The Ecoscan 10(3&4): 607-609, 2016
AN INTERNATIONAL QUARTERLY JOURNAL OF ENVIRONMENTAL SCIENCES

QUANTITATIVE MICROBIAL ANALYSIS IN THE RIVER CHENAB AT AKHNOOR, JAMMU

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ABSTRACT

Two years *viz.* 2009 – 2010/2010 – 2011, microbial quantitative (MPN index/100ml.) analysis at three stations of the river Chenab, at Akhnoor, has shown a mean variation between 1 (November and December) to ≥240 (March – October and February)/1 (January) to ≥240 (March to September and February except at St. I in the month of February). Coliform count remained low during winter (November, December and January) and high during February to October. Analysis of coefficient of correlation (r) of MPN index per 100 ml., with various physico – chemical parameters of water, has shown variable correlation during both the years of study. Comparison with national and international standards has revealed that the water quality is within the allowable limits of drinking water quality during winter only.

KEY WORDS
The River Chenab
MPN index/100 ml
Open defecation
Animal grazing, Land washing.

Received : 00.00.2016
Revised : 00.00.2016
Accepted : 00.00.2016

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INTRODUCTION

Water quality of Himalayan streams is rapidly deteriorating due to increased anthropogenic pressures caused by multiple developmental activities like road, tunnels and reservoir constructions. In absence of proper toilet facilities, workers involved in various developmental activities generally go for open defecation. Rising population demand for animal food in the hills has further increased the number of nomadic tribes and their herds. Human and animal excreta flow into the water bodies along with rains and snowmelt water and add to the coliform rise. This renders water unfit for consumption. Earlier, Khajuria and Dutta (2009), Dutta (2014) and Dutta and Khajuria (2015) have contributed some information about coliform contamination in some lotic waters in Jammu. There is no such study for the river Chenab, an Himalayan tributary of the river Indus, draining Jammu region of JandK state, India. The river Chenab, formed by the confluence of Chandra and Bhaga streams at Tandi, Himachal Pradesh, enters Jammu near Padar. After passing through Kishtwar, Doda, Ramban, Reasi, Akhnoor and Pargwal, the river Chenab enters Pakistan. It is fed by a large number of snowmelt cold water and spring water fed tributaries along its length. The paper deals with microbial load of the river Chenab at three stations in Akhnoor, for which there is no record.

MATERIALS AND METHODS

For bacteriological analysis, water samples were collected in sterilized and clean B.O.D. bottles from three stations in Akhnoor and analyzed by multiple tube method (Senior, 1989; APHA, 1998).

RESULTS AND DISCUSSION

Quantitative analysis

In the river Chenab, MPN index / 100 mL., during the year 2009 – 2010, ranged between 1 (November and December at St. I) to ≥240 (March to October and February). In the subsequent year *viz.* 2010 – 2011, it varied between Â˜ 1 (January at St. I) to ≥40 (March to September and February, except at St. I in the month of February) (Table 1).

Present record of coliform is low in comparison to the earlier records from various lotic waters in the country. Aggarwal (1993) registered total coliform bacteria in the range of 19 to 22000 / 100 mL in river Betwa. Kataria *et al.* (1997) reported total coliform bacteria in the range of 240 to 2400 / 100 mL. in river Halai. Doctor *et al.* (1998) recorded MPN between 300 and 1600 / 100 mL. in river Bhadar. Singh *et al.* (2001) noticed coliform in the range between 24 – 9200 / 100 mL. at various stations of river Narmada at Hoshangabad, MP. Rajurkar *et al.* (2003) made bacterial analysis of river Umkhrash at Shilong and noticed pre-monsoon and post-monsoon variation between 470 to 96000 / 100 mL. and 700 to79920

Table: 1 Co-efficient of correlation between coliforms and physico-chemical characteristics of water at Stations I, II, III of the river Chenab, at Akhnoor, Jammu. (March, 2009 - February, 2010 and March, 2010 - February, 2011)

Stations	Station I		Station II		Station III	
	2009 - 2010	2010 - 2011	2009 - 2010	2010 - 2011	2009 - 2010	2010 - 2011
Parameters						
WT (°C)	**0.7**	**0.83**	**0.7**	**0.86**	**0.7**	**0.81**
Turb. (NTU)	0.42	**0.6**	**0.5**	0.61	0.43	**0.6**
pH	-0.25	-0.27	-0.06	-0.51	-0.21	-0.44
EC (mS/cm)	**-0.57**	**-0.92**	**-0.57**	-0.91	**-0.59**	**-0.88**
DO (mg/l)	-0.35	**-0.79**	**-0.54**	**-0.77**	**-0.63**	**-0.9**
CO3 (mg/l)	0.29	-0.45	0.09	**-0.53**	0.46	-0.41
BOD (mg/l)	0.42	0.44	0.41	0.47	**0.63**	0.39
$HCO_3^{'}$ (mg/l)	-0.42	-0.22	**-0.56**	-0.29	-0.42	-0.28
$Cl^{'}$ (mg/l)	-0.02	-0.49	**-0.59**	**-0.6**	-0.21	**-0.5**
Ca^{++} (mg/l)	**-0.74**	**-0.81**	**-0.54**	**-0.81**	**-0.67**	**-0.83**
Mg^{++} (mg/l)	-0.29	**-0.51**	-0.48	-0.47	**-0.79**	-0.34
TH (mg/l)	**-0.72**	**-0.86**	**-0.57**	**-0.68**	**-0.73**	**-0.87**
Na^{+} (mg/l)	**-0.54**	0.4	**-0.51**	0.3	**-0.55**	-0.36
K^{+} (mg/l)	**-0.51**	**0.53**	**-0.52**	**0.53**	-0.47	0.34
$SO_4^{''}$ (mg/l)	-0.01	-0.49	-0.12	**-0.62**	-0.01	**-0.62**
$SiO_3^{''}$ (mg/l)	**0.6**	-0.34	-0.09	-0.37	0.42	-0.31
$NO_3^{'}$ (mg/l)	0.22	-0.3	**0.68**	**-0.51**	-0.11	**-0.6**
$PO_4^{'''}$ (mg/l)	0.05	-0.1	0.18	-0.34	-0.26	0.3

Significant correlation at 0.05 ($P < 0.05$) ; Significant correlation at 0.01 ($P < 0.01$)

/100 ml., respectively. Khajuria and Dutta (2009) noticed MPN / 100 ml. in the range between 92 to > 180 in the raw water of the river Tawi at Sitlee water treatment complex. Dutta (2014) noticed perennial MPN / 100 ml. ≥240 in Devak river. Dutta and Khajuria (2015) observed annual variation in MPN / 100 ml. between 54 - ≥240, 92 - ≥240, 92 - ≥240 and ≥240 at Behar Devta station, Nagrota bypass station, Hariki Pohri station and Bhagwati nagar station of river Tawi, respectively.

Microbial contamination in water has been attributed to discharge of sewage, entry of human and animal excreta, wastes from slaughter houses, industrial effluents, immersion of dead animals, immersion of partially burnt human bodies, bathing and washing. (Atobatele and Owoseni, 2012; Ajesh *et al.*, 2014; Javed *et al.*, 2014; Khan *et al.*, 2014; Singh and Singh, 2014 and Abd Al-Kareem *et al.*, 2015)

Narrow annual variations in water temperature, high water discharge, continuous water agitation, low populated towns discharging sewage, absence of bathing and washing, absence of any industry in the catchment may explain present low range of microbes in the river Chenab water in comparison to the observations of earlier workers (op. cit.). Moreover, due to good availability of wood in the catchment, there is total burning of dead bodies.

Seasonally, microbial count remained high during March to October and February during the year 2009 – 2010. During the year 2010 – 2011, it remained high during March to September and February (except at St. I). MPN count showed a trough during November, December and January in 2009 – 2010. In the year 2010 – 2011, it recorded low count during October – January at all the three experimental stations and in February at St. I only.

Entry of animal excreta, grazing in the catchment, and human excreta (open defecation) along with rain water and snowmelt water may explain February to October a very high MPN count in the river Chenab water. In the upper catchment of the river Chenab, there are spring rains during February to May and monsoon during June to September causing land washing. This results in the entry of microbes in the river water. Moreover, with the rise in temperature, there is increased snowmelt in the catchment and land flushing.

In the catchment of the river Chenab, nomadic tribes, along with their buffaloes, sheep,goats, horses, *etc.* migrate during summer (May – October) for grazing. In absence of any facility, these people go for open defecation. Moreover, during summer, a good number of people from plains also migrate and reside in the towns and mostly go for open defecation. In the catchment of the river Chenab a large number of developmental activities like roads, railway tracks, tunnels and reservoir construction are in progress. In these projects, labor work is involved. These laborers, in absence of any proper facility, generally go for open defecation. All types of animals and human waste during land flushing enter the river Chenab water and add to the rise in bacterial count. Monsoon rise in microbial count has also been reported by Singh *et al.* (2001) from river Narmada; Chatterjee and Raziuddin (2002) from Nunia stream, West Bengal; Javed *et al.* (2014) from river Kabul; Khan *et al.* (2014) from river Siren and Singh and Singh (2014) from river Gomti.

During winter, these nomadic tribes move to the plains and there are less developmental activities in the catchment of the river Chenab. Moreover, during winter low temperature there is reduction in snow melting and rain is also in the solid form *viz.* snow. As a result of this, surface runoff is minimum. People residing in various towns, along the river Chenab, also migrate to the plains in Jammu. Winter low water temperature and reduced anthropogenic activities may explain winter fall in the microbial count in the river Chenab water. Singh *et al.* (2001), Khajuria and Dutta (2009) and Dutta and Khajuria (2015) also noticed winter trough in microbial count in lotic waters.

An observation of the Table 1 indicates annual variation in MPN index / 100 ml. between 1 – ≥240 at St. I; 2 – ≥240 at St. II and 2 – ≥240 at St. III, during the year 2009 – 2010. In the year 2010 – 2011, MPN index / 100 ml. count varied between Â˜1 – ≥240; 2 – ≥240 and 2 – ≥240 at St. I; St. II and St. III, respectively. Inflow of sewage drain from the Akhnoor city, upstream St. II, frequent washing and bathing in temple area by people may account for comparatively higher records of MPN / 100 ml. at this station in comparison to other stations of the river Chenab (Tables 1 and 2). Perennial microbial presence at all these stations indicates coliform survival at variable water temperature, water flow, suspended matter, turbidity, transparency, *etc.*

Analysis of coefficient of correlation (r) of MPN index per 100 ml., with various physico – chemical parameters of water, has shown variable correlations during both the years of study (Table 3).

Comparison of MPN index per 100ml with National and International Standards (BIS, 1991; WHO, 1992) reveals that the water during winter (November, December and January) is within the allowable limits of drinking water quality (Table 2). As per British Ministry of Health (1957), classification of drinking water, water of the river Chenab falls in satisfactory category during December, January and February during both the years of study (Table 2).

ACKNOWLEDGMENT

Emeritus Fellowship awarded by UGC to Prof. S.P.S. Dutta is gratefully acknowledged. This paper is the part of the project sanctioned by UGC to Prof. S.P.S. Dutta and is gratefully acknowledged. We are highly thankful to the Head, Department of Environmental Sciences, University of Jammu, Jammu, for providing laboratory facilities.

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