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Research Paper

Quantitative Microbial Analysis of River Tawi, the Longest Tributary of the Himalayan River Chenab, in Jammu Region of J&K State, India

Environmental Science

KEYWORDS : River Tawi, MPN index/100 ml., Sewage pollution.

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ABSTRACT

Quantitative (MPN index/100ml) microbial analysis at four stations of river Tawi viz. Behar Devta, Udhampur and Nagrota bypass, Hariki Pohri and Bhagwati nagar, Jammu, was undertaken during the year 2010 and 2011 and has been described. At the severely polluted Bhagwati nagar station, in Jammu city, MPN index/100ml was above 240 throughout the year. At the other three non-polluted stations, upstream Jammu city, microbial count was low during winter months. Comparison of microbial count with national and international standards has revealed that raw water is not suitable for drinking even at non-polluted stations and requires proper treatment before consumption.

Introduction

Due to rise in population, developmental activities and unscientific dumping of muck and industrial development, water bodies in hills and plains are fast losing their quality characteristics. River Tawi, the longest tributary of the river Chenab, in Jammu region, is the main source of drinking water in Jammu city after treatment. Even raw water of this river is consumed at various places along its length. This river passes through three districts viz. Doda, Udhampur and Jammu and receives untreated sewage, runoff from agricultural fields, human excreta, wastes from animal farms, at various places along its course. In Jammu city, in absence of any sewage treatment plant, daily large quantities of untreated sewage enter from Panjtirthi to Bhagwati nagar in river Tawi and add to coliform count. In order to assess the microbial quantity (total coliforms) of this Himalayan stream, one year study was conducted at four stations i.e. one in Udhampur and three in Jammu districts and has been described.

Materials and Methods

For bacteriological analysis, water samples were collected in sterilized and clean B.O.D. bottles. MPN count of coliform was done by multiple tube method (Senior, 1989 and APHA, 1998).

Results and Discussion

Quantitative analysis

During the year 2010 – 2011, MPN index / 100 ml. in river Tawi ranged between 54 – >240 at Behar Devta station, Udhampur, and 92 – >240 at Nagrota bypass station and Hariki Pohri station, Jammu. At Bhagwati nagar station, in Jammu city, MPN index / 100 ml. remained >240 during all the observations (Table 1).

A very high record of MPN index / 100 ml. at Bhagwati nagar station indicates highly polluted conditions and is the result of:

Discharge of sewage drains containing human excreta, waste water from septic tanks, slaughter houses wastes, dead animals, excreta from dairy farms, street washings containing excreta of stray animals, etc. (Raja *et al.*, 2008; Sati *et al.*, 2011; Krishnamoorthy and Nagarajan, 2013; Ajesh *et al.*, 2014; Javed *et al.*, 2014; Khan *et al.*, 2014; Singh and Singh, 2014; Sivaraja and Nagarajan, 2014 and Abd Al-Kareem *et al.*, 2015);

Open defecation along the banks of river Tawi in Jammu city and entry of human excreta during rains (Venkatesharaju *et al.*, 2010; Singh and Singh, 2014 and Sivaraja and Nagarajan, 2014);

In Gujjar nagar area, buffaloes, cows, etc. move freely along the banks of river Tawi and their excreta ultimately flows into river Tawi. Buffaloes are even seen bathing in river Tawi and add excreta into water (Abd Al-Kareem *et al.*, 2015);

Dumping of municipal solid wastes containing human excreta, animal excreta, organic matter, slaughter houses wastes, dead animals, etc. along the banks and even into river Tawi at Bhagwati nagar station. Dead organic matter as an important source of microorganisms is already on record (Chatterjee and Raziuddin, 2002);

Regrowth of some microbes, present in the sediments of river Tawi, derived from fecal pollution and dead organic matter (Taylor, 2003).

During April to October, microbial count was >240 at these three stations and is attributed to:

1. In the upper catchment of river Tawi, nomadic tribes from plains of Jammu, along with their buffaloes, sheep, goats, horses, etc., migrate during April to October for grazing their herds. During this period, a good number of workers from plains migrate to the hills for work in various developmental activities like road, tunnel and other construction works, etc. In the hills, local residents migrate to the plains for work during winter and back to the hills during early springs. In absence of proper toilet facilities, people generally go for open defecation along the banks of streams, nullahs and rivers. This human excreta and excreta of animals grazing in the hills flows into river Tawi during spring (February to May) and monsoon (June to September) rains in the hills.

2. Summer snow melt in the upper catchment of river Tawi also add to land washings and entry of microbes into river Tawi.

3. In the catchment of river Tawi, animal dung is applied as manure in the agricultural fields. This manure flows into river Tawi during rains or overflows from fields and add to coliform contamination (Javed *et al.*, 2014; Singh and Singh, 2014; Sivaraja and Nagarajan, 2014 and Abd Al-Kareem *et al.*, 2015). Thelin and Gifford (1983) found large populations of active fecal coliform even in dried fecal deposits. Dried fecal matter crust provides protection to fecal coliform and during rains these microbes get favorable conditions to grow (Dewedar and Baghat, 1995).

A look at the Table 1 reveals October to February low record of MPN index / 100 ml. at Behar Devta, Nagrota bye pass and Hariki Pohri stations, upstream Jammu city, of river Tawi. Earlier, Khajuria and Dutta (2009) also noticed winter trough in MPN index / 100 ml. at Sitlee water pumping station of river Tawi, Jammu. Dutta (2012) analyzed water samples of the river Chenab, at Akhnoor, and noticed winter trough in microbial count. This winter trough in microbial count at non-polluted stations of river Tawi is ascribed to:

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Bacterial low survival and poor multiplication at low temperature (Bhadra *et al.*, 2003; Singh and Rai, 2003 and Venkatesharaju *et al.*, 2010);

Nomadic migration from hills to plains;
Migration of labourers and residents from hills to plains;
Reduced surface runoff due to scanty winter rains and fall in snowmelt at low temperature. Moreover, during winter, at low temperature, rain is in the form of snow.

Comparison of MPN per 100ml with National and International Standards (BIS, 1991; WHO, 1992) reveals that the water quality exceeds the allowable limits of drinking water standards and is unsatisfactory as per British Ministry of Health, 1957 classification (Table 2).

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Table 1: Monthly quantitative variations of total coliforms (MPN / 100 ml) at various stations of river Tawi from Udhampur to Bhagwati nagar (Feb. 2010 - Jan. 2011).

Months	Behar Devta, Udhampur	Nagrota bypass, Jammu	Hariki Pohri, Jammu	Bhagwati nagar, Jammu
February, 2010	92	92	92	>240
March	160	160	160	>240
April	>240	>240	>240	>240
May	>240	>240	>240	>240
June	>240	>240	>240	>240
July	>240	>240	>240	>240
August	>240	>240	>240	>240
September	>240	>240	>240	>240
October	>240	>240	>240	>240
November	92	160	160	>240
December	54	92	92	>240
January, 2011	54	92	92	>240

Table: 2 Comparison of water quality of river Tawi on the basis of microbial count with National and International standards.

Parameter→	PCC / 100 ml.	WHO Ac Al	BIS Ac Al	British Ministry of Health	
Stations↓	2010 - 2011	0 10	0 10	Class	PCC
Behar Devta, Udhampur	54 - >240			Excellent	0 / 100
Nagrota bypass, Jammu	92 - >240			Satisfactory	1 - 3 / 100
Hariki Pohri, Jammu	92 - >240			Suspicious	4 - 10 / 100
Bhagwati nagar, Jammu	>240			Unsatisfactory	> 10 / 100
PCC : Presumptive Coliform Count Ac : Acceptable Al: Allowable					

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