | + |
| Shigella | - | - | - | - | - | - | - |
| Pseudomonas | - | - | - | - | - | - | + |
| Stap.aureus | - | - | - | - | - | - | - |
| E.coli+coliform | + | + | + | + | + | + | + |

**(E) SPRING WATER**

| Bacteria | Villages | | | | | | |
|---|---|---|---|---|---|---|---|
| | Jalalabad | Bazargay | Manchora | Rasheeda | Belasyedabad | Kathai | Shamdara |
| Salmonella | - | - | - | + | - | + | - |
| Shigella | - | - | - | - | - | - | - |
| Pseudomonas | - | - | - | - | - | - | - |
| Stap.aureus | - | - | - | - | + | - | - |
| E.coli+coliform | + | + | + | + | + | + | ++ |

- Sign indicates no bacterial species found;
+ Bacterial species found

The results from the laboratory work showed that 98 %of the water sources did not meet the safe limits for drinking water of the country as well as the WHO guidelines(zero=safe, 1-10equitable quality, 11-100contaminated water, 101-1000hazardous and >1000 very hazardous), while well water samples of Bela Syed Abad and Jalalabad are safe, meet the safe limits for drinking water as well as the WHO guidelines, which are zero (00) CFU/100ml. Well water of Kathai having 1 CFU/ml is of equitable quality as per WHO standard

(WHO, 2004a). Salmonella spp. was detected in (7.42 %) of water samples having range 1-20 CFU/100 ml, while *E.coli* & coliforms was detected in (91.4%) of water samples having colonial population between 1-33 CFU/100 ml. Highly polluted water is stream water of Jalalabad and spring water of Bela Syed Abad and Kathai ( mean value 33cfu100 $ml^{-1}$).

Questionnaire survey revealed that people of the study are mostly using open wells water and scheme water for their drinking purposes. Water sources are generally not covered from the surroundings and even sewerage and drainage lines are released in to water bodies like streams etc. In most cases septic tank found near the boring or well which contaminate the water source. It was observed that people do not have enough awareness about health and hygiene even not about the importance of cleanliness. In majority of the cases people use open defecation which is again a vital threat to water quality.

## CONCLUSION

The present study was conducted in Tehsil Oghi for the purpose to analyze microbial contamination in drinking water and assess the sanitation status of study area. Different water sources such as tap water, open wells, stream water, spring water and water supplies network in rural communities of the study area were selected. Microbial contamination and chemical parameters were determined through intensive laboratory work while sanitation measure and status were measure through questionnaire, field survey and meeting with different communities group to make reliable and clean picture of studied area regarding water quality and sanitation measures. A total of 175 water samples were collected from the study area with 35 samples from each source.All samples count about 100 %E.coli+ coliform. The minimum count was found for pseudomonas and Stap.aureus. In all cases it was found that majority of water sources were either of improper quality or biologically contaminated.

The resulting biological contamination of drinking water cause dangerous health effects to local communities, who were suffering from coliform bacteria (*E. Coli*) related diseases i.e., vomiting, (typhoid and paratyphoid), Jaundice, diarrhea, hepatitis, skin diseases, cholera and dysentery. The results of this study are in line with other studies conducted in different cities of Pakistan (Hussain *et al.*, 2011; InamUllah, 2014; Shedayi *et al*., 2015). On the basis of conclusion it is suggested that the concerned authorities should take every possible measure to provide safe and clean water to every household. Filtration plants, proper chlorination and awareness program should be carried out among the communities for safe drinking water. Safety of water sources supplemented by sanitation and hygiene elevation programs can recover the quality of rural water sources, where decontamination is not possible

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