Pak. J. Bot., 43(6): 2821-2824, 2011.

SURVEILLANCE OF MICROBIAL INDICATORS AND PHYSICOCHEMICAL PARAMETERS TO INVESTIGATE POLLUTION STATUS OF LAHORE CANAL

ARIFA TAHIR[1*], FARIHA KANWAL[1] AND BUSHRA MATEEN[2]

[1]*Microbiology Research Center, Lahore College for Women University, Lahore, Pakistan*
[2]*Department of Chemistry, Lahore College for Women University, Lahore, Pakistan*

Abstract

The Lahore canal is an important watershed in Lahore. The present study was conducted to monitor pollution load of Lahore canal. Surface water was collected from the middle of the canal at four different sites, and analysed for physicochemical parameters (temperature, pH, EC, DO, BOD_5, turbidity, nitrates, phosphates) and microbial load (bacteria (TVC), total coliform and fungi). Water quality parameters were monitored from May to August at four sites along 17Km long patch. Surface water was collected in the middle of the canal. The results were compared with IWQ guidelines proposed by WWF, Pakistan. Pollution load of Lahore Canal revealed an alarming situation. Water can be used for the irrigation purpose, but only with advanced treatment.

Introduction

Lahore canal is an important watershed and is a crucial source of irrigation water.It covers about 82 Km. There is no regular monitoring of water quality. Water monitoring reports provide status of water quality and possible use of water. The water bodies like streams, rivers and oceans have their own system of keeping themselves clean, but the wastewater of our cities is continuously reducing their self purification ability. Plants and animals living in these water bodies, when poisoned with harmful chemicals and metals cann't survive. Agricultural irrigation with wastewater is common in arid areas but has possible public health and environmental side effects, as effluent may contain pathogens, high level of salts, detergents and toxic metals (Faryal *et al*., 2007; Shazia *et al*., 2009).

The crops and vegetables irrigated with such polluted water become harmful for human beings (Shainberg & Oster, 1985; Farooqi *et al*., 2009).The Lahore Canal, usually a source of aesthetic pleasure for Lahoris, has converted into a dumping pit. The Lahore Canal, starts from the BRB Canal near Jallo and ends at Bhaipheru in Lumbe Jagir. It is 82 kilometers long with an average capacity of 350 cusec water. This canal was dug to irrigate agricultural land in parts of Lahore and Kasur districts. The level of pollution in the canal is swelling day by day due to non-availability of proper drainage system for industrial units and housing societies established along the canal bank. The ever-growing level of pollution in the canal is posing serious threats to human health besides making the water harmful for irrigation purposes. The present research work was conducted to analyze water quality and possible use of Lahore canal water.

Materials and Methods

Description of study area: Four sampling points were selected at different distances starting from Herbanspura to Jail Road. The starting point (Herbanspura) was about 10 kilometer away from the point where Lahore Canal emerges from BRB Canal.

Sample collection: Grab sampling technique was used for collection of water samples. Water samples were collected in sterile polyethylene bottles between 8:15am and 10:15am from May to August. All the samples were labeled and brought to laboratory and preserved in a refrigerator at 4°C for laboratory analysis. A total of 12 parameters were studied such as temperature, dissolved oxygen, turbidity, pH, biological oxygen demand (BOD_5), fecal coliforms.

Physicochemical analysis: Physicochemical parameters including temperature, DO, Conductivity and pH, were measured on site at the time of sample collection using portable instruments (DO, Conductivity and pH meters) while turbidity, BOD_5, nitrates and phosphates were analysed in Environment Lab., of Lahore College for Women University.

Microbiological processing of samples: The microbial population (TVC, total coliform and fungi) in different samples was estimated by pour plate method using different agar media (nutrient agar, MacConkey agar and potato dextrose agar). Different bacterial and fungal species were identified by Gram reaction (Heritage *et al*., 1996) and simple staining (Vashishta & Sinha, 1999) reaction respectively. Morphology and staining reaction of the selected cultures were observed by optical microscope (Model: Nikon Eclipse E 200).

Statistical analysis: Data was analyzed statistically for Mean and Standard Deviation by using mini-tab software.t-test was applied to find out significance. In figures, error bars indicate the standard deviation of mean values.

Results and Discussion

Impact of domestic sewage and industrial effluents on the quality of Lahore Canal water for irrigation and recreational purposes was monitored at four different locations (Herbanspura, Mughalpura, Mall Road and Jail Road). The data shows the physicochemical profile of canal water Fig. 1. The temperature is useful measurement to indicate the trend of various chemical, biochemical and biological activities (Wattoo *et al*., 2004). The temperature is an environmental variable. With varying weather conditions, temperature gradually increased from Herbanspura site to Mall Road site and then suddenly decreased at Jail Road site. The increased temperature from Herbanspura to Mall Road might be due to high sewage outfall at these sites.

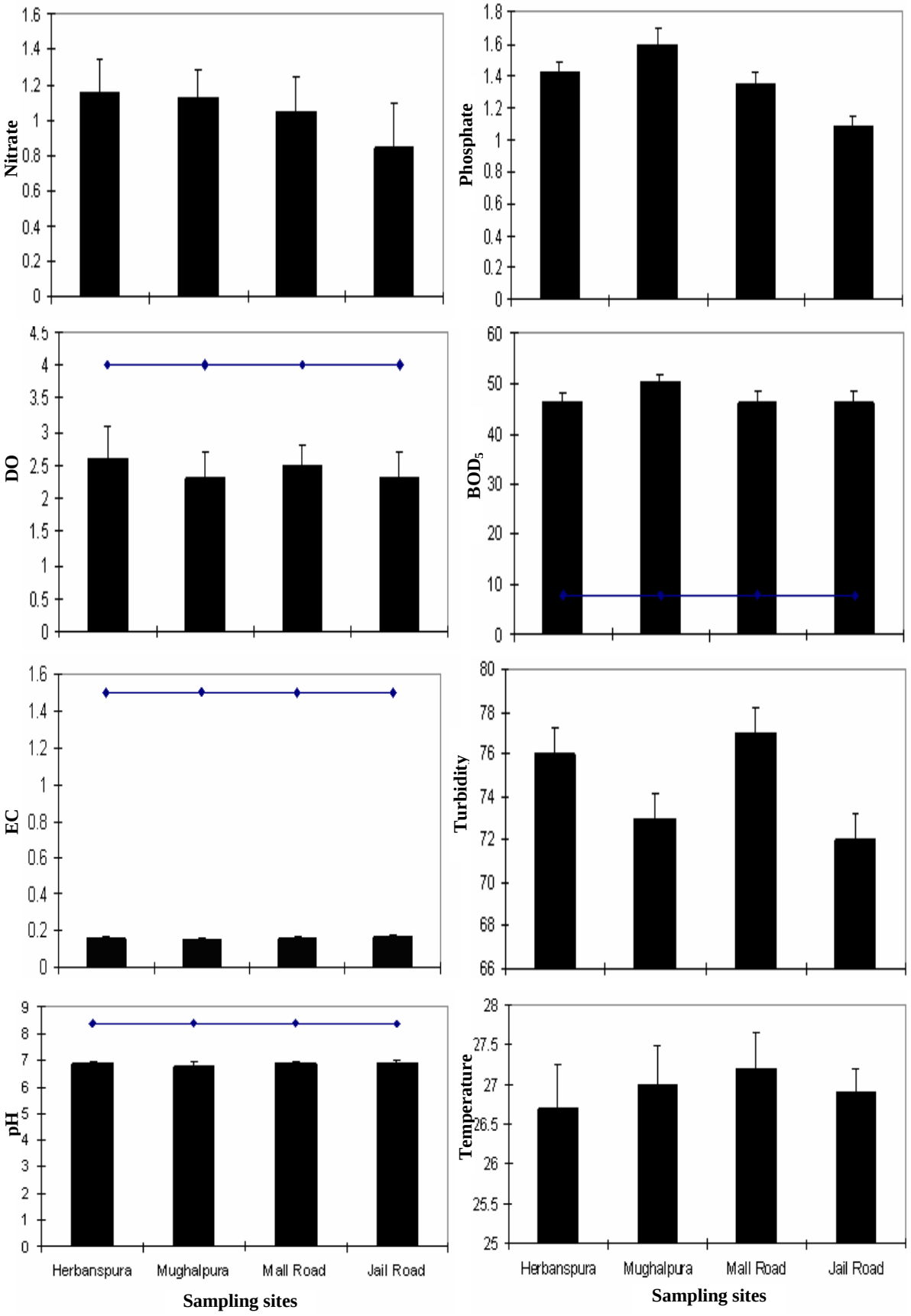

Fig. 1. Physicochemical analysis of Lahore canal water at four different sites.

The electri Neutral to alkaline pH is a general characteristic of flowing water. Many pollutants can alter the pH raising or lowering it excessively. These extremes in pH have adverse effects on aquatic biota**.** The pH should not be raised above 8.6 and below 6.0. If the pH falls below 4.0 or exceeds 9.0; it ceases biological life altogether (Davies, 1993). Highest pH was recorded at Herbanspura, Mall Road and Jail Road sites while lowest at Mughalpura site. The pH at all the sites was found within permissible limits. According to Shainberg & Oster (1985), the pH of irrigation water is not an accepted criterion of water quality because it tends to be buffered by the soil and most crops can tolerate a wide pH range.

cal conductivity of canal water is mainly associated with dissolved materials. The highest electrical conductivity (EC) was recorded at Jail Road site 0.17dS/m and lowest 0.15dS/m at Mughalpura site.The electrical conductivity at all the sites was found within permissible limits and canal water will not contribute any harmful effect to agricultural land and crops with respect to electrical conductivity.

Dissolved oxygen (DO) is the most important factor in the assessment of water quality .Adequate DO is vital for aquatic life and a function of temperature**.** It is high in winter due to low temperature and low in summer due to high temperature (Kumar, 2002). The maximum DO content was found at Herbanspura site and minimum DO content was found at Jail Road and Mughalpura site. The maximum DO content at Herbanspura might be due to lower temperature recorded at that site while minimum DO content at Jail Road and Mughalpura site might be due to high temperature than Herbanspura.The maximum BOD_5 level 50.3 mg/l was observed at Mughalpura site and it was minimum (46.2mg/l) at Jail Road site. The BOD_5 level at all the four sites was much higher than permissible limits. The high BOD_5 at Mughalpura was due to anthropological activities taking place at that site.This might be due to excessive sewage discharge and some industrial effluent containing huge amount of organic matter. Such a high level of BOD_5 showed that canal water is not suitable for irrigation and other purposes.

Turbidity is deleterious to aquatic organisms and may cause anaerobic conditions. It can interfere with respiration in aquatic fauna and also screen out light hindering photosynthesis and natural aquatic life. It is low in winter and high in monsoon (Davies, 1996). During study period, turbidity was increased from sunny to rainy and cloudy weather conditions. The highest values of turbidity were observed during rainy weather conditions, which might be due to rainfall and influx of dissolved content from the catchment area. The highest turbidity value was found at Mall Road site77NTU and lowest at Jail Road site 72NTU. The highest turbidity at Mall Road site might be due to pouring of domestic sewage and flowing of suspended matter from upstream to downstream. Pakistan Council of Research in Water Resources (2003) also reported very high turbidity value of Lahore canal water.

The highest nitrate content was observed at Herbanspura site and lowest at Jail Road site. Nitrate concentration is higher in summer and rainy season while low in winter season which is due to high decomposition rate of organic matter by aerobic and anaerobic bacteria at high temperature that transfer organic matter into nitrogenous organic matter (Kumar, 2002). In the present study highest values of nitrates were recorded during rainy and cloudy weather conditions, which might be due to nitrogen rich rainwater that brought large amount of contaminated sewage water. The highest nitrate content at Herbanspura site might be due to high sewage load and dumping of solid waste at Herbanspura Bridge and lowest at Jail Road site due to absence of anthropological activities.

A large increase in phosphate level is mainly due to sewage contamination (Nebel and Wright, 1998). It has been reported that phosphate level in water bodies is higher in summer and rainy season due to increased solar radiations and influx of phosphate rich rain water (Kumar, 2002). The highest value 1.60mg/l was recorded at Mughalpura site and lowest 1.08mg/l at Jail Road site.The highest phosphate level at Mughalpura site might be due to the release of laundry detergents and human waste. After Mughalpura, the 2nd highest value of phosphate was observed at Herbanspura site because both sites receive high loads of domestic sewage and solid waste.

The data (Fig. 2) of microbial monitoring of canal down that all the sites were found to have high total viable count.The bacterial growth is higher in summer and low in rainy and winter season(Sood *et al*., 2008). The TVC value was relatively higher at Mall Road site, which may be attributed to favorable temperature, sewage outfall from residential areas residing at that site. In fact, the water of Lahore Canal is also used for bathing, washing and swimming. The higher TVC values suggest that this practice should be avoided because use of such contaminated water might result in various diseases relating to skin, digestive system, ear and eyes. People also used to wash fruits in canal water, which is harmful for their health.

The increasing influx of heavy metals into water bodies from industrial, agricultural, and domestic activities is of global concern because of their well documented negative effects on human and ecosystem.

The number of total coliforms was above permissible limits at all the four sites. The highest number of total Coliform 8.2 $\times 10^2$ /ml was found at Mughalpura site and lowest at Jail Road site (Fig. 2). The highest value at Mughalpura site might be due to the fact that the banks of canal at this site were more densely populated and receive huge amount of waste water as compared to other sites. The lowest count was found at Jail Road site which might be due to little human activities. The total coliforms are relatively high in rainy and summer season than winter which suggests the role of precipitation on the source and extent of microbial pollution (Sood *et al*., 2008, Kistemann *et al*., 2002). The highest count of total coliform was found during rainy weather conditions because rain water took animal excreta from surrounding areas lead to high count of total coliform in the canal water. Such a high count of total coliform showed that canal water provides habitat for pathogenic microbes. Because of high microbial load in canal water, it is unfit for human recreational purposes. Moreover, canal water is also used for irrigation purposes for crops including vegetables. It is known that various pathogens occur on vegetables harvested from soil irrigated with contaminated water (Baghel *et al*., 2005). When vegetables are irrigated with canal water, it seeps into the soil and facilitates the entry of a number of pathogens into the food chain. So, vegetables grown with contaminated water might have been involved in the spread of enteric bacterial pathogenic diseases. Pathogens might be transmitted through cattle milk because buffaloes and cows drink from the canal too. Earlier Amin *et al*., (2005) also reported high total coliform in the bottom mud of Lahore canal.

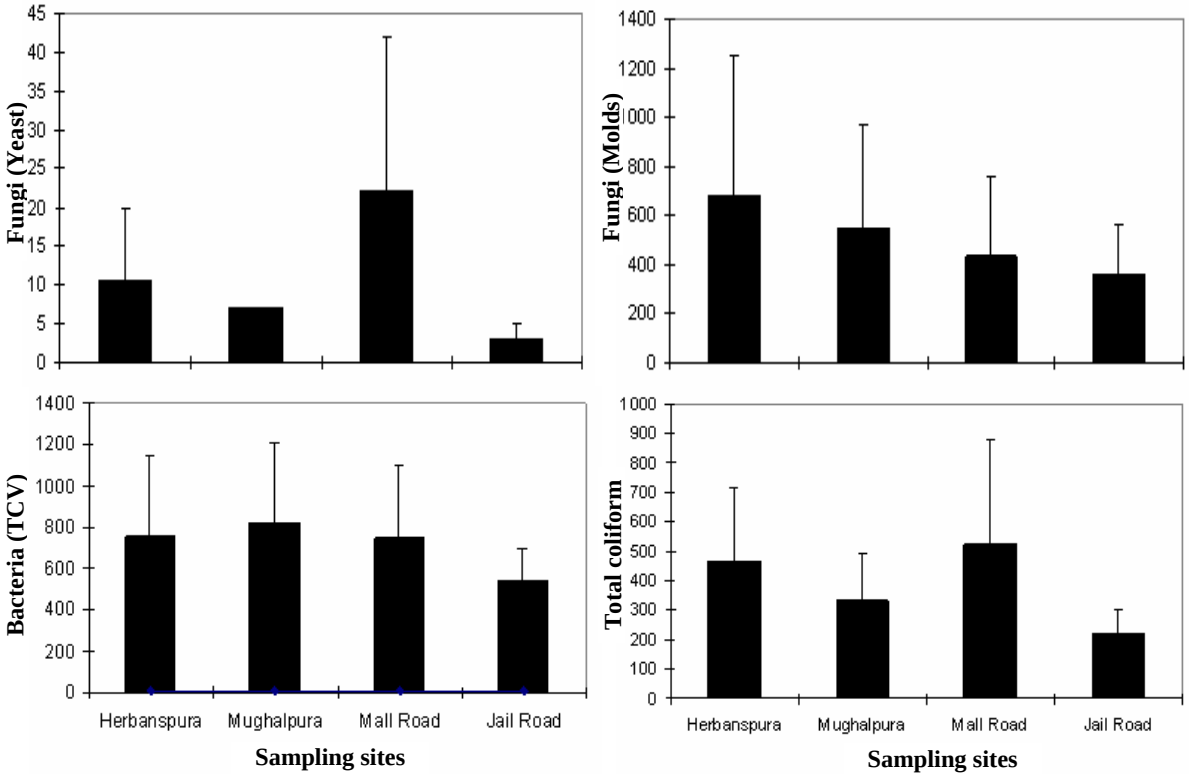

Fig. 2. Microbial load of Lahore canal water at four different sites.

The high fungal count (yeast and molds) was observed at Herbanspura and Mall Road sites. The highest yeast count was found at Herbanspura and lowest at Jail Road site.Such a high fungal count at herbanspura and Mall Road sites might be due to sewage outfall. In addition to sewage outfall, Herbanspura site also receive high loads of solid waste that is a big source of fungal growth in rainy season due to relatively low temperature and humidity. The maximum fungal count was found in rainy days.

Conclusion

The surveillance of Lahore Canal water with respect to microbial and physicochemical pollution is of immense significance. Presence of high microbial load in canal water should be taken seriously by public health authorities. The canal water should not be used to irrigate crop particularly which are used in raw form such as carrot, cucumber and salad etc. Based on these studies the monitoring of other water bodies is strictly recommended.

References

Amin, S., N. Chaudhry and J.I. Qazi. 2005. Cellulolytic, Endosporeformer and Coliform bacterial profiles in the bottom mud of Lahore Canal at different location in the city. *Punjab University, Journal of Zoology*, 20: 201-207.

Anonymous. 2005. *Water Quality Status, Third Report.2003-2004*. Pakistan Council of Research in Water Resources (PCRWR).

Baghel, V.S., K. Gopal, S. Diwedi and R.D. Toipathi. 2005. Bacterial indicators of faecal contamination of the Gangetic river system right at its source. *Ecological Indicators*, 5: 49-56.

Davies, T.C. 1993. Pollution studies on surface waters of the Thrka area, Kenya. *Environmental management geo-water and engineering aspects*, 22: 131-136.

Davies, T.C. 1996. Chemistry and pollution of natural waters in Western Kenya. *Journal of African Earth Science*, 23: 547-563.

Farooqi, Z.R, M.Z. Iqbal, M. Kabir and M. Shafiq. 2009. Toxic effectsof Lead and Cadmium on Germination and seedling growth of *Albizia lebbeck* (L.) Benth. *Pak. J. Bot*., 41(1): 27-33: 2009.

Faryal, R., F. Tahir and A. Hameed. 2007. Effect of wastewater irrigation on soil along with its micro and macro flora. *Pak. J. Bot*., 39(1): 193-204.

Heritage, J., E.G.V. Evans and R.A. Killington. 1996. *Introductory Microbiology*. New York: Cambridge University Press.pp.96-97.

Kistemann,T., T. Clabel, C. Koch, F. Dangendorf, R. Fischeder, J. Gebel, V.Vacata and M. Exner. 2002. Microbial load of drinking water reservoir tributaries during extreme rainfall and runoff. *Applied Environmental Microbiology*, 68: 2188-2197.

Kumar, A. 2002. *Biomonitoring of Sewage Pollution*. New Delhi: A P H publishing Corporation. Inc. pp. 39-103.

Nebel, B.J. and R.T. Wright. 1998. *Environmental Science: The Way the World Works*. (2nd ed). Prentice-Hall. Inc. pp. 296-298.

Shainberg, I. and J.D. Oster. 1985. Quality of irrigation water. *International Irrigation Information Center*, 8.

Shazia Iram, Ahmad, A. Karam, A. Muhammad and S. Anjum. 2009. Analysis of pesticides of Rawal and Simly Lakes. *Pak. J. Bot*., 41(4): 1981-1987.

Sood, A., K.D. Singh, P. Pandey and S. Sharma. 2008. Assessment of bacterial indicators and physicochemical parameters to investigate pollution status of Gangetic river system of Uttarakhand (India). *Ecological Indicators*, 8: 709-717.

Vashishta, B.R. and A.K. Sinha. 1999. *Fungi: For Degree Students*. New Delhi: Hand and Company Ltd. pp. 484-487.

Wattoo, M.H.S., F.H. Wattoo, T.G. Kazi, S.A. Tirmizi, M.I. Bhanger, R.B. Mahar and J. Iqbal. 2004. Quality Characterization of Phulali canal water for irrigation purposes. *The Nucleus*, 41: 69-75.

(Received for publication 4 December 2009)