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Ph.D. Thesis, Dissertation and Reports
Bhutiani, R., 2004. Limnological status of river Suswa with reference to its mathematical modeling, Ph.D. Thesis submitted to Gurukul Kangri University, Haridwar, Uttaranchal, India.

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Abstracted and Indexed

Studies on solid waste generation and composition in the commercial area of Akhnoor Town, district Jammu

Shalini Sharma✉ and Subash C. Gupta

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Abstract

The present paper deals with the analysis of solid waste generation and composition within the municipal limits of Akhnoor town which marks its beginning from the main bridge on the river Chenab and extends up to Sohal-Sungal turn. The commercial area was divided into four different zones for the purpose of studies. From each zone, five different types of shops were selected for the sampling and analysis of solid waste for a period of one year. Characterization and management of solid waste along with methods of disposal of Municipal Solid Waste (MSW) were studied to analyze its impact on the environment and people inhabiting the area. Proper disposal methods have also been suggested so that the environment in general and the population inhabiting the area in particular is saved from the hazardous effect of fast increasing menace of the waste.

Keywords: *Solid waste, MSW, environment, disposal*

Introduction

Waste is an unavoidable by product of human activities. Economic development, urbanization and improving the living standards in cities, have led to increase in the quantity and complexity of generated waste. Management of solid waste resulting out of rapid urbanization has become a serious concern not only for the government departments, pollution control agencies, regulatory bodies but also for the general public in most of the developing countries. Various workers, both from India and abroad have worked a lot on generation, composition and management of solid waste, but no work seems to have been done on solid waste generated in the commercial area of Akhnoor town. However, some workers like Rampal *et al*. (2002), Kour (2004), Rampal *et al*. (2005), Gupta *et al*. (2007), Gupta *et al*. (2008), Jaswal (2008) and Kewal (2010) have provided some fragmentary information on the generation and characteristics of waste of Jammu Municipality. In present study, an attempt has been made to assess the status of solid waste pollution in commercial areas of Akhnoor town.

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Material and Methods

Study Area

The present study was conducted within the municipal limits of Akhnoor town which starts from the main bridge on River Chenab and extends up to Sohal-Sungal turn. Geographically, Akhnoor lies at a latitude of 32.9^0N and longitude of 74.75^0 E, situated in the North-West part of India and eastern part of Pakistan and is about 32Km from Jammu. It has a total area of 1.5 sq Km with a population of 11346.

Methodology

The study area was divided into four different zones for the purpose of waste collection. Five shops of each type i.e., Karyana, barber, tea stall, juice stall and fruit and vegetable shop were selected for the purpose of study, from each zone, thus totalling hundred shops from four different zones, for purpose of studies. The sampling was done over a period of one year, i.e., from June, 2007 to May, 2008. Monthly sampling of solid waste was done by collecting waste from each shop, segregated into different components and weighed separately with the help of spring balance. The various components of waste collected for analysis were identified as paperware, cardboard, clothware, jute, foliage, cotton, wood, food and

garbage (biodegradable); plasticware, metallicware, glassware, thermocoal, rubber, leather, egg shells and bones (non-biodegradable) and inert wastes. The calculated values indicating average of each type of shop was tabulated in tables 1-4.

Results and Discussion

The results of 12 months data on solid waste generation and composition are presented in Table-1, 2, 3 and 4.Comparative study of average solid waste (Kg/shop/month) generation at four different study zones, i.e. Zone-I to Zone –IV containing 5 different types of shops, 5 each, during one year has been made (Table 5).A critical evaluation of Table-5 has revealed that in the study area (i.e, Zone I to Zone-IV) the total solid waste generated (Kg/shop) was estimated to be 6797.71Kg with an average of 566.476 ±4.488 Kg out of which 6600.504 Kg was contributed by biodegradable waste (97.09%) comprising of paperware, card board, clothware, jute, foliage, cotton, wood, food/garbage, etc. Non-bio-degradable waste was found to be 89.532 Kg (1.31%) comprising of plasticware, metallicware, glassware, thermocoal, rubber, etc and 107.676 Kg of inert waste (1.6%) which comprised of hair, dust, pebbles, sand, gravels, etc with average values of 550.042±4.395 Kg, 7.461±0.051 Kg and 8.973±0.042 Kg, respectively. The per shop generation of these various components have been depicted in Table 1-5.

Table 1:- Qualitative and Quantitative Composition of Solid Waste (Kg/shop) at Zone-I

	Biodegradable waste					Non-biodegradable waste					Inert material					Total solid waste				
Shops / Months	Shop-01 Karyana	Shop-02 Barber	Shop-03 Tea stall	Shop-04 Juice stall	Shop-05 Fruit and vegetable	Shop-01 Karyana	Shop-02 Barber	Shop-03 Tea stall	Shop-04 Juice stall	Shop-05 Fruit and vegetable	Shop-01 Karyana	Shop-02 Barber	Shop-03 Tea stall	Shop-04 Juice stall	Shop-05 Fruit and vegetable	Shop-01 Karyana	Shop-02 Barber	Shop-03 Tea stall	Shop-04 Juice stall	Shop-05 Fruit and vegetable
June	212.4	13.35	44.7	2250	889.2	10.8	8.25	10.95	0	6.15	4.5	23.4	1.5	0	1.8	227.7	45	57.15	2250	897.15
July	207.6	10.2	41.85	2587.5	970.8	5.85	12.15	9.15	0	8.4	4.2	27.15	1.95	0	2.7	217.65	49.5	52.95	2587.5	981.9
August	232.95	13.35	49.8	2572.5	1191	10.95	9.75	12.3	0	8.55	4.2	24.45	2.85	0	3.15	248.1	47.55	64.95	2572.5	1202.7
September	262.8	14.7	51.45	2437.5	1281.6	15.6	11.4	15.9	0	9	5.4	27.9	3.3	0	2.7	283.8	54	70.65	2437.5	1293.3
October	245.25	14.1	52.8	2212.5	1189.2	15	10.65	15.75	0	8.7	4.5	27.15	2.7	0	1.65	264.75	51.9	71.25	2212.5	1199.55
November	218.85	3.9	45.15	1554	1205.4	14.7	10.5	17.25	0	9.15	4.2	27.75	1.95	0	2.25	237.75	42.15	64.35	1554	1216.8
December	222.45	5.7	45.75	1243.5	1082.7	13.65	11.4	18.75	0	8.7	3	28.35	2.25	0	1.5	239.1	45.45	66.75	1243.5	1092.9
January	201.75	6.45	42	1144.5	928.5	9.9	10.95	18	0	6.15	1.95	27	1.35	0	1.2	213.6	44.4	61.35	1144.5	935.85
February	199.5	7.35	37.35	1087.5	823.95	6.45	11.25	15.45	0	6.75	2.7	27.45	1.95	0	1.5	208.65	46.05	54.75	1087.5	832.2
March	189.45	7.95	35.4	1152	810.45	4.95	12.15	14.55	0	5.55	3	29.25	1.5	0	1.05	197.4	49.35	51.45	1152	817.05
April	195.6	11.25	41.7	1617	960.75	8.7	14.1	17.4	0	4.95	4.05	27.9	1.95	0	2.25	208.35	53.25	61.05	1617	967.95
May	119.55	8.4	39.9	1927.5	725.55	7.35	12.75	13.05	0	2.55	3.3	22.5	1.35	0	1.5	130.2	43.65	54.3	1927.5	729.6
Total	2508.15	116.7	527.85	21786	12059.1	123.9	135.3	178.5	0	84.6	45	320.25	24.6	0	23.25	2677.05	572.25	730.95	21786	12167
Total per month	209.013	9.725	43.988	1815.5	1004.93	10.325	11.275	14.875	0	7.05	3.75	26.688	2.05	0	1.938	223.088	47.688	60.913	1815.5	1013.91
Per Month/ Shop	41.803	1.945	8.798	363.1	200.985	2.065	2.255	2.975	0	1.41	0.75	5.338	0.41	0	0.388	44.618	9.538	12.183	363.1	202.783
Total per day	6.967	0.324	1.466	60.517	33.498	0.344	0.376	0.496	0	0.235	0.125	0.89	0.068	0	0.065	7.436	1.59	2.03	60.517	33.797
Per day/ Shop	1.393	0.065	0.293	12.103	6.7	0.069	0.075	0.099	0	0.047	0.025	0.178	0.014	0	0.013	1.487	0.318	0.406	12.103	6.759
A.V.	209.013	9.725	43.988	1815.5	1004.93	10.325	11.275	14.875	0	7.05	3.75	26.688	2.05	0	1.938	223.088	47.688	60.913	1815.5	1013.91
S.D.	35.393	3.62	5.397	585.451	181.494	3.767	1.486	2.972	0	2.053	0.964	2.086	0.624	0	0.663	38.581	3.9	6.828	585.451	183.658

A.V. -Average

S.D.- Standard Deviation

Table 2:- Qualitative and Quantitative Composition of Solid Waste (Kg/shop) at Zone-II

Shops / Months	Biodegradable waste					Non-biodegradable waste					Inert material					Total solid waste				
	Shop-01 Karyana	Shop-02 Barber	Shop-03 Tea stall	Shop-04 Juice stall	Shop-05 Fruit and vegetable	Shop-01 Karyana	Shop-02 Barber	Shop-03 Tea stall	Shop-04 Juice stall	Shop-05 Fruit and vegetable	Shop-01 Karyana	Shop-02 Barber	Shop-03 Tea stall	Shop-04 Juice stall	Shop-05 Fruit and vegetable	Shop-01 Karyana	Shop-02 Barber	Shop-03 Tea stall	Shop-04 Juice stall	Shop-05 Fruit and vegetable
June	239.55	11.7	48.75	1537.5	740.55	12.6	10.05	13.8	0	5.4	5.7	82.95	1.95	0	2.4	257.85	104.7	64.5	1537.5	748.35
July	209.85	13.5	46.65	1912.5	1006.8	12.45	10.8	12.75	0	5.85	4.2	88.95	1.5	0	1.95	226.5	113.25	60.9	1912.5	1014.6
August	221.4	8.7	50.25	2194.5	911.55	9.6	9.9	14.7	0	6.75	4.8	92.25	2.7	0	3	235.8	110.85	67.65	2194.5	921.3
September	229.05	6.3	48.9	1912.5	980.85	11.55	11.7	19.65	0	8.4	3	101.4	3.15	0	1.35	243.6	119.4	71.7	1912.5	990.6
October	195.9	4.05	43.2	1597.5	840.3	11.4	8.85	18	0	6.15	2.7	90	1.65	0	1.5	210	102.9	62.85	1597.5	847.95
November	189.9	5.85	44.1	1402.5	904.8	11.4	10.8	15.15	0	5.85	3.15	87.75	2.25	0	1.35	204.45	104.4	61.5	1402.5	912
December	169.2	5.4	45.75	1350	990	11.25	10.8	14.4	0	6.15	2.85	84.45	0.75	0	1.5	183.3	100.65	60.9	1350	997.65
January	158.4	6.15	46.8	1312.5	843.3	10.5	11.85	16.35	0	7.35	3.3	71.55	1.5	0	1.2	172.2	89.55	64.65	1312.5	851.85
February	141.45	7.5	42.9	1333.5	861.6	10.35	9.3	16.5	0	6	2.55	72.9	1.2	0	1.5	154.35	89.7	60.6	1333.5	869.1
March	134.1	6.3	38.85	1425	700.8	9	9.45	15.15	0	4.65	2.85	70.8	2.1	0	1.05	145.95	86.55	56.1	1425	706.5
April	160.2	10.05	43.5	1469.85	875.4	12	10.95	15.75	0	3.75	4.05	73.8	2.7	0	1.35	176.25	94.8	61.95	1469.85	880.5
May	200.7	10.35	45.15	1647	781.2	13.35	11.1	14.25	0	4.35	3.15	76.8	1.2	0	1.95	217.2	98.25	60.6	1647	787.5
Total	2249.7	95.85	544.8	19094.9	10437.2	135.45	125.55	186.45	0	70.65	42.3	993.6	22.65	0	20.1	2427.45	1215	753.9	19094.9	10527.9
Total per month	187.48	7.988	45.4	1591.24	869.763	11.288	10.463	15.538	0	5.888	3.525	82.8	1.888	0	1.675	202.288	101.25	62.825	1591.24	877.325
Per Month/ Shop	37.495	1.598	9.08	318.248	173.953	2.258	2.093	3.108	0	1.178	0.705	16.56	0.378	0	0.335	40.458	20.25	12.565	318.248	175.465
Total per day	6.249	0.266	1.513	53.041	28.992	0.376	0.349	0.518	0	0.196	0.118	2.76	0.063	0	0.056	6.743	3.375	2.094	53.041	29.244
Per day/ Shop	1.25	0.053	0.303	10.608	5.798	0.075	0.07	0.104	0	0.039	0.024	0.552	0.013	0	0.011	1.349	0.675	0.419	10.608	5.849
A.V.	187.48	7.988	45.4	1591.24	869.763	11.288	10.463	15.538	0	5.888	3.525	82.8	1.888	0	1.675	202.288	101.25	62.825	1591.24	877.325
S.D.	34.686	2.87	3.162	279.072	96.909	1.262	0.949	1.891	0	1.281	0.965	9.713	0.719	0	0.561	35.936	10.124	3.969	279.072	97.591

A.V. -Average

S.D.- Standard Deviation

Table 3:- Qualitative and Quantitative Composition of Solid Waste (Kg/shop) at Zone-III

Shops / Months	Biodegradable waste					Non-biodegradable waste					Inert material					Total solid waste				
	Shop-01 Karyana	Shop-02 Barber	Shop-03 Tea stall	Shop-04 Juice stall	Shop-05 Fruit and vegetable	Shop-01 Karyana	Shop-02 Barber	Shop-03 Tea stall	Shop-04 Juice stall	Shop-05 Fruit and vegetable	Shop-01 Karyana	Shop-02 Barber	Shop-03 Tea stall	Shop-04 Juice stall	Shop-05 Fruit and vegetable	Shop-01 Karyana	Shop-02 Barber	Shop-03 Tea stall	Shop-04 Juice stall	Shop-05 Fruit and vegetable
June	62.55	7.05	39.75	2047.5	607.8	5.7	4.95	13.35	0	4.2	4.65	20.55	1.35	0	1.95	72.9	32.55	54.45	2047.5	613.95
July	71.25	4.05	42.9	2377.5	686.1	8.25	6	10.5	0	4.65	3.9	22.65	1.65	0	2.25	83.4	32.7	55.05	2377.5	693
August	62.55	3.9	42.15	2325	462.6	5.4	8.85	11.1	0	2.85	3.75	18.9	1.5	0	1.35	71.7	31.65	54.75	2325	466.8
September	68.7	5.85	49.95	2134.5	759.9	7.35	8.25	16.05	0	3.45	3.45	20.7	2.7	0	1.8	79.5	34.8	68.7	2134.5	765.15
October	67.8	7.35	50.55	1690.5	740.25	6.9	7.5	14.1	0	2.7	3.75	20.25	3	0	1.5	78.45	35.1	67.65	1690.5	744.45
November	65.7	6.75	48.3	1612.5	855.15	7.35	8.25	16.2	0	3	3.3	21.15	2.85	0	1.65	76.35	36.15	67.35	1612.5	859.8
December	63.75	5.4	48.75	1254	798.6	8.25	9.75	16.05	0	1.95	2.85	23.85	1.95	0	1.5	74.85	39	66.75	1254	802.05
January	150.75	6.45	33.6	1143	854.7	10.5	12.3	16.35	0	1.5	3.15	24.45	1.5	0	1.35	164.4	43.2	51.45	1143	857.55
February	133.95	4.35	31.65	1008	681.9	4.5	12.45	15.75	0	1.35	1.65	23.85	0.3	0	0.75	140.1	40.65	47.7	1008	684
March	129.75	7.05	30.3	1183.5	694.5	4.05	11.85	15.15	0	1.5	0.45	23.55	0.75	0	1.05	134.25	42.45	46.2	1183.5	697.05
April	104.1	7.65	35.85	1642.5	630.45	5.55	9	13.95	0	3.15	2.85	22.2	1.05	0	1.5	112.5	38.85	50.85	1642.5	635.1
May	87.45	9.6	40.2	1926	719.7	4.35	9.6	13.2	0	2.7	4.35	23.4	0.75	0	1.35	96.15	42.6	54.15	1926	723.75
Total	1068.3	75.45	493.95	20344.5	8491.65	78.15	108.75	171.75	0	33	38.1	265.5	19.35	0	18	1184.55	449.7	685.05	20344.5	8542.65
Total per month	89.025	6.288	41.163	1695.375	707.638	6.513	9.063	14.313	0	2.75	3.175	22.125	1.613	0	1.5	98.713	37.475	57.088	1695.38	711.888
Per Month/ Shop	17.805	1.258	8.233	339.075	141.528	1.303	1.813	2.863	0	0.55	0.635	4.425	0.323	0	0.3	19.743	7.495	11.418	339.075	142.378
Total per day	2.968	0.21	1.372	56.513	23.588	0.217	0.302	0.477	0	0.092	0.106	0.738	0.054	0	0.05	3.29	1.249	1.903	56.513	23.73
Per day/ Shop	0.594	0.042	0.274	11.303	4.718	0.043	0.06	0.095	0	0.018	0.021	0.148	0.011	0	0.01	0.658	0.25	0.381	11.303	4.746
A.V.	89.025	6.288	41.163	1695.375	707.638	6.513	9.063	14.313	0	2.75	3.175	22.125	1.613	0	1.5	98.713	37.475	57.088	1695.38	711.888
S.D.	32.306	1.673	7.228	474.423	109.905	1.933	2.347	1.994	0	1.052	1.16	1.775	0.873	0	0.394	31.575	4.196	8.244	474.423	109.616

A.V. -Average

S.D.- Standard Deviation

Table 4:- Qualitative and Quantitative Composition of Solid Waste (Kg/shop) at Zone-IV

Shops / Months	Biodegradable waste					Non-biodegradable waste					Inert material					Total solid waste				
	Shop-01 Karyana	Shop-02 Barber	Shop-03 Tea stall	Shop-04 Juice stall	Shop-05 Fruit and vegetable	Shop-01 Karyana	Shop-02 Barber	Shop-03 Tea stall	Shop-04 Juice stall	Shop-05 Fruit and vegetable	Shop-01 Karyana	Shop-02 Barber	Shop-03 Tea stall	Shop-04 Juice stall	Shop-05 Fruit and vegetable	Shop-01 Karyana	Shop-02 Barber	Shop-03 Tea stall	Shop-04 Juice stall	Shop-05 Fruit and vegetable
June	55.95	1.65	31.05	2344.5	613.8	7.05	3.9	10.95	0	3	2.55	17.7	0.75	0	1.35	65.55	23.25	42.75	2344.5	618.15
July	60.9	2.7	30.15	2643	725.1	7.5	9.75	5.7	0	2.7	2.85	19.65	1.8	0	1.5	71.25	32.1	37.65	2643	729.3
August	58.5	6.15	23.25	2614.5	676.65	5.25	7.2	10.65	0	2.1	1.95	18.15	1.95	0	1.05	65.7	31.5	35.85	2614.5	679.8
September	63.6	7.65	26.4	2287.5	607.5	7.05	9.9	12.9	0	3.6	3.3	20.4	1.5	0	0.75	73.95	37.95	40.8	2287.5	611.85
October	69.3	10.2	28.95	1777.5	753.45	6.75	10.65	14.7	0	1.95	3	21.15	1.35	0	1.5	79.05	42	45	1777.5	756.9
November	70.8	10.95	31.95	1387.5	936	4.5	10.8	16.65	0	2.85	1.95	23.85	1.5	0	1.35	77.25	45.6	50.1	1387.5	940.2
December	63.9	6.6	42.45	1327.5	1075.8	5.55	9	15.75	0	1.2	2.7	23.85	2.25	0	1.35	72.15	39.45	60.45	1327.5	1078.4
January	67.5	6.45	42.75	1117.5	918.9	5.1	8.7	16.8	0	1.5	1.95	24.45	1.8	0	1.5	74.55	39.6	61.35	1117.5	921.9
February	63.9	5.55	42.9	958.5	747.3	4.5	9.6	15.3	0	1.65	1.5	25.65	0.75	0	0.3	69.9	40.8	58.95	958.5	749.25
March	63.15	5.4	39.45	1162.5	913.95	5.25	11.1	11.55	0	2.85	1.95	25.35	1.5	0	0.75	70.35	41.85	52.5	1162.5	917.55
April	53.7	5.4	37.35	1867.5	573.9	6.45	7.95	12.9	0	2.55	2.25	21	1.5	0	1.95	62.4	34.35	51.75	1867.5	578.4
May	57.15	4.65	34.35	2197.5	655.2	4.95	6.6	10.35	0	3.3	1.95	18.9	1.35	0	1.5	64.05	30.15	46.05	2197.5	660
Total	748.35	73.35	411	21685.5	9197.6	69.9	105.15	154.2	0	29.25	27.9	260.1	18	0	14.85	846.15	438.6	583.2	21685.5	9241.7
Total per month	62.363	6.113	34.25	1807.13	766.46	5.825	8.763	12.85	0	2.438	2.325	21.675	1.5	0	1.238	70.513	36.55	48.6	1807.13	770.14
Per Month/ Shop	12.473	1.223	6.85	361.425	153.29	1.165	1.753	2.57	0	0.488	0.465	4.335	0.3	0	0.248	14.103	7.31	9.72	361.425	154.03
Total per day	2.079	0.204	1.142	60.238	25.549	0.194	0.292	0.428	0	0.081	0.078	0.723	0.05	0	0.041	2.35	1.218	1.62	60.238	25.671
Per day/ Shop	0.416	0.041	0.228	12.048	5.11	0.039	0.058	0.086	0	0.016	0.016	0.145	0.01	0	0.008	0.47	0.244	0.324	12.048	5.134
A.V.	62.363	6.113	34.25	1807.13	766.46	5.825	8.763	12.85	0	2.438	2.325	21.675	1.5	0	1.238	70.513	36.55	48.6	1807.13	770.14
S.D.	5.334	2.66	6.702	606.36	158.91	1.07	2.081	3.239	0	0.752	0.545	2.842	0.438	0	0.448	5.269	6.363	8.71	606.36	158.45

A.V. -Average

S.D.- Standard Deviation

Table-5 Showing total average solid waste(Kg/ shop/month) generation and composition at study area (commercial) from June, 2007 - May, 2008

Quality of Waste	Zone-I		Zone-II		Zone-III		Zone-IV				Total	%age
	A.V.	S.D.	A.V.	S.D.	A.V.	S.D.	A.V.	S.D.	A.V.	S.D.	A.V.*12	
Biodegradable Solid waste	616.631	5.410	540.373	2.800	507.899	4.170	535.263	5.200	550.042	4.395	6600.504	97.090
Non-Biodegradable Solid waste	8.705	0.069	8.635	0.036	6.529	0.049	5.975	0.048	7.461	0.051	89.532	1.310
Inert Solid waste	6.885	0.029	17.978	0.080	5.683	0.028	5.347	0.029	8.973	0.042	107.676	1.600
Total Solid waste	632.221	5.508	566.986	2.916	520.111	4.247	546.585	5.277	566.476	4.488	6797.712	100.000

A.V. -Average

S.D.- Standard Deviation

An overall study has revealed maximum percentage of biodegradable solid waste (97.09%) followed by inert solid waste (1.6%) and non-biodegradable solid waste (1.31%) which is in accordance with the finding of Rampal et al (2002), Kour (2004), Rampal et al. (2005), Gupta et al. (2008), Jaswal (2008) and Kewal (2010) who also recorded highest percentage of biodegradable waste.On making a comparative study of solid waste generated at all the four study zones, it was recorded that the total average solid waste generated (Kg/shop/month) was found to be maximum in Zone-I (632.221±5.508Kg) followed by Zone- II (566.986±2.916 Kg), Zone-IV (546.585±5.277 Kg) and Zone-III (520.111±4.247 Kg). The minimum value (520.111±4.247 Kg) of waste generated was exhibited by Zone –III. Although the results have shown a variation in the solid waste generation in the study area during different months of the year, yet no set pattern of waste generation was observed. It has been recorded from the studies that people (shopkeepers) don't dispose off the waste properly in the area rather throw it in open or vacant land on roadsides, streets or nallahs. Moreover, for the final disposal of wastes, open dump method is generally followed by the municipality and for this purpose,

two dump sites are there in the area. One dump site is near the river Chenab and another in the outskirts of Akhnoor Town.

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Analysis of wetland Birds as seen in Yamuna river at Okhla (Delhi), Faridabad and Palwal Districts in Haryana, India

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Abstract

The present studies were done during 2008-11 for the observations of wetland birds in River Yamuna at Okhla (Delhi), Faridabad and Palwal districts in Haryana. Visits were made in an irregular manner. In all 2 visits were made at Faridabad; village Chandhat nearby Palwal and at Hodal nearby village Kulena. It is pertinent to mention that few visits were made in winter season at Okhla barrage in New Delhi. In all, 60 species were recorded belonging to 8 orders and 14 families. Out of these 60 species of wetland birds, 35 were winter migratory, 11 local migratory and 11 species of birds were resident. The specific wetland birds specific to Yamuna River between "Delhi-Faridabad-Palwal" segments include Ferruginous Pochard *Aythya nyroca*, Black-headed Gull *Larus ridibundus*, Greater Scaup *Aythya marila*, River Tern *Sterna aurantia* and Pallas Gull *Larus ichthyaetus*. Other popular wetland birds include, amongst others, Mallard *Anas platyrhynchos*, Northern Pintail *Anas acuta*, Northern Shoveller *Anas clypeata*, Red-crested Pochard *Rhodonessa rufina*, Common Pochard *Aythya ferina*, Tufted Pochard *Aythya fuligula*, Bar-headed Goose *Anser indicus*, Greylag Goose *Anser anser*, Brahminy Shelduck *Tadorna ferruginea*, Gadwall *Anas strepera*, Eurasian Wigeon *Anas penelope*, White-tailed Lapwing *Vanellus leucurus*, Ruff *Philomachus pugnax*, Common Greenshank *Tringa nebularia*, Pallas Gull *Larus ichthyaetus*, Painted Stork *Mycteria leucocephala*, Open-billed Stork *Anastomus oscitans*, White-necked Stork *Ciconia episcopus*, Eurasian Spoonbill *Platalea leucorodia*, Black tailed Godwit *Limosa limosa*, Wood Sandpiper *Tringa glareola*, Little Stint *Calidris minuta*, Common Redshank *Tringa totanus*, Spotted Redshank *Tringa erythropus* and Pied Avocet *Recurivirostra avosetta*.Black-headed Gulls were seen in thousands followed by Greylag Goose *Anser anser*, Northern Shoveller, Northern Pintail etc. Minimum number noticed were those of Greater Scaup, Ferruginous Pochards etc. Resident wetland birds include Little Cormorants *Phalacrocorax niger*, Median Cormorants *Phalacrocorax fuscicollis*, Large Cormorants *Phalacrocorax carbo* , Pond Herons *Ardeola grayii*, Night Herons *Nycticorax nycticorax*, Black winged Stilts *Himantopus himantopus*, Common Moorhens *Gallinula chloropus*, Bronze-winged Jacana *Metopidius indicus*, Red-wattled Lapwing *Vanellus indicus*, Grey Herons *Ardea cinerea*, large Egrets *Ardea alba* and Median Egrets *Mesophoyx intermedia*. However, Grey Herons were seen only in 2-3 numbers. It seems that most of the popular migratory birds, perhaps, prefer Jheels, Lakes, Barrages compared to Yamuna river stream. Birds in Yamuna are not continuous in their availability. Rather birds are encountered at specific spots only in a given segment. Painted Storks were seen in 1or 2 and that too in the vicinity of Yamuna region rather than its stream of water. However, birds were seen in innumerous numbers at Okhla Barrage in Yamuna River nearby Delhi.

Keywords: *Yamuna River, Okhla Barrage, Faridabad, Palwal, Wetland birds*

Introduction

The present studies have been carried out in Yamuna River between Delhi, Faridabad and Palwal. Faridabad District in Haryana lies in South Eastern direction touching Noida, Bulandshar, Aligarh and Mathura. The character of Yamuna has undergone tremendous alterations in the last 50 years. One such change is the absence of annual floods in August-September which were seen in furious dimensions upto 1960s. But now there are no more floods. The second most important change has been the sewerage addition in Delhi. Earlier, workers who have studied birds in Yamuna include Hutson (1954), Ganguli, 1975, Singh (1983), Gopal and Shah (1993), Grewal, 1996, Urfi (1993a; 1993b; 1996; 1997; 2003), Vyas (1996), Harris (2001). Some workers have also studies Yamuna at Okhla Barrage (Urfi, 2003). However, no one has studies Yamuna at Faridabad-Palwal-Hodal section and hence the present study was undertaken. However, wetland birds in rural ponds have been studied by Gupta and Kaushik (2010a-e, 2011,); Gupta *et al.* (2010a-c), Gupta *et*

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*al.(*2010), Gupta *et al.* (2009) and Gupta *et al.* (2012). At the same time, Gupta *et al.* (2011a-c) have also focused attention on wetland birds found in few prominent sanctuaries in Haryana.

Material and Methods

Yamuna River flows into plains at Kalesar nearby Hathini Kund in Yamunanagar district. It flows through Karnal, Panipat, Sonepat to reach Delhi. Soon after it continuous Uttar Pradesh and in the east as border between Haryana and Uttar Pradesh flowing to Mathura via Faridabad district in south east Haryana. Present studies attempt to focus attention on wetland birds of Yamuna in a section of 90-100 Kms between Faridabad and Palwal.The methodology followed is Ali (1996) and Gupta and Kaushik (2010a, 2011).The river bed was surveyed nearby in flowing water as well as the sandy area of 200 meters in eastern directions was also surveyed. Major segment of the studies attempts to understand the scenario of wetland birds including migratory as well as resident ones. Identification of birds has been done following Ali (1996); Ali and Ripley (1987); Grimmet *et al*., (1998) and Kumar *et al*., (2003, 2005). The nomenclature adopted was that of Manakadan and Pittie (2001). The observations were taken with the help of Camara (Zenith 1986 model with tele-lens and Nikon Coolpix P 500). Enough photographic evidence was generated.

Results and Discussion

The birds observed during 2008-2011 at Okhla (Delhi), Faridabad and Palwal districts in Haryana are computed in the form of table-1. The prominent birds spotted in Yamuna River are depicted in plates1-2. Analysis thereof in respect of Orders, families and residential status is given in figures1-3. The total number of 60 wetland birds belonging to 8 orders and 14 families. Further analysis of birds revealed that 35 species of birds were winter migratory, 11 local migratory and 11 species of birds were resident. The most dominant orders are Charadriiformes (18 species), Anseriformes (16 Species) and Ciconiiformes (12 species) (Fig.1) respectively. The minimum diversity of wetland birds is seen in Order Podicipediformes (Little Grebe) and Coraciiformes (Lesser Pied Kingfisher, White-breasted Kingfisher). The maximum avian diversity is seen in family Anatidae (16 species) followed by Ardeidae (8 species) (Fig.2). The minimum diversity is seen in family Podicipedidae (Little Grebe). Gupta and Kaushik (2011) reported 47 species of wetland birds belonging to 9 orders and 13 families from Hathnikund Barrage in Yamunanagar district in Haryana. Out of these 47 species, 26 species were winter migratory birds which visit the Yamuna barrage every year in winter season (Fig.3). At the same time, Gupta *et al.* (2012) reported 70 species of wetland birds from rural ponds in Panipat district just in the vicinity of Yamuna River.It seems migratory birds coming from far off places to Haryana prefer traditional ponds compared to Yamuna River. According to present studies, the birds specific to River Yamuna are Ferruginous Pochard, Black-headed Gull, Greater Scaup, River Tern, and Pallas Gull. The popular wetland resident's birds include Little Cormorants, Median Cormorants, Pond Herons, Night Herons; Black winged Stilts, Common Moorhens, Bronze-winged Jacana, Red-wattled Lapwing, large Egrets and Median Egrets, Lesser Pied Kingfisher, White-breasted Kingfisher and *Large* Pied Wagtail. On the other hand, popular winter migratory birds include Mallard, Northern Pintail, Northern Shoveller, Red-crested Pochard, Common Pochard, Tufted Pochard, Bar-headed Goose, Greylag Goose, Brahminy Shelduck, Gadwall, Eurasian Wigeon White-tailed Lapwing, Ruff, Common Greenshank, Pallas Gull, Painted Stork, Open-billed Stork, White-necked Stork, Eurasian Spoonbill, Black tailed Godwit, Wood Sandpiper, Little Stint, Common Redshank, Spotted Redshank and Pied Avocet. Tufted Pochards and Mallards were not seen in the stream. Instead these were seen at Okhla barrage only. Compared to the traditional rural ponds winter migratory birds (Gupta *et al*. (2009); Gupta *et al.*, 2010a-c, Gupta and Kaushik, 2010a) observed that Tufted Pochards, Red-crested Pochard, Pallas Gull, Black headed Gull, Greater Scaup, Ferruginous Pochards, Rudy Shelduck, River Lapwing are seen only in Yamuna stream and its vicinity of merely 100 yards on east and west ward side. Gupta and Kaushik (2010) have reported the absence of these birds from nearby pond to Yamuna in district Karnal (Gagsina and Raipur village ponds) where these birds were absent. These studies, therefore, indicate that there are some birds which are

common to Yamuna and nearby ponds like Northern Shoveller, Northern Pintail, Common Teal, Gadwall, Garganey, Bar-headed Goose, and Common Pochard. Some birds are specific to Yamuna only like River Lapwing, Pallas Gull, Black-headed Gull, Tufted Pochard, Rudy Shelduck and Red-crested Pochards.

Table.1. Checklist of wetland birds of Yamuna River at Okhla (Delhi), Faridabad and Palwal districts in Haryana state during 2008-11.

S. No.	Common Name	Res. Status	Scientific Name
Podicipediformes		**Podicipedidae**	
1	Little Grebe	R	*Tachybaptaus rufficollis* (Pallas, 1764)
Pelecaniformes		**Phalacrocoracidae**	
2	Little Cormorant	R	*Phalacrocorax niger* (Vieillot, 1817)
3	Indian Shag	LM	*Phalacrocorax fuscicollis* Stephens, 1826
4	Great Cormorant	LM	*Phalacrocorax carbo* (Linnaeus, 1758)
Ciconiiformes		**Ardeidae**	
5	Little Egret	LM	*Egretta garzetta (*Linnaeus, 1766)
6	Grey Heron	WM	*Ardea cinerea* Linnaeus, 1758
7	Purple Heron	LM	*Ardea purpurea* Linnaeus, 1766
8	Large Egret	LM	*Casmerodius albus* (Linnaeus 1758)
9	Median Egret	LM	*Mesophoyx intermedia* (Wagler, 1829)
10	Cattle Egret	R	*Bubulcus ibis* (Linnaeus, 1758)
11	Indian Pond-Heron	R	*Ardeola grayii* (Sykes, 1832)
12	Black-crowned Night Heron	LM	*Nycticorax nycticorax* (Linnaeus,1758)
		Ciconiidae	
13	Painted stork	LM	*Mycteria leucocephala* (Pennant, 1769*)*
14	White-necked Stork	LM	*Ciconia episcopus* (Boddaert, 1783)
15	Asian Openbill Stork	LM	Anastomus oscitans(Boddaert, 1783)
		Threskiornithidae	
16	Eurasian Spoonbill	WM	*Platalea leucorodia* Linnaeus, 1758
Anseriformes		**Anatidae**	
17	Greylag Goose	WM	*Anser anser* (Linnaeus, 1758)
18	Bar-headed Goose	WM	*Anser indicus* (Latham,1790)
19	Brahminy Shelduck	WM	*Tadorna ferruginea* (Pallas 1764)
20	Mallard	WM	*Anas platyrhynchos* Linnaeus, 1758
21	Gadwall	WM	*Anas strepera* Linnaeus, 1758
22	Eurasian Wigeon	WM	*Anas penelope* Linnaeus, 1758
23	Spot-billed Duck	WM	*Anas poecilorhyncha* J.R. Forester, 1781
24	Northern Shoveller	WM	*Anas clypeata* Linnaeus, 1758
25	Northern Pintail	WM	*Anas acuta* Linnaeus, 1758
26	Garganey	WM	*Anas querquedula* Linnaeus, 1758
27	Common Teal	WM	*Anas crecca* Linnaeus, 1758
28	Common Pochard	WM	*Aythya ferina* (Linnaeus, 1758)
29	Red-crested Pochard	WM	*Rhodonessa rufina* (Pallas, 1773)
30	Ferruginous Pochard	WM	*Aythya nyroca* (Güldenstädt, 1770)
31	Greater Scaup	WM	*Aythya marila* (Linnaeus, 1761)
32	Tufted Pochard	WM	*Aythya fuligula* (Linnaeus, 1758)
Gruiformes		**Rallidae**	
33	White-breasted Waterhen	R	*Amaurornis phoenicurus* (Pennant, 1769)
34	Purple Moorhen	R	*Porphyrio porphyrio* (Linnaeus, 1758)

35	Common Moorhen	LM	*Gallinula chloropus* (Linnaeus, 1758)
36	Common Coot	WM	*Fulica atra* Linnaeus, 1758
Charadriiformes		**Jacanidae**	
37	Bronze-winged Jacana	R	*Metopidius indicus* (Latham, 1790)
Charadriidae			
38	Little Ringed Plover	WM	*Charadrius dubius* Scopoli,1786
39	Red-wattled Lapwing	R	*Vanellus indicus* (Boddaert, 1783)
40	White-tailed Lapwing	WM	*Vanellus leucurus* (Lichtenstein, 1823)
41	River Lapwing	R	*Vanellus duvaucelii* (Lesson, 1826)
Scolopacidae			
42	Spotted Redshank	WM	*Tringa erythropus* (Pallas, 1764)
43	Common Redshank	WM	*Tringa totanus* (Linnaeus, 1758)
44	Ruff	WM	*Philomachus pugnax* (Linnaeus, 1758)
45	Little Stint	WM	*Calidris minuta* Leisler, 1812
46	Black tailed Godwit	WM	*Limosa limosa* (Linnaeus, 1758)
47	Common Sandpiper	WM	*Actitis hypoleucos* Linnaeus, 1758
48	Common Greenshank	WM	*Tringa nebularia* (Gunner,1767)
49	Wood Sandpiper	WM	*Tringa glareola* Linnaeus,1758
Recurvirostridae			
50	Black-winged Stilt	R	*Himantopus himantopus (*Linnaeus, 1758)
51	Pied Avocet	WM	*Recurivirostra avosetta* Linnaeus, 1758
Laridae			
52	River Tern	R	*Sterna aurantia* J.E.Gray, 1831
53	Black-headed Gull	WM	*Larus ridibundus* (Linnaeus,1766)
54	Pallas's Gull	WM	*Larus ichthyaetus (Pallas 1773)*
Coraciiformes		**Alcedinidae**	
55	Lesser Pied Kingfisher	R	*Ceryle rudis (*Linnaeus, 1758)
56	White-breasted Kingfisher	R	*Halcyon smyenensis* (Linnaeus,1758)
Passeriformes		**Motacilidae**	
57	White Wagtail	WM	*Motacilla alba* Linnaeus, 1758
58	Large Pied Wagtail	R	*Motacilla maderaspatensis* Gmelin, 1789
59	Citrine Wagtail	WM	*Motacilla citreola* Pallas, 1776
60	Yellow Wagtail	WM	*Motacilla flava* Linnaeus, 1758

Abbreviation:-R-Resident; WM-Winter Migratory; LM-Local Migratory; SM-Summer Migratory

However, workers like Urfi (2003) have reported huge 302 species of birds from Okhla Barrage which is an altered segment of Yamuna River in NCR region. Urfi (2003) reported two critically endangered species (White rumped vulture and Indian Vulture) and nine vulnerable species like Baikal Teal, Baer's Pochard, Saras Crane, Sociable Lapwing, Indian skimmer, Pallas's Fish Eagle, Lesser Adjutant Stork, Bristled Grassbird and Finn's weaver from Okhla Bird Sanctuary. But these birds could not be observed in the present study. At the same time, Urfi (2003) observed seven species of nearly threatened species like Ferruginous Pochard, Black bellied Tern, Grey-headed Fish Eagle, Darter, Black-headed Ibis, Painted Stork and Black necked stork from Okhla Bird Sanctuary. Only two species of Birds like Ferruginous Pochard and Painted Stork were observed in the present study. As such more birds are attracted to broader sheet of water compared to the narrow stream of slow flowing water in a populated river like Yamuna.

Fig.1.Greater Scaup

Fig.2.Greylag Goose

Fig.3.Greater Scaup

Fig.4.Bar-headed Goose

Fig.5. River Lapwing

Fig.6 Pallas's Gull

Fig.7.Ferruginous Pochard

Fig.8. Black-headed Gull

Fig.9. White-tailed Lapwing

Plate-1: Figs. 1-9 Few prominent winter visiting wetland birds spotted in River Yamuna-bed at Okhla (Delhi), Faridabad and Palwal districts during 2008-2011

Plate-2: Figs. 1-9 Few prominent winter visiting wetland birds spotted in River Yamuna-bed at Okhla (Delhi), Faridabad and Palwal districts during 2008-2011

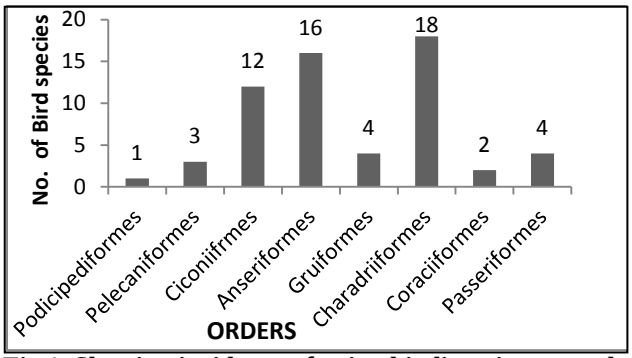

Fig.1. Showing incidence of avian biodiversity spotted in Yamuna River at Okhla (Delhi), Faridabad and Palwal districts in Haryana in order-wise manner during 2008-11.

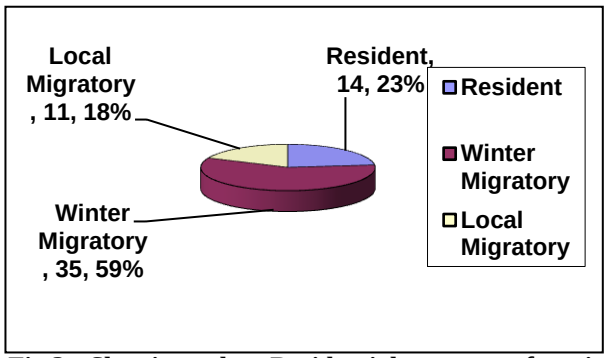

Fig.3 Showing the Residential status of avian biodiversity spotted in Yamuna River at Okhla (Delhi), Faridabad and Palwal districts in Haryana during 2008-11.

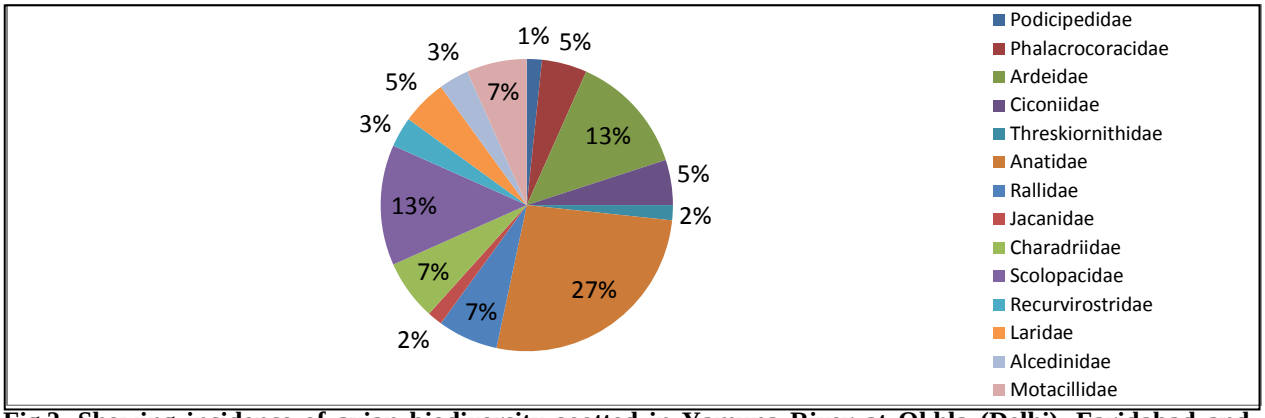

Fig.2. Showing incidence of avian biodiversity spotted in Yamuna River at Okhla (Delhi), Faridabad and Palwal districts in Haryana in family-wise manner during 2008-11.

Present studies also indicate that migratory birds like Painted Stork, Ferruginous Pochards are globally threatened (Birdlife International, 2001). At the same time, most of the birds seen in Yamuna river fall in Schedule IV of Wildlife (Protection) Act, 1972 of India. In view of these observations, the present studies also recommend that substantial steps be undertaken to safeguard these birds.

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Thanks are due to the authorities of Kurukshetra University, Kurukshetra for encouragement, inspiration and financial assistance. Thanks are also due to UGC, New Delhi for granting study leave to Priyanka.

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Establishment of population of introduced brown trout (*Salmo trutta*) co-related to their feeding habits in river Asiganga, district Uttarkashi, Uttarakhand

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Abstract

Uttarakhand is considered as one of the freshwater fish biodiversity zone within India and the aquatic biodiversity here is threatened primarily due to anthropogenic activity and introduction of non-native fishes. Colonization and invasion of new aquatic habitats are common in nature as a result of climatic or geotectonic events but humans provide additional artificial pathways by which introduced non-native fishes can overcome biogeographic barriers. Here, in this paper, we assessed the i) factors assisting establishment of introduced brown trout's (*Salmo-trutta*) population in river Asiganga and other fresh water systems in district Uttarakashi, ii) attributes of brown trout's dietary habits that are helping them establish their population by analyzing the stomach contents of brown trout and, iii) food preferences of brown trout. As evident from our studies it is found that fish fingerlings is the food of choice and based on the morphometric assessment most of these fingerlings being preferred as food are that of an endemic species Schizothorax. Brown trout does eat benthos but Selectivity Index data suggest that these benthos are not a preference but lie in the neutral zone as most of the values are between -0.25 to 0.25. Different feeding preferences and reduced water level in pockets of rivers for long distance migration, seems to be major factor in establishment and spread of brown trout which in turn is threatening the endemic fish species of Uttarakhand.

Keywords: *endemic species, Asiganga, brown trout, feeding habits*

Introduction

Non-native fish introductions and/or their invasions constitute one of the greatest threats to the abundance of endemic piscine fauna of any aquatic system (Richter *et al.,* 1997; Wilcove *et al.,* 1998, Wards and Wipple, 1959). These introductions can result in (or enhance) the rate of species loss and thus affect the structure and function of an ecosystem (Nilsson *et al*., 2008). For example in Western North America, introduced salmonids have displaced regionally endemic cutthroat trout subspecies, *Oncorhynchus clarkii* subsp., from both riverine and lacustrine habitats (Dunham *et al.*, 2002; Quist and Hubert 2004). Rainbow trout (*Oncorhynchus mykiss)*, brooktrout, (*Salvelinus fontinalis*), and lake trout (*Salvelinus namaycush*), have all contributed to cut throat trout decline through hybridization,competition, and/or predation (Griffith 1988; Ruzycki *et al.*,2003; Weigel *et al.*, 2003). Various factors play important role in influencing the invasion process and the subsequent success of establishment of populations of introduced species. Niche characteristics are one of the prominent factors (Kolar & Lodge, 2002; Peterson & Vieglais, 2001; Hierro *et al.*, 2005; Kolar, 2004). Besides this, sometimes the food resources and habitat available are used sub-optimally by the native species and thus provide opportunity to the introduced species, if environmental condition is suitable (Heger &Trepl, 2003).

In Garhwal Himalaya, several fish species have been reported (Badola, 1975; Badola and Pant 1973). Besides endemic species, several exotic fish species have been introduced in many rivers and streams in Garhwal region of Uttarakhand. One such prominent introduction site is river Asiganga,

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a tributary of river Ganges, in district Uttarkashi of Uttarakhand, India. *Salmo trutta* was introduced at the origin of river Asiganga at DodiTaal (elevation 4400 m), a high altitude small lake. The exact dates of introduction were never documented but it is said that it was done by British, however no documentation is available. It has been stated by Singh *et al.*,(1983) that introduction of brown trout in the Garhwal Himalaya region of the state Uttarakhand dates back to 1910 when, the then Ruler of Tehri State stocked the eyed ova of brown trout, carried from Kashmir, into Kalyani (Uttarkashi) and Talwari (Chamoli) hatcheries (Mackay, 1945). However credible documentation is still lacking and during all these years no researches were ever carried out to assess the ecological impact of these introduced fishes on endemic fish species in Garhwal Himalaya. With the aim of assessing the impact of these introductions on native fish species and identifying factors assisting the spread and establishment of brown trout's population, we examined, quantified and compared attributes of brown trout's dietary habits in river Asiganga using random sampling.The stomach contents of brown trout, from various section of the river, was analyzed and compared with the available dietary components (fishes, benthos etc.) in its natural habitat. Here we present data on food preferences of introduced brown trout and its effect on native species and aquatic ecology of river Asiganga and possible ecological/physico-chemical factors aiding the spreading of brown trout.

Material and Methods

Study site

The study site was located in the river Asiganga. River Asiganga originates at an elevation of 4400 meters at Dodital and merges into river Ganges at an elevation of 1158 meters at village Gangori in middle Himalaya (Fig 1, 2).

The river has catchment area of 192 sq. Km. and is predominantly monsoon fed with negligible contribution from snow melt during summer. From the point of origin to the point of its merger with the Ganges, this river flows for about 36 Km. The study area encompassed the last 25 Km region of the stream. In the study area/stretch the river has an average width of 6 to 10 meters, a depth of 80 cm to 4 meters and substratum is mainly composed of cobbles, pebbles and gravel. Fishes were also sampled from other sites (S2 – S5 – Fig 2).

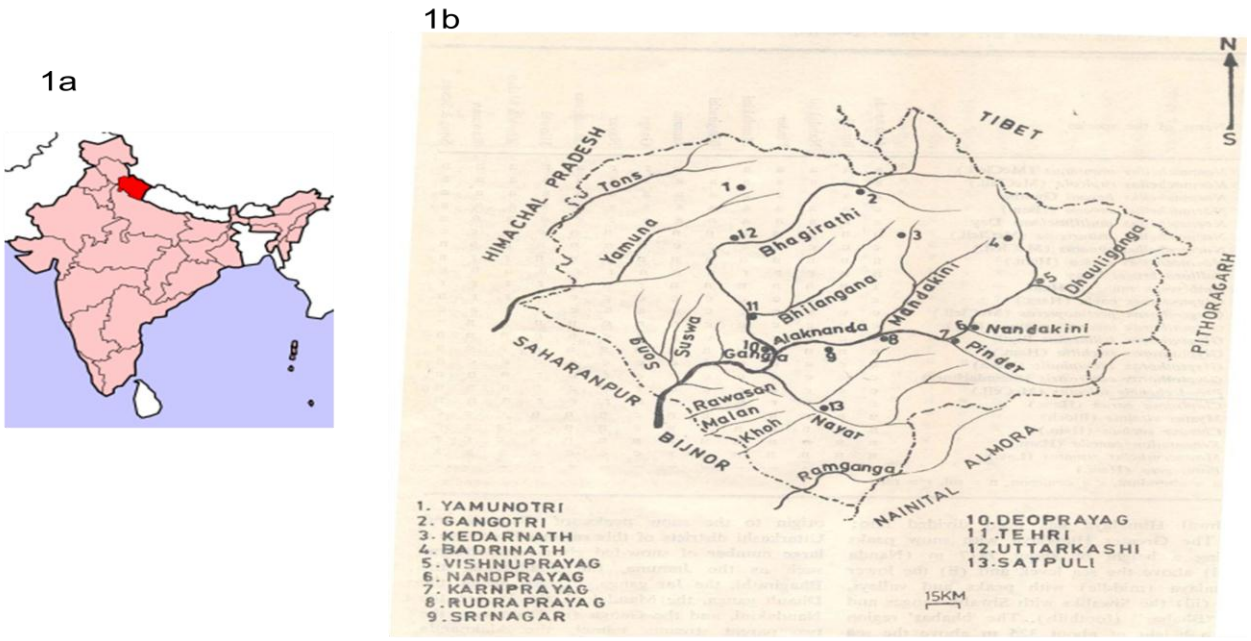


Fig. 1a. Location of Uttarakhand in India. **1b.** Fresh water resources of Uttarakhand. There are over 10 major rivers within a radius of approximately 200 km. Exotic fishes have been introduced in many rivers.

STUDY SITE

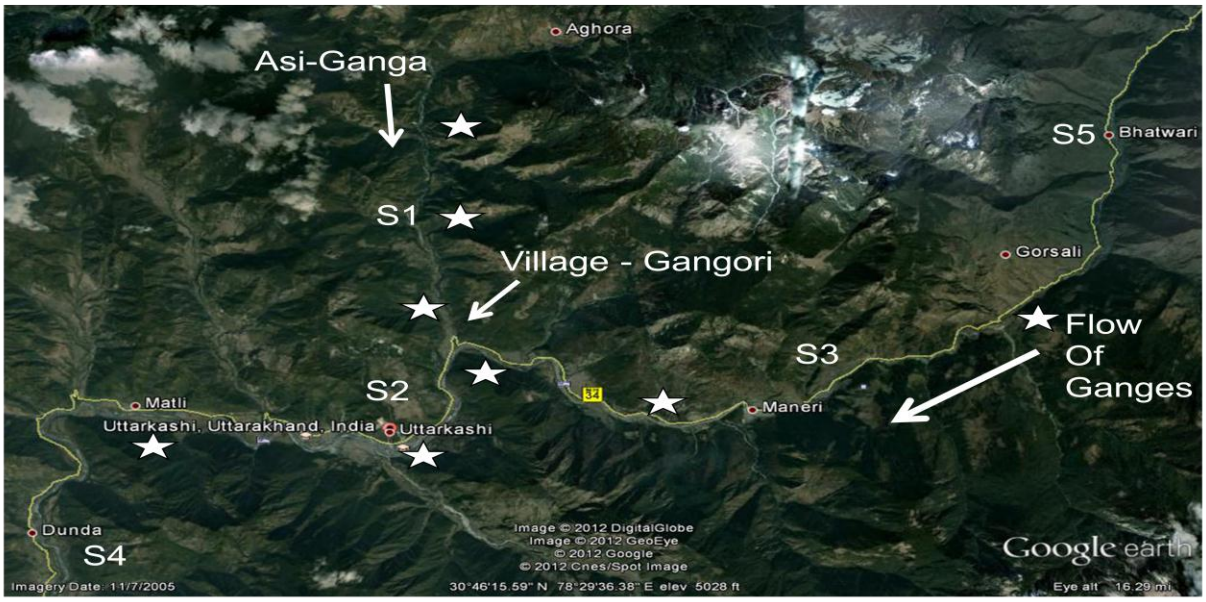


Fig. 2 Location of study area in district Uttarkashi. ☆ Represents spread of brown trout in the area. S1 to S5 are the survey sites. Majority of work on feeding behavior is from site S1.

Image from Google Earth

Fish collection

Brown trout were caught by hired fisherman along the same stretch where macro-benthos was collected at all the sites. The fisherman used cast net for capturing the fishes. The captures occurred at dawn and before dusk, from August-2009 to July-2011. Standard length (SL) and total length (TL) of each fish were measured. From each sampling, stomach of one to three fishes was preserved and placed in 10% formalin. Both - qualitative and a quantitative evaluation of stomach content of brown trout was made.

Stomach-content description

The contents of all stomachs collected were examined under a dissecting microscope. We counted and identified all items found within individualtrout stomachs. Contents were classified as *Ephemeroptera, Trichoptera, Plecoptera, Diptera,* fish finger ling etc. (native fish).

Prey-selection behavior or feeding preferences study

For prey selection in diet and environment between species, we quantified the abundance and composition of aquatic invertebrates in our study. We collected benthic invertebrate and the collected sample were preserved in 5% formalin. Quantitative estimation of benthic invertebrates was based on numerical counting i.e. units per meter square (Ind. m^2) under a dissecting microscope. Qualitative analysis was made as per the methods/keys of Ward and Whipple (1959), Needham and Needham (1962). Based on sampling data of benthos in aquatic habitat of brown trout and in the stomach, we quantified prey selection for the most common prey items for brown trout using Strauss's linear electivity index, L (Li = ri – pi,where ri and pi are the proportional abundances of prey item i in the diet and in the environment, respectively (Strauss, 1979). L ranges from –1 to+1, with negative values indicating avoidance, positive values indicating preference, and neutral use occurring in the range $0.25 < L < 0.25$.

Physico chemical parameters

Water samples were collected every month during August 2009 to September 2011. Surface water samples were collected with a clean plastic bucket. Preservation and transportation of the water

samples to the laboratory were as per standard methods (APHA, 1998). Water temperature was measured on the site using mercury thermometer.
The samples were analyzed for 7 different parameters. pH was measured by digital pH meter (Model LI-120) using a glass electrode pH, Carbondioxide and alkalinity was determined by titration. Dissolved oxygen was fixed immediately after collection and then determined by Winkler's method (Trivedy and Goel, 1984). Turbidity was measured by Nephelometer using 0.02 NTU standards indicator but is not include in dataset. Conductivity was measured by water analysis kit. The present study reports the seasonal pattern of the physico-chemical parameters at these three sites (Table 1).

Table 1: Physico-chemical parameters of river Asi- Ganges

Physico-chemical Parameter	Range or Mean ± SEM
Temperature (^{o} C)	8 to 15
pH	7.4 ± 0.16
CO_2 (mg/L)	2.13± 0.16
Alkalinity (mg/L)	9.16 ± 1.6
Dissolved Oxygen (mg/L)	8.86 ± 0.27
Conductance (mg/L)	84.16 ± 3.89

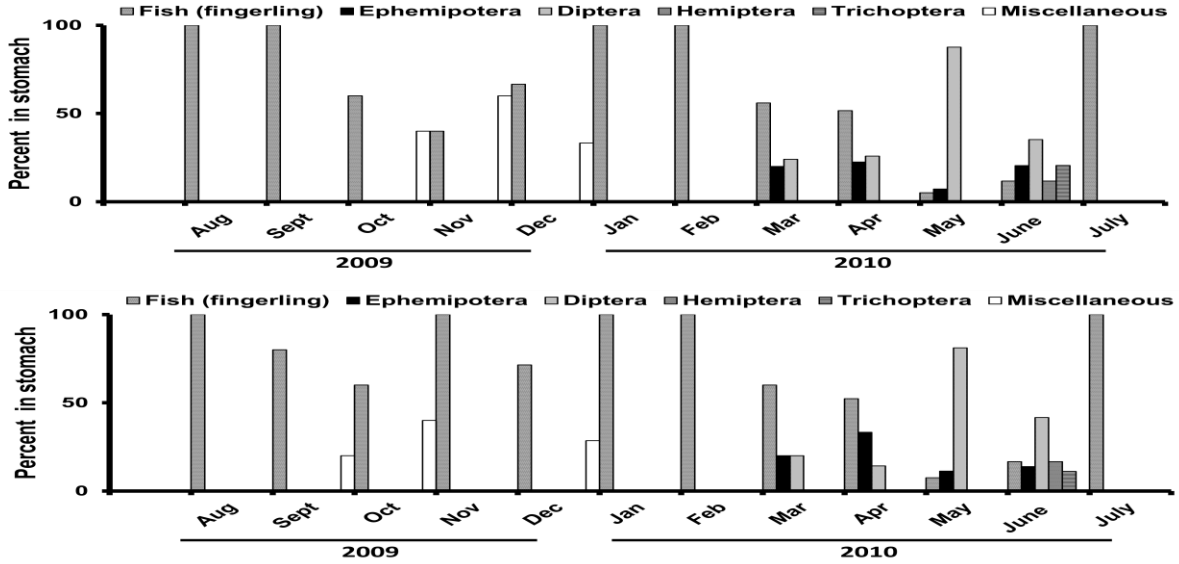
Results and Discussion

In total, we collected 60 brown trout during the entire period (over 2 years) of study and examined their stomach contents.

Stomach-content analysis

Stomach content analysis revealed some interesting observations. Almost 98% of brown trout's stomach examined had fish fingerling's and sometimes there were up-to 3 fishes in the stomach (Fig 4, 5). Based on morphometrics these fingerlings were mostly of Schizothorax species. Fishes of other endemic species like Glyptothorax, Nimachilus etc. were also observed. The aquatic insects particularly *Ephemeroptera* and *Diptera* are preferred besides fish fingerlings, while insect order *Hemiptera* and *Trichoptera* were rarely eaten by the trout. In the diet of trout fingerling of native fish present in high percentage (100%) followed by*Trichoptera* (87.6%) and *Ephemeroptera* (22.5%). Rader et al. (1997) have also reported that Trichoptera and Ephemeroptera are the most abundant prey in gut contents of Brown trout. In conclusion the diet composition at the whole sample level based on the percentage stomach contents of individuals of prey, fish fingerlings were the most ingested prey along with *Trichopteran*, while non-insect aquatic animals were rarely eaten by the trout. Our linear selectivity index suggests that the aquatic insects are a neutral zone food and not a preference.Our observation on factors assisting the spread and establishment of brown trout's population reveal that brown trout is venturing into new areas from the initial point of introduction. Brown trout is well known as a voracious predator and as there is ample number of endemic fish species in the area, the feeding requirements of this fish are well met. Besides this, there has been a lot of anthropogenic activity in the region, especially construction of hydroelectric power projects. Construction of these dams have a) reduced water level in certain sections of the river and,b)segregated populations of brown trout in specific geographical regions. These populations are now beginning to establish. We examined, quantified and compared attributes of brown trout's dietary habits in river Asiganga using random sampling. Data on stomach contents of brown trout, from various section of the river was analyzed and compared with the available dietary components (fishes, benthos etc) in its natural habitat. Here we present data on food preferences of introduced brown trout, the effect of introduced exotic trout species on aquatic ecology (and endemic fish species) of river Asiganga and possible ecological/ physico-chemical factors aiding the spreading of brown trout.In our study we have analyzed food content from stomach. The main reason for this analysis was the fact that brown trout is well known as a predator and we wanted to assess the impact of this introduced exotic species on endemic species. We could have done the radio-isotope analysis for feeding pattern but it would not give a clear picture on the exact food content. Most of the studies consider only gut content for analysis, but we are of the opinion that stomach content analysis gives the best analytical shot of feeding pattern. As evident from our stomach content analysis, fish fingerlings are the food of choice and based on the morpho-metric assessment, the endemic species being preferred as food is Schizothorax (species being

preferred as food needs further confirmatory test using molecular biology tools). These results are unique in terms of feeding habit of brown trout. Almost 100% of the diet in stomach of brown trout was fish fingerlings (Fig.5). This is also astonishing from the point of view of native species conservation as our study suggests that there are well established populations of brown trout in the area and all these populations probably prefer fingerlings of native species of fishes. This feeding habit of brown trout will have a severe impact on endemic fish population. This effect may not be evident as of now due to lack of baseline data on



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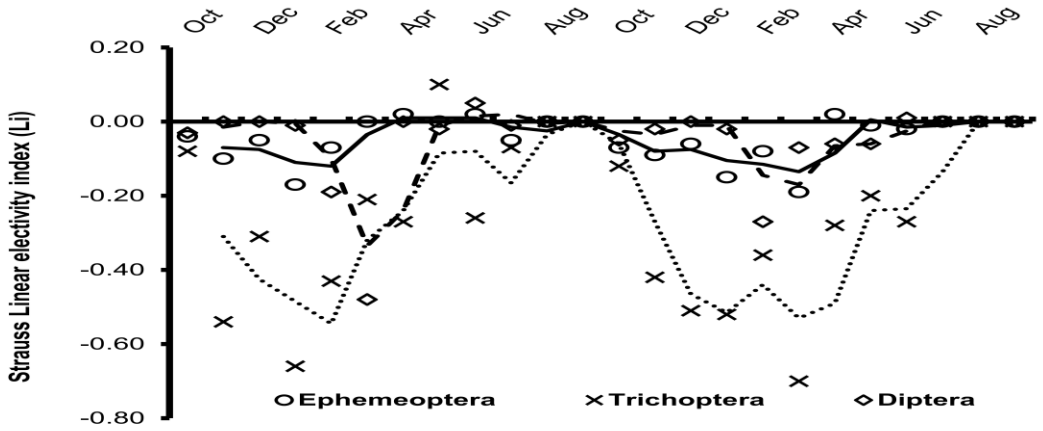

Fig. 4 Feeding preference of brown trout among benthos in river Asi-Ganga. Graph represents monthly data from August 2009 to July 2011 on the feeding preferences based on Strauss Linear electivity index (Li) – Strauss 1979. L ranges from –1 to+1, with negative values indicating avoidance, positive values indicating preference, and neutral use occurring in the range –0.25 < L < 0.25. Almost all the fishes examined throughout the lower reaches of river Asi-Ganga had fish or fingerlings of native species (based on morphometrics) in their stomach.

population dynamics of fishes in Uttarakhand but it will surely be the case in near future if immediate remediation steps are not taken. None of the studies so far have documented this fact that brown trout prefers fingerlings as food from this region. They do eat the benthos available but food preference analysis done using Linear Selectivity Index (Strauss – 1979) reveal that most of the values are between -0.25 to 0.25 which indicate neutral use. It has been reported by many investigators that brown trout prefers *trichoptera's, Ephemeroptera, Gammarus and Plecoptera*

(Fochetti*et. al*., 2003; Alp *et. al.*, 2003; Alp *et al.*, 2005) and this seems to be true in our study also. However, the preference lies in the neutral zone. This particular feeding habit preferring native fish fingerlings most of the time and eating benthos sometimes seems to be one of the main reasons for establishment and spread of brown trout in the region. Besides this habit, reduced water level in specific pockets of rivers (in the area of hydroelectric power projects), seems to be favoring

Fig. 5 Feeding preference of brown trout. Photograph showing fish fingerling in stomach of brown trout. Photograph number DSCN3615 taken during the study.

long distance trout movement/migrations.The movement may possibly also be a result of wash of entire population by fast moving flood waters in this region. The flash flooding does occur in this district at regular intervals. Introduced *Salmo trutta* already constitutes dominant population in the upper reaches of the river Asiganga (a tributary of river Ganges) and can be spotted along the entire length of river. It has even spread in the river Ganges, both up stream and down streams from the point of confluence (at village Gangori). During our survey, we could trace brown trout to almost 30 km downstream from Uttarkashi (till Dharasu and near ChinyaliSaur – a town on the edge of Tehri hydroelectric power project reservoir). Up streams, we could find this fish upto 50 km upstream (tillHarsil). But this upstream occurrence/presence could be a result of introductions carried there or may be these brown trout's managed to move upstream before construction of hydroelectric projects at Maneri (Phase-I). In the Himalaya, as in many other parts of the world, several exotic species have been introduced without any consideration of the impact of such introduction on the endemic fish. All the other countries across the world have taken immediate steps to either same the endemic species or eradicate the invading exotic species. In Uttarkashi district or even in Uttarakhand, the impacts and sensitivity of the situation arising due to this invading exotic species brown trout (*Salmo trutta*), has not been either envisaged or realized at present but this introduced exotic species brown trout (*Salmo trutta*) is going to be a major factor threatening the endemic fish species or Uttarkashi district and even Uttarakhand.

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Medicinal plants of Hirekalgudda state forest, Karnataka, India

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Abstract

The present contribution relates to the diversity of the medicinal flora of the Hirekalgudda state forest of Hassan district in the state of Karnataka. 54 medicinal floras belonging to 28 families have been reported which are used by villagers for primary health care to cure various ailments. These documented medicinal plants are remedy for number of diseases like bronchitis, diarrhea, skin diseases, gonorrhoea, jaundice etc. Relative abundance of medicinal flora showed maximum of Fabaceae (18.44%), followed by Euphorbiaceae (12.88%), Laminaceae (7.36%), Apocyanaceae (7.36%), Asclepidaceae (3.70%), Myrtaceae (3.70%), Verbinaceae (3.70%), Curbitaceae (3.70%) and Rubaceae (3.70%). Out of 28 families, 19 families were represented by a single species each (1.84%). The investigators identify the plants that need conservation and protection. Public and private involvement in management and utilization of medicinal plants in sustainable way is essential to combat human pressures on these valuable natural resources. The present investigation also gives some basic ideas to the researchers who are working in the areas of phytochemistry, pharmacology and biotechnology for further detailed study.

Keywords: Biodiversity, Hirekalgudda state forest, Hassan, medicinal flora

Introduction

Plants are indepensable source of both preventive and curative medicine (Purabhi Saikia and Mohamed Latif, 2011). Hundreds of plants species are recognized for their therapeutic values and used to treat various diseases.People living in remote areas primarily depend on herbal and indigenous healthcare systems due to limited access to modern healthcare facilities and their expensive nature. About 12.5% of the total 4, 22,000 plant species documented worldwide is reported to have medicinal values (Schippamann *et al.*, 2002). In India, drugs of herbal origin have been used in traditional systems of medicines such as *Unani* and *Ayurveda* since ancient times (Ramu and Prabha, 2009). The drugs are derived either from whole plant or from different organs, like leaves, stem, bark, root, flower, seed, etc. Some drugs are prepared from excretory plant product such as gum, resins and latex. Even Allopathic system of medicine has adopted a number of plant-derived drugs which form an important segment of the modern pharmacopoeia. Among ancient civilization, India has been known to be rich repository of medicinal plants. The forest in India is the principal repository of large number of medicinal and aromatic plants, which are largely collected as raw materials for the manufacture of drugs and perfumery products. The biodiversity of medicinal plants of different regions were recorded by a number of investigators (Priti *et al.*, 2011; Raafat *et al.*, 2008; Gidey, 2010; Kharkwal, 2009). Medicinal plants occupied an important position in the socio-cultural, spiritual and medicinal arena of rural people of India. Their sustainable management and harvesting can conserve biodiversity, sustain human and environmental health, generate employment and enhance export earnings. Therefore, an attempt has been made to document the diversity and uses of medicinal plants grow in Hirekalgudda state forest of Hassan district of Karnataka state.

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Study area

The study area Hirekalgudda state forest is located away from Arasikere taluk of Hassan district. It lies between 15^0 6' to 76^0 75' Eastern latitude and 13' 4^0 to 13' 5^0 Northern latitude. This forest consists of a mass of rocky hills raising more or less 3100 mt. above the surrounding area.

Material and Methods

Intensive exploration trips were conducted twice a week from August 2005 to August 2007. Field trips were made twice a week in the beginning and once in the week later to obtain a thorough collection of ephemerals. The work was conducted among local people, rural persons, farmers and *vaidyas* to know the medicinal importance of the mentioned plants. The plants with medicinal values are known from local people and rural persons were collected, and studies were conducted to know their medicinal uses.

The plant specimens were collected after drying. The herbarium sheets were prepared and identified (Diwakar and Sharma, 2000; Naik, 1998; Sharma *et al.*, 1996; Singh *et al.*, 2001). The authenticity of the identified plant specimens were checked by referring the recent monographs and through comparison with authentic herbarium specimens at Madras Herbarium, Botanical survey of India, Sri Krishnadevaraya University Herbarium, Anantapur (SKU), Regional Research Centre, Bangalore (RRCBI) and Manasagangotri, Mysore(MGM).

Results and Discussion

During the floristic exploration on medicinal plants of Hirekalgudda state forest, 54 species of belonging to 28 families were collected. The details regarding family, morphology of useful parts and medicinal values of the medicinal plants were given in the Table-1.

Table -1: Distribution of medicinal plants in Hirekalgudda state forest

S. No.	Botanical Name of Medicinal plant	Family	Morphology of the parts used	Medical usage
01	*Acacia nilotica* L.	Mimosaceae	Leaves and gum	Haemorrhoea, ulcers and leprosy
02	*Acalypha indica* L.	Euphorbiaceae	Leaves and root	Skin diseases, expectorant and dysentery
03	*Achyranthes aspera* L.	Amaranthaceae	Whole plant	Rheumatism, scabies and piles
04	*Adhatoda zeylanica* Medikus	Acanthaceae	Leaves and flowers	Jaundice, leucoderma and loss of memory
05	*Aegle marmelos* (L.) Corr. Serr.	Rutaceae	Fruit, bark and leaves	Hypochondria
06	*Azadirachta indica* A. Juss.	Meliaceae	Flowers, leaves and seeds	Jaundice, chicken pox and measles
07	*Bacopa monnieri* (L.) Pannel	Scrophulariaceae	Whole plant	Brain tonic and anticonvulsant
08	*Bauhinia variegate* L.	Caesalpiniaceae	Root and bark	Diarrhoea, leprosy and intestinal worms
09	*Calotropis gigantea* (L.) R.Br.	Asclepiadaceae	Whole plant	Purgative, leprosy and piles
10	*Carissa carandus* L.	Apocyanaceae	Root and fruit	Piles, eye diseases and hemorrhage
11	*Cassia auriculata* L.	Caesalpiniaceae	Bark, root and seeds	Urinary discharge, skin diseases and tumors
12	*Cassia tora* L.	Caesalpiniaceae	Pod, seeds and leaves	Skin diseases, diabetes and eye diseases
13	*Catharanthus roseus* (L.) G. Do.	Apocyanaceae	Whole plant	Anticancer, insect bite and diabetes
14	*Ceiba pentandra* (L.) Gaertner	Bombacaceae	Root, bark and flower	Dysentery, skin eruptions and haemoptysis

15	*Cissus quadrangularis* L.	Vitaceae	Root, leaves and stem	Dyspepsia, indigestion and piles
16	*Crotolaria retusa* L.	Fabaceae	Whole plant	Diarrhoea, scabies and leprosy
17	*Cucumis sativus* L.	Cucurbitaceae	Fruits and seeds	Demulcent, diuretic and headache
18	*Datura stramonium* L.	Solanaceae	Flowers and seeds	Curing bites of mad dog, tumors and elephantiasis
19	*Eucalyptus globulus* Labill	Myrtaceae	Dried leaves, root and essential oil	Purgative, stimulant and expectorant
20	*Euphorbia heterophylla* L.	Euphorbiaceae	Leaves and root	Dropsy, rheumatism and anthelmintic
21	*Ficus benghalensis* L.	Moraceae	Whole plant	Diabetes, gonorrhoea and piles
22	*Gymnema sylvestre (*Retz) R.Br.ex	Asclepiadaceae	Leaves and root	Diabetes, vomiting and cardio tonic
23	*Heliotropium indicum* L.	Boraginaceae	Whole plant	Ulcer, skin diseases and rheumatism
24	*Helicterus isora* L.	Sterculiaceae	Root, bark and fruits	Diarrhoea, constipating and vermifuge
25	*Hyptis suaveolens* (L.) Poit	Laminaceae	Leaves	Skin diseases, dental problems and rheumatism
26	*Ixora coccinea* L.	Rubiaceae	Root, leaves and flowers	Cough, gonnorrhoea and diarrhoea
27	*Jasminum pubescens* Willd	Oleaceae	Leaves and flowers	Cough, inflammation and rheumatism
28	*Jatropha curcas* L.	Euphorbiaceae	Fruits, leaves and root	Diarrhoea, dysentery and urinary discharge
29	*Jatropha glandulifera* Roxb.	Euphorbiaceae	Fruits and leaves	Chronic rheumatism, sinuses and paralysis
30	*Leucas aspera* (Willd) Link	Lamiaceae	Whole plant	Chronic rheumatism, skin eruption and snake bite
31	*Mangifera indica* L.	Anacardiaceae	Root, bark and seed	Astringent, dysentery and bronchitis
32	*Mimusops elengi* L.	Sapotaceae	Bark, stem and flower	Astringent, anthelminitic and diarrhoea
33	*Momordica charantia* L.	Cucurbitaceae	Whole plant	Constipation and fever
34	*Nerium odorum* Sol.	Apocynaceae	Root	Astringent, toothache and epilepsy
35	*Ocimum americanum* L.	Lamiaceae	Whole plant	Toothache, stomachic and asthma
36	*Ocimum basilicum* L.	Lamiaceae	Whole plant	Stomachic, anthelmintic and toothache
37	*Parkinsonia aculeate* L.	Caesalpiniaceae	Flowers	Antiseptic, diarrhea and gonorrhoea
38	*Passiflora foetida* L.	Passifloraceae	Whole plant	Skin diseases, flatulence and inflammations
39	*Phyllanthus emlica* L.	Euphorbiaceae	Fruits	Jaundice and swelling
40	*Physalis minima* L.	Euphorbiaceae	Whole plant	Diuretic, laxative and expectorant
41	*Pongamia pinnata* (L.) Pierre	Fabaceae	Root and seeds	Anthelmintic, tumors and piles
42	*Psidium guajava* L.	Myrtaceae	Leaves, root and fruit	Rheumatism, diarrhea and dysentery
43	*Pterocarpus marsupium* Roxb.	Fabaceae	Leaves, heatwood and gum	Astringent, constipation and diarrhoea

44	*Sesamum orientale* L.	Pedaliaceae	Whole plant	Dysentery, urinary complaints and ulcers
45	*Tamarindus indica* L.	Caesalpiniaceae	Bark, seed and flowers	Opthalmia, eye diseases and vaginal discharge
46	*Tectona grandis* L. f	Verbinaceae	Root and leaves	Inflammations, dyspepsia and flatulence
47	*Terminalia catappa* L.	Combretaceae	Fruits and bark	Piles, dyspepsia and eye diseases
48	*Thevetia peruviana (*Pers.) Merr.	Apocynaceae	Root, leaves and seeds	Tumors, purgative and abortifacient
49	*Toddalia asiatica* (L.) Lam	Rutaceae	Leaves and root	Diarrhoea, fever and rheumatism
50	*Tragia involucrate* L.	Euphorbiaceae	Whole plant	Hypodermic, diuretic and sterility
51	*Tribulus terrestris* L.	Zygophylaceae	Leaves and root	Gonorrhoea and increase menstrual flow
52	*Tridax procumbens* L.	Asteraceae	Whole plant	Skin diseases and elephantiasis
53	*Vitex negundo* L.	Verbinaceae	Whole plant	Asthma, epilepsy and piles
54	*Zornia diphylla* (L.) Perse	Fabaceae	Whole plant	Dysentery and inflammation

These collected medicinal plants are used for the treatment of several diseases like ulcers, leprosy, measles, gonorrhea, jaundice, chicken pox diarrhea, piles, headache, elephantiasis, dropsy, rheumatism, diabetes and skin diseases. The most represented families are Fabaceae (10) followed by Euphorbiaceae (7 species), Laminaceae and Apocyanaceae (4 species each) and Asclepidaceae, Cucurbitaceae, Myrtaceae, Rubaceae and Verbinaceae (2 species).

Percentage of families are given in Table- 2 and depicted in Fig. 1.

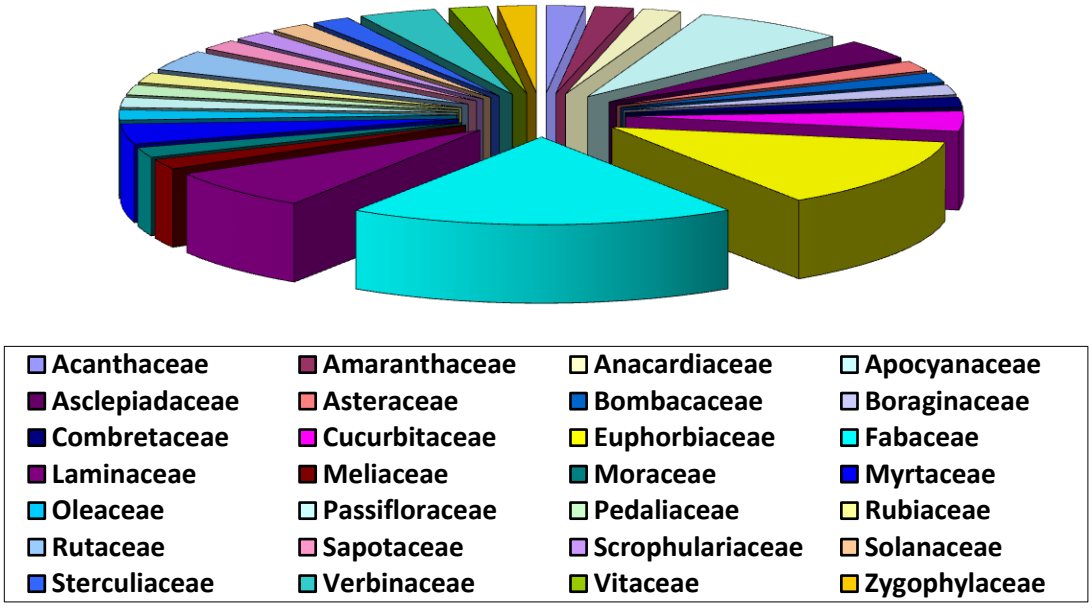

Fig. 1: Distribution of medicinal plants

Table- 2: Percentage of families

Family	Percentage
Acanthaceae	1.84
Amaranthaceae	1.84
Anacardiaceae	1.84
Apocyanaceae	7.36
Asclepidaceae	3.7
Asteraceae	1.84
Bombacaceae	1.84
Boraginaceae	1.84
Combretaceae	1.84
Cucurbitaceae	3.7
Euphorbiaceae	12.88
Fabaceae	18.44
Laminaceae	7.4
Meliaceae	1.84
Moraceae	1.84
Myrtaceae	3.7
Oleaceae	1.84
Passifloraceae	1.84
Pedaliaceae	1.84
Rubiaceae	1.84
Rutaceae	3.7
Sapotaceae	1.84
Scrophulariaceae	1.84
Solanaceae	1.84
Sterculiaceae	1.84
Verbinaceae	3.7
Vitaceae	1.84
Zygophylaceae	1.84

Some plants like *Achyranthes aspera, Euphorbia heterophylla, Heliotropium indicum, Hyptis suaveolens, Jatropha glandulifera, Psidium guajava, Toddalia asiatica* and *Vitex negundo* are used in the treatment of Rheumatism. Plants like *Bauhinia variegata, Crotolaria retina, Helicterus isora, Ixora coccinea, Mimusops elengi, Parkinsonia aculeate Jatropha curcas* and *Toddalia asiatica* are used for Diarrohoea. *Acalypha indica, Cassia tora, Hyptis suaveolens* and *Passiflora foetida* are used in the treatment of skin diseases. Similarly *Adhatoda zeylanica, Azadirachta indica* and *Phyllanthus emblica* are used for Jaundice. In addition to this, some plants like *Catharanthus roseus, Ficus bengalensis* and *Gymnema sylvestre* are used to cure diabetes.The Phytochemical constituents and medicinal properties of most of the medicinal plants were recorded in the last few decades by a number of workers (Nandakerni, 1976; Joshi, 2000; Nudrat and Usha, 2005).A large number of medicinal plants of great commercial value grow spontaneously in the forests. Forestry plays an important role in the economy of the district. However, the collection of medicinal plants should preferably be done in a planned and systematic manner through experts in government organizations. So that herbal wealth is not overexploited. Due to unscientific collection and over exploitation, many of the medicinal plants are on the verge of extinction in the study area.

All the forest based medicinal herbs can be cultivated in congenial agro-climatic conditions under the guidance of technical experts. Public and private involvement in management and utilization of medicinal plants in sustainable way is essential to combat human pressures on these valuable natural resources. Encouraging people to grow medicinal plants in home gardens and mixing with crops in farmlands are important.

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Evaluation of nutritive value of local fishes in Wani region, Dist. Yavatmal, (Maharashtra state)

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Abstract

In the present investigation an attempt has been made to evaluate nutritive values of local fishes available in Wani area from Nirguda river and Wardha river. The present study was carried out during the period of Nov. 2008 to Oct. 2009. During study the survey, collection, identification and biochemical analysis of local fishes was done.The results of present study showed that all the fishes were rich in protein content, maximum protein content found in *Anguilla bengalensis* 29.34 % and minimum found in *Punctius curmuca* 10.34 %. Lipid contents of fishes were low and varied from 1.23 % in *Rasbora daniconius* to 6.54 % in *Heteropneustes fossilis* Glycogen content of fishes were negligible and varies from 0.11 % in *Ostebrama cotio* to 0.090% in *Cyprinus carpio.*

***Keywords**: Biochemical analysis, Wardha river, Nirguda river, local fishes. protein, lipid, carbohydrate.*

Introduction

Malnutrition is a big problem in many developing countries. While, deficiencies of vitamin A, iron, iodine and other micronutrients are of great concern of public health all over the world. Their consequences include nutritional blindness, poor learning capabilities, poor growth and increased morbidity and mortality rates. Development and agricultural program including fisheries and aquaculture which is mainstream nutrition issues can go a long way in alleviating the problem of malnutrition in poor countries, (Chilama, 2003).

India can now claim to be self-sufficient in rice and wheat. However, these achievements do not mean that the problem of chronic malnutrition has been solved. To cope up with the challenges of malnutrition in developing countries fisheries can play a vital role in augmenting food supply and raising nutritional level. Fish is a rich source of proteins, fats, vitamins (A, B and D), and minerals such as iron, calcium, zinc, iodine, phosphorus, selenium, fluorine, copper and magnesium. Fish bones can be used as calcium supplements for human consumption (Phira *et al.*, 2006). Fish roes (eggs) were rich in phosphorous, iron and calcium contents and can be used for making pickles (Balaswamy 2009). Fish manure tended to have a higher content of Mn, Cd, Cr, Pb. Fe and Zn than most other livestock manure. In India potential of fish culture is yet to be fully explored and exploited. Fishes being rich source of proteins and have high nutritive value, the biochemical analysis is very essential to evaluate nutritive values of locally available small indigenous fishes having less commercial values and used by poor communities. In present study the biochemical analysis of fishes in Wani area was done to evaluate nutritional value of local fishes.

There is a wealth of literature available on biochemical composition of various fish species (Balaswamy et al. 2009; Balaswamy et al., 2007; Ismail, 2007; Kamal et al., 2007; Balaswamy et al., 2006; Al-Habib, 1990; Kent, 1987; Weatherly and Gill, 1987. etc.

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Material and Methods

For the present study two water bodies includes Wardha river and Nirguda river in Wani area was selected for fish collection. Wani is located at co-ordinates $20^0$07' N latitudes and $78^0$95' E longitude, at 228 m AMSL (Above mean sea level).

The two spots on Wardha river and two spots on Nirguda river were selected where fishing activities were frequently carried out. Fishes were collected from these selected spots with the help of local fishermen and also from local fish markets. Fish collection was done during the period from November 2008 to October 2009 twice in every month. Fishes were identified up to the species level with the help of standard keys and book, (Day, 1967; Qureshi and Qureshi, 1983; Jhingran, 1997; Daniels, 2002 and Gupta and Gupta, 2006). Immediately after fish collection, photographs were taken with the help of digital camera, on graph paper to know the measurement of fish.

To prepare the sample for the biochemical analysis, the fishes were washed thoroughly with tap water and kept in a slanting position in a tray to remove water. Only the edible portions such as muscles were taken for the experiment. Samples were macerated with tissue homogenizer and used for investigation.

Protein contents were determined by using Lowry, *et al.*, (1951) method. Lipid contents were determined by using Bligh and Dyer, (1959) method. And glycogen contents were determined by Montgomery, (1957) method.

Results and Discussion

The present investigation deals with biochemical composition of fishes, protein, lipids and glycogen, with an object of understanding the nutritive value of local fishes (Table-I).

Protein Contents

All fishes were found to be rich source of protein. The maximum and minimum protein contents of muscle among the thirty seven species were 29.74% in *Anguilla* bengalensis and 10.34 % in *Punctius curmuca*. Higher protein contents were found in *Lebeo rohita* 22.21% , *Cyprinus carpio* 21.32%, *L. calbasu* 21.23%, *Channa punctatus* 21.34%., *C. striatus* 21.54% and *Barlilius barna* 19.80%; whereas lower values were found in *Rasbora daniconius* 10.63%, *Punctius sarana* 10.44% *P. ticto* 11.83%, *P. sophor* 10.73% and *Salmostoma bacaila* 11.63%.

Lipid contents:

In the present study, the lipid content of muscles among the thirty seven species varies from 1.23% in *Rasbra daniconius* to 6.54% in *Heteropneustes fossilis*. Higher lipid contents were found in *Labeo rohita* 5.22%, *Cirrhinus mrigala* 4.62%, *L. calbasa* 4.84, *Rita rita* 4.21, *Calarius batrachus* 4.32% , *Channa punctatus* 4.63%, *C. striatus* 4.61% and *Nandus nandus* 5.39%. While lower lipid contents were found in *Barilius barna* 1.61%, *Cyprinus bendelinsis* 1.34%, *Punctius sarana* 1.85%, *P. sophore* 1.84%, *P. ticto* 1.31, *P. curmuca* 1.48%, *P. amphibius* 1.63%, *Garra mullaya* 1.91%, *Ompok bimaculatus* 1.66%, *O. pobo* 1.42% and *Wallago attu* 1.91%.

Glycogen contents:

In present investigation, glycogen contents of muscle among all the thirty seven species were found negligible and varies from 0.011% in *Osteobrama cotio* to 0.090% in *Cirrhinus carpio*. Higher glycogen contents were found in Mystus *seenghala 0.085%, Cirrhinus mrigala* 0.078%, *Catla catla* 0.076%, *Anguilla bengalensis* 0.076%, *Heteropneustus fossilis* 0.075% and *Punctius curmuca* and *P. amphibius* 0.074%. Whereas lower glycogen contents were found in *Tilapia mossambicus* 0.013%, *Mastacembelus armatus* 0.018%, *Wallago attu* 0.019% and *Rita rita* 0.019%.

The results of present study showed that all the fishes were rich in protein content, maximumu protein content found in *Anguilla bengalensis* 29.34 % and minimum found in *Punctius curmuca* 10.34 %. Lipid contents of fishes were low and varied from 1.23 % in *Rasbora daniconius* to 6.54 % in *Heteropneustes fossilis* Glycogen content of fishes were negligible and varies from 0.11 % in *Ostebrama cotio* to 0.090% in *Cyprinus carpio.*

The present investigation deals with biochemical composition of fishes, protein, lipids and glycogen, with an object of understanding the nutritive value of local fishes. These results were in good agreement with previous works of Rahman *et al.*, (1994); Hossain *et al.*, (1999) and Kamal, (2007). These results also nearly similar to FAO, (1991).

Table-I: Body composition of fishes in Wani area

S.N.	Scientific Name	Local Name	Protein %	Lipid %	Glycogen %
1	*Notopterus notopterus*	Patola	17.43	3.87	0.023
2	*Anguilla bengalensis*	Tambu	29.74	3.34	0.076
3	*Salmostoma bacaila*	Chal	11.63	1.82	0.046
4	*Barilius barna*	Batri	19.80	1.61	0.066
5	*Cyprinus bendelisis*	Zora	13.34	1.34	0.034
6	*Rasbora daniconius*	Gana	10.63	1.23	0.026
7	*Cyprinus mola*	Nawari	19.70	2.44	0.058
8	*Osteobrama cotio*	Bhondu	11.90	2.21	0.011
9	*Punctius dorsalis*	Kodsi	12.63	2.76	0.039
10	*Punctius sarana*	Karwadi	10.44	1.85	0.032
11	*Punctius sophore*	Karwadi	10.73	1.84	0.037
12	*Punctius ticto*	Tepri	11.83	1.31	0.036
13	*Punctius curmuca*	Bhurungi	10.34	1.48	0.074
14	*Punctius amphibius*	Ghuruti	16.46	1.63	0.074
15	*Garra mullaya*	Mahir	17.82	1.91	0.044
16	*Cirrhinus mrigala*	Mrigal	19.37	4.62	0.078
17	*Catla catla*	Katla	18.62	3.25	0.076
18	*Labeo calbasa*	Karoti	21.23	4.84	0.048
19	*Labeo rohita*	Rohu	22.21	5.22	0.059
20	*Cyprinus carpio*	Cipla	21.32	3.96	0.090
21	*Rita rita*	Bhokni	14.61	4.21	0.019
22	*Mystus cavasius*	Katwa	13.12	3.84	0.021
23	*Mystus seenghala*	Singat	17.75	3.45	0.085
24	*Ompok bimaculatus*	Barangi	14.84	1.66	0.023
25	*Ompok pobo*	Waddi	13.92	1.42	0.021
26	*Wallago attu*	Sawda	15.65	1.91	0.019
27	*Clarias batrachus*	Mangur	16.31	4.32	0.063
28	*Heteropneustes fossilis*	Ingur	18.34	6.54	0.075
29	*Xenetodon cancilla*	Chocha	15.26	2.93	0.022
30	*Ambasis nama*	Zanjad	16.81	2.56	0.038
31	*Ambasis ranga*	zanjad	16.22	2.37	0.042
32	*Nandus nandus*	Dukkar	13.61	5.39	0.024
33	*Tilapia mossambicus*	Telabi	16.47	2.31	0.013
34	*Glossogobius girus*	Kaddu	15.53	2.33	0.066
35	*Channa punctatus*	Mallar	21.34	4.63	0.044
36	*Channa striatus*	Dhadak	21.54	4.61	0.064
37	*Mastacembelus armatus*	Bamb.	18.51	3.92	0.018

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Ontogeny of feeding and digestive system in cobitidian fish *Noemacheilus montanus* (McClelland)

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Abstract

Noemacheilus montanus **is a bottom feeder water tracer fish of Himalayan region. The fish moves within the minute water capillaries in the mountain region and inhabited in small tributaries of hill stream. The incubation period spanned over 40-45 hour. After 1st day post-hatching the mouth was opened and upper and lower lips were distinguished. By second day post hatching taste buds were developed on both the lips. The larvae show rudiments of barbels on second day and which continue to grow and by 5th day post hatching these acquire slender and long shapes with many taste buds scattered all over the surface. The large numbers of taste buds secrete huge amount of mucous which is morpho-ecological adaptation in these larvae for movement as well as this protect the larvae in their habited zone. Various taste buds are also located on the upper and lower lips which are heterogeneous in shape. These taste buds greatly help this loach to locate the food and render this fish with carni-omnivorous habit enabling them to be the scavengers of the water body where they live. The pharyngeal region was distinguished from the buccal cavity by the development of the gill structure evident by 1st days post-hatch which are also having a large number of taste buds and mucous cells. These are helpful to take movement as well as respiration in the environment having less amount of water.**

Keywords*: Ontogeny, taste buds, mucous cells, buccopharynx, hatching*

Introduction

Fishes are the dominating vertebrate group as far as number of species is concerned and in their immense variety have adopted many nutritional habits. Some species are extremely specialized in their feeding habits while others are omnivorous. The alimentary tract of teleostean fish has been studied widely and described morphologically, to determine the function of many specialized anatomical structures in relation to the different feeding adaptations (Hirji, 1983; Rombout et al., 1983; Loewe and Eckmann, 1988). The alimentary canal in a teleost is composed of "Kopfdarm" (mouth, buccal cavity and pharynx) and "Rumpfdarm" (remainder of the alimentary canal), the latter is efficiently equipped with sphincters and valves at various regional junctions. The mouth, buccal cavity and the pharynx are associated with the selection, seizure, orientation and predigestive preparation of the food. The form and position of the mouth, dentition on the jaws and in the buccopharynx and the gill rakers show a close relation with the mode of feeding and the kind of food (Al-Hussaini, 1947b; and Kapoor et al., 1975b).The buccal cavity and pharynx in fishes form single unit of structure and function, therefore, it is termed as "buccopharynx". The other organs like lips and barbels are the associated parts of the buccopharyngeal region. The barbels which are the house of taste buds act as taster to locate the food material while the lips help to scrap the food items from the bottom or substratum of the environment (Singh *et al*., 1993; Bahuguna and Maithani, 2005). Taste buds are the peripheral sensory organs of the gustatory system. Although not directly involved with the digestion and absorption of food, buccopharynx affect the processing and transport of food. At yolk absorption, the buccopharynx is lined with squamus epithelium along with scattered mucus cells and taste buds (Govoni, 1980). In relation to changes in the diets of fish larvae, taste

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buds become more numerous and functional as larvae grow (Twongo and MacCrimmon 1977,). Teeth develop in the areolar connective tissue underlying the buccopharyngeal epithelium, subsequently erupting during the larva period (Twongo and MacCrimmon 1977, Govoni 1980).

Many workers have done enormous work on the ontogenetic development of the digestive tract including the buccopharynx in many fishes viz., Boulhic and Gabaudan (1992), Baglole *et al*. (1997), Green and McCormick (2001), Unal *et al.* (1999), Ostaszewska and Wegiel (2002), Gisbert *et al.* (1999, 2004), Pena *et al*. (2003), Makrakis *et al.* (2005), Abol Munafi *et al*.(2006).

N. montanus is a vermiform cobitid usually worm-shaped, long and thin having a ventrally placed, bottom facing mouth encircled with barbels. The mouth is well suited for its scavenging benthic lifestyle. *N. montanus* is carni- omnivorous in its feeding habitat (Singh and Bahuguna, 1983) and hence acts as a scavenger in the aquatic environment. It is not very picky about its food. In the present study the development of the anterior portion of the digestive tract in *N. montanus* larvae i.e the buccopharynx and the associated organs like lips, barbels, teeth and of course a brief account of respiratory organ, the gills have been studied.

Material and Methods

Noemacheilus montanus breeds naturally once in a year during the months of August and September. The brooders of *N. montanus* were collected from River Alaknanda and its tributaries. They were released in three different tanks in the hatchery where they spawn naturally by providing sandy bottom. A constant flow of water current was also maintained in these tanks. The brooders spawn within 2-3 days. After spawning the brooders were carefully removed and shifted to another tank. The fertilized eggs were transferred to the flour sieves which were made to float in the glass aquariums properly aerated and kept in air- conditioned laboratory. The fertilized eggs and the subsequent developing embryos were photographed in live condition with the help of photo micro system (Olympus CX41) in different magnifications to study the morphological development of the fish. The larvae hatching were started after 40 hrs of fertilization. After hatching, the observations were made, daily, until the larvae reached post flexion stage. The newly hatched larvae were fixed in different fixatives viz. Bouin's fluid (aqueous and alcoholic), calcium formol, 70% alcohol and 4% formalin taking a time interval of 4-8 hours till post flexion stage for carrying out histological evaluations. The samples are kept in fixative for about 18-24 hours and then washed in 70% alcohol until no more colour comes away. The samples were then preserved in 70% alcohol for further processes. After removal of fixative samples were dehydrated by using alcoholic series. After dehydrating, clearing was done in order to remove the dehydrating agent from the larvae. This was accomplished by use of xylene. The cleared samples were soaked in molten wax (E Merck Histo Paraffin Wax, 54-56 ^{0}C melting point) long enough to ensure that they were completely impregnated. Now the wax impregnated samples were embedded in wax blocks made with the help of thick L-shaped metal pieces. The tissue blocks were trimmed to the correct shape and attached to the object holder of the microtome. Now the attached blocks were cut into ribbons of sections of 5-6 µ thickness (both transverse and longitudinal sections) with the help of an Erma rotary microtome (Japan). A thin smear of Mayer's albumen was applied on clean slide for adhering the sections of the slide and then the ribbon of sections were put on these slides. Water was applied over these and then the slides were warmed on a hot plate (35-40 ^{0}C) in order to flatten the sections.The flattened and dried sections were first freed from wax by immersing them in two successive jars of xylene for 5-10 minutes each. Now staining was done and the methods given by Gray (1964), Taylor (1967), Pearse (1975) and Kaji *et al.* (1996) was followed. The slides were stained in Ehrlich's acid alum haematoxylin and Eosin stain (Double staining), Mallory's triple staining, Heidenhain's iron haematoxylin, Mercuric bromophenol blue, PAS reagent. The stained slides were again dehydrated in graded alcohol series, cleared in xylene and drained. Now DPX was used as a mountant and dropped liberally over the sections which were then covered with the help of suitable sized cover slips. The prepared slides were then

examined under the Olympus PM-6, PM-10 and CX 41 microscopes and photographed at varying magnifications for histological study of the desired organs.

Results and Discussion

In the present study the development of the buccopharynx and also the associated parts like lips, barbels and teeth in the larvae of *N. montanus* from pre to post flexion stage has been studied and the results are stated as follows.

Lips: In newly hatched larvae the digestive system was still not differentiated. After 1st day post hatching the mouth was opened and upper and lower lips were distinguished. By second day post hatching taste buds were developed on both the lips (Fig 4 and 5). The transverse section showed that the lips had an epidermis and a dermis layer.

Barbels: Barbels showed their appearance on the 2nd day post hatching in the form of rudimentary outgrowths (Fig 2 and 3). Thereafter as the fish grew the barbels increase in length and also the number of taste buds increased on their surface. Three pairs of barbels were present in the *N. montanus* fish. Histology of the barbels showed that they were composed of epidermis and dermis. The dermis was composed of polygonal oval cells which were compactly arranged (Fig 6 and 7). The barbel's epithelium was containing many taste buds exhibiting their gustatory function.

Buccal Cavity: A small buccopharyngeal cavity appeared on the first day of hatching (Fig 1). The mouth showed opening by day 1st after hatching. The buccal cavity was composed of simple squamus epithelium. By day 2 post hatching the fish larvae developed taste buds in the buccal cavity (Fig 3 and 5). A few goblet cells were also seen interdispersed within the epithelium (Fig 5). Oral valves were present on the day 3 post hatching and were defined by dorsal and ventral epithelial folds that were evaginations of connective tissue. They were also composed of simple squamus epithelium .Teeth started to develop on upper and the lower jaw by day three. The shape of the teeth in this fish larva was broad with a sharp cutting edge. On day 5 post hatching, three pairs of teeth were seen on the lower jaw and five pairs were present on the upper jaw (Fig 8). The number increased as the larvae grew further. The numerosity of taste buds and mucus cells on the buccal epithelium increased progressively with the development of the fish larvae. No stratification of the oral mucosa was seen till the post flexion stage.

Pharynx: The pharyngeal region was distinguished from the buccal cavity by the development of the gill structure evident by 1st days post-hatch (Fig 1). By day 2 post hatch the taste buds and mucus cells were seen in the pharyngeal epithelium on the roof of pharynx as well as the gill arch. Taste bud cellular components included marginal cells, light receptor cells, dark receptor cells, and basal cells. These were identical in all taste buds. On the day 5 post hatching pharyngeal teeth appeared in the post gill region in the larvae of *N. montanus* (Fig 8). The teeth were of same structure and type as seen in the buccal cavity. The gill rakers showed development from pre to post flexion stage. They were unadorned and stubby at this stage.

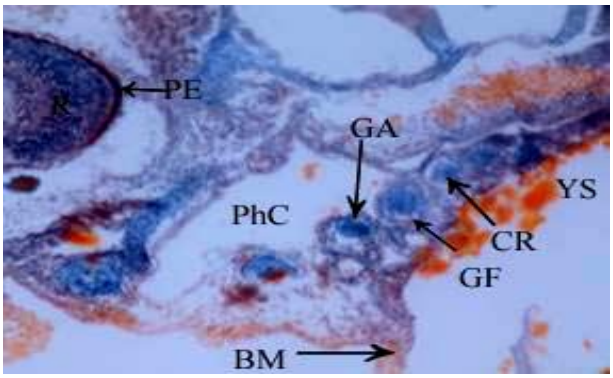

Fig 1: L.S. of 1 dph larva through the head region showing pharyngeal cavity, rudimentary gills, basal membrane and the pigmented retina (400X).

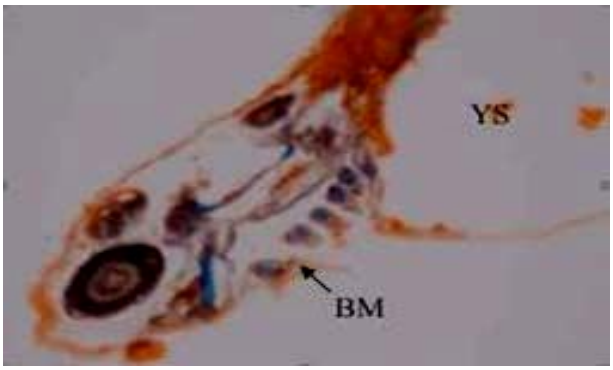

Fig 2: L.S. of 2 dph larva through the anterior half of the body (100X).

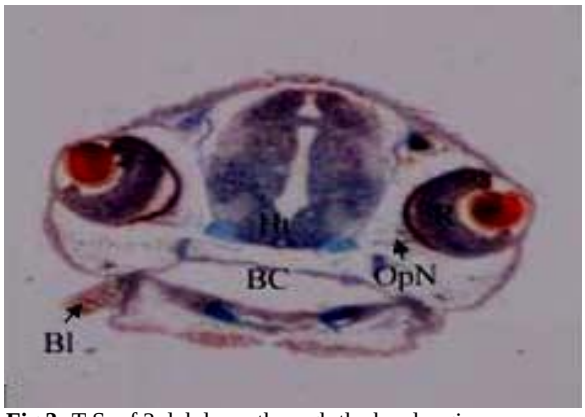

Fig 3: T.S. of 2 dph larva through the head region showing the barbel, buccal cavity, eyes and optic nerve (40X).

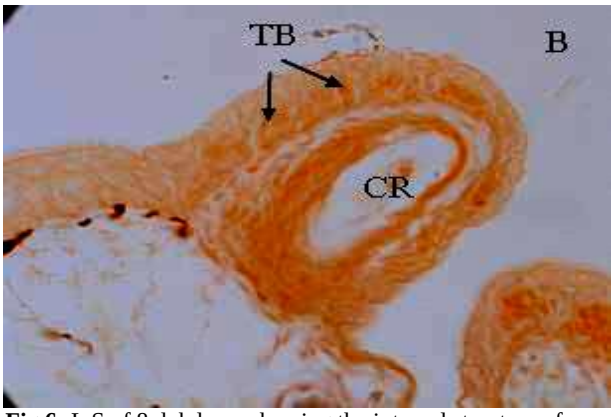

Fig 6: L.S of 8 dph larva showing the internal structure of barbel which possess numerous taste buds (1000X)

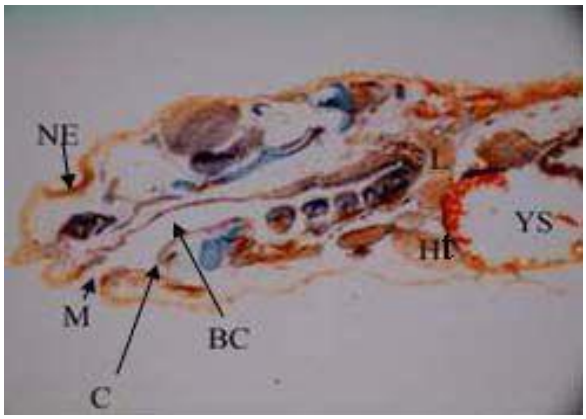

Fig 4: L.S. of 2 dph larva through the anterior half of the body showing the nasal epithelium,buccopharyngeal cavity, heart and brain (100X)

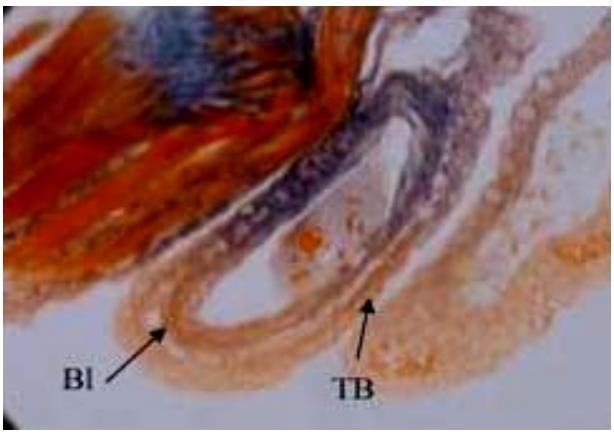

Fig 7: L.S of 9 dph larva showing taste buds on barbel and internal cartilage rod (1000X)

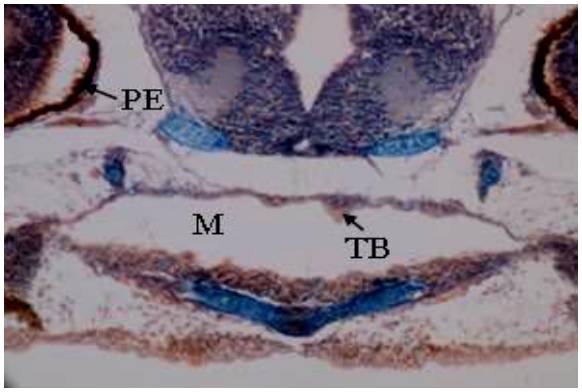

Fig 5: T.S. of 2 dph larva showing the taste buds in buccal Region (400X)

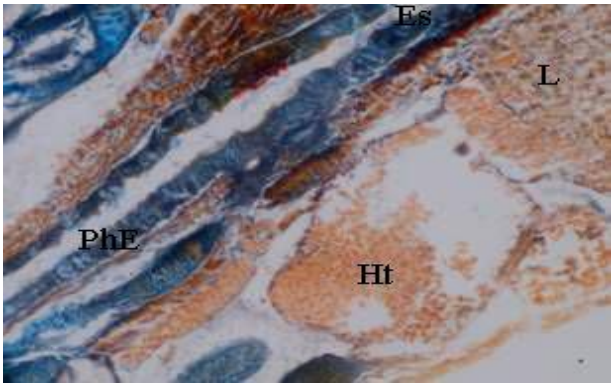

Fig 8: L.S of 5 dph larva showing the pharyngeal teeth and liver (400X)

B=Barbel; BC=Buccal Cavity; BM=Basal Membrane; Br=Brain; C=Capatulum (Valve); CR=Cartilaginous Rod; GA=Gill Arch; GF=Gill Filament; Ht=Heart; L=Liver; M=Mouth; NE =Nasal epithelium; OpN=Optic Nerve; Ph=Pharynx; PhC=Pharyngeal Cavity; PhE=Pharyngeal Epithelium; PE=Pigment Epithelium; TB=Taste Bud; YS=Yolk Sac.

The lips are the primary food procuring organs. They assume different forms in different fishes and may be also adhesive in some teleosts (Kapoor *et al.*, 1975b; Kapoor and Khanna, 1994). In *N. montanus* larvae, mouth was ventrally placed that shows its bottom dwelling habit**.** The lips did not develop any adhesive pad till the post flexion stage which suggests that the larvae till this period stays in the slow current area or shallow river water.

Three pairs of barbels were present in the larvae of *N. montanus* and their histology showed that they were well equipped with taste buds. The taste buds are the peripheral sense organs of the gustatory system. In fishes, they enable the animal to identify food by detecting distinct chemical substances on a short distance (Kasumyan, 1997). The presence of taste buds thus signifies the role of gustation in feeding in this fish.

Outstanding among the obvious adaptations for feeding in fishes are the teeth. They are thought to have arisen from scales covering the lips. There is strong correlation among kind of dentition, feeding habits and food eaten. The teeth develop at an early stage in the *N. montanus* larvae at about day 3 post hatching that suggests its carnivore feeding habit. The teeth of the *N. montanus* larvae morphologically are intermediate between the hooked and shearing teeth which suggest that this fish is an omnivore.

Many freshwater and marine fishes are equipped with oral valves behind the lips (Gudger, 1946) whose surfaces are provided with taste buds (Kapoor, 1957b). In *N. montanus* larvae crescentric maxillary valve is present along the inner margin of upper lip which contains many taste buds. This connective tissue hanging increase the sensory surface of the buccal cavity and support the results as observed in some other fishes by Girgis (1932,1952a,b) and Subla (1970) etc.

Besides protecting the tender gill filaments from abrasion by ingested materials that are coarse in texture, gill rakers are also specialized in relation to food and feeding habits. They show marked structural correlation with the feeding mechanism of fishes (Iwai, 1964; Kapoor 1965a). The gill rakers in *N. montanus* larvae are well developed and are stubby and unadorned. Long gill rakers characterize the majority of bottom feeders which stir up the mud. Long gill rakers have also been reported in other bottom feeding fishes like *Mugil auratus* and *Upeneus barberinus* (Al- Hussaini, 1947b).

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Awareness of rural women of Punjab regarding pollution causing and environmentally safe waste disposal practices

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Abstract

Household waste disposal practices are main source of pollution. Rural folk dispose their waste in open areas due to lack of awareness about their consequences. Some practices were identified to check their awareness about these practices. The present study was conducted to find out the awareness regarding pollution causing and environmentally safe waste disposal practices in three regions of Punjab i.e. Majha, Malwa and Doaba. For this purpose, 240 rural women of district Gurdaspur, Hoshiarpur and Ludhiana were selected. Data were collected through interview schedule. The study findings revealed that large majority of respondents (91.67 per cent) were aware regarding open drainage of water is source of pollution followed by 87.33 per cent regarding burning of waste and plastic in open air causes pollution. Data regarding environmentally safe waste disposal practices showed that large majority of respondents were aware that selling of electrical waste (90%), disposal in closed container (87.08 %) and faecal matter disposal in *pakka* pits (80%) are safe disposal practices for environment. About eighty per cent of respondent had high level of awareness. Age, education, mass media exposure, family education and family size were significantly correlated with level of awareness. Although the women had awareness about pollution causing practices but they don't know the alternatives and management strategies to control pollution.

Keywords*: Awareness, waste disposal pollution causing practices, waste disposal environmentally safe practices, pollution*

Introduction

Rural people generally dispose the waste with the garbage that produces carcinogenic gases which are harmful for human health. Rural women burn the household waste and plastic materials inside their houses. They dispose plastic materials in garbage which is biggest pollutant of environment. Due to lack of awareness in homemakers they generally follow these practices which are dangerous to human health, environment and surrounding. Hence the present study was an attempt to find out the awareness of rural women regarding pollution causing and environmentally safe waste disposal practices with following objectives:

1. To identify the pollution causing and environ -mentally safe waste disposal practices.
2. To study the awareness of rural women regarding pollution causing and environmentally safe waste disposal practices.
3. To study the relationship between socio-personal profile and level of awareness.

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Materials and Methods

The study was conducted in three socio-cultural regions i.e. Majha, Malwa and Doaba of Punjab State. Three districts one from each region of Punjab were further selected. A sample of 240 women was drawn randomly from twelve villages by selecting twenty rural women from each village (four from each selected district). Keeping in mind the objectives of the study, an interview schedule was prepared for collection of information. To identify the major pollution causing practices and environmentally safe waste disposal practices, relevant literature and experts from Punjab Agricultural University, Ludhiana and Environment Pollution Control Board were consulted. The

collected data were analysed by using frequency, percentage and correlation coefficient.

Results and Discussion

Table 1 depicted that large majority of respondents (91.67 per cent) were aware regarding open drainage of water is source of pollution followed by 87.33 per cent regarding burning of waste and plastic in open air causes pollution. Data regarding environmentally safe waste disposal practices showed that large majority of respondents were aware that selling of electrical waste (90%), disposal in closed container (87.08 %) and faecal matter disposal in *pakka* pits (80%) are safe disposal practices for environment. Thirty six percentage of respondents was not aware that dumping and landfill method is harmless. These practices also got lowest mean score i.e. 0.63. Only one third of respondents were aware that open throwing of expired medicine cause pollution. The findings are in line with the research conducted by Israel (2007) found that people were aware about open burning of household waste pollute air and also affect their health. The findings were also supported by Kalana (2010) who reported the preferred method of electronic waste disposal by residents was sale and storage.

Table 1: Distribution of respondents according to their awareness regarding environmentally safe and pollution causing waste disposal practices (n=240)

Pollution causing practices	Awareness		Mean score	Rank
	Aware f (%)	Not aware f (%)		
Burning of waste products in open air pollutes air	212(88.33)	28(11.67)	0.88	3.5
Burning of plastic in open air produce toxic gases	211(87.92)	29(12.08)	0.88	3.5
Improper disposal of computers and laptops waste lead to environmental pollution	195(81.25)	45(18.75)	0.81	6.5
Expired medicine pharmaceuticals not disposed off properly produce toxins in environment	90(37.50)	150(62.5)	0.37	12
Open drainage of water is not good for health	220(91.67)	20(8.33)	0.92	1
Disposal of faecal matter in open drain or in fields is harmful for environment	195(81.25)	45(18.75)	0.81	6.5
Faecal matter disposal in *kaccha* pits pollutes for water and soil	188(78.33)	52(21.67)	0.78	9
Environmentally safe practices				
Faecal matter disposal in *pakka* pits is safe for environment	192(80)	48(20)	0.80	8
Disposal of waste in closed container is safe for environment	209(87.08)	31(12.92)	0.87	5
Dumping or landfill method is harmless	152(63.33)	88(36.67)	0.63	10
Separate disposal of organic waste from synthetic waste is safe for environment	147(61.25)	93(38.75)	0.61	11
Selling of electrical and other household wastes instead of dumping or throwing in garbage is safe practice	216(90)	24(10)	0.90	2

Table 2: Distribution of respondents according to their level of awareness regarding waste disposal practices (n=240)

Level of awareness	Frequency	Percentage
Low(0-4)	14	5.83
Medium(4-8)	36	15
High(>8)	190	79.17

Table 3 Relationship of various socio-personal characteristics with level of awareness (n=240)

Socio-personal characteristics	r-value
Age	0.179*
Education	0.328*
Respondents income	0.040 NS
Extension contacts	-0.002 NS
Mass media	0.242*
Family size	-0.119*
Family education	0.17*
Family income	0.073 NS

***5% level of significance, NS= non significant**

2 Level of awareness regarding waste disposal practices

The level of awareness was measured by assigning the one score to aware and zero to not aware response categories. Total scores of respondents were divided into three levels i.e. low, medium and high. Data in this respect was recorded in Table 2 reveled that 80 per cent respondents had high level of awareness regarding pollution causing waste disposal practices. Only 15 per cent respondent had medium level of awareness followed by 5.83 per cent low. It was observed by investigator that women were aware about wrong practices but they are practising all these practices because they don't know management strategies.

3 Relationship of various socio-personal characteristics with level of awareness

Data given in Table 3 revealed that age, education, mass media exposure and family education were positively and significantly correlated with awareness where as respondent's income, extension contacts and family income had no significant effect on awareness. Family size was negatively significant correlated with level of awareness.

Conclusion and Suggestions

Although women had awareness about pollution causing practices but they don't know the alternatives and management strategies to control pollution. Respondent age, education, mass media exposure and family education had positive and significant relationship with level of awareness. There is need to educate rural women regarding management of pollution causing waste disposal practices through different interventions. Mass media had positive and significant relationship with level of awareness. So, it is suggested that special attention should be paid by mass media planners to include more programmes and articles regarding environment pollution of these practices.

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Water quality assessment of Godavari river water at Nashik

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Abstract

Rivers are vital and vulnerable freshwater systems that are critical for the sustenance of aquatic life and also the main resource for domestic, industrial and agricultural purpose. Godavari is one of the sacred river rises near the Trimbakeshwar in the district of Nasik in the Indian state of Maharashtra. The river is approximately 1,465 km long and has a total catchment area of 31 mha. It flows in the eastward direction through the states of Maharashtra and joins the Bay of Bengal in Andhra Pradesh. Godavari river is under the serious threat as a result of the growing urbanization and industrialization and river water is used for irrigation, drinking and domestic purpose. Therefore the water quality of Godavari river was assessed by determining physico-chemical parameters like pH, temperature, conductivity, Total Dissolved Solids, Total Hardness, Dissolved oxygen, Biological oxygen demand, Chemical oxygen demand, Phosphates, Sulphates and heavy metals like Na, K, Fe, Pb at three locations S1, S2 and S3 during winter, summer and monsoon seasons in the year Nov. 2008 to Oct. 2010. The standard deviation and coefficient correlation of physico-chemical parameters was also calculated. The variations observed in physico-chemical parameters of Godavari river water during the study period may be due to increased influx of sewage, domestic and agricultural wastes which may vary from simple nutrients to toxic and hazardous substances thus making the river water unfit for drinking and domestic purpose.

Keywords*: Godavari river, water quality, physico-chemical parameters, standard devaiation, coefficient correlation*

Introduction

Water is one of the most precious resources on this universe for human habitation. Viewing the overall scenario of aquatic ecosystem, the rivers in India have been contaminated by biological, organic and inorganic pollutants. The pollution of river Godavari in India is more critical and severe as huge amount of pollution load discharged by bathing, washing of cloths and vehicles, sewage from municipality, garbage from vegetable market and mixing of cremation ash is directly with this water. This has resulted into the change in physic-chemical and biological characteristics of river water, make water unsuitable for drinking purpose, agricultural use, posing serious threat to survival of aquatic biota and thereby human beings. In the present investigation an attempt has been made to know the water quality of Godavari river at Nasik by evaluating the physico-chemical parameters being affected of wastes, sewage and industrial effluents which may be discharged into water body due to overpopulation, urbanization and industrialization.

Study Area

The Godavari River is one of the sacred rivers of central India, attracting pilgrims from all parts of the country. It has a total course of 1,412 km flows in eastward direction through the state of Maharashtra and joins Bay of Bengal in Andhra Pradesh. Nasik, a major industrial town situated at Latitude 19^0 – 33' and 20^0 – 53' North and Longitude 73^0 – 16' and 75^0 – 6' East is located in Northern Maharashtra on Western edge of the Deccan Plateau on the banks of the Godavari. Kumbha mela is held once in twelve years on the banks of the river. The Site selected for collecting water sample is S1-Someshwar, origin of river where water enters into the city, S2- Ramkund, a holy place where most of rituals are being performed also a place for human activities like bathing, washing, dumping of wastes take place,

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S3-Nasik Road is the exit point of river from the city.

Material and Methods

Water samples were collected from three sampling stations S1 to S3 of Godavari river in Nashik, once in a month during Nov. 2008 to Oct. 2010.The water quality has been assessed for three seasons i.e. winter, summer and monsoon. Collected water samples were stored in pre-cleaned one litre plastic containers. Once collected the water samples were immediately preserved and transported to the laboratory for physico-chemical analysis following the methods given by APHA (1989), Trivedy and Goel (1986).

Results and Discussion

Maintenance of healthy aquatic ecosystem depends upon the physico-chemical and biological characteristics. The physico-chemical parameters were measured and results were demonstrated by winter, summer and monsoon values, mean values and statistical evaluations i.e. standard deviation and coefficient co-relation was computed for two years at three sampling stations S1-S3 of Godavari River at Nasik. The results presented in table 1-4 reveal that quality of Godavari river water at different sampling stations is not same, showed seasonal variations may be due to anthropogenic activities, can lead to acceleration of process of eutrophication.Temperature is one of most important physical parameter which affects dissolved oxygen, rate of photosynthesis, physiological activities and distribution of biota. The mean temperature of water was found to be minimum 24.50^{o}C at station S1 (2008-09) and maximum 25.10^{o}C at station S3 (2009-10) during the study period. Bhalla *et al*.,(2006) observed similar findings. Temperature showed negative correlation with DO r=-.68 (2008-09) & r=-.67 (2009-10) and positive correlation with all other parameters which are presented in Table 3 & 4. The pH of water is an important indicator parameter to determine the degree of pollution. The mean value of pH ranged from minimum 8.49 at station S1 in (2008-09) to maximum 8.66 at station S3 (2009-10) during two years study period. The water was alkaline throughout the study period. Similar trend has been observed by Sharma *et al*., (2011). pH showed negative correlation with DO r=-.87 (2008-09) & r=-.86 (2009-10) and positive correlation with all other parameters which are presented in Table 3 & 4.

Conductivity is the measure of water ability to conduct electrical current and is influenced by dissolved salts present in water body. The mean values of conductivity ranged from minimum 270.03 μmho/cm at station S1 in (2008-09) to maximum 295.64 μmho/cm at station S3 in (2009-10). High conductivity values indicate a large quantity of dissolved mineral salts may be due to addition of minerals from rain water runoff and other discharges, thereby making water unsuitable for drinking purpose. Conductivity showed positive correlation with all parameters except DO as shown in Tables 3 & 4.

Total dissolved solids are the solids present in the dissolved state which increase turbidity and decreases photosynthesis, eutrophication, increases water temperature and low dissolved oxygen. The mean values of TDS found to be minimum 220.08 mg/lit at station S1 (2008-09) and maximum 248.30 mg/lit at station S3 (2009-10).Bhalla (2010) reported similar findings. TDS showed negative correlation with DO r=-.76 (2008-09) & r=-.74 (2009-10) as given in table 3 & 4.The hardness of water is due to presence of excessive calcium and magnesium. The hard water is unsuitable for domestic and industrial use as it forms scales in boiler reducing their efficiency. The mean value of TDS ranged from minimum 99.10mg/lit at station S1 in (2008-09) to maximum 124.08mg/lit at station S3 in (2009-10).The amount of hardness recorded in Godavari river at three stations during the study period is within desirable limits. TDS showed positive correlation with all parameters except DO as shown in Tables 3 & 4.Oxygen is essential for the metabolism of all aquatic aerobically respired biota. Dissolved oxygen in water indicates water quality and diversity of living things. The amount of dissolved oxygen is higher where there is good aquatic life. The mean values of DO found to be min. 220.08 mg/lit at station S1 (2008-09) and max.248.30 mg/lit at station S3 (2009-10). Bhalla and Sekhon showed the same results.The DO showed negative correlation with all other physicochemical parameters during two years study period as shown in tables 3- 4.

Table 1:Mean Seasonal Values and Standard deviation of physico-chemical parameters of Godavari River Water at Nasik during Nov. 2008- Oct. 2009

Stations	S1					S2					S3				
Parameters	**Win**	**Sum**	**Mon**	**Mean**	**S.D.**	**Win**	**Sum**	**Mon**	**Mean**	**S.D.**	**Win**	**Sum**	**Mon**	**Mean**	**S.D.**
pH	8.28	8.70	8.50	8.49	0.29	8.40	8.65	8.70	8.58	0.27	8.50	8.70	8.65	8.61	0.34
Temp.	20.10	28.50	24.90	24.50	3.44	20.50	29.10	25.90	25.16	3.59	20.50	29.20	25.60	25.10	3.56
Conductivity	230.80	322.48	290.15	281.14	37.99	235.50	332.18	301.87	289.73	40.55	242.62	336.17	308.14	295.64	39.22
TDS	174.35	290.39	230.15	231.63	47.38	188.54	301.15	252.75	247.48	46.12	196.52	305.60	242.80	248.30	44.73
TH	128.57	80.10	99.67	102.78	19.90	140.90	90.35	110.80	114.01	20.79	160.93	98.73	112.60	124.08	26.69
DO	8.00	4.35	6.15	6.16	1.51	7.20	4.85	5.58	5.87	1.02	8.40	4.20	5.10	5.23	3.27
BOD	3.50	11.40	11.90	8.93	3.85	3.70	11.80	11.70	9.06	3.81	3.95	11.90	12.10	9.31	3.81
COD	50.15	68.15	80.02	66.10	12.32	52.19	75.15	85.49	70.94	13.93	55.18	78.80	85.98	73.32	13.15
PO_4	0.87	1.60	1.00	1.15	0.34	0.93	1.68	1.09	1.23	0.33	1.01	1.90	1.10	1.33	0.42
SO_4	32.65	69.45	48.63	50.24	15.07	34.46	69.98	49.75	51.39	14.57	36.20	70.15	48.95	51.76	14.02
Sodium	2.10	3.50	3.00	2.86	0.61	2.30	3.10	2.80	2.73	0.35	2.58	3.50	3.10	3.06	0.37
Potassium	1.85	1.55	0.40	1.26	0.63	1.95	1.65	0.45	1.35	0.64	2.00	1.75	0.42	1.39	0.69
Iron	0.015	0.029	0.012	0.018	2.810	0.018	0.040	0.013	0.023	1.290	0.028	0.032	0.026	0.028	2.870
Lead	0.00	0.02	0.004	0.008	2.730	0.002	0.024	0.010	0.012	2.870	0.001	0.010	0.022	0.011	2.720

All parameters are in mg/l except temterature ^{o}C and conductivity µmhos/cm

Table 2:Mean Seasonal Values and Standard deviation of physico-chemical parameters of Godavari River Water at Nasik during Nov. 2009- Oct. 2010

Stations	S1					S2					S3				
Parameters	**Win**	**Sum**	**Mon**	**Mean**	**S.D.**	**Win**	**Sum**	**Mon**	**Mean**	**S.D.**	**Win**	**Sum**	**Mon**	**Mean**	**S.D.**
pH	8.40	8.60	8.55	8.51	0.34	8.50	8.70	8.65	8.61	0.34	8.55	8.75	8.70	8.68	0.35
Temp.	20.20	28.90	25.10	24.73	3.58	20.40	29.00	25.40	24.93	3.54	20.30	29.10	25.50	24.96	3.65
Conductivity	220.60	320.86	280.65	274.03	41.24	230.65	327.58	295.17	284.46	40.33	240.80	330.27	304.20	291.75	37.62
TDS	170.15	270.10	220.00	220.08	40.82	185.05	285.40	240.15	236.86	41.07	190.75	300.40	234.60	241.75	45.25
TH	130.25	70.60	96.45	99.10	24.42	138.60	85.65	104.75	109.66	21.92	149.15	90.35	110.85	116.78	24.38
DO	9.00	4.65	6.10	6.58	1.82	9.40	4.23	5.98	6.53	2.16	8.80	3.85	5.65	6.10	2.04
BOD	3.60	10.80	11.20	8.53	3.50	3.85	11.00	11.60	8.81	3.53	4.07	11.40	11.90	9.12	3.58
COD	48.85	67.82	76.17	64.28	11.43	50.63	70.02	80.45	67.03	12.37	54.25	70.80	78.06	67.70	9.98
PO_4	0.90	1.65	1.02	1.19	0.32	0.95	1.75	1.10	1.26	0.37	1.05	1.88	1.15	1.36	0.36
SO_4	30.80	60.18	40.55	43.83	12.21	33.15	63.65	42.65	46.48	12.75	35.80	68.95	45.10	49.95	13.96
Sodium	2.21	3.60	3.10	2.97	0.57	2.50	3.40	3.00	2.96	0.41	2.82	3.80	3.20	3.27	0.42
Potassium	1.90	1.45	0.36	1.23	0.43	2.00	1.60	0.40	1.33	0.47	1.95	1.40	0.36	1.23	0.45
Iron	0.014	0.030	0.010	0.018	2.730	0.018	0.035	0.015	0.022	0.030	0.025	0.029	0.020	0.024	2.140
Lead	0.000	0.023	0.005	0.009	1.010	0.003	0.025	0.013	0.013	3.140	0.002	0.010	0.020	0.010	2.600

All parameters are in mg/l except temterature ^{o}C and conductivity µmhos/cm

Table 3: Correlation coefficient of different physicochemical parameters at three stations (S1, S2, S3) of Godavari river at Nasik during Nov.2008-Oct.2009

Parameters	**pH**	**Temp**	**conduct**	**TDS**	**TH**	**DO**	**BOD**	**COD**	**PO_4**	**SO_4**	**Na**	**K**	**Fe**	**Pb**
pH	**1**													
Temp	0.94	1												
Conduct	.98	.87	1											
TDS	.98	.99	.93	1										
T H	.96	.83	.99	.90	1									
DO	-.87	-.68	-.94	-.76	-.97	1								
BOD	.89	.70	.95	.78	.97	-.99	1							
COD	.99	.91	.99	.95	.98	-.91	.93	1						
PO_4	.94	.78	.98	.85	.99	-.98	.99	.96	1					
SO_4	.99	.94	.98	.98	.96	-.87	.89	.99	.93	1				
Na	.35	.04	.51	.16	.57	-.75	.73	.43	.65	.34	1			
K	.99	.92	.99	.96	.98	-.90	.92	.99	.96	.99	.41	1		
Fe	.96	.82	.99	.88	.99	-.97	.98	.98	.99	.95	.60	.97	1	
Pb	.88	.98	.79	.95	.74	-.55	.58	.84	.67	.88	-.12	.85	.72	1

Table 4: Correlation coefficient of different physicochemical parameters at three stations (S1, S2, S3) of Godavari river at Nasik during Nov.2009-Oct.2010

Parameters	pH	Temp	conduct	TDS	TH	DO	BOD	COD	PO4	SO4	Na	K	Fe	Pb
pH	**1**													
Temp	0.95	1												
Conduct	.99	.95	1											
TDS	.97	.99	.97	1										
TH	.99	.95	.99	.98	1									
DO	-.86	-.67	-.86	-.74	-.85	1								
BOD	.99	.90	.99	.94	.99	-.92	1							
COD	.97	.99	.97	.99	.97	-.72	.93	1						
PO_4	.97	.87	.97	.91	.97	-.94	.99	.90	1					
SO_4	.98	.88	.98	.92	.98	-.93	.99	.91	.99	1				
Na	.79	.57	.79	.65	.78	-.99	.86	.62	.90	.88	1			
K	.10	.39	.10	.30	.11	.41	-.02	.33	-.10	-.07	-.52	1		
Fe	.99	.97	.99	.88	.99	-.81	.97	.98	.95	.96	.73	.18	1	
Pb	.78	.93	.78	.89	.79	-.36	.70	.91	.64	.66	.25	.69	.83	1

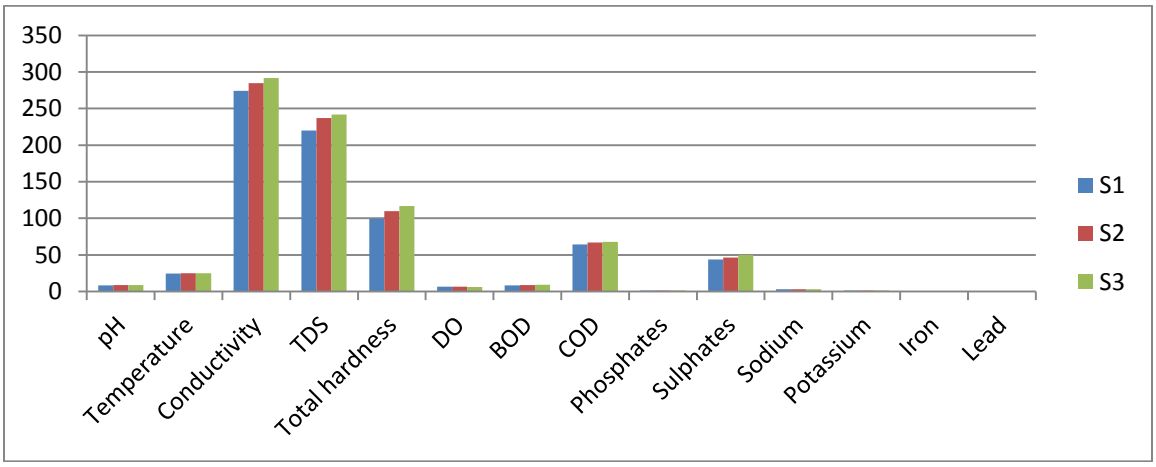

Fig.1 Mean variation of physico-chemical parameters at three stations (S1,S2,S3) of Godavari river at Nasik during Nov.2008-Oct.2009.

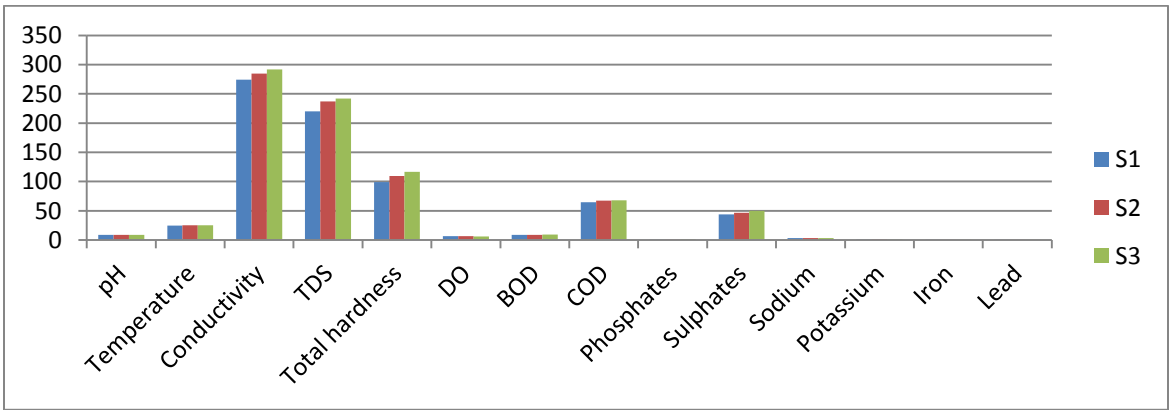

Fig.2 Mean variation of physico-chemical parameters at three stations (S1,S2,S3) of Godavari river at Nasik during Nov.2009-Oct.2010.

The amount of BOD determines the quantity of biodegradable organic matter present in an aquatic system and is direct measure of state of pollution. The mean values of BOD found to be minimum 8.53 mg/lit at station S1 (2008-09) and maximum 11.70 mg/lit at station S2 (2009-10) during the study period. BOD showed positive correlation with all parameters except DO as shown in Tables 3 & 4.Chemical Oxygen is the amount of oxygen consumed during chemical oxidation of organic matter. Higher values of COD may indicate pollution potential from domestic sewage and industrial effluents. The mean values of COD found to be minimum 64.28 mg/lit at station S1 (2008-09) and maximum 73.32 mg/lit at station S3 (2009-10) during the study period. Higher values at S3 may be due to accumulation of non-biodegradable compounds which might have a high potential of adverse health effects on human. Bhalla and Yadav (2010) have reported the similar findings. COD showed positive correlation with all parameters except DO as shown in Tables 3 & 4.Phosphorous is an essential nutrient to living organism, resulting in excess growth of phototrophs, depletion of dissolved oxygen, prime contribution for degradation of water quality, stimulating algal growth thus leading to eutrophication. The major sources of inorganic phosphorous are domestic sewage, industrial effluents and agricultural runoff, where phosphate containing fertilisers are used. In the present investigation the mean values of Phosphate found to be minimum 1.15 mg/lit at station S1 (2009-10) and maximum 1.36 mg/lit at station S3 (2008-09) during the study period. Bhalla *et al*., (2006) observed similar findings. Phosphates showed positive correlation with all parameters except DO as shown in Tables 3 & 4.

In the present investigation the mean values of Sulphates found to be minimum 43.83 mg/lit at station S1 (2008-09) and maximum 51.76 mg/lit at station S3 (2009-10) during the study period. Higher values recorded at station S2 and S3 can be attributed to the addition of sewage and industrial effluents into the river. Sulphates showed positive correlation with all parameters except DO as shown in Tables 3 & 4.Sodium and Potassium are two naturally occurring ions found in water. An increase in concentration of these two elements indicate man made contribution from irrigation and human wastes. The mean values of Sodium found to be minimum 2.86 mg/lit at station S1 (2009-10) and maximum 3.27 mg/lit at station S3 (2008-09) during the study period. Higher values encountered in the waters were due to sodium rich sewage effluent poured at sampling stations S2 and S3.Potassium occurs in rain water up to 0.1 mg/lit and up to few ppm in surface waters. High values of Potassium indicate man made pollution (Matthews and Harvey,1982). In the present investigation the mean values of Potassium found to be minimum 1.23 mg/lit at station S1 (2008-09) and maximum 1.39 mg/lit at station S3 (2009-10) during the study period. Maximum values observed at station S2 and S3 was due to pouring of domestic wastes in river water. Sodium and Potassium showed positive correlation with all parameters except DO as shown in Tables 3 & 4. Potassium also showed negative correlation with BOD (r=-.02), PO_4 (r=-.10), SO_4 (r=.07), Sodium (r--.52) during 2009-2010 as in table 4.

Heavy metals are the most important inorganic pollution parameters. Natural input of heavy metals due to pollution is of prime concern in urbanized areas. In the present investigation the mean values of Iron ranged to be minimum 0.018 mg/lit at station S1 (2008-09) and maximum 0.028 mg/lit at station S3 (2009-10) during the study period. More concentration of Iron at station S2 and S3 can be related to the discharge of sewage and industrial effluents. Iron though an essential element is discarded beyond 1 ppm due to bitter taste. It causes respiratory problems in fishes also unsuitable for washing purposes because high concentration may cause stains on the fabric. The mean values of Lead ranged to be minimum 0.008 mg/lit at station S1 (2008-09) and maximum 0.011 mg/lit at station S3 (2009-10) during the study period. The threshold value of WHO for lead is 0.05 mg/lit and our value does not exceed the threshold value in any of the season. Lead accumulation in the body damages neural and digestive system, blood circulation, kidney, lungs, glands and genital organs. Lead and Iron showed positive correlation with all parameters except DO as shown in Tables 3 & 4.

Conclusion

The variations in the physico-chemical parameter of Godavari river at Nasik indicate the disturbed balance of river may also affect the aquatic life may be due to continuous dumping of municipal sewage, domestic waste and agricultural runoff into the river water. Thus it is concluded that quality of river water is not satisfactory and is unsuitable for drinking purpose and other domestic uses and it is suggested that dumping of solid and liquid wastes without prior and proper treatment should be stopped. There is no change in the water quality during two years study period.

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Screening and Optimization of Extracellular Alkaline Protease Production from *Bacillus Spp*

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Abstract

Protease enzyme catalyzes the hydrolysis of protein. Among the various proteases, bacterial proteases are most significant when compared with animal and fungal proteases. In the present study a protease producing bacteria were isolated from soil collected from Govt. Holkar Science College, Indore campus and identified as Bacillus spp. They were grown within a temperature range between 25°C & 45 °C and pH range of 6.0 to 11.0. The optimum condition for protease production obtained was 35 °C at pH 9. The best carbon and organic nitrogen sources for this bacterial strain were fructose and yeast extract, respectively, while the most effective inorganic nitrogen sources was urea. It is envisaged that the isolate can be a potential source of alkaline protease for use as additive in industrial applications like detergent industry.

Keywords*: Alkaline protease, Bacillus sp, Screening*

Introduction

Proteases are the most important industrial enzymes that execute a wide variety of functions and have various important biotechnological applications (Mohen *et al*., 2005). They constitute two thirds of the total enzymes used in various industries and it account for at least a quarter of the total global enzyme production (Kumar *et al.,* 2002). These enzymes are used primarily in detergent additives, hence holding more than 50% of total enzyme market. Among bacteria, *Bacillus* spp. are specific producers of extracellular alkaline proteases (Godfray *et al.,* 1985). These enzymes occupy a pivotal position due to their wide application in food processing (Pastor *et al.,* 2001), pharmaceutical industries (Anwar and Saleemuddin, 1998; Gupta *et al.,* 2002), peptide synthesis (Kumar and Hiroshi, 1999), leather processing (George *et al.,* 1995) and in weaving processing (Helmann, 1995). Alkaline proteases occur widely in plants, animals and microorganisms.

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The inability of the plant and animal proteases to meet current world demands has led to an increased interest in microbial proteases (Kumar *et al.,* 2008). In addition, proteases from microbial sources are preferred to the enzymes from plant and animal sources, since they possess almost all characteristics desired for their biotechnological applications (Gouda , 2006). Alkaline proteases are produced by a wide range of microorganisms including bacteria, moulds and yeasts. In bacteria, this enzyme is produced mainly by many members belonging to genus *Bacillus* especially, *B. licheniformis, B. horikoshii, B. sphaericus, Bacillus furmis, Bacillus alcalophilus, Bacillus subtilis* (Ellaiah *et al.,* 2002).It is well established that extracellular protease production in microorganisms is greatly influenced by media components. Therefore, the effect of various carbon and nitrogen substrates, divalent metal ions, environmental and fermentation parameters were evaluated (Adinarayana and Ellaiah , 2002). The present investigation is aimed at optimization of growth conditions and other parameters which have been predicted to play a significant role in enhancing the production of alkaline proteases. For this, various parameters of nutritional and

environmental factors were tested and growth and protease activity were measured.

Material and Methods

Isolation: Soil samples were collected from college garden, Indore. One gram of soil was dissolved in 100 ml of distilled water. One ml of thoroughly mixed sample was used for serial dilution. The serially diluted samples were plated on basal medium of pH 8.5-11. The bacterial isolates were inoculated onto nutrient milk agar plates and incubated at 37^{o}C for 24 h. Proteolytic bacterial isolates showing zone of clearance was picked up, purified by repeated streaking on the same medium and finally transferred to nutrient milk agar slants and maintained at 4 °C.

Production media and culture conditions: The culture was grown in 250 ml of erlenmeyer flasks containing 100 ml medium consisting of glucose 1.5 g %, Urea 2.0 g %, KH_2PO_4 0.2 g %, K_2HPO_4 0.2 g %, $MgSO_4.7H_2O$ 0.1 g %, $CaCl_2$ 0.1g %, milk (Sanchi Shakti) 7.5% (v/v) for 24 h and inculated with loop full of 24 h old culture prepared in basal media. The pH of the media was adjusted to 9.0 and the supernatant were collected after centrifugation at 12,000 rpm for 10 minute as the crude enzyme source.

Protease assay: Proteolytic activity in the culture supernatant was determined by using the spectrophotometric method [Hagihara *et al.*,1958] with slight modification. 0.5ml of enzyme solution was incubated with 0.5 ml of 1% casein in glycine-NaOH buffer (0.2 M, pH 9) at 35 ^{o}C for 15 min and the reaction was terminated by the addition of 3 ml trichloroacetic acid (5%). The reaction mixture was allowed to stand for 15 minute. Tyrosine released was estimated using Folin Ciocalteau's Reagent. One unit of enzyme activity was defined as the amount of enzyme required to release 1 µmol of tyrosine/min/ml under standard assay conditions.

Optimization of temperature and pH:

The effect of temperature was determined by growing the isolate in production media at varied temperatures (25-45^{o}C). The effect of pH on protease production of the isolate P-2b was determined by growing the isolate in production media of different pH in the range of 6-11 using appropriate buffers, Tris-HCL buffer (pH 6.0–8.0), glycine-NaOH buffer (pH 9.0– 11). All the flasks were incubated at 35^{o}C for 24 hours. The resulting culture was subjected to centrifugation at 10,000 rpm, 4^{o}C for 15 minutes. Finally the protease activity was assayed.

Optimization of various carbon and Nitrogen sources

Effect of Carbon Sources: The sterilized production broth was prepared with Glycine-NaOH buffer (pH-9) with the various carbon sources like fructose, sucrose, lactose and maltose. These carbon sources were used to replace the carbon source available in the media. The isolate P-2b was inoculated into different carbon sources flasks and the flasks were incubated at 35^{o}C for 24 hours. The resulting culture was subjected to centrifugation at 10,000 rpm, 4^{o}C for 15 minutes. Finally the protease activity was assayed.

Effect of Nitrogen Sources: The sterilized production broth was prepared with Glycine-NaOH buffer (pH-9) with the various nitrogen sources like Peptone, Yeast extract, Ammonium Sulphate and Potassium nitrate. These nitrogen sources were used to replace the nitrogen source available in the media. The isolate P-2b was inoculated into different nitrogen sources flasks and the flasks were incubated at 35^{o}C for 24 hours. The resulting culture was subjected to centrifugation at 10,000 rpm, 4^{o}C for 15 minutes. Finally the protease activity was assayed.

Results and Discussion

The extracellular protease enzyme was synthesized by *Bacillus* sp. isolated from soil of Govt. Holkar Science College garden, Indore. The results obtained in the present study revealed the ability of collected *Bacillus* sp. to produce extracellular protease. *Bacillus* spp. usually produces extra cellular protease during late exponential phase (Ward, 1985). Different culture conditions were used to obtain the maximum levels of protease production by *Bacillus* spp. (Plate 1).

Effect of temperature and pH on growth and protease production: The effects of different incubation temperatures on protease production were evaluated. It is known that temperature is one of the most critical parameters that have to be controlled in bioprocess (Chi and Zhao, 2003). It is obvious from the results (Fig. 1) that 35 ^{o}C was generally more favourable for protease production.

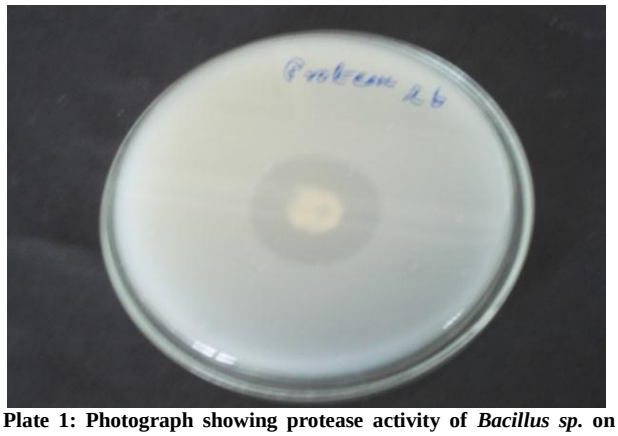
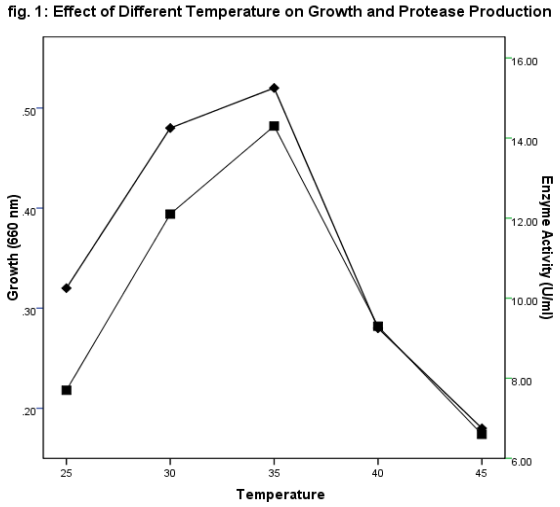
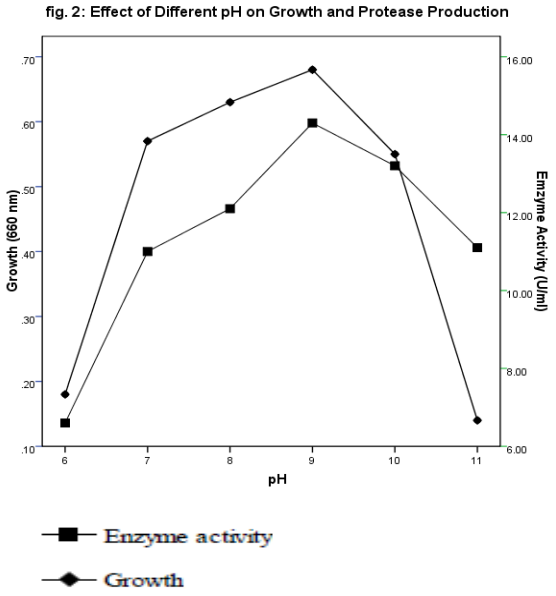


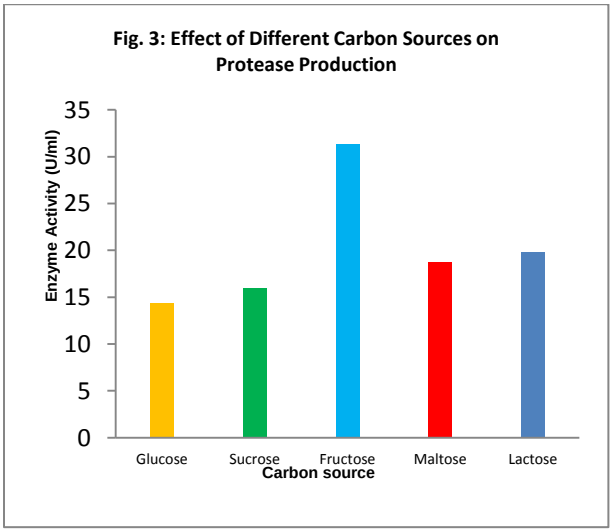
Plate 1: Photograph showing protease activity of *Bacillus sp.* on nutrient milk agar media



However, the temperature below or above 35 ºC resulted a sharp decrease in protease yield as compared to the optimal temperature. It has been noted that the important characteristic of most microorganisms is their strong dependence on the extracellular pH for cell growth and enzyme production (Kumar and Tagaki, 1999). The production medium was adjusted at different pH values of different buffers. The results of pH studies showed (Fig. 2) that the best buffer was Glycine-NaOH buffer with pH 9.0 for protease production. A notable decline in the enzyme productivity occurred at both higher and lower pH values.

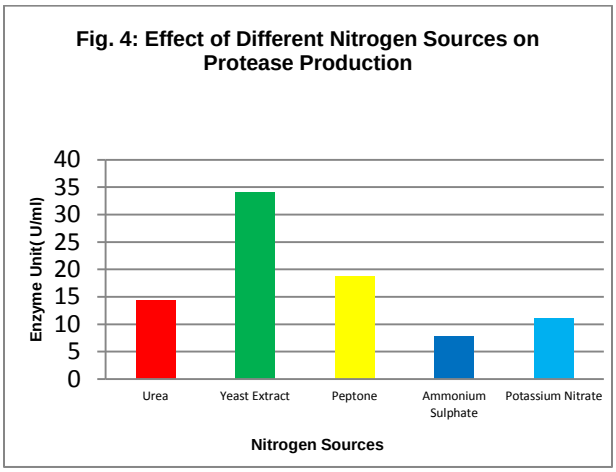
Effect of Carbon Source: Various sources of carbon such as fructose, lactose, maltose and sucrose were used to replace glucose which was original carbon source in production media. Results obtained showed that, fructose brought the highest protease production as compared to other carbon sources at 24 hrs of incubation (Fig 3). Hence, fructose was the best carbon source for protease production. Fructose has been reported as the best carbon source for alkaline protease production by *Bacillus licheniformis* S40 (Sen and Satyanarayana, 1993).





Effect of Nitrogen Source: Production of extracellular protease has been shown to be sensitive to repression by different carbon and nitrogen sources (Haulon *et al.*, 1982). The effect of nitrogen sources was studied in the production

medium, where urea was replaced with peptone, yeast extract, ammonium sulphate and potassium nitrate. Among various nitrogen sources tested, yeast extract found to be best nitrogen source for protease production (fig 4).



Conclusion

The media optimization is an important aspect to be considered in the development of fermentation technology to maintain a balance between the various medium components, thus minimizing the amount of unutilized components at the end of fermentation. However, particularly the *Bacillus* spp. are known for their ability to produce proteolytic enzymes with potential use in industries. In the present investigation we have determined the optimum parameter for maximum production of alkaline protease. The best carbon source for protease production was fructose while organic nitrogen sources were better for growth and enzyme production compared to inorganic ones.

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Studies on the ambient air quality status in the Industrial belt of Kashipur, Uttarakhand, India

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Abstract

Industrial activity in Kashipur area, Uttarakhand give rise in to significant level of pollutants in the atmosphere, which affect the quality of life in the industrial area. In the present study, air quality status has been monitored using the AAQSM procedure in the industrial area of Kashipur, Uttarakhand, India. During course of study 24 hr. average criteria pollutants such as sulfur dioxide, oxides of nitrogen, respirable suspended particulate matter and suspended particulate matter for 2011 at ten air quality monitoring stations were measured. All the ten air quality monitoring stations has been analysed against NAAQS for particulate matters (SPM & RMP), SO_2 and NO_x concentrations for monitoring period of 2011. Results of monitoring reflect that ambient air quality of all the stations are under prescribed limits. The study concluded that some area need immediate attention for its proper management to maintain ambient air quality further it is suggested that maintenance of unpaved roads is of utmost importance.

Keywords*: Vehicular pollution; traffic intersection; air quality index; air quality standard; health effects*

Introduction

India has experienced substantial increases in industrial growth and expansion in recent years. The industry has resulted in increased pollutant emissions and the deterioration of environmental quality and human health in major cities in India. After formation of Uttarakhand as a new State rapid industrialization and urbanization took place due to this there is great pressure on the environmental components. Kashipur is an old industrial town of Uttarakhand State, earlier belonging to Uttar Pradesh. This town experienced an industrialization way back in 1988 – 1989. Few major type of industries working in this area belongs to Distillery, Chemical, Paper and other small industries. After formation of Uttarakhand in the year 2000 and due to fiscal benefits various kinds of industries are coming up in this area, which includes paper, distillery, chemical and gas based thermal power. Specifically, pollutant concentrations near industrial sector major intersections and roadways in the city are exceeding the Indian national ambient air quality standards (NAAQS). Thus, users (motorists, pedestrians, residents etc.) in these corridors are exposed to pollution levels (Nagendra *et al.*, 2004). Exposure to vehicular air pollution directly affects respiratory, nervous and cardiovascular systems of humans, resulting in impaired pulmonary functions, sickness, and even death (Hall, 1996). Therefore, this study is carried out to evaluate and validate the present ambient air quality status at Kashipur town of Uttarakhand with specific reference to Industrial area and M/s India Glycols Limited. Several air quality standards and guidelines have been introduced by the Central Pollution Control Board (CPCB) of the Indian Ministry of Environment and Forests to reference and regulate air quality of particular importance are the Air (prevention and control of pollution) Act (1981), the Environmental Protection Act (1986). The Indian NAAQS for criteria pollutants are summarized in Table 1. These standards and guidelines address individual pollutants and are developed based on highest percentile values over various averaging periods (Central Pollution Control Board, 2000). As such, it is difficult to incorporate these standards into a reference scale. Further, the awareness of high air pollution concentrations and or even the frequency

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of with which the NAAQS are exceeded is not sufficient for the citizens to assess urban air quality. The general public needs information on the levels and potential health risks of air pollution presented in a simple, understandable format. However, 2% of the time, it may exceed but not on two consecutive days.

Table 1. National Ambient Air Quality Standard

Indian national ambient air quality standards Pollutants	Time-weighted average	Concentration of pollutants in ambient air		
		Industrial areas	Residential, rural and other areas	Sensitive areas
Sulfur dioxide (SO_2) (lg/m^3)	Annual[a]	80	60	15
	24 h[b]	120	80	30
Oxides of nitrogen as (NO_2) (lg/m^3)	Annual[a]	80	60	15
	24 h[b]	120	80	30
Suspended particulate matter (SPM) (lg/m^3)	Annual[a]	360	140	70
	24 h[b]	500	200	100
Respirable particulate matter (RPM) (<10 lm) (lg/m^3)	Annual[a]	120	60	50
	24 h[b]	150	100	75

a Annual arithmetic mean of minimum 104 measurements in a year taken twice a week 24 hourly at uniform interval.
b 24 hourly/8 hourly values should be met 98% of the time in a year

Description of Study area.

Kashipur has been identified as one of the potential Industrial developing area in Uttarakhand. The study area located in the industrial area of Kashipur in Udham Sing Nagar district of Uttarakhand between 29°10'32.1798' North Latitude and 79°0'24.3457" East Longitude. Major industries in the study area can be categorized broadly into three: viz., Pulp & Paper, Chemical and Steel as given below in Table 2.This town experienced an industrialization way back in 1988 – 1989. Few major type of industries working in this area belongs to Distillery, Chemicals, Paper and other small industries. After formation of Uttarakhand in the year 2000 and due to fiscal benefits various kinds of industries are coming up in this area, which includes paper, distillery, chemical, and gas based thermal power.The primary sources of suspended particulate matter in the ambient air environment of industrial area of Kashipur are process of chemical plant, process of paper industries, from transportation of heavy vehicles and boilers in industries.

Selection criteria of siting the monitoring stations.

A total of 10 stations were set up to monitor the ambient air quality in the study area following standard siting criteria (IS: 5182, Part XIV). Each such sited station represents a unique category of micro environment. Monitoring station was selected based on the criteria mentioned below:

1. Access, security and availability of electricity.
2. Zone of possible pollutant concentration.
3. Area of population exposure.
4. Wind direction.
5. Dispersion of pollutants from other sources located outside the study area.
6. Non-Industrial reference station providing background level

In order to establish the baseline air quality status in a study area, about 10 ambient air quality stations were selected within the 10 Kms radius study area of the proposed project site including one station in upwind direction. These stations were selected on the basis of even distribution over the study area taking in to consideration various factors like topography of the region, proximity of sensitive establishment and human settlements, industrial activities in the area and its proximity, down wind direction etc. Location plan of the sited ambient air quality monitoring station is presented in Figure 1 and each station site is briefly described below:

On Site i.e. India Glycols Limited is located around 7 km east of Kashipur city. Uniqueness of this station is the fact that we are taking it as base

station and all other station are within 10 km radius of this station.

Ginni Khera is a very small village located around 3 km north east of Prolific Papers (P) Limited. Uniqueness of this station is that, it is away from industries (except one paper plant) and city. The selected study station is considered to be agriculture land and exhibit intense agri-business and ruler activity.

Nandrampur is a village located around 2 km north east of India Glycols and around 500 m north east of Highway .Uniqueness of this station is the fact that it in down wind direction of chemical industry and highway. There is heavy traffic of heavy vehicles in the highway due to industrial transportation.

Dhakia Kalan is a village located around 7 km north east of India Glycols and around 6 km north east of Highway .Uniqueness of this station is it is away from industries thus it can be use for reference data.

Dabhaura Mustahkam is a village located around 3.5 km south east of India Glycols and around 2.5 and 2 km east of Chima Paper and Multiwall Paper respectively. Uniqueness of this station is the fact that it in up wind direction of paper and chemical industry and highway. This station has taken as reference station providing background level.

Barkheri is a village located around 2 km west of Chima Papers and around 2 km South of India Glycols Limited. Uniqueness of this station is the fact that it is affected with pollution load of paper and chemical industry and unpaved road.

Berkhera Pandey is a village located in the west of Shravanti Energy and North of Flexi Tuff. Uniqueness of this station is the fact that it in down wind direction of a Flexy Tuff.

Kharakpur Devipura is a village located around 4 km west of India Glycols Limited and in between India Glycols Limited and Kashipur City. Uniqueness of this station is that, it is away from industries and city. The selected study station is considered to be agriculture land and exhibit intense agri-business and ruler activity.

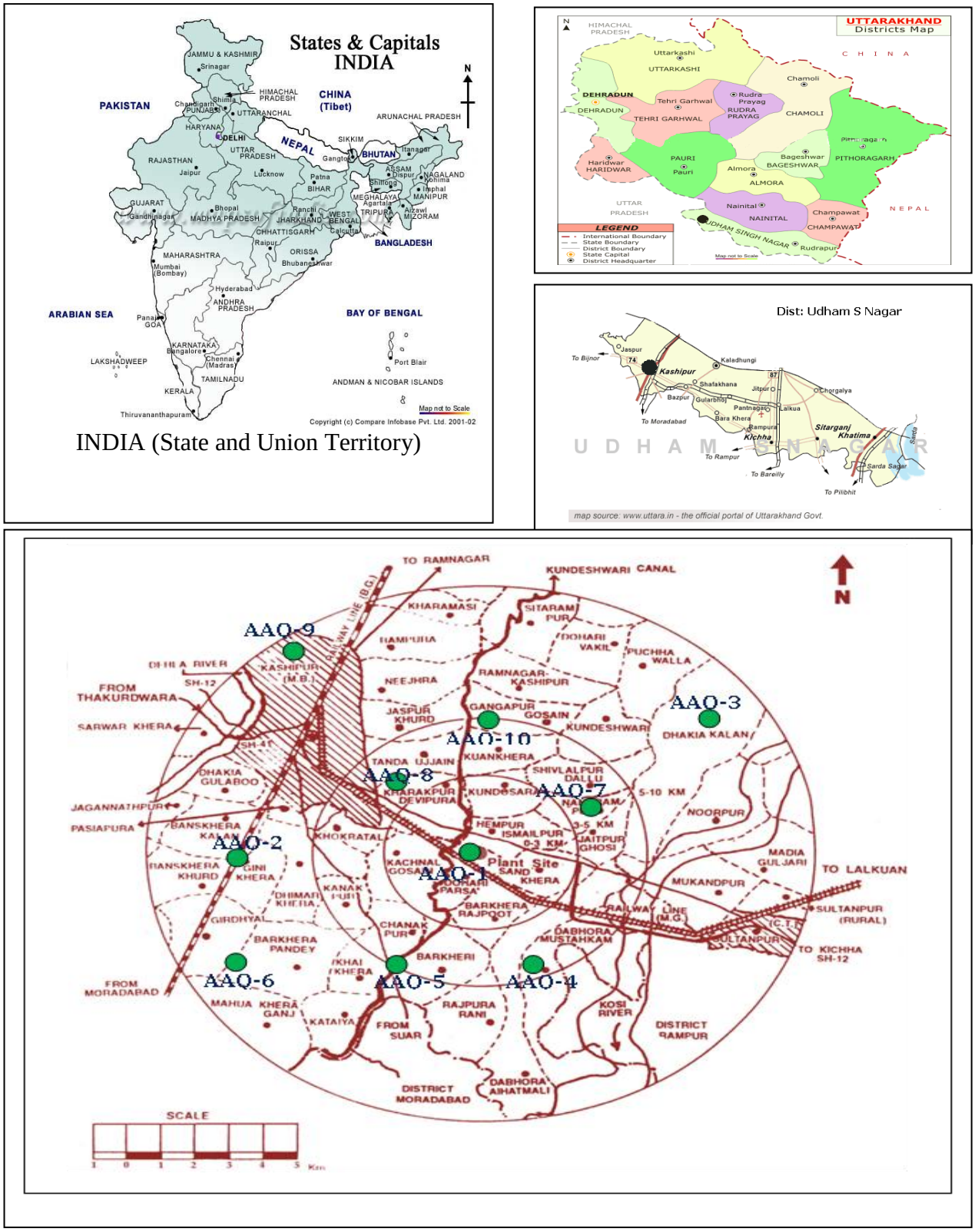
Kashipur station is located in the in telephone exchange building of Kashipur. Uniqueness of this station is that, it will represent the pollution load of local transportation as it is adjacent to highway. The selected study station is considered to be the major traffic intersections area of the city and exhibit intense human activity.

Gangapur gosain is located in aproximaely 6 km north of India Glycols Limited. Uniqueness of this station is that, it will represent the pollution load of ruler activity. The selected study station is considered to be agriculture land and exhibit agri-business.

Table 2 Industrial Activity in Kashipur Area

Industry	Location	Product
India Glycols Limited	Bazpur Road	Chemicals
Goraya Straw Board Mills Pvt Ltd	Bazpur Road	Paper
Multiwal Pulp & Board Mills (P) Ltd.	Bazpur Road	Paper
Prolific Papers (P) Limited	Village Girdhai, Aliganj Road,	Paper
Cheema Papers Ltd	Nainital Road	Paper
Shravanti Energy	Aliganj Road	Electricity (yet to start)
Gama Energy	-	Electricity (yet to start)
Beta Energy	-	Electricity (yet to start)
Naini Paper	Ramnagar Road	Paper
SRF	Ramnagar Road	Chemical
Kashi Vishwanth Steels Ltd	Bazpur Road	Steel, Special Alloys
Jindal Baverages	Bazpur Road	Frozen Foods, Edible Oils

Fig. 1 Map of Industrial Area of Kashipur, showing study area and Air Monitoring Station



Methodology of Air Quality Monitoring (Sampling and Analysis)

Methodology of ambient air monitoring consist of sampling, collection of air samples (following standard procedures) at selected sampling locations using Respirable dust sampler with impinge attachment for gaseous sampling, of Envirotech-make (model APM-451) during summer season in the year 2011. Whereas the concentration Particulate matter 2.5 will be monitored by installing Envirotech made APM 50MFC particulate matter sampler. 24 hourly ambient air samples (separated as day and night) were collected for SPM, PM_{10}, $PM_{2.5}$, SO_2 and NO_x. These samplers were operated at an average flow rate of 1.0-1.2 m^3/min. for sampling/collection of SPM, PM_{10}, and $PM_{2.5}$ levels. They were computed as per standard method after determining the weights of Whatman GF/A filter paper before and after sampling in electronic balance. For SO_2 and NO_x , ambient air samples were collected using Respirable dust samplers of model APM-451 with impinge attachment provided with specific absorbing solutions, which were operated at an average flow rate of 0.2-0.5 l/min. (IS: 5182, part II). The impinge samples (containing SO_2, NOx in specific absorbing solution) were put in iceboxes immediately after sampling and transfer to a refrigerator until analyzed. These were analyzed spectrophotometrically using spectrophotometer. Techniques used for ambient air quality monitoring is given below:

Table 3: Techniques used for ambient air quality monitoring

Parameter	Technique
1. Suspended Particulate Matter	Respirable Dust Sampler (Gravimetric method)
2. PM 10	Respirable Dust Sampler (Gravimetric method)
3. PM 2.5	APM 550 Fine Particle Sampler
4. Sulphur Dioxide	West and Gaeke
5. Oxides of Nitrogen	Jacob and Hochheiser

Results and Discussion

The level of air pollutants were observed at considerably lower level, due to dust suppression and dissolution of gaseous pollutants naturally, by precipitation due to humid atmosphere. Air pollution status and its assessment, is provided below:

Average concentration level of SPM, PM10, PM2.5, SO_2 and NO_X, as observed are presented in Table 4 and Figure 2 & 3 reflecting air quality in the study area.Significant level of SPM can be observed in Kashipur City, Barkheri village and On site at India Glycols Limited. The highest level of SPM can be observed at Kashipur city due to intense human activity and traffc intersections, and second highest SPM observed at Berkheri is mainly due to Chima Paper and unpaved road. Third highest SPM is found on site at India Glycols Limited due to its own activity of storage of coal, movement of coal and biomass fired boiler activity. Still the SPM level of all these are well below the NAAQS.Significant level of RPM (PM10 & PM2.5) can be observed in Kashipur City, Kharagpur Devipura village and On site at India Glycols Limited. The highest level of RPM can be observed at Kashipur city due to intense human activity and traffic intersections consist of heavy earth moving machine movement in highway, and second highest RPM observed at Kharagpur Devipura village is mainly due to agriculture land and exhibit intense agri-business and ruler activity and unpaved road. Agriculture activity will cause emission of fine dust. Third highest RPM is found on site at India Glycols Limited due to its own activity of storage of coal, movement of coal and biomass fired boiler activity. Higher RPM is monitored at two more monitoring station Ginni Khera and Gangapur Gosain and these higher RPM level is due to agriculture land and exhibit intense agri-business and ruler activity and unpaved road. Agriculture activity will cause emission of fine dust. Still the RPM level of all these are well below the NAAQS.Significant level of SO_2 can be observed in Kashipur City and On site at India Glycols Limited. The highest level of SO_2 can be observed at Kashipur city due to intense human

activity and traffc intersections consist of movement of vehicles at highway. Higher SO_2 level is found on site at India Glycols Limited due to its plant activity and coal fired boiler for steam and power generation. Emission of SO_2 due to movement of heavy carriage vehicles carrying raw materials and finished products. Still the SO_2 levels of all these stations are well below the NAAQS.Significant level of NO_X is observed on site at India Glycols Limited and at Kashipur City. The highest level of NO_X observed on site at India Glycols Limited is due to its plant activity mainly coal fired boiler for steam and power generation and oil fired heater for process. Emission due to movement of heavy carriage vehicles for carrying the raw material and finished product also increase the level of NOx in the area. The higher level of NO_X observed at Kashipur city due to intense human activity and traffic intersections consist of movement of vehicles at highway. Still the NO_X levels of all these stations are well below the NAAQS.

Table 4: Average value of pollutants in 2011

Code	Station	SPM	PM_{10}	$PM_{2.5}$	SO_2	NOx
		All value in μ g/m^3				
AAQ-1	On site	249.5	62.4	22.4	21.5	26.6
AAQ-2	Ginni khera	155.2	68.1	19.9	21.3	11.3
AAQ-3	Dhakia kalan	164.3	54.8	21.1	21.2	12.4
AAQ-4	Dhaubora mustakam	149.1	55.3	19.3	20.8	12.7
AAQ-5	Barkheri	264	52.9	20.5	21.2	17.5
AAQ-6	Berkera pandey	150.7	52.4	19.6	21.4	11.4
AAQ-7	Nandrampur	168.4	57.6	20.4	20.6	12.3
AAQ-8	Kharakpur devipura	143.6	63.5	21.2	20.5	11.5
AAQ-9	Kashipur (Kashipur City)	278.5	75.5	22.8	22.1	21.6
AAQ-10	Gangapur gosain	154.7	65.6	20.7	21.5	12.3

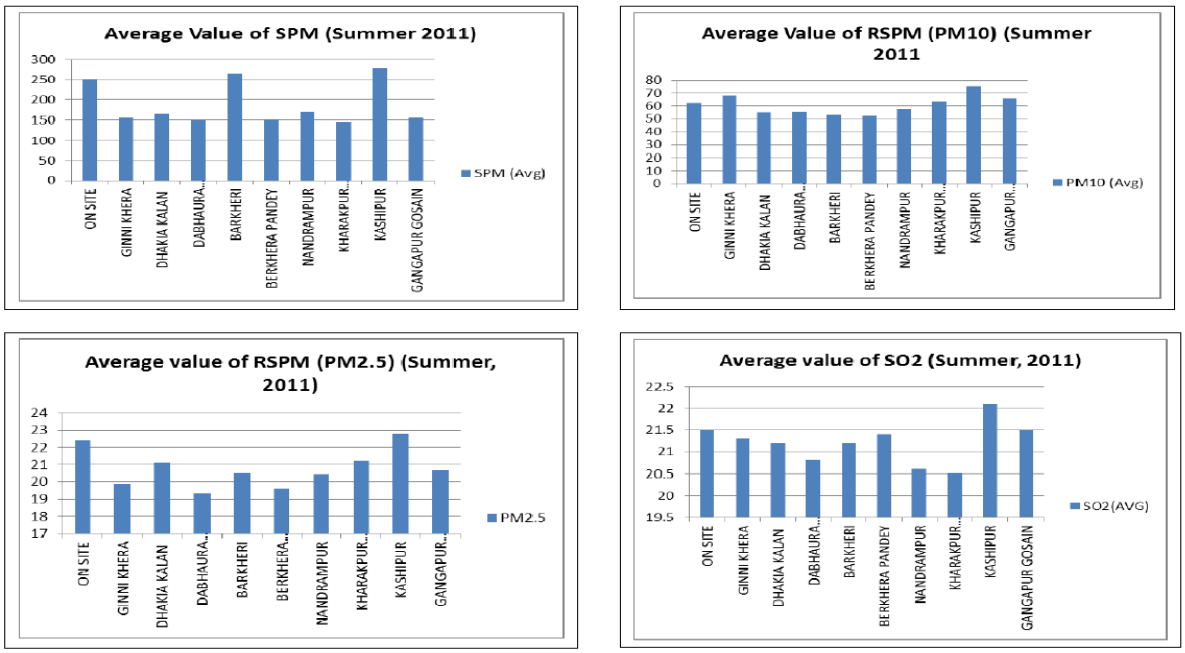


Figure 2 Average Concentration Level of Particulate and Gaseous Air Pollutants in Monitoring Station (Summer, 2011)

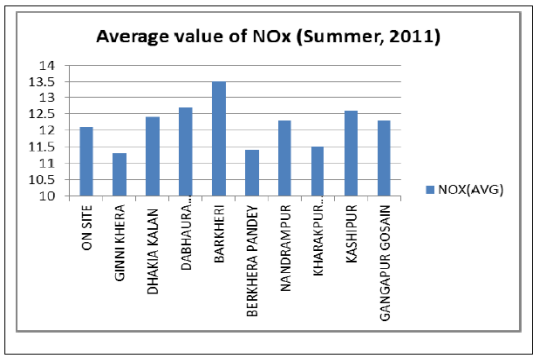


Figure 3 Average Concentration Level of Particulate and Gaseous Air Pollutants in Monitoring Station (Summer, 2011)

Conclusion

This study reveals that ambient air quality of Kashipur industrial area is presently within limit of NAAQS. A detailed study is in progress to observe whether this air quality status is deteriorating or stagnant which will help in developing strategies for control and prevention of air pollution in the area.

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Physico-chemical studies of water quality in Banganga (Small River) of Shri Mata Vaishno Devi, Katra, J & K

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Abstract

Banganga is the first major station for a yatries when they undertake their on-foot journey from Katra to Bhawan (Shri Mata Vaishno Devi). The pilgrims reach a small bridge under which flows Banganga, the legendary river associated with the miracles and legends of Mata Vaishno Devi. There is water in the river all through the year. Various physico-chemical and biological parameters were taken into consideration during the course of study, these includes colour, temperature, DO, BOD, COD, pH, total hardness, total suspended solids and Total dissolved solids. Based on the results of this study it has concluded that slight increase of pollutants in downstream of the river was observed in comparison to the upstream, hence it is an alarming position of increasing pollution load in the river.

Keywords*: Banganga, DO, BOD, COD, TDS*

Introduction

The discharges of huge quantities of horse dung, sewage, effluents and more of the man made activities etc. have been major concern in water pollution. These effluents without proper treatment are discharged into the nearby aquatic bodies in large quantities, causing massive destruction of aquatic flora and fauna by means of suspended solids, immediate depletion in oxygen content, undesirable taste and odour creating substances and by interfering the respiratory metabolism of the animals and aquatic lives. Banganga is the place where an arrow was pierced in to the earth/ground and from where sprouted the Ganga so that the Vaishno Mata and her devotee (some believe it was Hanuman) could drink water and quench their thirst. The river originates from a 200-feet- high cliff in the Samkhal area. The legend goes that after the Goddess Mata Vaishno Devi left the Bhumika Temple, she went to the Trikuta Hills passing through here. At this time, Veer Hanuman felt thirst. The Goddess shot an arrow in to the stone and a holy river was produced, now known as Ban Ganga. It is called Ban Ganga because the Goddess Vaishno Maa washed her hair at this place. It is about 3-km from Katra.Present days it is stream offshoot of the Ganga and there is a spot where there are steps leading down to the stream. Banganga, is considered a sacred and as in normal Hindu tradition, devotees like to bath in it before proceeding further. There are a couple of Ghats built too, for this purpose. The first one is normally very crowded and the other is comparatively more spacious. By keeping in view the importance of this river, in this investigation, the various physical, chemical and biochemical parameters of the water samples of this river were studied by taking water samples from the three different spots, two of them are bathing ghat (Ghat1 and Ghat2) and the remaining is downstream, after the bathing Ghats.

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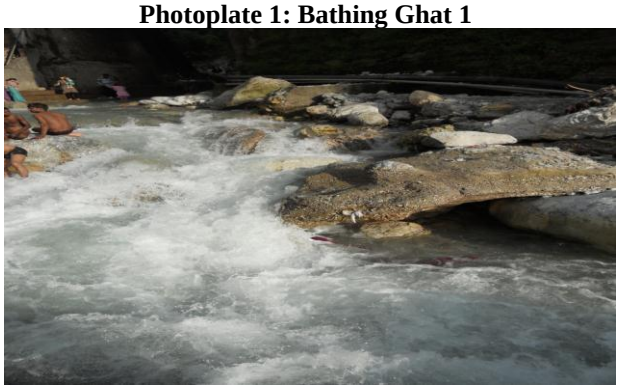
Material and Methods

For physico-chemical analysis of water, the samples were collected from three different sites Site 1- Bathing Ghat 1, Site 2, Bathing Ghat 2 and Site 3- Downstream of the Ghats (Photo plate 1-3).The collected samples were stored in cleaned, high density polyethylene (HDPE) bottles. The use of HDPE bottles minimizes container pollution and promotes the sample preservation (Hall GEM, 1998)]. Samples were stored in refrigerator at 4 ^{0}C prior to analysis. The physico-chemical parameters

and biological parameters were analyzed following the standard methods of APHA (1998), Trivedi and Goel (1986) and Khanna and Bhutiani (2004).The temperature was recorded at the site with the help of mercury thermometer, pH were measured in the field itself using pH metre and dissolved oxygen was analyzed in the laboratory using Wrinkler's modified iodide-azide method. Chemical oxygen demand (COD) is measured by dichromate reflux method using a ferrion indicator. Hardness of sample is determined by complexometric titrations. This study was performed in the months of Jan – May 2012.

Photoplate 1: Bathing Ghat 1



Photoplate 2: Bathing Ghat 2

Photoplate 3: Downstream of the Ghats

Result and Discussion

Result of Physico-chemical studies of Banganga river (Nala) at three different sites is recorded in the table 1.

The water sample at Site-1 and Site-2 were transparent in colour and at Site-3 its colour is blackish brown which may be due to release of effluent water of pilgrims.At Site-1 and Site-2 points the samples were found odourless while at Site-3, it has maximum undesirable smell but not toxic.pH value of pure water is 7 while alkalinity or acidity has effect on it. The pH at sample point Site-1 is recorded as 7.2 while at point Site-3 it is maximum i.e. 8.8.At other point Site-2 the value is less than 7.2.The higher value at Site-3 may be due chemicals (alkaline nature) present in effluent water.The total suspended solid (TSS) is a measure of degree of quality of water and its presence is objectionable in river for many reasons. In the present study the total suspended solids ranged between 20-28 mg/L, maximum was 28 mg/L at Site-3 site and minimum was 20 mg/L at Site-1 site. The high level of TDS in the effluent indicates the presence of high concentration of chlorides, sulphates, nitrates ,carbonates of Ca and Mg, which contributes to high salinity in water (Pandey et al,2002).In present investigation , TDS value varies from 2700-4000 mg/L. It is measured by evaporation of water.Hardness in water is due to mainly Ca++ and Mg++ ions present in water .The hardness of water measured from 108 mg/L to 250 mg/L. The maximum value observed is at site Site-3 .Turbidity and transparency of water are reciprocal to each other. Pure water is fully transparent. Almost all samples collected at point Site-1 to Site-3 are turbid. At sampling point Site-3, turbidity is maximum (57.8) i.e. because of more suspended impurity in effluent water. BOD is a measure of amount of oxygen consumed by microorganism during the decomposition of organic matter present in water sample. In Banganga river BOD of different sites water sample is found slightly in higher range (15.0-30.0 mg/L) which indicates high proportion of organic matter, that causes depletion of dissolved oxygen in water and which are dangerous for aquatic life. Highest level of BOD at sampling site Site-3 indicates that it is most polluted by effluent.COD determines the amount of oxygen required for chemical oxidation

of organic matter using a strong chemical oxidant such as K_2CrO_4 under reflux condition. In Banganga river maximum COD recorded 400 mg/L at Site-3 as it receives high pollution load in comparison to other sites. The lowest COD value observed at site Site-1 which is least polluted.Dissolved oxygen (DO) value is a measure of degree of organic matter present in water sample. Pollution by organic matter and its presence is essential to maintain variety of forms of life in water. The standard for sustaining aquatic life is stipulated at 5 mg/l, a concentration below this adversely affects on aquatic biological life and concentration below 2 mg/l may lead to death for most fishes. In the present study the highest DO value (8.0 mg/l) was found at sampling site Site-1 and lower value (4.2 mg/l) observed at site Site-3 where high effluent discharge.

The MPN (most probable number) test allows detetection of presence of coliforms in a water sample and estimation of their numbers. This test consists of three steps a presumptive test, confirm test and completed test. In the present study Presumptive test was performed using five tube method. These test tubes were incubated for 24 to 48 hours and then examined for the presence of coliforms which is indicated by gas and acid production. In Site-1 and Site-2 the MPN count was found to be 6 per 100ml and 7 per 100ml respectively which is within permissive limits. In site -3 it was fond to be very high 20/100ml which may be due to horse dung.

Table: 1 Physico-Chemical properties of water at different sites of Banganga Nala

S.No.	Parameters	Bathing Ghat-1	Bathing Ghat -2	Downstream of the Ghats
1	Temperature(^{0}C)	18	17.8	18.5
2	pH	7.2	7.2	7.8
3	Colour	Transparent	Transparent	Blackish brown
4	T.S.S(mg/L)	20	22	28
5	T.D.S(mg/L)	2700	2900	4000
6	Total hardness(ppm)	108	140	250
7	D.O(mg/l)	8.0	6.0	4.2
8	B.O.D(mg/l)	15	19	30
9	C.O.D(mg/l)	24	25.6	64
10	MPN count of Coliforms	6	7	20

Conclusion

In the present study**,** the physico-chemical and biological parameters indicated that there is a pollution load at Site -3 (downstream of the Ghats), it may be due to release of huge quantities of sewage-effluents, horse dung and some of the man made activities are being carried out thus affecting the quality of water at a faster speed. Thus, water quality is deteriorated and therefore stringent action must be taken by Municipal Corporation for its cleaning and to prevent deterioration and to protect the river ecosystem.

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Impact of media composition on the growth of flower decomposing fungi

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Abstract

A growth experiment was conducted at Madhav Science College , Ujjain , India to find out the optimum growth requirements of flower decomposing fungi. In this experiment, Selected test fungi i.e. *Penecillium sp., Aspergillus sp., Mucor sp.,Rhizopus sp. , Alterneria sp.*etc, were taken and allow to grow in various kinds of media viz. semi defined media with floral extract , chemical defined media, semi defined media with yeast extract and semi defined media with floral extract & yeast extract. After incubation, observations indicate that semi defined media with yeast extract and floral extract is more suitable for fungal growth and absence of yeast extract slightly affect the fungal growth.

Keywords*: Basal medium, floral extract, fungi, decomposition, yeast extract*

Introduction

Composting is a biological process by which organic materials are degraded through the enzymatic activities of consecutive groups of microorganisms. It is a natural way to reduce organic wastes and produce organic fertilizer or soil conditioner (Gajdos, 1992). Composting process occur in a warm moist environment by action of bacteria, fungi and other organisms (Anastasi *et. al*., 2010; Annibale, *et al*., 2006 Salvator and Sabee, 1995). It requires conditions that are favorable for microbial growth including both physical and chemical factors. The organic waste materials used in the composting process can either be anaerobic or aerobic, but the process is much faster and less odoriferous if done aerobically. Although composting is a microbiological process, but little is known about microorganisms involved and their activities during specific phases of the composting process.Different microbial communities predominate during the various composting phases (mesophilic and thermophilic), each of which being adapted to a particular environment.The composition of the microbial communities during composting is determined by many factors (temperature, pH, water content, C/N, etc). In order to enhance the rate of composting microbial, inoculums added in composting bin. Inoculums prepared in the lab by using different nutrients ingradients. These ingredients are both organic and inorganic in nature. (Tiquia and Michel, 2002). Under aerobic conditions, temperature is the major selective factor for populations and determines the rate of metabolic activities.The objective of our study is to reveal the importance of different ingredients of nutrient for the growth of selected strain of fungi. In our study we selected floral degrading fungi and allowed to grow in different composition media. Experimental results show that C and N contents play an important role .Excluding above sources, vitamins also play compassionate role although not provided sole source of energy and allowed to grow alone.

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Material and Methods

Fungal strains:

Several species of fungi were isolated from floral wastes. Out of these, one *Alterneria Sp* four *Aspergillus* spp., two *Chrysosporium* ,one *Cladosporium* ,one *Mucour* sp., two *Penicillium*

spp., one *Rhizopus* sp. and one *Trichoderma sp.* were selected by screening method. The screened fungi were maintained on Czapek- Dox Agar medium.

Media

For isolation, culturing, maintenance of stock cultures, and experimental studies the following range of media were used: Czapek- Dox Agar (Sucrose, 30 g; $NaNO_3$, 2 g; K_2HPO_4, 1 g; KCl, 0.5 g; $MgSO_4$, 0.5 g; $FeSO_4$, 0.002 g; Agar, 20 g; Distilled water,1 L), basal medium (Li Gao Xingzhong liu , 2010) K_2HPO_4 ,1.0 gm; KCl , 0.5 gm; $MgSO_4$, 0.5 gm; $FeSO_4$, 0.01 gm ; Distilled water,1 L (Sati & Bisht , 2006) K_2HPO_4 ,1.0 gm; $FeCl_3$, 0.5 gm; $MgSO_4$, 0.2 gm; yeast extract , 1.0 gm ; Distilled water,1 L. in basal medium 10% floral extract were added as a carbon & nitrogen source. During preparation of media four different types of media were prepared which contained different composition table 1.

Table 1: Different medium composition

Name of Medium	Composition of Medium
M1	Only basal medium
M2	Basal medium with 10% floral extract
M3	Basal medium with yeast extract
M4	Basal medium with yeast extract and floral extract

The above mentioned composition media prepared and distributed as 45 ml in 100 ml conical flask. Flasks were sterilized at 121°C for 15 min.

Inoculation and incubation:

Spores of selected fungi transferred in media (M1, M2, M3 & M4) by cork borer method. Each fungal species was inoculated in each medium and made double set. All media were incubated at 28°C for 7 days. After 07 days of incubation the net hyphal growth (Dry weight) in the media were determined. Adhered agar medium from the mycelia mat was removed by straining through a filter paper (Whatman No. 1). The mycelia mat rinsed with distilled water 3–4 times to remove traces of basal medium and placed in a Hot air oven at 105° C for 24 hrs. The fungal biomass weighed with a digital electronic balance.

Results and Discussion:

In this study we have taken the four different composition medium i.e. (M1-basal medium, M2-basal medium +yeast extract, M3-basal medium+ floral extract, M4-basal medium +yeast extract +floral extract). They all were screened for the growth of selected floral waste decomposing fungi (viz. *Alterneria Sp.*; *Aspergillus Spp*., *Mucour sp.*, *Cladosporium sp.Penicillium sp., Rhizopus sp*, *Trichoderma sp.*) The growth results of these fungal isolates are shown in figure no. 1 and table-2.

Basal medium (M1) without carbon and nitrogen source (the control) supported little growth. Basal medium + floral extract (M2) supported significant growth but not the best.

Basal Medium + Yeast extract (M3) supported little growth.Basal medium +yeast extract +floral extract (M4) supported best growth.

The results show that M4 is the most suitable medium for fungal growth as compare to M1, M2 and M3.Only basal medium was observed to be a poor source of fungal growth for all studied fungi. Basal medium + floral extract supported moderate growth of all selected fungi.

The variety and galaxy of fungi and their natural beauty occupy prime place in the biological world and India has been the cradle for such fungi. Only a fraction of total fungal wealth has been subjected to scientific scrutiny and mycologists have to unravel the unexplored and hidden wealth. (Manoharachary *et. al*., 2005) .composting is a process in which organic solid turn in to valuable product with the help of microorganisms. The active component involved in the biodegradation and conversion processes during composting is the resident microbial community, among which fungi play a very important role. (Brown, 1995; Tiunov and Scheu 2000).

In the present study, out of four different composition media, M4 medium support the maximum growth of all selected fungi. The growth of fungi mainly depend upon the suitable carbon & Nitrogen sources but the presence of trace amount of vitamins influenced the growth (Alexopoulos *et al*., 1996). Northolt and Bullerman (1982) reported that the growth of fungi depends on the composition of the growth media, water activity (aw), pH, temperature, light, and the surrounding atmospheric gas mixture.

Figure no.1: Growth of fungi with different composition of medium

Basal medium (M1)

Basal medium with floral extract (M2)

Basal medium with yeast extract (M3)

Basal medium +yeast extract+ floral extract(M4)

Table 2 Average dry weight (mg) yields of fungi after 7 d using different composition of medium

Fungal species	Basal Medium		Basal medium + yeast extract		Basal medium + floral extract		Basal medium +yeast extract + floral extract	
	Set-A	Set-B	Set-A	Set-B	Set-A	Set-B	Set-A	Set-B
Alterneria sp.	10	10	30	30	90	80	130	130
Apergillus sp.1	00	00	20	30	70	80	90	100
Aspergillus sp.2	10	00	40	30	80	80	130	120
Aspergillus sp.3	00	00	30	20	80	90	130	130
Aspergillus sp.4	10	10	30	20	80	80	120	120
Chrysosporium sp.	10	00	20	20	60	70	110	110
Cladosporium sp.	00	10	30	40	70	70	100	100
Mucour Sp.	10	10	30	20	70	80	100	110
Penicillium sp.1	10	00	20	20	60	70	100	110
Penicillium sp2	00	10	20	30	60	70	100	100
Rhizopus sp.	00	00	30	20	70	60	100	100
Trichoderma sp.	00	10	20	20	70	70	110	100

The effect of environmental factors on the growth of fungi is generally less specific and restricted than the nutrient factors. In basal medium very less growth is seen it may be because of the absence of carbon and nitrogen while supplies of floral extract enhance little but not significant growth M2 where as in the M3 media which supplies yeast extract supports only little growth but the addition of floral

extract together with yeast extract in M4 condition supports the best growth it may be because of fulfillment of C and N requirement as well as vitamins.These finding demonstrates that selection of appropriate composition of medium is an essential first step for the best growth of fungi and for commercial preparation of inoculums for the degradation of floral waste.

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Study of ichthyofauna diversity of Dejla Dewada reservoir from Bhagwanpura Tehsil, M.P.

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Abstract

The present study deal with identify the ichthyofauna presented in Dejla Dewada reservoir. West Nimar (Khargone). is one of the district of M.P.. The dejla dewada reservoir is situated on the river kunda, near village Bhagwanpura about 35 Kms. away from the district head quarter of West Nimar (Khargone). The geographical position of this reservoir latitude 21- 36'-45" and longitude is 75- 37'-30". It is man made reservoir made in 1986-87 with the help of world bank. It is situated 369.56 M above the mean sea level. In all 28 species belonging to 5 order and 9 families have been found in this reservoir. The study gives initial information about fish production of reservoir.

Keywords *:ichtyofauna, diversity, reservoir*

Introduction

The most important gift for mankind is water which plays a significant role in different vital and structural activities. The water of this reservoir is mainly used for irrigation, agriculture, drinking, fish management and various human activities. The ichthyofauna of British India including Ceylon and Burma published by Day1889. After that the ichthyofauna of various parts of India have been published. Some of the important contributions in this regard are Menon, 1949, Misra, 1952, Hora,59, Srivastava,1968, Jhingran,1982, Pandey,1999, Nanda & Tiwari,2001.The ichthyo population of any aquatic ecosystem play a significant role in Indian economy. Approximately 21,723 ichthyofauna are known out of these about 40% fishes found in fresh water aquatic system. India ranked third in inland fish production in the world. The M.P. occupy 2.75 hectares area with 60 reservoir and got second position in India. The complete data of the ichthyofauna of M.P. is not found. Several studies have been done in past The ichthyofauna of Sagar lake studied by Swarup, 1953 and Qureshi & Qureshi, 1970 .Soni, 1959 described the ichthyofauna of lower lake of Bhopal. Misra, 1962 gave an account of ichthyofauna available in the M.P., Pathak & Pathak, 2000 studied the ichthyofauna of tribal district West Nimar of M.P. The present communication deals with the details of diversity of ichthyofauna of this reservoir which will helpful in the management and development of fishery. The documentation of fish fauna was done during December 2009 to November 2011.The proper identification of fishes is great importance and many workers have done this type job on different aquatic bodies in India.

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Material and Methods

The sampling of ichthyofauna has been made for every month through out study period of twenty four months from December 2009 to November 2011. Four collection centers was selected in the studied water body viz. one at up stream site, two at reservoir site and one at downstream site. The collection of fishes were made with the help of meshed gill net, cast net and traps and directly from fishermen during the fishing time The fishes were brought to the laboratory and preserved in 5% formaline solution after noting the coloures and pigmentation of fishes. The fishes were identified

upto genus \ species with the help of keys provided by Day (1958), Srivastava (1980), Jhingran (1982), Jayaram (1994).

Description of study site

The Dejla Dewada reservoir is situated on the river kunda near village Bhagwanpura about 35 Kms. away from the district head quarter of West Nimar (Khargone). The geographical position of this reservoir latitude 21ñ- 36'- 45" and longitude is 75ñ -37' -30". It is situated 369.56 meters above the mean sea level. It is a man made reservoir made up in 1986-1987 with the help of world bank finance, which receives rain water from the neighboring area.

Results and Discussion

The total 28 species of fish fauna were identified, they represented 5 orders and 10 families from Dejla Dewada reservoir these are shown in table - 1

Table 1 List of Fishes Recorded in Dejla-Dewada Reservoir during December 2009 to November 2011

Order	Family	Genera	Local Name
Cypriniformes	Cyprinidae	1. *Catla – Catla* (Ham.) 2. *Cirrhinus mrigala* (Ham.) 3. *Cirahinus reba* (Ham.) 4. *Labeo rohita* (Ham.) 5. *Labeo Calbasu* (Ham.) 6. *Labeo boga* (Bloch) 7. *Labeo bata* (Ham.) 8. *Tor-tor* (Ham.) 9. *Punctius ticto* (Ham.) 10. *Punctius sophore* (Ham.) 11. *Rosbora-daniconius* (Ham.) 12. *Danio devario* (Ham) 13 *Nemachelius botia* (Ham)	Catla Mirgal Rewah Rohu Kala-beinse Burmese Fish Gootellah Mahasher Fire fin Katcha karawa Rasobora Zebra fish Striped Loach
	Siluridae	1. *Ompok bimaculatus* (Bloch) 2. *Wallage attu* (Schn)	Jalkapoor Barari
	Bagridae	1. *Mystus Seenghala* (Sykes) 2. *Mystus bleekeri* (Day) 3. *Mystus aor* (Ham.) 4. *Rita rita* (Ham.)	Dariai Tengara Tengara Dariai Teugara Rita
	Claridae	1. *Clarius batrachus* (Linn.)	Magur
	Heteropneustidae	1. *Heteropneustus fossilis* (Bloch)	Singi
Clupeiformes	Notopteroidae	1. *Notopterus notopterus* (Pallas)	Patra
Beloniformes	Belonidae	1. *Xenentodon Cancila* (Ham.)	Kawa
Ophiocephaliforme	Ophiocephalidae	1. *Channa marulius* (Ham.) 2. *Channa gachua* (Ham.) 3. *Channa. Punctatus* (Bloch)	Saur Dheridhok Girai
Mastacembeleformes	Mastacembelidae	1. *Mastacembelus armatus* (Lac.) 2. *Mastacembelus Pancalus* (Ham.)	Baam Malga

Dubey and Mehra (1959) observed 71 species of fishes from Chambal river .Dubey &Verma (1965) in the survey of M.P. recorded 104 species of fishes. Khanna & Badola (1990) gave an account of ichthyofauna of the river Ganga from the foot-hills of Garhwal Himalaya. Pathak & Pathak (2000) recorded 40 species of fishes from tribal district West Nimar (Khargone). Pathak & Mudgal(2005) were noted 29 species of fishes from Virla reservoir of district West Nimar (Khargone) . Sharma et al.(2007) published ichthyofauna of Kishanpura lake Indore. Keshre & Mudgal (2010) recorded 18 species of fishes from Mohgat reservoir district of East Nimar (Khandwa).The water quality influenced the fish diversity of aquatic systems. There no previous information available on ichthyofauna diversity of Dejla Dewada reservoir. So, it is not possible to say anything about the reason of decline or increasing the quantity of ichthyofauna diversity to this reservoir. In the present study duration 28 species belonging to the 9 families. Out of these families Cyprinidae was dominant with 13 species followed by family Bagridae with 4 species, family Ophiocephalidae with 3 species, family Siluridae and Metacembelidae 2 species and families Claridae, Heteropnustidae,Notopteroidae and Belonidae represented by 1 species. The order of family dominance are shown below:

Cyprinidae > Bagridae > Ophiocephalidae > Siluridae = Metacembelidae > Claridae= Heteropnustidae = Notopteroidae = Belonidae

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Dayalbagh: An eco-village model for environment conservation

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Abstract

With the development of world towards industrialization, globalization, higher economic growth, population growth and living standards, the consumption of natural resources has been raised a lot. However, there is a limited capacity of our planet to meet the increasing demands for natural resources and to absorb emissions and wastes resulting from us. Ecovillage is a solution for healing the planet as it demonstrates a viable, sustainable human and planetary future. In this research paper Ecovillage design patterns will be analyzed and evaluated for environmental conservation. Case study of Dayalbagh is also presented to evaluate its performance as an Ecovillage.

Keywords*: Environment conservation, ecovillage dimensions, ecovillage, pattern, performance*

Introduction

Over the past several decades, growth has leapfrogged beyond cities and older suburbs into many areas that were once rural. Today development is converting farms and forests to other uses at an increasingly rapid rate. This is an indication that standards in the management of world's natural environmental resources have fallen, which leads to a diminution in the public benefit that agricultural land forests provide (Takeuchi, 1998). However, with changes in values and pursuit of different living, awareness of environmental conservation has increased and ways of living in harmony with natural environments are now widely discussed. The word 'eco-village' is a key word for establishment of sustainable human settlements internationally (Atkisson *et al.,* 1991; Ansted and Franta, 1994).Eco-villages are the newest and most potent kind of communities with strong and vibrant social structures, united by common ecological, economic, social and spiritual values. (Robert and Diane 1991) defined an Ecovillage as a: "human-scale full-featured settlement in which human activities are harmlessly integrated into the natural world in a way that is supportive of healthy human development, and can be successfully continued into the indefinite future". Eco-villages (Jackson and Svensson, 2002) are also described as urban or rural communities of people, who strive to integrate a supportive social environment with a low-impact way of life. To achieve this, they integrate various aspects of ecological design, permaculture, green production, alternative energy and community raising practices. It is an attempt to live sustainably in the face of the limits to growth that the planet is experiencing and to renew the quality of lives with a reconnection to nature.In the research field, there are some specialists discussing Ecovillage in different ways. Most of the Researchers **(**Anderson and Cordell, 1988; Hartig *et al.*, 1991; Hartig *et al.* 1997; Berga *et al.*, 2003; Jonathan, 1998; Takeuchi*et al.* 1998; Jacksonand Svensson, 2002; Berg, 2003; Irrgang, 2005**)** focused on the investigations and environmental aspects in Ecovillages or the discussion of communal lives. However, focus on the patterns or design principle is very less. To evaluate the performance of an Ecovillage, there is a need to discover patterns of it by using a set of methodological design. Thus the aim of this research is identifying the patterns for evaluating the performance of an Ecovillage.

Material and Methods

To identify the pattern for evaluating the performance of an Ecovillage, the process followed

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is depicted in Figure 1. In this research paper, patterns of Dayalbagh, a suburb of Agra in the state of Uttar Pradesh, India, and its performance as an Ecovillage is evaluated. As the residents are not aware of patterns, only the key persons were interviewed. Mr. Prem Prashant, (at present Junior Vice President of Dayalbagh, Former Chief Secretary, Harayana).

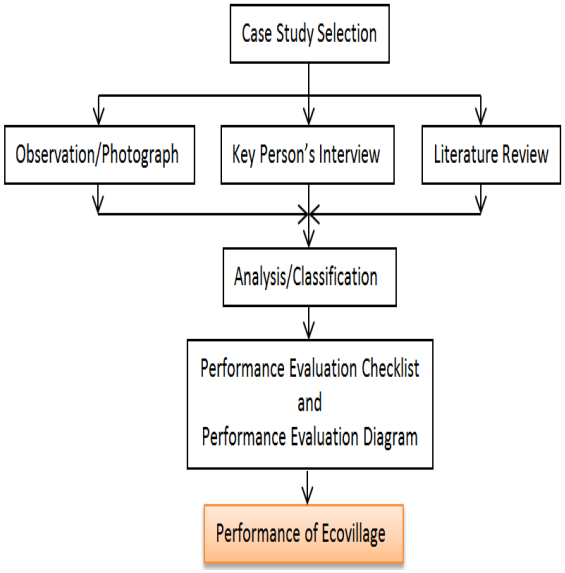


Fig. 1:- Process of the research

Prof. Sant Saran Srivastava (at present Chairman Shiromani Nagar Committee, Ex-Registrar, Dayalbagh Educational Institute), Mr. Subedar Singh (General Manager, Agriculture , Dayalbagh) Mrs. Surekha Yadav (Advocate and Social Worker, Dayalbagh) and Prof. A. K. Sinha (Member of Wildlife Board of India, UP Government,Lucknow) were the interviewees for this research. Some of the residents were selected randomly to fill a questionnaire to get basic information of the site. The background of Dayalbagh and its features were identified by surveys and available literature (Kumar, 2012) and the photographs were taken by the author.

Case study: Dayalbagh: Background

Dayalbagh, translated as "Garden of the Merciful", exists as a satellite projection of the northern periphery of Agra and is on National Highway 2. It is a self-sustained colony well-known for its serene environment, secular establishments like the industries, the educational institutions, the agriculture farm and the activities of its inmates who lead an active, disciplined and co-operative community life, conforming to the high spiritual ideals of their faith. In Dayalbagh full benefit is taken of the characteristics of rural areas and living infrastructures with advance amenities that cannot be created in urban areas.

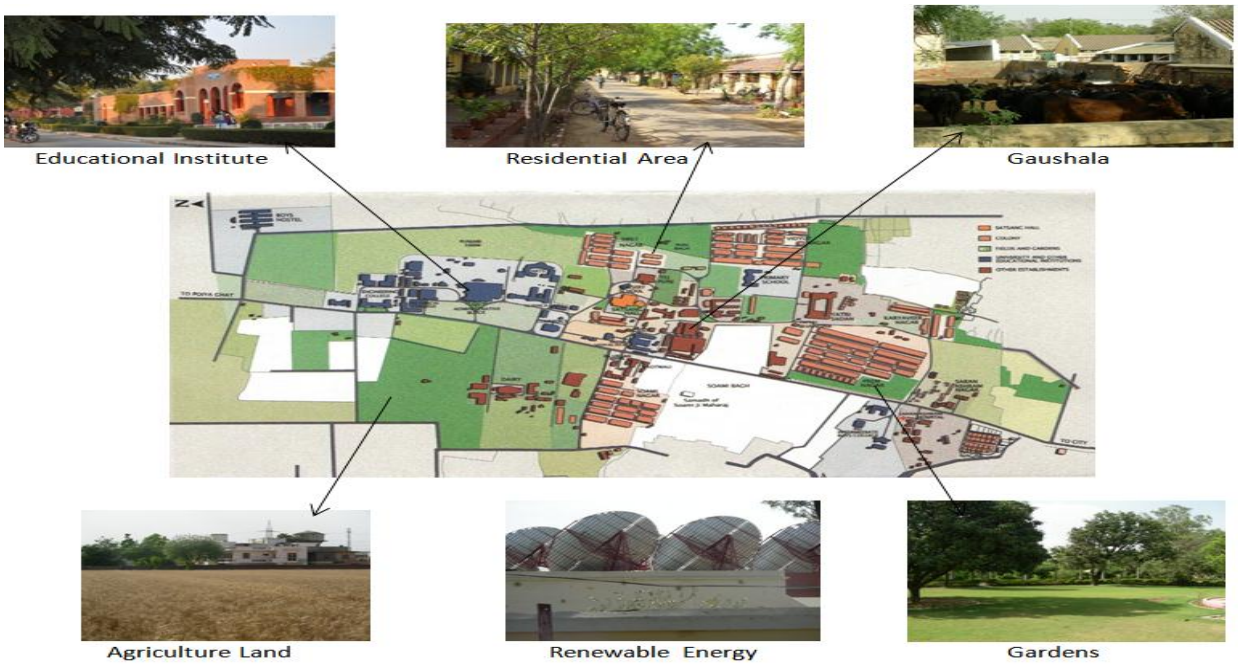


Fig. 2:- Layout of Dayalbagh

Table 1: Basic Characteristics of Dayalbagh

Parameters	Description
Location	North of city Agra, bounded on the north and west by river Yamuna
Geographic Coordinates	27°-13'-27.36" North, 78°-00'-48.93" East
Terrain	Generally level land, undulating in some parts
Total Area	2235 acres
Land use • Agricultural Area • Farm Land • Grass Land • Forest • Area prone to diluvial action of River • Institutional Area • Residential Area • Canal • Roads • Other Infrastructure	 1390 acres 260 acres 28 acres 250 acres 88 acres 146 acres 52 acres 8 acres 2 acres 11 acres
Climate • Average summer temperature • Average winter temperature • Average annual rainfall	 35°– 47° C 2°– 14° C 77.65 cm
Crop Pattern	3 types (Ravi, Kharif, Jayad)
Population (2010) • Males • Females • Children (12 yrs and below)	2896 (Total) 1296 1319 308
Literacy • Male • Female	96% (Total) 97% 95%

The physical infrastructure of Dayalbagh is given in Table 2. The total land area of Dayalbagh is 2235 acres of which 63% of the total land area is covered by greenery, the minimum requirement of which at any place in India should be 33% (Figure 3).

Facilities at Dayalbagh

A. Agriculture

One of the major comprehensive visions of Dayalbagh is that of integrated agriculture vision which pair small scale production in kitchen and community gardens with larger plot farming in the suburb. There are Green Houses, botanical gardens, Nurseries for seed growing and Krishishala and Sewage Treatment Plant for agriculture management. The Agricultural layout of Dayalbagh is shown in Figure 4.

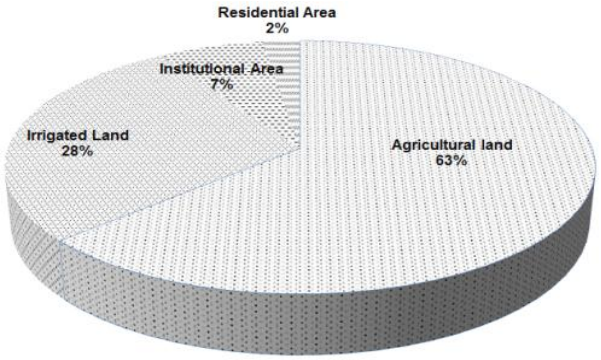


Fig. 3:- Land Usage

Farming (Figure 5) is labor intensive and all members of the community voluntarily participate in it. This type of farming saves energy, transportation and provides fresh crops at a cheaper rate. It also saves wastage and improves environment.

B. Educational Facility

Visionary Leaders of Dayalbagh foresaw education as a thrust area for the community. The foundation of a school was laid down the very next day after the foundation of the colony. The education system followed here is unique and provides value-based, multi-disciplinary education with work experience. The educational institutes of Dayalbagh are listed in Table 3.A Research and Technology Park has been established to encourage research activities in recent technologies. At present this Research Park has two centers: Quantum Nano Systems Center and Center of Consciousness Studies. The Center of Consciousness Studies relate to the scientific study of the subject Theology. Professor Stuart Hameroff, Director, Center of Consciousness Studies, University of Arizona, Tuscon, during his visit to DEI remarked that DEI is the only place where this subject is being studied in such a wide perspective. Thus it is clear that at Dayalbagh the goal of education and the goal of spirituality are one and the same in their ultimate consummation.

Table 2: Physical Infrastructure

Infrastructure	Description	Note
Residential Colony	Six Mohallas: Prem Nagar, Vidyut Nagar, Swet Nagar, Soami Nagar, Karyaveer Nagar and Saran Ashram Nagar	971 Houses an approx. 850 households (all owned by Radhasoami Satsang Sabha or by some institutions like Dayalbagh Educational Institute. There is no private property within the colony)
Educational infrastructure	Schools and University	With playgrounds and full-fledged libraries
Medical Facilities	• Saran Ashram Hospital • Ayurvedic Pharmacy • Unani Dispensary • Homeopathy Dispensaries • Acupressure clinic • Drug Depot	Hospital has facilities in Basic health care, Dental care, Pediatric care, Eye-care center (with operation facilities), Physiotherapy, Emergency care, Maternity care, ultrasound, ECG, and pathological testing
Banks	• Radhasomai Urban Co-operative Bank Ltd. • New Agra Urban Co-operative Bank Ltd. • Dayalbagh Mahila Co-operative Bank Ltd.	
Shared Facilities	• Dayal Bhandar (Community Kitchen) • Yatri Sadan (Pilgrim shed with basic facilities) • Satsang Hall (Religious Congressional place)	
Other Infrastructure	• Gymnasium and PT Ground • Gaushala (with 839 herds of cattle of Sahiwal and Friesien breeds) • Printing Press • Construction Department • Essential Services Department • Electric and Water Supply Department • Eco-friendly Cremation Ground	Milk is distributed at nominal rates for the residents and free for the young students. The Dayalbagh Press prints Books and two Satsang weeklies, English Herald (also available in its e-version) and Prem Pracharak

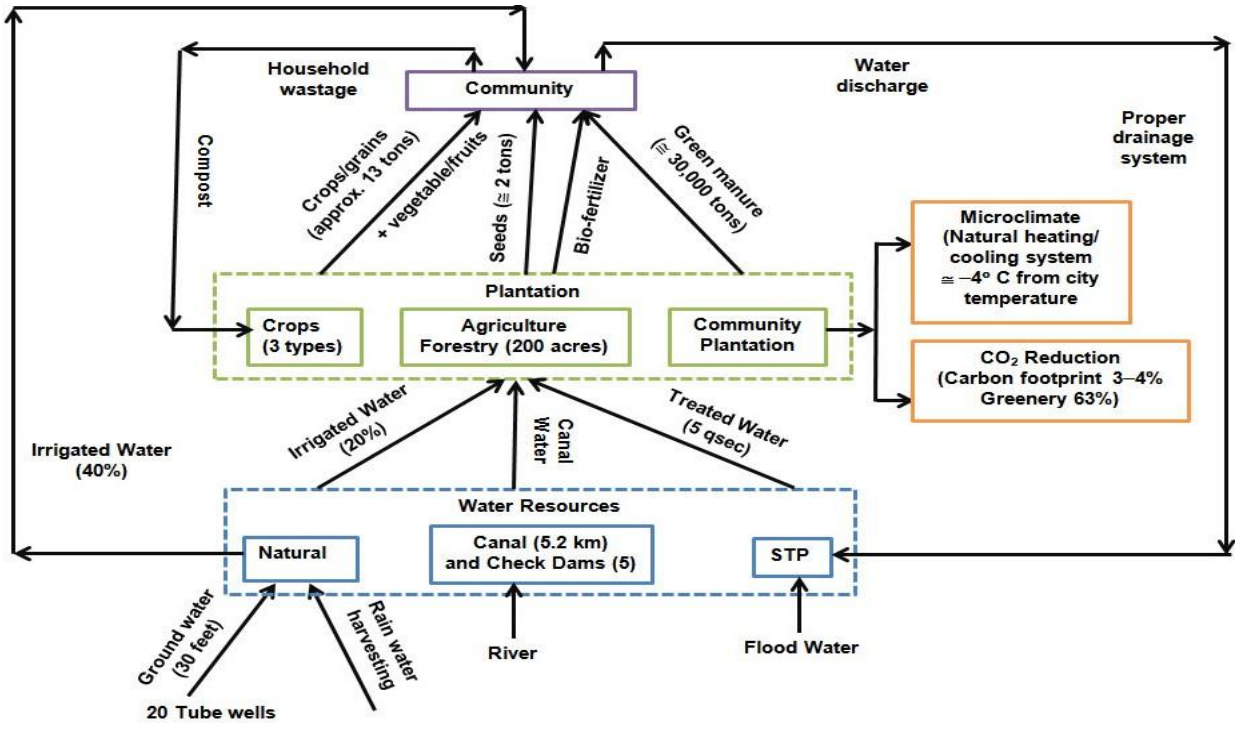


Fig. 4:- Agriculture Layout of Dayalbagh

Fig. 5:- People at Agriculture Farm

C. Industries at Dayalbagh

Dayalbagh acquired a name for its small-scaled industries which were a true manifestation of the 'swadeshi spirit'. These industrial units run as Joint Stock Companies and Co-operative Societies, manufacturing footwear and leather goods, travel accessories, handloom weaving, Ayurvedic and Unani medicines, textile and hosiery including woolen knitted garments, soaps and detergents, canvas and rexine goods. To augment industrial activities, exhibitions are held all over the country to improve sales and to make Dayalbagh goods available to general public. The goods produced are sold almost at cost. Leather goods and footwear are also produced from the cattle which are already dead.

D. Medical Facilities

To provide medical aids to residents of the colony, Saran Ashram Hospital and various dispensaries are established at Dayalbagh (Table 1). Various Pharmaceutical medicines like chavanprash, Pain balm, Digestive Powder (churan), manjan, etc. are also prepared here. Medical camps are organized to provide free treatment and medicines to the nearby villages.

E. Life at Dayalbagh

Life in Dayalbagh is self-managed and follows a systematic way. The day here begins with congregational prayers, followed by physical fitness exercise and works on the farms and in colony by way of Seva (community service), where after people go to their respective vocations. The day ends with Evening prayer.

F. Administration of Dayalbagh

Radhasoami Satsang Sabha, a religious and charitable society registered under the Societies Registration Act 1861, is the apex body governing the affairs of the community members and the colony of Dayalbagh. Civic affairs are managed through Shromani Nagar Committee under overall supervision and control of Radhasoami Satsang Sabha.

G. Rich Landscaping

There are fewer roads and more landscaped public spaces at Dayalbagh. All the three components of social forestry: community forestry, agro forestry and urban forestryare in practice at Dayalbagh. Due to these urban parks, hot winds from Rajasthan are obstructed by the dense vegetation here which is why the maximum summer temperature in Dayalbagh is nearly 4° lesser than the city. Maximum temperature in Agra usually is 48°C whereas the maximum temperature in Dayalbagh fluctuates between 42°C to 44°C (*Source: Aj Daily newspaper*).

Fig. 6:- Agro Forest in Dayalbagh

Fig. 7:- Kurtalam (Urban Park of Dayalbagh)

H. Biodiversity of Dayalbagh

Biodiversity of Dayalbagh is very rich. Table 4 gives the plant diversity, Table 5 shows animal diversity and Table 6 lists the avian diversity.Talltrees provide vegetation that shades and cools streets, courtyards and buildings in summer. Due to presence of dense and tall trees in this region the soil is highly productive and soil erosion is negligible here. Dayalbagh because of its fresh air, naturally become the lungs of the city.

Table 4: Plant Diversity

Medicinal (11): *Emblicaofficinalis (Amla), Acacia nelotica (Babool), Bambusaarundaceae (Bamboo), Aeglemarmelos (Bel) etc.*
Timber: *Mangiferaindica* (Mango), *Tectonagrandis* (*Teak*), *Dalbergialatifolia* (*Shesham*)
Fuel: *Azadiractaindica* (*Neem*), *Tamarindusindica* (Tamarind), *Syzygiumspp* (*Black berry*), *Buteamonosperma* (*palas, flame of the forest*)
Native (13): *Ficusbengalensis* (*Banyan*), *Ficusreligiosa* (*Peepal*), *Punica granatum* (Pomegranate), Citrus spp. (*Orange*), Musa paradisiaca (Banana) Vitis vinifera (Grapes), etc.
Spices (8): Zingiber officinale (Ginger), Coriandrum sativum (Coriander), Allium cepa (*Onion*), Allium sativum (Garlic), *Azadiractaspp* (*curry leaves*)
Other (Decorative) (17): *Saracaasoka* **(**Ashok**),** *Shorearobusta* **(**Pine trees**),** *Bombaxceiba* **(***Semal***),** *morus alba* **(***Mulberry***),** *Michaeliachampaca* **(***Champa***), etc.**

Table 5: Animal diversity

Mammals
Squirrel
Pangolin
Pteropusgigantica
Pteropusmedius
Bosephalustragocamelus(blue bull)
Langur
Rhesus Monkey
Jungle cat
Donkey
Mule
Pygmy hog
Porcupine –*Hystrix*
Hog deer
Herpestes mongoose
Herpetofauna
Naja naja Cobra
Python molurus
Python reticulatus
Viper aruselli
Bungarus cerelulus
Ptyas mucosus Rat snake
Krait
Ophio phagus Hannah
Tree snake
Echiscarinata
Eryx johnii
Sand boa
Natrix piscator
Trionyx punctatum
Chitra indica
Kachu gatectana
Varanus bengalensis common Indian monitor
Varanus griseus desert monitor
Calotes versicolor Garden lizard
Hemidactylus flaviviridis wall lizard
Mabuia
Ureotyphlous Limbless lizard-
Chaemeleon zeylanicus
Rana tigrina
Rana cyanophlyctis
Hoplo batrachustigrinus

Table 6: Avian Diversity

Wetland Birds	**Land Birds**
Sarus Crane	Peafowl
Storks	Black Francolin
Herons	Indian Grey Hornbill
Adjutant	Vultures and other scavenger birds
Ibis	Kites, Falcons and hawks
Shanks	Owls
	Sparrows and other passerine birds

Analysis: The eco-village dimensions of Dayalbagh

This section presents the analysis of Dayalbagh as an eco-village (Jackson and Svensson, 2002). identified four dimensions of Ecovillage: Ecological, Economic, Social and Spiritual dimensions. Xhexhi, (2011) categorized the dimensions regarding Ecovillage design into three - Architectural, Ecological and Social dimensions as architecture is the main issue. In this paper patterns have been identified for four dimensions: Architectural, Ecological, Social and Spiritual. Each dimension will be subdivided into 5 elements (Jackson, 2004; Jackson and Svensson, 2002; Fotopounos, 2002). Each element is defined and analyzed in following paragraphs to evaluate the performance of Dayalbagh as an Ecovillage.

A. Elements in Architectural Dimension

i.Localization

Definition: Planning is localized utilizing existing infrastructure and public transportation.

Dayalbagh is well connected to the main city Agra. Despite the environmental features the existing infrastructure and public transportation are utilized to conveniently support the resident's daily living. On the other hand the work place, schools/college/university, etc. have made it more convenient for daily living.

ii. Layout

Definition: The physical arrangement affects the way residents contact and move around within the area and also affects how the communal facilities are used. It also influences the relationship between private and communal activities.

Dayalbagh colony has six Mohallas with about 850 households. The houses at Dayalbagh are placed in row facing to streets. The benefit of this arrangement is that there is spontaneous contact between neighbors which contributes to the resident's social relationships and the sense of belongings.

iii. Communal Premises

Definition: A common locality is accessible to all households. There are possibilities for organized activities.All the common (Workplace, Educational Institutes, Hospitals etc.) localities are easily accessible to the households. The locality is used for recreation, socializing and even for professional workspace which does not infringe on common usage.

iv. Communal outdoor spaces

Definition: The communal outdoor environment offers:

a. Adequate space for residents being outdoor
b. At least 5 hours of sunshine between 9 to 17 o' clock for mental and physical health
c. Healthy and safe environment for children
d. Luxuriant vegetation to provide a habitat for birds, butterflies and other creatures
e. Aids to recognition, belonging and confidence

The outdoor spaces within Dayalbagh offer all the above properties.

v. Environmental friendly material

Definition: Environmental friendly material refers to non-toxic, less energy consuming, biodegradable and recyclable material and those have been proven reliable and are certified.

The Physical infrastructure of Dayalbagh is build up by these materials:

Buildings

The Dayalbagh colony is well planned and has a garden character. Community design (buildings, infrastructure and activity areas) is done that respects and includes the needs of the Earth, local flora and fauna, as well as the needs of humans.. Following are the features of the buildings of Dayalbagh:

- Natural/non-toxic insulation materials,
- Design to blend with the environment (colors, materials, site selection, etc.),
- Design and construction planning for long life and/or renewability,
  Passive solar features at Dayalbagh Educational Institute and its hostels and at present partly for domestic purposes,
- CFL lamps throughout,
- Roofing with natural clay tiles

Transportation

In Dayalbagh residential quarters, work place, schools, health centers and shops are very close to each other. Thus people mostly commute on bicycles or on foot. Battery charged tempos and solar energy vans are used inside Dayalbagh for commuting the senior citizen and infirm people. There is a CNG bus for transporting pilgrims between railway stations and Dayalbagh during the Basant, Holi and Bhandara (Religious Feasts) celebrations.

B.Elements in Ecological Dimensions

i. Permaculture

Definition:

a. Plan the ground by zoning
b. Natural and cultural attributes are retained to the greatest extent possible
c. Every household has access to a gardening space for household needs
d. Building and landscaping are adapted to micro-climate.

The site of Dayalbagh has sufficient area while all houses are situated along the axis from west to east. Zoning concept regarding permaculture is

implemented for Dayalbagh. The natural and cultural attributes such as local architectural form and materials of the site are retained to the greatest extent possible. The colony is planned as ecology whole which means it adjusts to local elements and environment. Every household has gardening space at the front and backside of the house which is used for plantation of decorative plants. Building and landscaping are adapted to the microclimate, including access to sunlight, shelter from the wind and proper water drainage system.

ii. Organic Food Production

Definition: The opportunity for residents to cultivate their own food is provided. Dayalbagh practices organic farming for food production. Pesticides, insecticides, fungicides and other harmful chemicals are not used in the agricultural fields here. The percentage usage of fertilizers is depicted in Figure 10.

Fig. 9:- Organic farming practices at Dayalbagh

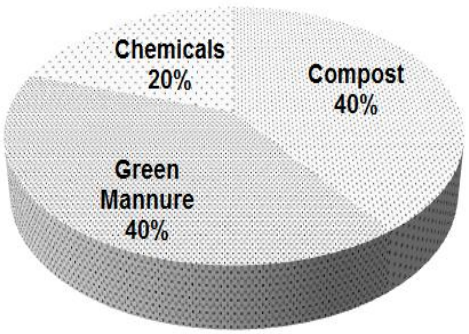


Fig. 10:- Percentage usage of fertilizers

iii. Renewable energy systems

Definition: a. Heating requires as little energy as possible using renewable energy. Electric wiring and appliances are energy efficient. Bulk purchase from M/s Torrent Power Ltd. is made at 33 KV which after step down is supplied to the colony. Use of electricity is regulated to 300 units per month per house. The occupants invariably consume electricity much less then this limit. To preserve environment utilization of solar energy in the colony is growing. Solar panels are steadily being implanted on tops of several buildings. About 70% of energy requirement of Dayalbagh Educational Institute is met with solar energy. The energy consumption at Dayalbagh is depicted in the figure below.

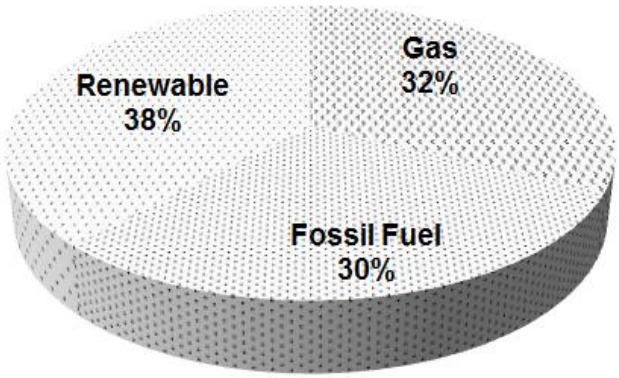


Fig. 11:- Energy Consumption

iv.Protecting biodiversity

Definition:

a. Residents should be aware of ecological issues
b. Environmental education must be part of curriculum
c. Hunting and poaching should be restricted
d. Proper health measures should be taken to protect the animals

a. **Public Awareness**

The Society for Preservation of Healthy Environment, Ecology and Heritage of Agra (SPHEEHA) is actively engaged with Dayalbagh Educational Institute for sensitizing the public towards ecology related issues. There is a Horticulture Department where the community members participate in activities to maintain orchards and green ways which further improve the ecology system of Dayalbagh.

b.**Environmental Education**

Environmental education is taught at Dayalbagh from the primary school level. Children clean the

colonies by picking up the plastics and polybags (although use of these is restricted) and dump them in dust bins under the supervision of their teachers.
Students of university level work for the environment under National Service Scheme (NSS). Camps are organized by NSS to clean the nearby slum areas and educate the slum people about the cleanliness and waste disposal. Short and weekly camps are also organized for the students which inculcate the habit of environment cleaning and public awareness. Environmental management and impact assessment is included in the syllabi of Science Graduates and Post Graduates and also for M.Phil. students.The urban parks of Dayalbagh also work as educational place where children can learn about nature and environment.

Fig. 12:- School and University students cleaning the environment

c. **Negligible anthropogenic pressure**

Anthropogenic pressure is negligible at Dayalbagh as people are religious and vegetarian. They consider teasing and hurting animals is a sin. There is a cohabitation of human with biodiversity. Animals do not get scared when humans come nearby live freely without any fear of being poached or accidental death.

d.**Health Measures**

There is a cattle breeding center for improving the breed of its cattle at Gaushala. Feeding and milking of the animals is done regular staff as well as by volunteers. Animals are not killed here for leather production. Old and dry animals are not sold in the market, but are taken care of in Gaushala till their natural death. Regular health checkups are done for animals by veterinarians.

e.**Negligible Congestion and Pollution**

The residents mostly use bicycle or walk for commutation. Pollution level is less as compared to other areas of the city as number of vehicles passing by Dayalbagh is very low. Dayalbagh also has broad carbon sinking areas which help in less carbon emission and create balanced environment.

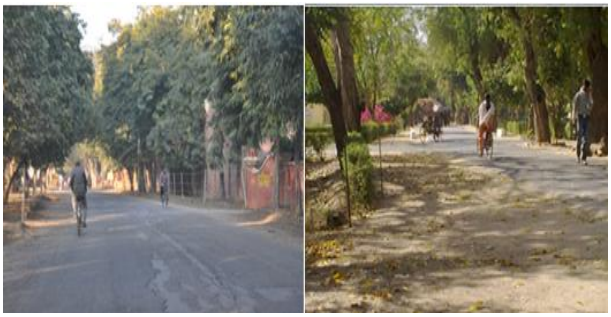


Fig. 13:- Congestion and Pollution free environment

v.Recycling and waste management

Definition:

a. Sewage is treated on site to the great extent possible.
b. Solid wastes are reused or recycled
c. Rain water runoff is designed to infiltrate the soil

a. Water re-charging initiatives

To augment water availability for irrigation, water is treated from Sewage Treatment Plant (STP), the capacity of which at present is 14 million liters/day. Recharge system of underground water with drain water is taken up with due precautions. Black water is treated and used for irrigation.

a. Recycling of Biomass into Organic Manure

The Biomass generated in the Dayalbagh Colony like grass, weeds, leaves are regularly collected

from various Mohallas and transported to Gaushala compound to be user as fodder or for composting. This compost is being used in the agriculture fields to promote organic farming.

c.**Water Harvesting System**

Every house in Dayalbagh is connected with a pipe line which passes from the threshold of all the houses for the conservation of rainwater and the water is sent into the agricultural field. Water table is higher as compared to that of city. Domestic waste water is sent through the pipelines to the treatment chambers which are utilized for gardening etc.

Fig. 14:- Water conservation system

C. Elements of Social Dimensions

i. Public Participation

Definition:a.Establishment of communal identity process

b.Administration encourages residents to participate in maintenance and take responsibility for common spaces and properties.

Residents of Dayalbagh participate in the planning and design process and contribute to establishment of communal identity process. They participate in maintenance and take responsibility for common spaces and properties.

ii. Preventive health practices

Definition: Concern for health and well-being of other members in the community, irrespective of age, sex, status, caste and creed.

Free services, consultation, testing as well as supply of medicines are available. The members are given preventive treatments from time to time, for example administration of quinine in the Malaria season or distribution of Kalmegh for prevention from chicken gunia etc. Every Sunday there is a free medical camp for the people living in neighboring villages and other localities, where a team of doctors (specialists and physicians) give treatment and preventive measures to them. Government Preventive programs also run within the community. Tele-medicines consultations are also being facilitated.

iii.Women Empowerment

Definition: Efforts are done for social upliftment of women.

An Association of ladiesis established for social upliftment of women and to promote co-operative work among them. It runs a Library and children reading room, meets the requirements of household articles of consumption like, spices, pickle etc.The ladies of the Association are also engaged in knitting, stitching, block printing etc. This Association organizes cooking training for girls.

iv.Promoting unending education

Definition: Educational development should be integrated in such a manner that it brings about a social transformation and reduction in the ranks of the unemployed. The objective should be to enable students to inculcate the dignity of manual labor, and to encourage initiative and creative work.

The education policy of here aims to develop a 'Complete Man' imbued with the values of humanism, secularism and democracy. The education provided here is very cost effective at very low fees. Students get ample opportunities for working in agricultural farms, factories or workshops, so that they develop vision for a real integration of the basic ingredients of Humanities, Sciences and Technology and an operational concept of work-experience in the new educational set up for national needs.

v.Green business

Definition*:*Green business means developing the local business to offer the job opportunities to the residents.

There are various functional departments like educational institutes, hospitals, banks, industrial units within Dayalbagh. Products like clothes, chyavanprash, pain balm, soaps and many others are also produced which create employment opportunities to the community members.

D.Elements of spiritual dimension of Dayalbagh

i. Proximal Decision Making

Definition: Decision-making is transparent. The community has the power of self-governance regarding community issues.

Community at Dayalbagh provides a deep sense of belonging to a group. A non-discriminatory method agreeable to the community is used for important community decisions and directions. The community also follows all the rules and regulations laid down by the Government.

ii.Unity with Nature

Definition: Spiritual concern is one of the possible conditions to initiate a eco-village, where there is a spiritual guide who helps the community to develop their relationship to the divine.

Community places values on cultivating inner peace. The community members believe in the teachings of Radhasoami Faith and act according to these teachings. The tenants of Faith are based upon a living belief in a) the existence of God, b) oneness of essence of God and the spirit-entity in man and c) continuity of life after death. The community members develop the spiritual faculty by becoming the disciple of spiritual teacher known as *Sant Satguru*.

Sant Satguru is a Master, who has by means of practices (devotional and spiritual), fully developed His spiritual faculty and realized the True Supreme Being or is processed of His status from His birth.

iii. Community Service

Definition: The community members wishing to devote themselves to a life of spiritual mastery and selfless service, are encouraged/supported by the community.

The Community Members at Dayalbagh believe in simplicity. Community Service (Seva) is the basic tenet of the Community Members. People are religious and feel everything they do as their pious responsibility and perform their duties with perfection. They offer selfless service within the community and outside the community too. Hundreds of members young and old, men and women, render seva in agriculture, Dayal Bhandar, Gaushala, night security, cleaning the colony etc. The attempt here is to live and work in harmony for the service of mankind and not for selfish aims.

vi. Celebrating life and honoring culture

Definition: Earth-based spiritualties are the primordial religion of the humanity.

The community aligns and unites for a common vision or purpose. The community responds supportively to marginalize community members (the poor, ill, dying, troubled, disabled, elderly, etc.). Members endeavor to strengthen its ability to successfully handle challenges/crises. Brotherly spirit pervades among all the members of the community and prejudices and superstitious regarding caste, creed, nationality or color do not find place in Dayalbagh. Summer Camps are organized during summer vacations for the children of the community from various regions to develop habit of community living and to know about the Satsang culture and values.

Fig. 15:- Youth at community Service

vi.Creation of a peaceful, loving, sustainable world

Definition: Peaceful living is about the conscious pursuit of authentic happiness and finding true fulfillment in life. The community must have'friend of-all' attitude and there must be internal and external harmony of its member.

Life in Dayalbagh is systematic with "simple living and high thinking" policy. This system of life is helpful for the harmony in physical, mental and spiritual subsystems of our life. This also leads to the better worldliness. The members believe in the ideal of Fatherhood of God and Brotherhood of Man.

Results and Discussion

Based on the above analysis, these 20 elements are summarized and scored in a Performance Evaluation Checklist (PEC) for evaluating fulfillment and performance of Dayalbagh as an Ecovillage. Each of the element is scored as 0- not implemented, 1- fulfills little, 2- fulfills somewhat and 3- fulfills much. From the checklist, Architectural dimension scores 14 points, Ecological dimension scores 14 points, Social dimension scores 14 points and the Spiritual dimension scores 14 points.The results are now applied to Performance Evaluation Diagram (Figure 16), a modified evaluation diagram (Jackson and Svensson, 2002). Each score in the diagram has its own color to present its scale. The darker colors

present the higher degree of fulfillments for the criteria. Based on this diagram the performance of each dimension will be known. Then the orientation of the Ecovillage can be defined to emerge the interpretation. The performance evaluation diagram indicates that all the four dimensions of an eco-village are fulfilled at Dayalbagh and therefore its performance as an eco-village is good.According to the evaluation shown in the Table 9, it can be seen that all the four dimensions of the Ecovillage have the same weightage. The total grade is 56 out of 60. This indicates that the entire performance in Dayalbagh is even and all of the four dimensions jointly and evenly support the performance of sustainability in it. Thus, Dayalbagh is a balanced Ecovillage model.It is important for an integrated eco-village that the total grade is high and the entire performance is even at the same time. If the total grade of an Ecovillage is high, but has a very strong orientation, while other dimensions are neglected, this eco-village can cause some unbalanced results for the daily living [Lin, 2007].

Table 8: Performance Evaluation Checklist

Dimensions	Elements	Score 0	1	2	3	Subtotal	Total
			fulfills little	fulfills somewhat	fulfills much		
Architectural	Localization			✓		14	54
	Layout				✓		
	Communal premises				✓		
	Communal outdoor spaces				✓		
	Environmental friendly material				✓		
Ecology	Permaculture				✓	14	
	Organic food production				✓		
	Renewable energy				✓		
	Protecting biodiversity				✓		
	Recycling and waste management			✓			
Social	Proximity decision making			✓		14	
	Preventive health care				✓		
	Women empowerment				✓		
	Unending Education				✓		
	Green business				✓		
Spiritual	Creating awareness			✓		14	
	Unity with nature				✓		
	Selfless service				✓		
	Celebrating life and honoring culture				✓		
	Creation of peaceful world				✓		

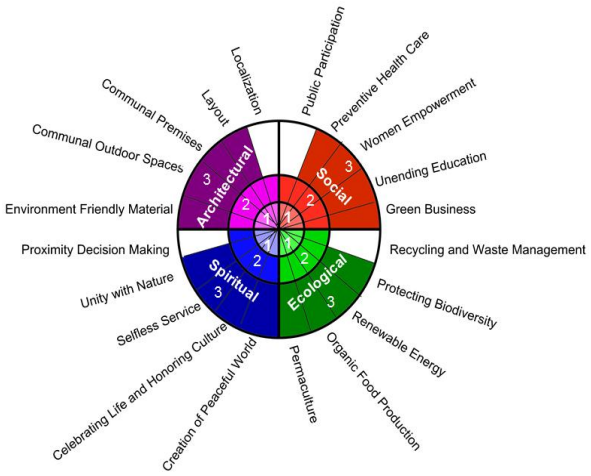


Fig. 16:- Performance Evaluation Diagram

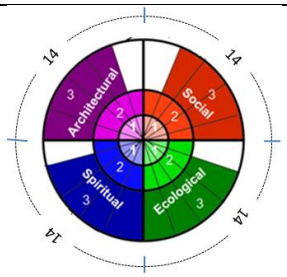
Conclusion

This paper demonstrates using the Performance Evaluation Checklist and Performance Evaluation Diagram that Dayalbagh is a balanced eco-village model having strong and vibrant social structures, united by common ecological, architectural, social and spiritual values. Dr. Gur Dayal Das (Agarwal, 2010) remarked during his visit to Dayalbagh, "with its stress on low-consumption, simple life-style, large open unpaved-unbuilt spaces, green areas providing habitat to variety of flora and fauna, large contributions to outside community (and the world as a whole) in terms of learning and spiritual peace and above all the 'friend–of–all' attitude and the internal and external harmony of its member, the Dayalbagh community is a good model of an eco-village to be emulated by other communities".

Replication of Dayalbagh Ecovillage Model will result in revitalizing measures of environment restoration and enrichment.

The exploration from the Dayalbagh Ecovillage experience leads to consideration of how the wisdom gained from it can be utilized more broadly in the global level. However, different regions have different contexts. Thus when Dayalbagh Ecovillage experience is transferred, the respects for local contexts should be guaranteed in order to adapt the Ecovillages local needs, natural conditions and social customs.

Table 9: Overall Performance of Dayalbagh

Performance	
Architectural Dimension	14
Ecological Dimension	14
Social Dimension	14
Spiritual Dimension	14
Total Grade	56
Performance Evaluation Diagram	

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Assessement of nuvan toxicity to lipids in snake headed fresh water fish *Channa punctatus*

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Abstract

The healthy functioning of the biosphere in our planet, the life depends entirely on the water flow and steady state phenomenon. Lethal concentration of Nuvan calculated for the fresh water snake headed fish *Channa punctatus* 0.27ml/L after 24, 48, 72 and 96 hours. For the chronic study 1/10th Nuvan concentration (0.027ml/L) provided to observe fish. Blood serum cholesterol (Chol.) and triglycerides (TG) estimated after chronic toxic stress of Nuvan to fish *Channa punctatus.* Fish serum TG revealed significant decrease level while Cholesterol showed significant elevated level after 7, 14, 21, and 28days at different level $p > 0.05$, $p < 0.01$ and $p < 0.001$ in fresh water fish *Channa punctatus.*

***Keywords**: Toxicity, fish, cholesterol, fish serum*

Introduction

Water is not only a vital environment factor to all form of life but it has also a great role to play in socio-economic development of human population, so earth is most intimately linked with water. Aquatic environment is subjected to different types of pollutants which enter water bodies with industrial domestic agriculture wastes water and severely affect the water. Aquatic environment is subjected to different types of pollutants which enter water bodies with industrial domestic agriculture wastes water and severely affect the water. Due to the intensive development of agriculture and growing food demands, there has been a great agriculture and growing food demands, increase in the manufacture and utilization of pesticides like insecticides, herbicides and other organic chemicals.Organophosphates widely used in agricultural field including the major crops such as cotton, rice, corn, wheat, barley, sorghum and soyabean. Their use is also important in top fruit, and vegetables for both foliage and root protection. Selective toxicity data have been exploited in veterinary uses of the organophosphorus as for ectoparasites control on cattle and sheep in the form of ear tags sprays and dips. Organophosphate and their residue which used in farming are continuously discharge into the environment. When the fresh water get contaminated by the various kind of pollutant like Nuvan that create mainly by humans. So the fish live in very intimate contact with their environment and are therefore very susceptible to measure water quality which may be reflected by the fish health. Blood is highly susceptible to internal environment. In most cases in the medium for signals in the animal disturbance a integrated functions can be detected or strongly indicated, with rather simple analysis of blood parameters. Cholesterol is a compound of all the cell membrane as well as membranes of the cellular organelles. It is also a precursor of steroid as cortisol, testosterone and estrogen hormones and bile salts. Cholesterol serves as a marker for both cardiovascular disease and oxidative stress. It also linked with increased carotid plaque and CVD, coronary disease, biliary cirrhosis, liver disease and nephrotic syndrome.While Triglycerols (TGs) are non polar hydrophobic molecules essential insoluble in water TGs provide stored energy and insulation. Immediately after a meal TG appear in

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the blood as major constituent of chylomicrons. The remaining TGs, plus additional triglycerides synthesized within the liver are then re-packaged as VLDL and secreted into the blood from liver. TG level may be associated with a higher risk of heart disease and stroke, cirrhosis, nephrotic syndrome, diabetes obesity and cardiovascular disease (CVD).

If the toxicant disrupt fish blood biochemistry blood serum parameters choosed to present finding to find out effect of toxicant on whole body of experimental animal fish *Channa punctatus* lipids like cholesterol and triglyceroides to heart function.

Material and Methods

Healthy live fresh water snake headed fish *Channa punctatus* weighing 50to70 gms and 12-14 cms in length were collected from local fresh water pond Malpura at Agra district (U.P.) in November month. Fishes were kept in large glass aquarium (75×37.5×37.5 cm) capacity 25 nonchlorinated tap water, which was stored one week before experiment. Aquaria bathed 1% $Kmno_4$ solution to avoid any kind of dermal infection. Fishes were acclimatized seven days prior to experiment at temp. ± 20-25°C with 7.2 pH. During experimentation commercial marketed food or egg yolk was provided to fish twice in a day 10.30 am and at 4.30 pm. Feeding was stopped 24 hours before starting the experiment. Dead fish (if any) removed from aquaria as soon as possible to avoid water fouling, water was changed after 2 or 3 days.

Nuvan "Dichlorvos" (DDVP) purchased from local Chipitola market at Agra which manufactured by Syngenta India Ltd. 14 J Tata road, Mumbai has taken for present study. Experiment divided into two parts, (i). for LC_{50} determination and (ii) for biochemical estimation.

For LC_{50} determination five aquaria were setup, four treated with different concentrations (0.1, 0.2, 0.4 & 0.8 ml) and one control group of healthy fish maintained simultaeneously.In each aquaria, six fishes were taken in 25 tap dechlorinated water. After 24, 48, 72 & 96 hours survival and mortal no. of fishes were observed and calculated mortality percentage and draw mortality percentage graph. With the help of standard table and regression line analysis calculated LC_{50} value (Table I and Fig. 1). The data was analysed statistically by log dose/probit regression line method (Finney, 1971). For chronic study sub lethal concentration of Nuvan 1/10th was applied to fish. At the end of each experimental duration 7, 14, 21 and 28 days, fish sacrificed simply by a little struck on fish head by the help of hand and after the autopsy, blood directly collected from heart chamber with the help of scissor, forceps and sterilized disposable syringe. Blood collected in centrifuge tube, kept it 30 minutes in saliently position then centrifuged for 30 minutes at 3000 rpm and after two hours supernatant carefully separated in glass vials with help of rubber bulb pipette. Fish blood serum cholesterol estimated by Wybenga *et al*. Method (1970) and serum triglycerides (TG) estimated by McGowan Method (1983). Data was analysed statistically by student 't' test, Fischer and Yates (1950).

Table – I : Toxicity evaluation of Nuvan to *Channa punctatus* specifying fiducial limits

Experimental Animal	Compound	Regression equation	LC_{50}	Variance	Fiducial limits
Channa punctatus	Nuvan (DDVP)	$Y = 5.01 + 2.22 (X_m – 2.46)$	0.27 ml/L	0.042	$m_1 (+) = 2.53$ $m_2 (–) = 2.41$

Result and Discussion

When a fresh water fish *Channa punctatus* treated with 1/10th sublethal dose of Nuvan that is 0.027 ml/L to chronic study for the period of 7, 14, 21 and 28 days then cholesterol estimated highly significant elevation in blood serum of *Channa punctatus* (Table II and Fig. 2). Increased in serum cholesterol due to organophosphate toxicity. It may be due to liver dysfunction enhanced the cholesterol production and cholestasis occuring in liver with liberation of cholesterol into blood serum by the liver cell destruction after Nuvan stress it linked with greater risk of Coronary Artery Disease (CAD).Same results came from Perrier *et al.* (1972) to *Cyprinus carpio*. Verma *et al.* (1980) resulted that cholesterol is an important biochemical component in vertebrates because of its relationship to many physiologically active steroid, it

relationship to many physiologically active steroid sex hormones, adrenal cortex hormone and bile salts etc. Tyagi (1984) have also resulted hyper cholesterolaemia in *Channa punctatus* and *Heteropneustes fossilis* respectively under exposed of various dyes.

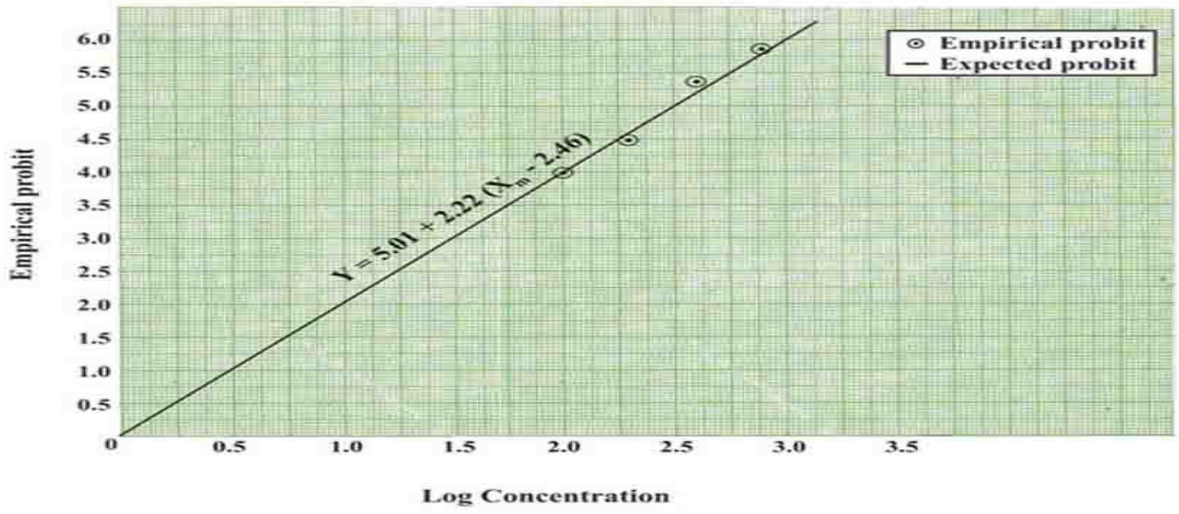
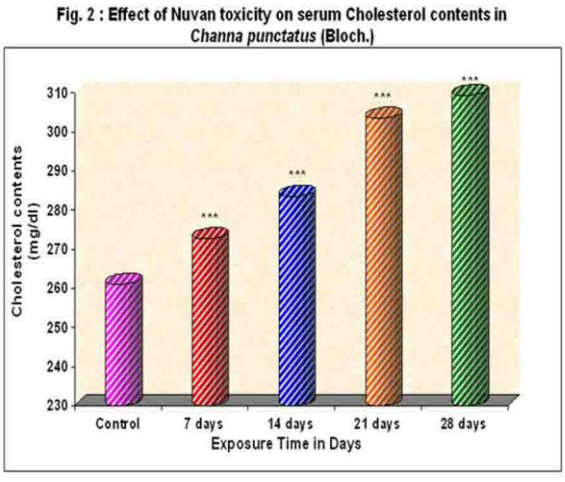


Fig. 1 : LC_{50} determination

Table II: Cholesterol content (mg/dl) in blood serum of *Channa punctatus* after Nuvan toxicity

Cholesterol (mg/dl)	Control	Exposure Time				Result
		7 days	14 days	21 days	28 days	
Range	258 – 264	270 – 276	281 – 286	300 – 307	306 – 312	Increased
Mean	261.0	272.67	283.5	303.5	309.3	
± S.Em.	0.805	0.751***	0.795***	0.982***	1.55***	
t value		10.90	19.91	30.57	21.76	

± S.Em. – Standard error of mean
***** – Very highly significant (p< 0.001)**



Bandopadhyay *et al.* (1983) viewed to elevation in cholesterol content in the fish treated with toxicant is due to necrosis of the liver cells. Hilmy *et al.* (1983) reported sharply elevation in serum cholesterol in *Angilla vulgaris* and *Mugil cephalus* due to DDT and endrin toxicity. Elevation showed, may be due to impaired function as evidence by the transfer of major cations from hepatic tissue to the serum and by elevated serum cholesterol.Awasthi *et al.* (1984) reported hypercholesterolemia to *Channa punctatus* and *Heteropneustes fossilis* due to organophosphate stress. Rao and Rao (1984) observed rise cholesterol level in *O. mossambicus* under methyl parathion. This result indicated relation to induced gluconeogenesis and the diversion of acetyl-Co A to cholesterol synthesis

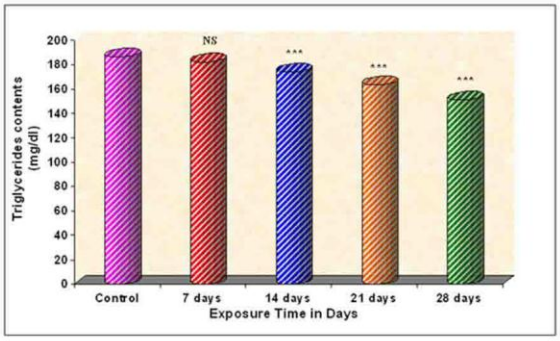
during methyl parathion intoxication. Gluth and Hanke (1985) supported alternation in level of cholesterol in *Cyprinus carpio* due to several pollutants.Radhaiah *et al.* (1987) reported increased level of total lipid content suggested the lipogenesis under pesticidal heptachlor intoxication in *Tilapia mossambica*.Tewari and Reddy (1988) find out hypercholestrolemia in *Heteropneustes fossilis* under starvation stress, it suggested probably the inactivity of liver during saturation cause irregularities in cholesterol metabolism resulting hypercholestrolemia. Reddy and Raw (1989) resulted that cholesterol enhance in *Metapenaeus monoleros* exposed to phosphomidon methyl parathion and lindane. This further stated enhancement due to increased diversion of acetyl-CoA to acetoacetate formation for cholesterol synthesis.Same observation given by Gill *et al.* (1990) to *Puntius conchorius* under phosphomidon stress and Akela *et al.* (1991) to *Clarias batrachus* under eldrin stress. Sen *et al.* (1992) also reported enhance blood cholesterol may be due to structural damage of the liver cell to *Channa punctatus*. Singh and Srivastava (1995) estimated hypercholestermia in blood of *Heteropneustes fossilis* due to formothion and propoxur stress.Goel and Agarwal (1996) depicted increased in blood cholesterol level significant in *Channa punctatus* under methyl parathion toxicity. Elevation in the blood cholesterol level may be due to the hypermetabolic state of fish or to impaired liver function. Singh and Singh supported (1997) our finding under DAP stress to *Channa punctatus*. Sharma, B. (1999) also observed very little change in serum cholesterol in *Clarias batrachus* under carbaryl toxicity. Geetha *et al.* (1999) suggested increased plasma cholesterol in *Catla-catta* due to methomyl exposure may as result of damage of liver cell. Srivastava *et al.* (2000) observed significant elevation in total cholesterol level of blood all concentration of malachite green in respect to all intervals in *Heteropneustes fossilis*.Begum and Raghawan (2001) resulted carbofuran toxicity to lipid metabolism in physiologically important tissue in food fish *Clarias batrachus*, carbofuran intoxication has elevated total lipid in all tissue investigated. Elevation suggested initiation of lipogenesis including sterols tissue steroidogensis was activated that resulting formation of corticosteriods since stress condition elevate the corticosteroids in the blood of animal.Yadav and Akela (2002) suggested increase level of cholesterol in *Channa punctatus* due to heat stress, it might be due to cholesterol metabolism is primary function of liver so the rise in level if gonad cholesterol enhanced production of it in the liver of inhibits excretion to bile duct. Adbelmeguid *et al.* (2002) explained elevation in lipid contents are frequently association with in lipid contents are frequently associated with increased bio concentration of lipophilic toxicants, which is usually correlated enhanced toxicity of the *Cyprinus carpio* and *T. zilli* under water pollution. Malhotra and Sharma (2003) resulted slight increase in blood cholesterol of *C. striatus*. Increased in cholesterol content of the blood suggested that this pesticide either enhanced the cholesterol production or inhibited excretion through the bile duct. It may also be due to necrosis of liver cells. Maruthanagayan and Sharmila (2004) reported that cholesterol level of the blood was found to be increased *C. carpio* on sublethal monocrotophos treatment.Okechukwu and Auta (2007) resulted increase level in serum cholesterol level under λ-cyhalothrin, may cause obstruction in the liver within intra and extra hepatic. However in chronic condition such as cirrhosis that's involving cells, destruction in liver cells because liver is the key organ to synthesis and excretion of cholesterol. Logaswamy *et al.* (2008) supported significant increase in cholesterol indicated lipid profile in blood thyperlipidanemia may be due to abnormal lipid metabolism which is probably the result of hepatic dysfunction and chronic hypoxic condition. Min and Kang (2008) resulted higher level of cholesterol in *Nile tilapia* and *O. niloticus* under water borne benomyl.When a fresh water fish exposed 1/10th sublethal dose of Nuvan (0.027ml/l) from the period at 7, 14, 21 and 28 days. TG level showed reduces significantly in blood serum of *Channa punctatus* (Table III and Fig. 3).Decrement in triglycerides in stress fish might be occur liver cirrhosis, affecting synthesis of TG due to reduce glucose availability in treated fish is essential for TG synthesis because it form alpha glycerophosphate which is the specific precursor of glycerol with fatty acids and toxicant may block the secretion into the serum of *Channa punctatus* under toxic stress. Same result in our favour with pesticide stress on fish.

Table III:Triglyciredes contents(mg/dl) in blood serum of *Channa punctatus* after Nuvan toxicity

Triglycerides (mg/dl)	Control	Exposure Time				Result
		7 days	14 days	21 days	28 days	
Range	184 – 189	177 – 188	169 – 178	160 – 166	147 – 155	Decreased
Mean	186.5	182.5	174.0	163.3	151.0	
± S.Em.	0.636	1.26^{NS}	0.968***	1.21***	0.913***	
t value		2.235	9.12	13.41	27.51	

± S.Em. – **Standard error of mean**
NS – **Non significant (p > 0.05)**
******* – **Very highly significant (p< 0.001)**

Fig. 3 : Effect of Nuvan toxicity on serum Triglycerides contents in *Channa punctatus* (Bloch.)



Lombardi (1966) described four several mechanisms that can effect for accumulation of TG. The rate of synthesis of hepatic triglyceride is normal, but the liver cell is unable to secrete the triglyceride into the plasma serum. This secretion is normal but rate of synthesis is increased. There is both an increase in the rate of synthesis and a block in the secretion of the synthesized TG and the TG synthesis takes place in a compartment of the cell other than endoplasmic reticulum and the pool is not accessible to the normal secretary pathway. It appears that a combination of liver necrosis, effecting the synthesis of TG and blockage of the secretion into the serum was responsible for the inhibition observed prolonged exposure period in fish *Channa gariepinus* after λ-cyhalothrin.

Folmar (1993) resulted decrease level of TG in *Lagodon rhomboides* blood after exposure of three chemical. Hussien *et al.* (1996) depicted decrease TG level in *Chrysichthyes auratus* under atrazine toxic stress, decrement if TG concentration could be due to decreased glucose availability in exposed fish glucose in essential for TG synthesis, because it form alpha glycerophosphate which is the specific precursor of glycerol with which fatty acids. Das and Bhattacharya (2002) resulted decrease TG value in *Channa punctatus* in the toxic administration.

Okechukwu and Auta (2007) reported inhibition in TG level may be due to rate of synthesis and rate of release of TG by the parenchymal cells into the systemic circulation under toxic stress in *Clarias gariepinus* λ-cyhalothrin. Kori *et al.* (2007) depicted decrease in plasma TG level allow to pressure that the lipolysis procedings during exposure period was the major source of energy. In exposure condition TG are known to be lipolytically broken down to glycerides and fatty acid and the muscle stop using glucose and restrict their ketone utilization to necessary energy being supplied via oxidation of fatty acid. Min and Kang (2008) did not find significant result in TG level of *Nile tilapia* and *O. niloticus* under benomyl stress. Velisek *et al.* (2008) reported reduce level of TG in rainbow trout under metribuzin stress.

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A Review on isolation and molecular identification of *Aeromonas* Spp.

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Abstract

This paper reviews the isolation and identification of *Aeromonas* spp. through biochemical tests and molecular typing with special reference to their infection in human beings and future prospective of research related to human health.

Keywords*: Aeromonas, **i**solation, biochemical properties, molecular typing*

Introduction

Genus *Aeromonas* are Gram-negative, non-spore forming, rod-shaped, facultative anaerobic bacilli. They are generally motile by polar flagella (Baron and Finegold, 1990; Villari *et al.*, 2003). They grow over a wide range of temperature 0-40^{o}C, with human (motile mesophilic) strains growing at between 10-40^{o}C, with 30^{o}C as the optimum temperature, while the non-motile psychrophilic species grow at between 22-28^{o}C in soil, food and animal body (Jatau and Yakubu, 2004; Cheesbough, 2005). Until recently, *Aeromonas* were classified in the family *Vibrionaceae* (Jawetz *et al.*, 2004). However, molecular genetic evidence (including 16s rRNA catalog, 5srRNA sequence, and rRNA-DNA hybridation) suggests they are not closely related to *Vibrio* species. Therefore in the latest edition of Bergey's Manual of Systematic Bacteriology, they are classified as a separate family the *Aeromonadaceae* (Sylvia *et al.*, 2004; Jawetz *et al.*, 2007). *Aeromonas* are ubiquitous in fresh and brackish waters (Jawetz *et al.*, 2004). These organisms have also been isolated from a wide variety of sources including soil, sea food and humans (Bishara, 1984; Michael *et al.*, 2000).

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The concentration of *Aeromonas* varies with environment in which they are found. In clean rivers, lakes, and storages reservoirs, their concentration is typically around 102 cfu/ml. The concentration in ground water is generally less than 1 cfu/ml. Drinking water immediately leaving the treatment plant may contain between 0-102 cfu/ml, with potentially higher concentration in drinking water distribution systems, attributed to growth in Biofilms (Payment *et al.*, 1988; United State Environmental Protection Agency, 2005). Higher density of 108 cfu/ml can be found in waste waters, treated sewage and crude sewage (Holmes *et al.*, 1996). They are also found in sinks, drain pipes and household effluent (Araujo *et al.*, 1991). *Aeromonas* species have been isolated from a variety of foods, including red meat (beef, pork and lambs) poultry produce, fish and shellfish (USEPA, 2005). *Aeromonas* species have been implicated in a variety of infections in humans such as gastroenteritis, wound infections (cellulitis), septicemia and occasionally others including urinary tract infection, meningitis, and peritonitis (Michael, 1991). *Aeromonas* infections are typically acquired through two routes, ingestion of contaminated water or food, or through contact of the organisms with a break in the skin (Jawetz *et al.*, 2004). Diseases associated with *Aeromonas* are intestinal and extra-intestinal. They are also implicated in colitis, meningitis, and are frequently isolated from wound infection sustained in aquatic

environments (Krovacek *et al.*, 1992). They are also being implicated in respiratory infection (Janda and Abbot, 1998). In recent years, *Aeromonas hydrophila* has gained public health recognition as an emerging pathogen (Bottarelli and Ossiprendi, 1999). Although food poisoning potential has not been reported, the association with human gastroenteritis strongly suggests that *A. hydrophila* plays a significant role in food borne diseases (Balaji *et al.*, 2004). The presence of these organisms in stools is significantly more often associated with diarrhea than with carrier state (Agger *et al.*, 1985; Aslani and Alikhani, 2004; Jawetz *et al.*, 2007; Kandakai-Olukemi *et al.*, 2007). *Aeromonas hydrophila* can be isolated with variable frequency from different foods (raw, refrigerated or frozen) of animal origin (Ventura *et al.*, 1998). Some preservative techniques seem ineffective in inhibiting the replication of *A. hydrophila*, which can multiply although at slow rate in products which are refrigerated and vacuum packed or packaged in modified atmosphere. The organism can also replicate at low pH (4.5) or at high sodium chloride (NaCl) concentration (up to 5%) in the environment (Bottarelli and Ossipnendi, 1999). The isolation of *A. hydrophila* from chlorinated water has been reported and it is less sensitive to chlorine compared to the coliforms (Chamorey *et al.*, 1999).

Medium for Isolation of *Aeromonas* Spp.

Shotts and Rimler (1973) proposed new differential medium, Rimler-Shotts and tested 109 isolates representing 13 genera of bacteria obtained from aquatic environments and animals. They found this medium to be effective in presumptive identification of the strains of *A. hydrophila* with 94% accuracy and this medium was designed to facilitate diagnosis of *A. hydrophila* infections in animals and humans. Mishra *et al.* (1987) compared five selective media for their effectiveness in primary isolation of *Aeromonas* spp. and found sheep blood agar with 30mg of ampicillin per litre (ASBA 30) in association with DNase-toluidine blue agar to be the most sensitive medium as it permitted more growth of *Aeromonas* colonies and effectively suppressed competiting microflora. Havelaar *et al.* (1987) reported satisfactory recoveries of *Aeromonas* spp. in a new medium, ampicillin dextrin agar at an ampicillin concentration of 10 mg/L and incubation for 24 hours at 30°C under aerobic conditions. They also observed that this medium had a greater confirmation rate along with its high specificity and no false negative colonies were encountered. Markwardt *et al.* (1989) assessed the applicability of Coomassie Brilliant Blue agar (CBB) as a differential medium for *A. salmonicida* and found this medium to be very valuable in diagnostic and epizootiological work and also in determining the presence of the pathogens in fish samples. Ribas *et al.* (1991) compared the properties of Starch Glutamate ampicillin penicillin-l0C agar with Ampicillin dextrin agar and m-Aeromonas medium for isolation of *Aeromonas* spp. in water samples. They found Starch Glutamate ampicillin penicillin-l0C agar to be the most adequate medium for *Aeromonas* spp. isolation due to its high specificity and selective composition. Holmes and Sartory (1993) considered Ampicilin Dextrin agar (ADA) to be highly satisfactory and selective, as this medium permitted good recovery of *Aeromonas* spp. in comparison to Ryan's medium, Bile-Salt-Irgasan-Brilliant Green agar (BIBA) and an agar medium containing xylose and ampicillin (XAA).

Von Graevenitz and Bucher (1993) reported that broth enrichment methods are frequently used to recover aeromonads from samples where they may be present in low numbers together with larger numbers of other bacteria. Also they found that use of Alkaline Peptone Water (APW) enrichment increased recovery of aeromonads from clinical specimens and APW with or without ampicillin (10 or 30 mg/L) may be used for qualitative detection of aeromonads when using the membrane filtration method for sample processing. Jenkins and Taylor (1995) compared the Rimler-Shotts (RS) medium and Starch-Glutamate-ampicillin-penicillin-based medium (SGAP-l0C) for the recovery of *Aeromonas* spp. Their studies indicated that, the recovery frequency of *Aeromonas* spp. was higher, efficient and specific on SGAP-l0C at 24°C for 48 hours, thus proving it to be a better choice of the laboratory for recovery of *Aeromonas* spp. from clinical fish samples. Gobat and Jemmi (1995) evaluated seven selected agar media and two enrichment broths for isolation of *Aeromonas* spp. from meat, fish and shellfish samples. Their findings revealed that Bile-salts-irgasan-brilliant green agar (BIBG) at 35^{0}□C was the most selective

medium and presumptive identification of *Aeromonas* on sheep blood agar supplemented with 30mg/L ampicillin (ASBA 30) was very easy. Singh (1997) compared two commercially available media, Ryan's *aeromonas* medium (RAM) and *pseudomonas aeromonas* selective agar base (GSP) and one laboratory prepared medium Starch ampicillin agar (SAA) for their ability to recover *Aeromonas* spp. from raw ground meats in Eastern Canada. He observed that in all instances, SAA was better than GSP and RAM with 100% of typical colonies confirming as *Aeromonas* spp. Sachan and Agarwal (2000) tested six selective agents (ampicillin, novobiocin, cephalothin, bile salts, brilliant green and ethanol) during the development of a selective enrichment broth for the isolation of *Aeromonas* spp. from chicken meat. They found that, of the six selected agents, cephalothin to be the best selective agent owing to its greater selectivity and efficiency in recovering stressed and lower cell concentrations of *Aeromonas* spp.

Biochemical Properties

Leblanc *et al.* (1981) isolated 195 strains of motile *Aeromonas* from fish which were characterized as *A. hydrophila* and *A. sobria.* They classified these organisms serologically and observed a relationship between heat-stable particulate antigens and virulence of *A. hydrophila*, also a cross-reaction between *A. hydrophila* and *A. sobria* was observed. Martinez-Murcia (1992) reported that *A. allosaccharophila* could not be identified in clinical laboratory since it did not possess unique biochemical characteristics which enable it to phenotypically separate this group from other mesophilic species. Janda *et al.* (1996) characterized 268 *Aeromonas* isolates upto genomospecies level by performing a series of biochemical tests. They biochemically separated the members of *A. hydrophila* complex *(A. hydrophila,* HG2 and *A. salmonicida)* and serogroups analysis of these 268 isolates indicated that, each genomospecies was serologically heterogenous and individual serogroups could be found in more than one species. Borrell *et al.* (1998) identified 983 isolates of *Aeromonas* upto the genomospecies level. The use of citrate and production of acid from sorbitol enabled them to separate the members of *A. hydrophila* complex and the most common genomospecies from intestinal sources encountered were *A. veronii* biotype *sobria* and *A. caviae.* On their result findings, they stated that prevalence of these pathogenic genomospecies should be regarded as an important threat to public health. Alavandi and Ananthan (2003) studied the differences between clinical and environmental *Aeromonas* spp. with respect to their biochemical properties, serogrouping and virulence factors. Their results did not reveal any significant differences between them, but differences were observed in respect to the ability of the *Aeromonas* isolates to produce the β-haemolytic where in higher percentage of environmental isolates were haemolytic. Awan *et al.* (2005) carried out biochemical characterization of *Aeromonas* spp. isolated from food and environment using seven types of API strips. They observed that these strips provided an extensive biochemical profile of the isolates and strip API 20E gave the most reliable results where as in all other strips some of the characteristics appeared as significant in differentiation of the various species.

Molecular Typing of *Aeromonas*

Although certain biochemical tests allowed for some improvements, phenotypic identification of the genospecies of *Aeromonas* was difficult. The molecular typing methods were used as taxonomic tools to discriminate among strains of *Aeromonas* for epidemiological purposes.

Phenotyping

Different phenotypic methods used to study *Aeromonas* strains are biotyping, phage typing, serotyping, chromatography of cell wall fatty acid methyl esters (FAME), multilocus enzyme electrophoresis (MEE), plasmid analysis and ribotyping. These phenotypic methods are based on phenotypical chracteristics of microorganisms.

1. Biotyping

Biotyping is based on activity patterns of metabolic enzymes of cells using enzymes with not more than 20 kinds and based on biochemical tests that differentiate *Aeromonas* to the species level. Different enzyme activity in the different microorganisms has the effect of gene expression in each strain for producing the various enzymes. The biotyping has low discriminatory power because it

is correct for 78% of all *Aeromonas* strains and is not sufficient to distinguish the different genospecies of *Aeromonas* and has little discrimination for epidemiological investigations (Havelaar *et al.*, 1992).

2. Phage typing

Phage typing is technically demanding and requires the maintenance of viable phages (which as lytic bacteriophages such as viruses are capable of infection and lysing bacterial cells) and control strains for propagating phage. A study was done using a total of 95 different phages to type clinical *Aeromonas* isolates from fecal specimens. These phages could type 81% of the *Aeromonas* strains (Altwegg *et al.*, 1988). A comparison between phage typing with three phenotypic *Aeromonas (A. hydrophila*, *A. sobria*, and *A. caviae)* and with DNA hybridization groups found that there was not strong association. These demonstrated that phage typing should be a conjunct study with other typing methods for typing and epidemiological study of *Aeromonas.*

3. Serotyping

Serotyping is based on the differences of antisera such as somatic O- and flagella H-antigens, somatic O- and K-antigens or lipopolysaccharide antigen. Serotyping was studied as the direct epidemiologic linkage between strains isolated from patients and strains isolated from the public water system, and it was found that serotyping could not demonstrate epidemiology with *Aeromonas* strains causing disease with patients and isolation from the environment (Guinee and Jansen,1987; Havelaar *et al.*, 1992; Moyer *et al.*, 1992).

4. Chromatography of cell wall fatty acid methyl esters (FAME)

FAME has low discrimination power to identify and type individual *Aeromonas* strains but is found useful to study the overall relationship between the *Aeromonas* groups which are isolated from different origins (Havelaar *et al.*, 1992).

5. Multilocus enzyme electrophoresis (MEE)

Multilocus enzyme electrophoresis is used to detect different metabolic enzymes, and the different protein profiles to identify the diversity of bacteria due to variations in genes encoding metabolic enzymes (Selander *et al.*, 1986). In addition, this method is highly reproducible and has discriminatory power (Picard and Goullet, 1985). Despite the genetic complexity of the genus *Aeromonas*, the use of MEE might be the sole method for species determination. For example, *A. hydrophila* complex (HG1, 2, and 3) was separated by using two enzymes: elastase and lysine decarboxylase, while *A. caviae* (HG 4, 5, and 6) was separated by using pyrazinamidase enzyme. This method might be suitable for typing each single *Aeromonas* strain (Abbott *et al.*, 1992). The diversity of enzymes produced by *Aeromonas* strains from the environment was more than *Aeromonas* strains from humans (Picard and Goullet, 1987). *Aeromonas* strains from humans have lower genetic distance than *Aeromonas* strains from the environment, demonstrating the variety of enzymatic systems produced by *Aeromonas* strains from the environment (Tonolla *et al.*, 1991).

Genotypic methods

These genotypic methods are based on genome analysis of microorganisms.

1. DNA-DNA hybridization

The deoxyribonucleic acid relationships among members of the genus *Aeromonas* found that variation of genome size and percentage of guanine and cytosine (G+C) ranged from 57.1 to 62.9%. The motile *Aeromonas* showed a wide variation in percentage homology, while in contrast the non-motile *Aeromonas* appeared to be a genetically homogenous group, with very high homology values (Maclnnes and Trust, 1979).

2. Plasmid analysis

Plasmid analysis is relatively simple and does not require very special equipment. Bacterial strains are lysed to prepare a plasmid, and tested with electrophoresis and ethidium bromide staining. Plasmid analysis is of little epidemiological value due to there being few plasmids in the genus *Aeromonas* and plasmids can be easily lost. In addition, plasmids might be conjugate between strains, and thus have low discrimination to identify *Aeromonas* strains (Chang and Bolten, 1987). The relationship between plasmid and capacity of

pathogenicity of *A. hydrophila* isolated from the environment indicated that the number of plasmids is different between *A. hydrophila* strains from the different environments and the number of *A. hydrophila* plasmids relates with the capacity for pathogenicity. *A. hydrophila* strains from the environment have more diversity of plasmids (Borrego *et al.*, 1991).

3. **Ribotyping**

Ribotyping is based on the hybridization of rRNA or of a DNA probe containing genes coding for rRNA to genomic DNA in the strains. The genomic DNA is digested with an appropriate restriction enzyme, and the digested fragments separated in an agarose gel are transferred onto a membrane by Southern blotting. This restriction pattern reflects the heterogeneity in the restriction sites. Reproducibility and stability of ribotyping patterns is excellent. Ribotyping is useful for epidemiological investigation of *Aeromonas* strains (Altwegg *et al.,* 1991).

4. Pulsed Field Gel Electrophoresis (PFGE)

PFGE is based on the different profiles generated from specific restriction endonuclease cutting to produce a large number of fragments. These fragments were separated in agarose gel by the influence of constant low electric field strength. Advantages of this method are that it is a rapid and discriminatory technique. Disadvantages are inconvenience or impossibility to compare a large number of fragments (Talon *et al.*, 1996).

5. Sodium dodecyl sulfate (SDS)-polyacrylamide gel electrophoresis (SDS-PAGE)

SDS-PAGE analysis uses separation of whole cell protein such as outer membrane protein (OMPs) according to size of protein by using SDS-polyacrylamide gel electrophoresis (SDS-PAGE). Protein profiles of the various organisms are investigated. However, the patterns produced are usually very complex, and thus it is difficult for interpretation (Hanninen, 1994).

6. Restriction endonuclease analysis

Restriction endonuclease analysis involves comparison of the number and the size of fragments produced by digestion of DNA with a restriction endonuclease (RE) as an enzyme that cuts DNA constantly within a specific recognition site. Usually, RE is composed of 4 to 6 bp fragment products ranging from 5-50 kb. The complete digestion of DNA with a specific RE gives a reproducible array of fragments. These fragments can be separated by agarose gel electrophoresis and visualized by staining with ethidium bromide. It is not easy to interpret restriction profiles because of the large number of bands. This problem can be improved by using a nucleic acid probe to reduce the number of bands after restriction endonuclease digestion (Kuijper *et al.*, 1989).

7. Restriction Fragment Length Polymorphism (RFLP-PCR)

RFLP-PCR is a technique to make restriction endonuclease profiles by using restriction endonuclease cutting PCR-products. The selection of a specific restriction endonuclease is important and is based on two criteria which are (1) the restriction fragment must be suitable for analysis in terms of size and frequency and (2) the fragments in this size range should not be too numerous, to avoid overlapping bands. Usually, 16S rRNA genes of all *Aeromonas* strains are highly similar and the difference of nucleotides has range of 1 to 32 bases (Matinez-Murcia *et al.*, 1992). The RFLP-PCR study of *Aeromonas* using l6S rRNA genes with endonuclease, *Alu*I and *Mbo*I, and using computer analysis provided the specific profiles in each species of clinical *Aeromonas* isolates (Borrel *et al.*, 1997), but *Nar*I and *Hae*III were used to differentiate *A. salmonicida* from *A. encheleia*. Figueras *et al.* (2000) added two additional endonucleases *Alw*NI and *Pst*I to this restriction fragment length polymorphism (RFLP) method to differentiate *A. salmonicida* and *A. bestiarum* and for recognition of *A. popoffii*.

8. Randomly Amplified Polymorphic DNA polymerase chain reaction (RAPD-PCR)

Williams and colleagues developed the RAPD-PCR technique in 1990. RAPD-PCR is a rapid and simple technique, which requires no previous knowledge of nucleotide sequences, and is not reliant on the actual transcription and translation. In addition, it is highly sensitive, requiring a minimum amount of template DNA and it potentially analyses

the whole genome, as well as being highly discriminative. RAPD-PCR was used to study the differentiation of seven *A. hydrophila* strains and thirteen *A. salmonicida* strains in genospecies and it was found that the scatter profiles of motile *A. hydrophila* isolates were different between isolates (Miyata *et al.*, 1995; Inglis *et al.*, 1996; Oakey *et al.*, 1996). These indicate the genomic diversity of *A. hydrophila* isolates, while the profiles of non-motile *A. salmonicida* isolates were homogeneous. RAPD-PCR may be useful for preliminary investigation of relatedness within *Aeromonas* groups because: (1) RAPD-PCR analysis has proved useful to demonstrate the similarity of isolates of *A. salmonicida* subspecies *salmonicida* from widely diverse geographical origins; (2) the technique allows discrimination of atypical strains and demonstration of like isolates within the heterogenous hydrophila-complex; (3) RAPD-PCR promises to be useful in epidemiological studies for rapid identification of bacteria for which a source of reference DNA is available and may be useful in preliminary investigations of relatedness within groups; but (4) the limitations of the method in comparative studies between systems must be borne in mind, at least within the current technical constraints (Inglis *et al.*, 1996).

9. Amplified Fragment Length Polymorphic-Polymerase Chain Reaction (AFLP-PCR)

For the AFLP-PCR analysis, the total genomic DNA of microorganism is digested with restriction endonucleases. Then restriction fragments are selectively amplified under high-stringency PCR conditions. The amplification products are separated by running polyacrylamide gel and visualized by autoradiography and the AFLP-profile or band patterns is useful to differentiate between strains of microorganisms. AFLP-PCR can separate the different 14 DNA hybridization groups (HGs) in the genus of *Aeromonas.* The digitized fingerprints of 13 AFLP corresponds with the DNA hybridization group and shows the significant genotypic heterogeneity of *A. eucrenophila* (HG6), but this method does not separate the difference between *A. veronii* (HG8/10) and *A. eucrenophila* (HG6) (Huys *et al.*, 1996). AFLP technique is a valuable high-resolution genotypic tool for classification of *Aeromonas* species.

Conclusion

Aeromonas causes traveller's diarrhoea affecting millions of people, particularly traveller's visiting less developed regions (Asia, Africa and Central and South America). *Aeromonas* spp. should be included in the list of possible enteric pathogens so that the organisms will not be overlooked. *A. hydrophila* is responsible for causing Motile Aeromonad Septicemia (MAS), Hemorrhagic Septicemia, Ulcer disease or Red-Sore disease in fresh water fishes. 'Stress' is the main underlying factor in addition to mishandling, overcrowding, transportation under poor conditions, poor level of nutrition and poor water quality. The presence of *Aeromonas* in fishes is the most common and troublesome cause of Motile Aeromonad Septicemia and treatment with terramycin and romet approved to be useful for control of Motile Aeromonad infections in fishes. The virulence factor of these isolates associated with EUS can be compared with of human diarrheal and environmental isolates. Modern methods like PCR, Plasmid profile are more affective to differentiate virulent and avirulent strains of *Aeromonas*.

Future Scope

Aeromonas hydrophila is a widespread representative of *Aeromonas* found in water, water habitants, domestic animals and foods (fish, shellfish, poultry, and raw meat). The microorganism has the potential to be a foodborne pathogen, especially strains from hybridization group (HGl), associated with clinical cases of illness. The pathogen produces different virulence factors including exotoxins, cytotoxins and others. As a psychrotroph, *A. hydrophila* grow in foods during refrigeration. The disease spectrum associated with this microorganism includes gastroenteritis, septicemia, traumatic and aquatic wound infections, and infections after medical leech therapy. Multiple resistance of the bacterium to many antimicrobials is a fact of high significance. The potential of *A. hydrophila* to become a food borne pathogen is a controversial issue. Many approaches are effective for control of the presence of *A. hydrophila* in food for human consumption. The serotypes of *Aermonas* should be studied thoroughly using the latest tools of molecular biology to get the detailed antigenic

profiles. This can be added to better understanding of the zoonotic nature and mutation patterns of the organisms. The epidemiological features of *Aeromonas* spp. infection should be vividly studied including the environmental factors, immunosuppressive factors and other adaptability factors of host and pathogen responsible for the establishment of pathogenic state. Public health and safety aspect of meat products sold in the market should always be the first priority and should taken into account strictly. Detailed characterization of various toxins of the organism can be further studied. Also, efforts should be directed to have better vaccines with specific portion of the immunogens to get better immunogenicity than the vaccines used now a days with variable efficacies. The multiple drug resistance phenomenon showed by these organisms should also be studied in details and the changes of transferable drug resistance and plasmid borne resistance phenomenon in order to invent newer antimicrobial substances which are cheap, safe and effective with newer mechanism of action. All slaughterhouse workers should be screened serologically. The pathogenicity can be studied in detail through histopathological examination to know the extent of pathogenesis of the disease.

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Seasonal variation in water quality of River Vishwamitri with reference to physico-chemical parameters

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Abstract

River Vishwamitri at Vadodara was studied for physico-chemical parameters at four sites for summer and monsoon seasons in the year 2011. The correlation between various water quality analysis was performed. In summer, pH, EC, TDS, TSS, Turbidity and BOD showed positive correlation with temperature and negative correlation with COD, Chloride and hardness. In monsoon, TDS, EC, Turbidity, BOD, COD, Chloride and Hardness showed positive correlation with temperature and negative correlation with pH and TDS. The undesirable changes in the river quality parameters suggested that the river is highly polluted as it is used as a sewer collector.

Keywords*: Correlation, physico-chemical parameters, pollution, seasonal variation, Vishwamitri, water quality*

Introduction

Natural streams and rivers are the sources of water to fulfill human needs at different location (Mahadev *et al.*2010). River pollution in India has now reached to a point of crisis due to unplanned urbanization and rapid growth of industrialization. The entire array of life in water is affected due to pollution in water (Saksena *et al.* 2008). The problem of water quality deterioration is mainly due to human activities such as disposal of dead bodies, discharge of industrial and sewage wastes and agricultural runoff which are major cause of ecological damage and pose serious health hazards (Meitai *et al.*2004). Vadodara is a major industrial city of Gujarat state. There are number of industries located in and around the residential areas of the city which are having significant environmental impact. The Vishwamitri flows west through the city of Vadodara and joins with the Dhadhar river and Khanpur River and empties into the Gulf of Khambhat, near Khanpur village. As it flows through Vadodara, the Vishwamitri river is subjected to the drainage of the city's sewage and effluents from nearby industries. It definitely causes some significant impact on the water environment. The river water remains turbid all through the year with characteristic odour at many places. Examining physico-chemical characteristics of the river help discern changes brought about by industrial and domestic wastewater discharge during the river course. Hence, the present study focused on assessing river water parameters in two different seasons.

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Material and Methods

Four sampling station were selected based on accessibility and introduction of waste. Samples for physico-chemical analysis were collected for two seasons; summer and monsoon (March-October) during the year 2011. Standard methods (APHA 1995) were used during collection, preservation and estimation of different parameters.

Results and Discussion

The results of seasonal variation of physico-chemical parameters of river water are presented in Fig. 1 to10. Correlation coefficients between various parameters are indicated in Table 1 and 2.
Study of physico-ch emical characteristic of river water suggests that the various parameters depend upon the hydrochemistry of study area and also upon the waste water released (Sharma *et al.* 2011).

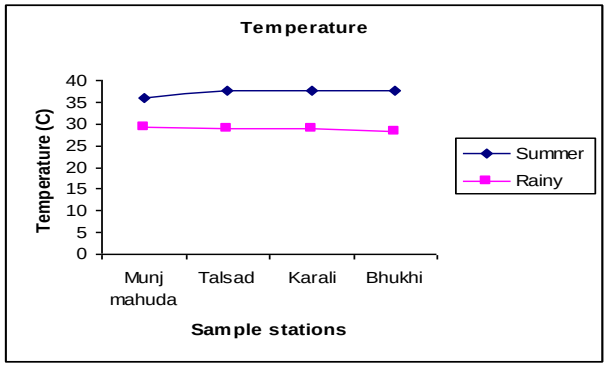

Fig. 1

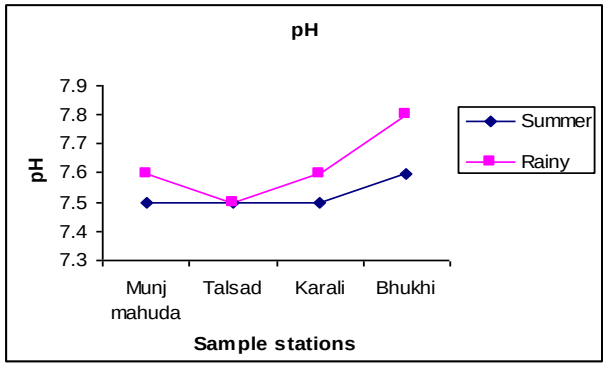

Fig. 2

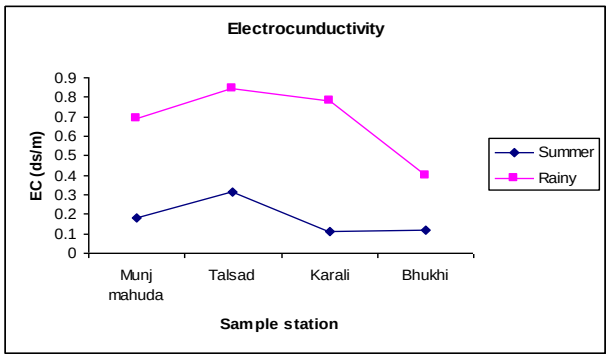

Fig. 3

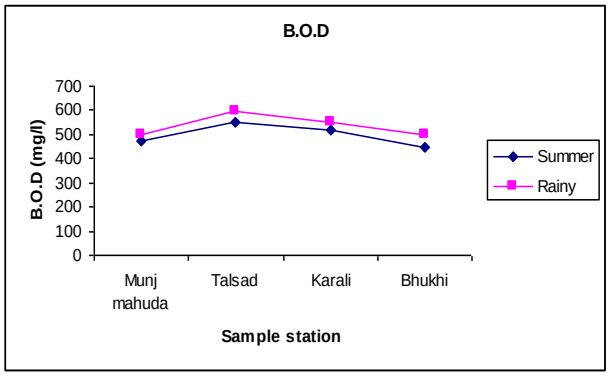

Fig. 4

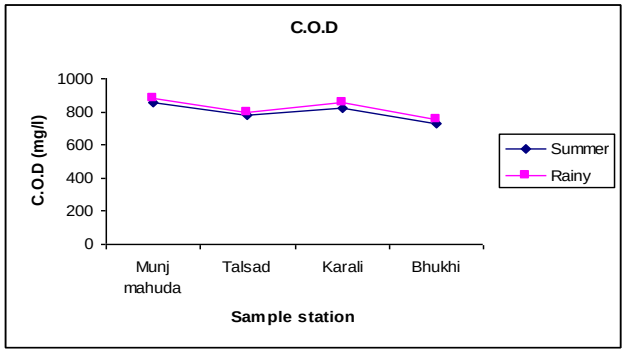

Fig. 5

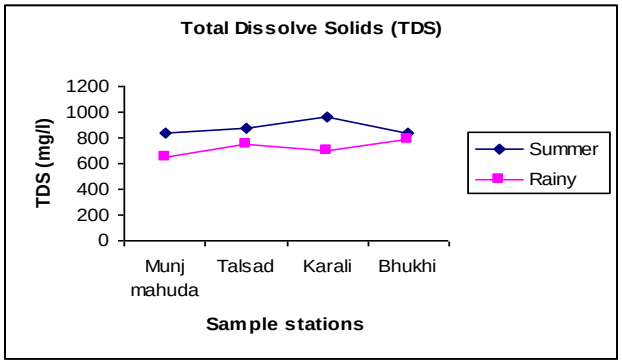

Fig. 6

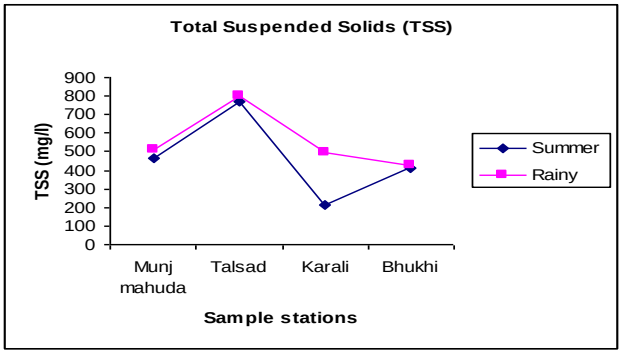

Fig. 7

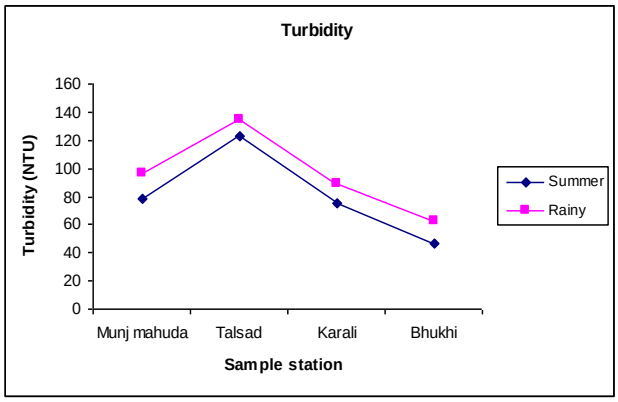

Fig. 8

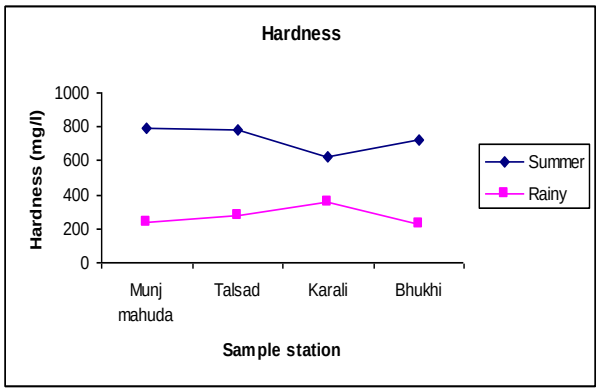

Fig. 9

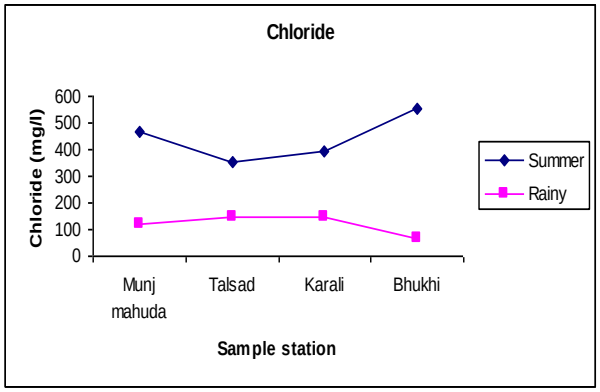

Fig. 10

Table No. 1 Correlation coefficients between the parameters during summer season

	Temp.	pH	TDS	TSS	Turbidity	EC	BOD	COD	Chloride	Hardness
Temperature	1	0.333	0.518	0.017	0.156	0.077	0.477	-0.635	-0.304	-0.518
pH		1	-0.426	-0.159	-0.722	-0.446	-0.713	-0.812	0.855	-0.059
TDS			1	-0.555	0.083	-0.288	0.489	0.264	-0.538	-0.859
TSS				1	0.742	0.946	0.446	-0.215	-0.343	0.825
Turbidity					1	0.919	0.897	0.237	-0.88	0.414
EC						1	0.693	-0.005	-0.626	0.689
BOD							1	0.174	-0.971	-0.022
COD								1	-0.4	0.02
Chloride									1	0.04
Hardness										1

Table No. 2 Correlation coefficients between the parameters during rainy season

	Temp.	pH	TDS	TSS	Turbidity	EC	BOD	COD	Chloride	Hardness
Temperature	1	-0.866	-0.846	0.437	0.662	0.867	0.356	0.871	0.833	0.554
pH		1	0.467	-0.81	-0.932	-0.975	-0.76	-0.521	-0.941	-0.895
TDS			1	0.075	-0.191	-0.485	0.189	-0.977	-0.454	-0.025
TSS				1	0.963	0.712	0.877	-0.059	0.66	0.947
Turbidity					1	0.849	0.832	0.21	0.794	0.951
EC						1	0.765	0.578	0.992	0.863
BOD							1	-0.076	0.773	0.96
COD								1	0.57	0.101
Chloride									1	0.843
Hardness										1

Temperature is basically important for its effects on certain chemical and biological reactions taking place in water and aquatic organisms. It depends upon the season, time of sampling and also upon the temperature of effluents which are being added into the river. The higher temperature was recorded in summer than in rainy season in the present study of river Vishawamitri water which were within range 28-38^{0}C (Fig.1). Similar seasonal variation in water temperature was recorded by Saksena *et al.*

(2008) in Chambal river and Nath and Shrivastva (2001) in river Narmada. In summer season temperature showed negative correlation with COD, Chloride and hardness and positive correlation with pH, TDS, TSS, turbidity, EC, and BOD. While in rainy season temperature showed negative correlation with TDS and pH and positive correlation with TDS, turbidity, EC, BOD, COD, chloride and hardness.pH is an important parameter which is important in evaluating the acid-base balance of water. The pH values of water at sewage discharge points were usually lower than that of the river water (Sharma *et al.* 2011). If pH value is higher than the permissible limit, it will affect adversely alkalinity of the soil, microbial life and corrosion rate (Saikh and Mandre, 2009). Slightly alkaline pH is preferable in waters, as heavy metals are removed as carbonate or bicarbonate precipitates (Ahipathy and Puttaiah, 2006). Patel and Patel observed summer minima but recorded monsoon high. Summer minimum are due to increased decomposition rate, leading to acidification and lowered the pH of water (Chetana *et al.* 1997). In present study, pH was found slightly alkaline in all four study site between ranges 7.5 to 7.8. pH value in all the sites showed the same seasonal trend with summer minima and monsoon maxima (fig.2). pH showed negative correlation with TDS, TSS, turbidity, EC, BOD, COD and hardness and was positively correlated with chloride and temperature in summer season. During rainy season pH showed positive correlation with TDS and negative correlation with TSS, Turbidity, EC, BOD, COD, Chloride, Temperature and Hardness.Conductivity is the measure of capacity of substance or solution to conduct electrical current through the water and also an excellent indicator of TDS, which is a measure of salinity that affects the taste of potable water. Concerned to season it was found maximum in monsoon season compare to winter and summer (Saikh and Mandre, 2009). In present study maximum EC was observed during rainy season (0.400 - 0.842 ds m^{-1}) and minimum in summer season (0.115 – 0.316 ds m^{-1}) (Fig.3). Conductance showed significant positive correlation with turbidity, TSS, temperature, BOD and hardness, while negatively correlate with COD and Chloride in summer season. In rainy season conductance showed significant positive correlation with hardness, chloride, BOD, COD, turbidity, TSS and temperature and negative correlation with pH and TDS.BOD and COD are the most important parameter used to assess the quality of water regarding organic matter present in both suspended and dissolve form. COD is the amount of oxygen required to carry out oxidation of organic waste by using strong oxidizing agent, where BOD is the amount of oxygen required to microorganism to degrade organic waste anaerobically (Saikh and Mandre, 2009). In all four sites, highest BOD and COD values were observed during summer with lowest value in rainy season (Fig.4 and 5).Dissolved solids in water include all inorganic salts, silica and soluble organic matter. Pure water must be free from most suspended particles, which are responsible for turbidity. TDS was highest in summer due to evaporation, reduced input of water and also greater solubility of ions at higher temperature which contribute to increased concentration and was at the minimum value in the rainy season due to an increased input from rains. The TDS concentration of river Vishwamitri water samples in summer and rainy season was found to be in range of 842 – 961 mg L^{-1} and 650 – 790 mg L^{-1} respectively as shown in fig. 6. TDS showed negative correlation with pH, TSS, EC, chloride and hardness in summer and in rainy season TDS showed negative correlation with turbidity, EC, COD, chloride, hardness and pH.Turbidity is a measure of the amount of suspended colloidal particles and dissolved materials. Increase in turbidity indicated an enhanced pollution status of the water body. The present study reported high values in rainy days (63-135 NTU) for turbidity with low summer averages (46-123 NTU)(Fig.8). High monsoon averages are owing to the turbulence arising out of flood like situation observed during the rainy season, resulting also in the formation of foam. Low summer averages are due to gradual sedimentation in the stream (Ahipathy and Puttaiah, 2006). Turbidity showed negative correlation with chloride during summer season and also showed negative correlation with TDS and pH during rainy season.In the present study, maximum values (624

– 791 mg L^{-1}) of hardness were observed due to evaporation and reduced inflow in summer, and minimum values (230 – 276 mg L^{-1}) due to dilution in the rainy season (Fig.9). Hardness is due to the presence of calcium and magnesium salts in water. Hardness showed negative correlation with BOD, TDS, pH and temperature and significant positive correlation with chloride, COD, EC, turbidity and TSS in summer season. It showed negative correlation with pH and TDS and positive correlation with chloride, COD, BOD, EC, turbidity, TSS and temperature. An excess of Chloride (Cl^-) in inland water is usually taken as an index of pollution. Sewage water and industrial effluents are rich in Cl^- and hence the discharge of these wastes results in high chlorides levels in fresh waters. In present study maximum chloride was observed during summer season (355- 554 mg L^{-1}) while minimum chloride values were recorded during rainy season (65 – 150 mg L^{-1}). Only hardness and pH were positively correlated with chloride in summer season. Whereas in rainy season Cl^- showed positive correlation with number of parameters like hardness, temperature, TSS, turbidity, EC, BOD and COD.It is therefore conclude that the river is highly polluted as it is used as a sewer collector and is unfit for domestic and agricultural purposes.

Acknowledgement

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Studies of surfacewater quality of the Kashipur, Uttarakhand, India

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Abstract

Pollution of water bodies is one of the areas of major concern to environmentalists. Water quality is an index of health and well being of a society. Industrialisation, urbanisation and modern agriculture practices have direct impact on water resources. These factors influence the water resources quantitatively and qualitatively. The study area selected were the Bahella river, Mahadev stream and Kosi river basin of Kashipur, Uttarakhand, India. The Bahellariver, Mahadev and Kosi river water is an important source of potable water supply for Kashipur as well as adjointed areas of the U. S. Nagar district for all purposes.Thephysico-chemical parameters like temperature, pH, turbidity, total hardness, alkalinity, BOD, COD, chloride, nitrate and phosphate and fluoride content in water of Bahella river, Mahadev stream and Kosi river were studied to ascertain the drinking and domestic as well as irrigation water supply in Kashipur area. In this present study water quality of Bahellariver, Mahadev stream and Kosi river is taken into account and Khokartalwater is found to be severely polluted with reference to these analyzed parameters.

Keywords*:Kosi river, Bahellariver, Mahadevstream, dissolved oxygen, water quality, Kashipur*

Introduction

India has experienced substantial increase in industrial growth and expansion in recent years. The industry has resulted in increased pollutant emissions and the deterioration of environmental quality and human health in major cities in India. After formation of Uttarakhand as a new State rapid industrialization and urbanization took place due to this there is great pressure on the environmental components.Water is one of the most common yet the most precious resources on earth without which there would be no life on earth. Pollution is a serious problem as 70% of India's water resources and as growing number of its water reserves have been contaminated by biological, organic and inorganic pollutants (Yadav and Kumar, 2011).In south asian countries such as Nepal, India and Bangladesh, pollution of rivers is more severe and critical near urban stretches due to hugeamount of pollution load discharged by urban activities. The Bagmati River in the Kathmandu valley, Yamuna River at Delhi, Buriganga River of Dhaka, Tamiraparani River and Ganga Riverand Ruva River, suffer from severe pollution (Karn, *et. al*., 2001). Water of river Hindon was found to be more polluted than river Narmada Sidhartha, (2002). The pollution of Pamba River is due to Sabrimala pilgrimage, free flow of sewage, domestic waste andfaecalmatter into the river. The main cause of water pollution is human activities. Humans produce bodily wastes that enter the river and polluted water Rao, (1979). Industries discharge variety of pollutants in the waste water including heavy metals, organic toxins, oil nutrients and solids. Many of the substances are toxic or even carcinogenic.Pathogens can obviously produce water born diseases in either human or animal hosts. These wastes also increase the concentration of suspended solids (turbidity), bacteria and virus growth leading to potential health impacts. Increase in nutrient load may lead to eutophication; organic wastes increases the oxygen demand in water

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leading to oxygen reduction in water with potentially severe impacts on whole ecosystems Rao (1979).

Description of Study area.

Kashipur is an old industrial town of Uttarakhand State, earlier belonging to Uttar Pradesh. This town experienced an industrialization way back in 1988 – 1989. Few major type of industries working in this area belongs to Distillery, Chemical, Paper and other small industries. After formation of Uttarakhand in the year 2000 and due to fiscal benefits various kinds of industries are coming up in this area, which includes paper, distillery, chemical, and gas based thermal power.Kashipur has been identified as one of the potential Industrial developing area in Uttarakhand. The study area located in the industrial area of Kashipur in Udham Sing Nagar district of Uttarakhand between 29°10'32.1798'North Latitude and 79°0'24.3457"East Longitude. Major industries in the study area can be categorized broadly into three: viz., Pulp & Paper, Chemical and Steel as given below in Table 2.The sources of water contamination are mainly effluent from industries located at Kashipur, from seweragedisposal from homes. The sources of water contamination are also the water purification process, dumping of chemicals in the water resources, accidents of oil leakage etc.Surface water is mainly contaminated due to direct sources of water contamination. Like the industries effluent, sewage plants, mines, oil plants and tankers, leakage of fuel, direct disposal of waste in water sources, and agriculture.Sewage includes organic matter, animal and human excreta-one of the major pollutants of water in the urban and rural areas is the sewage. The sewage contains the organic matter that encourages the growth of microorganisms. These organisms besides spreading diseases also consume the oxygen present in water. This creates an imbalance in the aquatic ecosystems.Water bodies are being constantly polluted by dumping of sewage which includes organic matter and by the runoff from the agricultural fields that contains fertilizers. Pollutants like sewage, organic wastes and fertilizers contain good amount of inorganic nutrients like nitrates and phosphates.Eutrophication also results in overgrowth of plants like Eicchornia that covers the entire surface of water. This reduces the light reaching the lower layers in water.Thus, enrichment of water with inorganic nutrients like nitrates and phosphates is called eutrophication.These nutrients enrich the water promoting the growth of algae. The water turns green. This is called algal bloom. Rich algal growth leads to great increase in the number of the decomposers. All these life forms-decomposers, algae, other plants, fishes and other aquatic animals, use the oxygen in the water for respiration. This causes great demand for oxygen and results in depletion of oxygen.

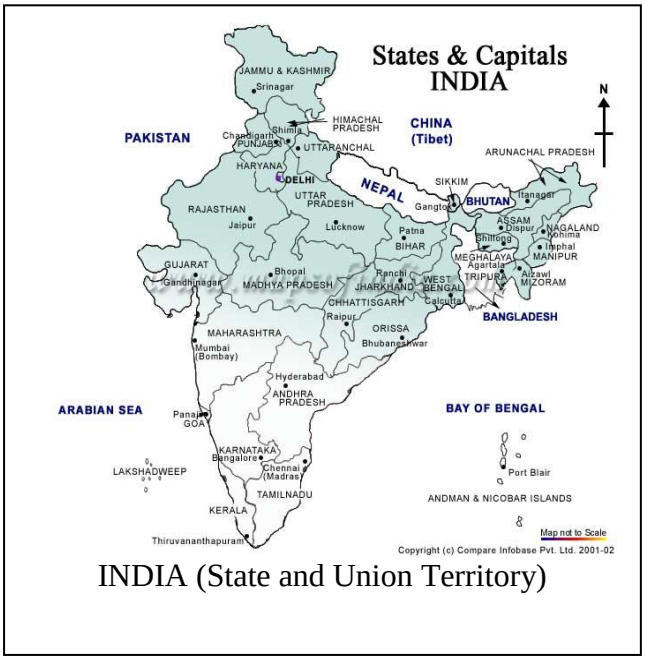
Table 1. Industrial Activity in Kashipur Area

Industry	Location	Product
India Glycols Limited	Bazpur Road	Chemicals
Goraya Straw Board Mills Pvt Ltd	Bazpur Road	Paper
Multiwal Pulp & Board Mills (P) Ltd.	Bazpur Road	Paper
Prolific Papers (P) Limited	Village Girdhai, Aliganj Road,	Paper
Cheema Papers Ltd	Nainital Road	Paper
Shravanti Energy	Aliganj Road	Electricity (yet to start)
Gama Energy	-	Electricity (yet to start)
Beta Energy	-	Electricity (yet to start)
Naini Paper	Ramnagar Road	Paper
SRF	Ramnagar Road	Chemical
KashiVishwanth Steels Ltd	Bazpur Road	Steel, Special Alloys
Jindal Baverages	Bazpur Road	Frozen Foods, Edible Oils

Selection criteria of siting the monitoring stations

A total of 6 sampling locations areset up to monitor the surface water quality in the study area. Each such sampling point represents a unique category of microenvironment.The area under study is the basin of river Kosi which pass through Kashipur,

Uttarakhand. It covers 2,367 Km² areas. The people of this area work mainly in agriculture and industries in nearest places. The Kosi River water is used for agricultural, domestic use and as well as drinking purpose.The area under study is the basin of river Bahellawhich pass through Kashipur, Uttarakhand. The people of this area work mainly in agriculture and industries in nearest places. The Bahella River water is used for agricultural, domestic use and as well as drinking purpose in some places.The area under study is Khokratalwhich is near KharagpurDevipura village of Kashipur, Uttarakhand. The people of this area work mainly in agriculture and industries in nearest places. The Khokratal water is used for agricultural,domestic use.The area under study is the Mahadev stream which passes through villages near Kashipur, Uttarakhand. The people of this area work mainly in agriculture and industries in nearest places.TheMahadev stream water is used for agricultural and domestic use in some places.These stations were selected on the basis of even distribution over the study area taking in to consideration various factors like topography of the region, proximity of sensitive establishment and human settlements, industrial activities in the area and its proximity, down wind direction etc. Location plan of the sited ambient air quality monitoring station is presented in Figure 1 and each station site is briefly described below:



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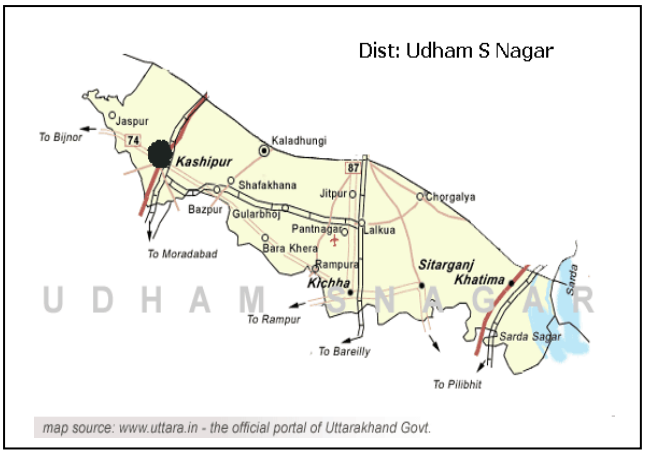

Methodology (Sampling and Analysis)

Water Sampling:

Water samples were collected from 6 locations which aresituated in Kosi river basin and from each location four water samples were taken for study toanalyse the water quality. The samples are collected in clean polyethylene bottles and prior tocollection, the bottles are rinsed throughly with sample water. The water samples are takenthrough pumping so the samples will be a representative in order to avoid any contaminationfrom the surface of river basin.

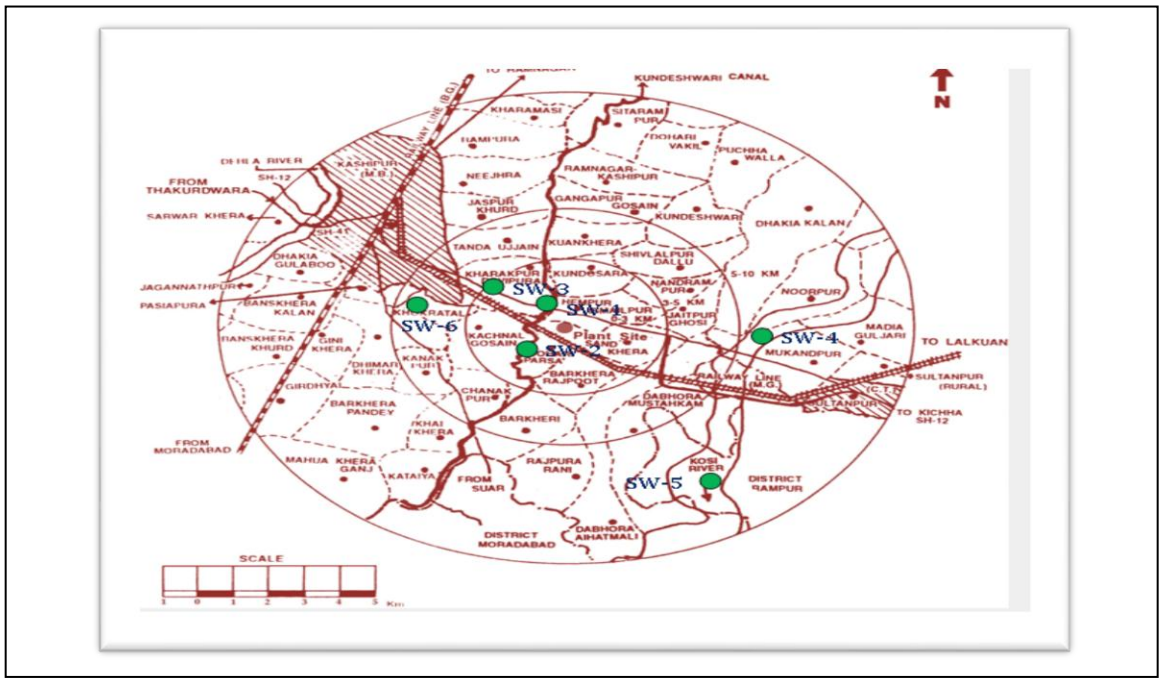

Fig. 1 Map of industrial area of Kashipur, showing study area and air monitoring station

Table 2: Techniques used for ambient air quality monitoring

Parameter	Technique
1. Water temperature	Water temperature was recorded in the field using mercury thermometer.
2. pH	The pH of the samples was determined by using digital pH meter
3. Turbidity	Turbidity was determined by Naphelo-turbidity meter
4. Total hardness	Total hardness was determined tetrimetrically using EDTA method
5. Total alkalinity	Total alkalinity was determined by tetrimetrically method.
6. BOD	BOD was determined as per standard method.
7. COD	COD was determined by potassium dichromate open reflex method
8. Chlorides	Chlorides were determined by Mohr's argentometry method.
9. Nitrate and phosphate	Nitrate and phosphate content is determined per standard method
10. Fluoride	Fluoride content is determined using ELICO-52 UV spectrophotometer

Results and Discussion

The maximum water temperature (20.0^{o}C) was obtained at Bahellariver and minimum watertemperature (17.0^{o}C) was obtained at Kosi river. The variation in water temperature may be due to

different timing of collection. Temperature controls behavioral characteristics of organisms, solubilty of gases and salts in water. No other factor has so much influence on temperature Khanna & BhutianiThe maximum value of pH of the water samples

was recorded as 8.0 at Bahella river and minimum value of pH was recorded as 7.48 at Mahadev stream &Kosi river . In general pH was within the limits of standard value. For drinking water source, a pH range of 6.5-8.5 is recommended.The present study shows the turbidity in the range of 2.2 -4.8 NTU. World Health Organization prescribed the

highest desirable limit 5.0 NTU and maximumpermissible limit 25.0 NTU. The value of turbidity present is within permissible limits.The alkalinity of water is its capacity to neutralize acids. The maximum alkalinity was recorded as 302mg/l at Bahella River and minimum value is recorded as 143mg/lat Mahadev stream. BIS has set a desirable levelof alkalinity in drinking water to be 200 mg/l where as its value has been prescribed to be 600 mg/l in the absence of alternative source. So in maximumstations value of total alkalinity present in water are within limit.

Table 3: Average value of pollutants in 2011

S. No	Parameter	Unit	BahellaRiver (U/S)	Bahella River (D/S)	Mahadev Stream	Kosi River (U/S)	Kosi River (D/S)	Khokratal
1.	pH	-	7.85	8	7.48	7.52	7.48	7.65
2.	Temperature	Deg C	20	18	19	17	19	18
3.	Color	Hazen	C.L.	C.L.	C.L.	C.L.	C.L.	Light yellow
4.	Conductivity	µδ/cm	624	-	464	522	-	532
5.	Dissolved Oxygen	mg/l	3	4	5	4	4	2.8
6.	Total Coliform	MPN/100 ml	32	36	38	28	34	54
7.	B.O.D. (3days at 27 degC)	mg/l	4	8	3	2	8	6
8.	COD	mg/l	16.2	18	14	8	18	24.4
9.	Total dissolved Solids	mg/l	488	385	352	337	385	393
10.	Total Suspended Solids	mg/l	252	56	114	119	56	147
11.	Turbidity	NTU	4	2.2	3	4.2	3	4.8
12.	Total Hardness as CaCO3	mg/l	373	288	383	353	288	478
13.	Total Alkalinity as CaCO3	mg/l	158	302	155	157	302	190
14.	Chlorides as Cl	mg/l	16	32	14	14	32	56
15.	Sodium	mg/l	41.4	-	39.1	35.5	-	33.6
16.	Potassium	mg/l	18.1	-	16.6	20.7	-	19.3
17.	Iron as Fe	mg/l	0.46	0.12	0.33	0.35	0.12	0.54
18.	Zinc as Zn	mg/l	0.025	-	0.021	0.019	-	0.038

parameter but indicates water quality.Biochemical oxygen demand is usually defined as the amount of oxygen required by bacteria in stabilizing the decomposable organic matter.BOD gives an idea

In the present study water hardness of different locations was observed in the range of 288-478mg/l. The hardness of water is not a pollution

about the extent of pollution. In present study water samples, sampling stations BOD was found in the range of 2-8mg/l, it indicates that thepollution affects the water quality. As water can be use as drinking water without conventional treatment but after disinfection if BOD 5 days 20^0C is 2 mg/l or less.The chemical oxygen demand is a measure of oxygen equivalent to the requirement of oxidizing organic matter contents by a strong chemical agent.The COD test is helpful in indicating toxic conditions and the presence of biologically resistant organic substances. The maximum COD value was recorded 24.4mg/l at station Khokhratal and the minimum values was recorded as 8 mg/l at station Kosi River. The high value of COD due to high level of pollutants present in water samples.Dissolved oxygen is usually defined as the amount of oxygen available in in stabilized water. DO gives an idea about the extent of pollution. In present study water samples, sampling stations DO was found in the range of 2.8-5 mg/l, it indicates that the pollution affects the water quality. As water can be use as drinking water without conventional treatment but after disinfection if DO is 6 mg/l or more. Chlorides occur in all natural waters in widely varying concentrations. The chloride contents normally increases as the mineral content increases. In present study the chloride concentration were found in the range of 12-56mg/l. The maximum chloride contents were due to addition of natural contaminants and pollutants in the Khokratal.The nitrate content of water bodies was found in the range of 16-32.5mg/l. The highest value of 32.5 mg/l was recorded at station SWQ6 (Khokratal) while minimum at station SWQ1 (BahellaRivel U/S) and it is observed that all the station except SWQ1 (BahellaRivel U/S)are higher the accepted limits of drinking water standards of ICMR. (Limit of Drinking water as per ICMR 20 ppm and ISI 45 ppm).The fluoride content in water is below detectable limit.

Conclusion

Most of the water samples collected in Kosi river basin is evident in all physico-chemicalparameters examined. In general all the parameters are within the range of standard valuesprescribed by various agencies.The water of Khokratalis highly contaminated during the course of study and it is unfit for consumption, domestic and irrigation purposes.Some steps are needed urgently to improve the quality of Kosi River.

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Documentation of fishes and physico-chemical characters of a stream Indrawati- a spring fed tributary of River Bhagirathi at Uttarkashi (Central Himalaya, Garhwal) India

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Abstract

Most of the riverine resources in Garhwal region are mountainous and perennial either snow fed or spring originated. All these mountainous streams provide a good natural habitat for survival of hill stream fishes. Present communication deals with documentation of Ichthyofauna along with physico-chemical properties of a similar perennial spring fed stream Indrawati- a left side tributary of river Bhagirathi. It comes down from the hills of Baragari and through Joshiyara debouches into the river Bhagirathi at Uttarkashi (elevation 1128 masl). Major part of stream water is mainly abstracted for the irrigation purpose in the side lying fields all along its length. There is heterogeneity in the stream bed characteristics which results into the existence of varied fish fauna. Study reports eleven fish species from the stream belonging to two orders, three families and six genera. Fishes belonging to cyprinidae family are found more commonly than the cobitidae and sisoridae family. Fishery of the stream is of subsistence nature and is under intense pressure of anthropogenic activities. Fishes captured are of generally small sized. The physico-chemical characteristics recorded during the study period in the different seasons are water temperature (9.0-16.0 ^{0}C), velocity (.50 m^{-s}-1.46 m^{-s}), TDS (49 mg^{-l} – 65 mg^{-l}), pH (8.0 - 8.3), DO (7.3 mg^{-l} – 10.5 mg^{-l}), Free CO_2 (0.10 mg^{-l} – 0.30 mg^{-l}) and turbidity (06-30 NTU).

Keywords*: Hill stream, Ichthyofauna, physico-chemical characteristics, river Bhagirathi, stream habitat*

Introduction

Indrawati stream is a spring fed perennial stream. It originates from the Baragari hills and merges into river Bhagirathi on its left bank at Uttarkashi (elevation 1128 masl). The stream is life line for people settled in small hamlet along the stream bank. Besides irrigation, stream water is used for drinking and other household purposes by the inhabitants. It provides critically important habitat for some of the important hill stream species of river Bhagirathi in Garhwal Himalaya. It provides habitat heterogeneity (pools, rapids, runs, falls and cascade) for the subsistence of some small sized cat fishes, lesser barils and few loaches. Fish fauna exhibits enormous diversity in their habitat, size, colour and shape. They are found in almost every type of water body (fresh, marine and brackish). Approximately 32,300 fish species are catalogued in fish base (http://www.fishbase.org/) from world over. Huge heterogeneity in the climatic condition and altitudinal variation favors very rich fish faunal diversity in India. A total of 2,500 fish species have been reported from Indian waters of which 930 species are the freshwater species (Jayaram, 2010). Indian uplands also have a rich ichthyofaunal diversity of 258 species (Sunder *et al*., 1999). The Garhwal region of Central Himalaya which has pristine water resources with tremendous range of thermal regime supports 64 fish species from number of large and small river systems studied by Singh *et al*., (1987). Though documentation of ichthyofauna of Garhwal (Central Himalaya) have been carried out by many workers (Badola and Pant, 1973; Badola, 1975; Sharma, 1984; Singh *et al*., 1987; Lakra *et al.*,1987; Dobriyal 1991; Khanna and Badola, 1991, Singh *et al*., 1993; Agarwal *et al*., 2005, 2011; Uniyal and Kumar, 2006; Bisht *et al*., 2009), but comprehensive information on some of the important small streams is still lacking. The

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Indrawati stream - a small but important tributary of Bhagirathi river system is one of them which didn't receive any attention. The present study is an attempt to fill up this lacuna and to catalogue the base line information of the fish species and water quality of Indrawati stream.

Study area:

Study area is located in the upper and lower stretches of the Indrawati stream (31^0 27' 34" N to 31^0 13' 22" N latitude and 77^0 58' 51'' E to $78^0$53' 32'' E longitude) (Fig.1). The upper stretch (1250 masl) is ~5 km upward from the Joshiyara, where the river is gorge like and rocky or full of large boulders (Fig 2). The stream has high gradient in this stretch. The lower stretch (1130 masl) is located at Joshiyara where the river has somewhat less gradient. The stream bed consisted of cobbles, pebbles and sand besides boulders. The river water is also abstracted in agricultural fields on both river banks in lower stretch. The total water discharge of stream fluctuates considerably, sometime in the

Fig. 1 Sampling sites (S-1 and S-2) in Indrawati stream- a tributary of river Bhagirathi

Fig. 2 Upper stretch of Indrawati Stream

summer season for a short duration, stream seems almost discontinuous at several places restricting water in the pools. The stream shows heterogeneity in the streambed characteristics in the lower and upper stretches. Deep pools are dominated in the lower stretches along with rapids and runs. While upper stretch is dominated by rapid, fall, runs and cascade type of habitat.

Material and Methods

Two sampling sites- one each in upper and lower stretches, were selected depending on the habitat variation and substratum types. For the documentation of ichthyofauna of Indrawati stream, experimental fishing was done in both upper and lower stretches of the stream. Collection was made from both the stretches during daytime (6:00-18:00 hrs) while 'baur' and 'gill net' were also fixed during late evening hours (17:00 -18:00 hrs) and recovered in early morning (5:00 -7:00 hrs). The fishes were collected with the help of local fishermen proficient in this occupation. The cast nets (dia. 2.0 m, mesh size 1.8 x 1.8 cm), gill nets locally called Jal (mesh size 1.2 x 1.2 cm, L x B = 12 m x 1.5 m) and another type of gillnet 'phans or baur' are primarily used for the collection of fish samples. The 'baur' is a type of indigenous nets, fabricated of several fine nylon loops knotted over a long nylon cord of 5-8 m length, rope is spread on the bottom of stream cross section with the help of large stones tied in few loops. Some other type of indigenous fishing method/ traps viz. goda, pot trap, hammering, hook and lines, diversion of river channel, and hand picking are also used. Digital images of fresh specimen were taken prior to preservation. Subsequently the representative fish samples were preserved in 8% formaldehyde solution at the site of their collection. Small fish specimen (<150 mm in total length) were preserved directly without preservative injection or opening the visceral cavity. But the large specimen (>150 mm in total length) were preserved with preservative injection or slitting the abdomen. Afterwards fish samples were transferred to the laboratory with extensive care for further taxonomic studies. The identification of fish species was done in the laboratory on the basis of their morphmetric and meristic characters. The standard keys outlined in literature (Day, 1878; Menon, 1974; Srivastava, 1980; Tilak, 1987; Talwar and Jhingran, 1991; Shrestha, 2008: Badola, 2009; Jayaram, 2010) and fish data base developed by NBFGR was also consulted for the identification of fishes. Physico-chemical characters of the stream viz. Temperature, Water velocity, DO, Free CO_2, TDS, pH and Turbidity were also determined seasonally (monsoon, summer and winter). These parameters were analyzed after following Trivedy and Goel, (1986) and APHA, (1998). The relative abundance (RA) of fish across different seasons was worked out by the following formula.

RA = Number of samples of particular species × 100/ Total number of samples

Results and discussion

Fish diversity and abundance:

The preparation of fish species inventory of Indrawati stream, from fishery viewpoint and ecological characteristics was done during the period 2010-12. A total of eleven fish species are collected from the whole stretch of stream during study period. All the species found in the stream are endemic, belonging to six genera, three families and two orders (Table 1). Among these three families, the species belonging to Cyprinidae family are found most common occupant in the stream. Cyprinidae family is represented by six species of three genera. The species of Cobitidae family are found rarely. It is represented by three species of a single genus. The family Sisoridae is also found rarely and has two species of two genera in the stream. Only *Schizothorax richardsoni*, is

found abundantly. While the species viz. *S. plagiostomus, Barilius bendelisis* and *B. barna* are found commonly during the study period. While *Tor chilinoides, T. putitora, Noemacheilus beavani, N. rupicola, N. multifasciatus, Glyptothorax pectinopterus* and *Pseudecheneis sulcatus* are found rarely in the stream.

Table 1. Relative abundance of fish species of Indrawati stream in different seasons

Ichthyo species with order and family	Common name	Status	Relative abundance		
			Summer	Monsoon	Winter
Order Cypriniformes					
1. Family Cyprinidae					
Barilius barna	Fulra	c	9.70	12.36	11.85
Barilius bendelisis	Fulra	c	10.54	11.29	11.85
Schizothorax plagiostomus	Asela	c	12.65	13.44	14.81
Schizothorax richardsonii	Maseen	a	28.69	26.88	28.14
Tor chillinoides	Khasra	r	5.90	5.91	6.66
Tor putitora	Khasra	r	6.75	8.60	5.92
2. Family Cobitidae					
Noemacheilus beavani	Gadiyal	r	5.06	5.37	3.70
Noemacheilus multifasciatus	Gadiyal	r	4.21	4.30	2.96
Noemacheilus rupicola	Gadiyal	r	6.32	5.37	4.44
Order Siluriformes					
1. Family Sisoridae					
Glyptothorax pectinopterus	Kathrua	r	4.64	5.37	4.44
Pseudecheneis sulcatus	Kathrua	r	5.48	4.83	5.18
Total eleven species (3 orders, 3 families and 6 genera)					

The Indrawati stream is characterised by diverse flow, varying water depth, meandering nature and erratic hiding cover. All these varying habitat characters of the stream, provide critical habitats for some important IUCN, (2011) referred endangered (*Tor* and *Glyptothorax* spp.) and vulnerable (*Schizothorax* and *Pseudecheneis* spp.) hill stream fish taxa. It is also observed that the habitat of freshwater stream fishes is more dependent on physical features rather than on chemical features as in other aquatic habitats (Srivastava and Sarkar, 2000). Owing to these divergent ecological conditions various life stages of these fish species (adults, juveniles and spawners) are observed in the stream. In the upper stretch, the Indrawati stream is narrowed with high gradient and fast flowing water dominated by big boulders. The rapid, falls and cascade type of habitats are dominant in this stretch (Fig.2). Species having special adhesive apparatus on the ventral surface (*Glyptothorax* and *Pseudecheneis* spp.), adapted to these fast currents are reported from upper stretch of the stream. However, *Garra* sp. having similar typical hill stream adaptation could not be reported from Indrawati stream which may be due to low total discharge in the stream. The species found in the upper stretch are seldom found in lower stretch. The lower stretch (Fig.3) of the stream is characterised by wide channel, less gradient with moderate currents. The habitat is characterised by deep and shallow pools followed by some rapids and riffles. The *Tor, Schizothorax, Barilius* and *Noemacheilus* spp. are found mostly in this lower section of the stream and very rare in the upper stretch. This lower stretch (near confluence with Bhagirathi river at Uttarkashi) is very important segment of the stream from the viewpoint that it provides critical habitat (breeding ground) for the brooders of *Tor*, *Schizothorax*, *Barilius* and *Noemacheilus* spp. and also the nursery ground for early stages of their life cycle. In this segment of the stream fingerlings and juveniles of all these species, are found abundantly. The juveniles of *Schizothorax* and *Tor* by attaining a size migrate into the river Bhagirathi. The shoals of lesser barils (*Barilius* spp.) and some loaches (*Noemacheilus*

species) were limited to shallow pools having rather high temperature. The individuals of *Barilius* could not be observed in the upper stretch. They continuously migrate between lower and middle stretches. Thus, these observations clearly reflect on the habitat specific distribution of hill stream fishes.

Fig. 3 Lower stretch of stream near its confluence with Bhagirathi river

Total water discharge of Indrawati stream is comparatively low. Thus due to less total discharge the stream has small sized fishes and less ichthyofaunal diversity as compared to the other tributaries of river Bhagirathi (viz. Assiganga and Bhilangana) having more discharge with greater fish diversity (Agarwal *et al.* 2011). The continuous fluctuating discharge in different seasons also affects the diversity and distribution of fish species. The significant correlation between stream volume and fish species abundance has been reported by Johnson and Arunachalam, (2010). Sehgal, (1999) observed that the fluctuating discharge of water and drying out of streams, leaving only isolated pools or no water at all is also important matter for the fish distribution and their diversity. During present study it is also observed that in the summer season the stream seems discontinuous at several places on its banks, leaving water in side-pools. In this period these side pools provide shelter to the fishes for their subsistence. The stream restores itself depending on precipitation. This reduction of torrential streams to semi- stagnant pools at some places also exposes the fish to terrestrial predator affecting the fish population (Agarwal and Singh, 2009). Stream substratum type is very important for providing feeding and breeding niche to most of the fish species. It largely influences the distribution of fish fauna (Agarwal *et al*., 2011). The substratum of Indrawati stream is comprised of bedrock, boulders, cobbles and gravels. This substratum type provides all the ecological requirements to the existing fish taxa of the stream. The stony substratum provide suitable habitat to *Schizothorax* sp. for feeding on periphyton by scraping the stones. The large boulders in the stream while serve as hiding cover to the *Barilius* and *Noemacheilus* spp. they also support *Glyptothorax* and *Pseudecheneis* spp. to adhere by their adhesive apparatus to withstand in fast water current. The stony substratum with boulders, cobbles and gravels is primary requisite for the young stages of most of the hill stream fishes.

Threats to fish resources of Indrawati stream

The fish fauna of Indrawati stream is under serious threat due to various anthropogenic hazards (abstraction of stream water, mining of sand and gravel, use of agricultural pesticides and destructive fishing practices). The abstraction of water for irrigation purpose in nearby fields results into the considerable reduction of water in dry months. This affects the stream habitats deleteriously. The fish fauna is impecunious during this period and the fishes are noticed restricted to the deep pools which serve as natural abode for their existence. Further, chemical fertilizers and pesticides are frequently used by the farmers. These chemical fertilizers and pesticides leach into the stream and contaminate the water thus affecting the physico-chemical properties of the water. This leads to deleterious effect on early life history stages of many fish species inhabiting the stream. Another factor which influences the fish fauna in Indrawati stream is removal of sand, gravel and boulder from the stream for various constructions activities. The stones and the boulders often provide suitable habitat as fish hiding covers, breeding and feeding grounds. The removal of this material completely destructs the habitat and substratum type and hiding covers used by the resident species. Thus, the fish fauna is being affected seriously. The use of unscientific or destructive fishing methods by the denizens is causing threat to the fish wealth of the stream. People living on the banks of the stream used chemical (bleaching powder), some

ichthyotoxic plants (*Xanthoxylum, Euphorbia, Sapiump, Randia, Agave, Polygonum*) extracts and some time electric current. These methods indiscriminately kill all the fishes including their early life stages thus causes serious damage to fishery.

Table 2: Physico-chemical characters of Indrawati stream at sampling site S-1 and S-2

Physio-chemical parameters	Seasons					
	Summer		Monsoon		Winter	
	S-1	S-2	S-1	S-2	S-1	S-2
	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD
Temperature (^{0}C)	15.3±1.54	14.2±1.65	16.0±1.33	15.8±2.16	10.0±1.81	9.0±2.64
Velocity (m^{-sec})	0.5±0.15	0.7±0.1	1.4±0.132	1.46±0.40	0.9±0.1	1.0±0.2
pH	8.3±0.44	8.3±0.34	8.2±0.36	8.0±0.43	8.0±0.68	8.0±0.36
D.O. (mg^{-l})	7.75±0.58	8.0±0.5	7.3±0.7	8.3±1.08	10.0±1.32	10.5±0.75
Free Co_2 (mg^{-l})	0.15±0.026	0.10±0.026	0.30±0.161	0.18±0.026	0.12±0.028	0.1±0.02
TDS (mg^{-l})	49±5.29	53±10.81	56±5.29	65±12.12	52±2.65	52±6.0
Turbidity (N.T.U)	19±3.46	09±2.0	30±4.58	14±3.0	14±2.0	06±2.0

Sampling site S-1 (lower stretch 1130 masl), Sampling site S-2 (Upper stretch 1250 masl)

Physico-chemical profile of the stream

Physico-chemical parameters of Indrawati stream analyzed during summer (S) monsoon (M) and winter (W) has shown characteristic seasonal variation in both the sites (Table 2). The temperature of stream is found low throughout all seasons (annual range 9.0±2.64 to 16.0±1.33^{0}C). Lower reaches of the stream (S-1) has recorded slightly higher temperature from the upper stretch (S-2) in all the seasons. It might be due to higher elevation and dense vegetation in the riparian zone of S-2. The low temperature range round the year is highly conducive for cold water fish species. Velocity of the stream water shows large variation in sampling sites. In summer months it is low. Average high water velocity (m^{-s}) is found at S-2 (0.7±0.1 S, 1.46±0.40 M, 1.0±0.2 W) than S-1 (0.5±0.15 S, 1.4±0.132 M, 0.9±0.1W) because of high gradient of stream in upper stretch. Sometimes in summer season due to absence of precipitation, the stream seems discontinuous. Water was found alkaline in all the seasons at both the sites. No significant difference is recorded in pH value from both the sites. Dissolved oxygen (mg^{-l}) at both sites showed significant variation in summer and monsoon season. However DO of stream water from upper stretch (S-2) is recorded comparatively high (8.0±0.5, 8.3±1.08, 10.5±0.75 mg^{-l}) than the lower stretch (S-1) (7.75±0.58, 7.3±0.7, 10.0±1.32 mg^{-l}) in summer, monsoon and winter months respectively. High oxygen contents at S-2 are due to presence of frequent water falls in upper reaches causing mixing of air in the stream water. Free CO_2 (mg^{-l}) was found low in all the seasons at both the sites. Total dissolved solids (mg^{-l}) in the stream recorded slightly higher value (53±10.81, 65±12.12) at S-2 than S-1 (49±5.29, 56±5.29) in summer and monsoon seasons respectively. However in winter same TDS value (52 mg^{-l}) is recorded at both sites. Stream water is recorded less turbid throughout the year. S-1 portrayed comparatively high turbidity value (N.T.U) (19±3.46 S, 30±4.58 M, 14±2.0 W) in comparison to S-2 (09±2.0 S, 14±3.0 M, 06±2.0 W). These observations on the physico-chemical characteristics very well co-relate the occurrence and distribution of fish species in the Indrawati stream. The high velocity, large gradient with clear oxygenated water dominated by rocky- stony substratum in upper stretch of the stream favoured the survival and existence of *Glyptothorax* and *Pseudecheneis* spp. The occurrence of these species in lower stretch is accidental and reported only in monsoon months when heavy rain disturbed the substratum and these fishes wash away from stones due to turning down by the force of water with heavy silt. Bisht *et al.* (2009) has reported that seasonal distribution and relative abundance of fish

fauna is directly related to change in physico-chemical properties, channel course, water discharge and pattern and geometry of tributaries. Present observation also reveals that fish diversity decreases with increase in gradient of stream. However substratum is also an important factor which influences the density and diversity of fish fauna in Indrawati stream. Similar observation has been made by Singh and Kumar, (2000) while working on the Ichthyofauna and ecology of hill-streams of Garhwal Himalaya.

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Biosorption of lead using pretreated cells of *Aspergillus* species

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Abstract

Microbial bioremediation is an emerging technology for environmental cleanup. Application of living biomass for metal binding depends on nutrient type and concentration, environmental conditions and cell age. In addition, living biomass may be subject to toxic effect of heavy metals at elevated concentrations. To overcome the disadvantages; non-viable or dead biomass is preferred. To test these hypothesis three fungal strains were isolated from effluent of chemical and pharmaceutical industry using SDA agar. Identification of the above isolates was carried out and was identified to be predominant strains of *Aspergillus* i.e. (*Aspergillus niger and Aspergillus flavus*). Further preliminary test was performed to check the tolerance of the fungi to different metal salts of lead, copper, chromium, zinc, nickel, cadmium using 1mM concentration. All three fungal species showed tolerance to metal salts like lead nitrate, zinc sulphate and cupric sulphate above 20 mM. Furthermore minimum inhibitory concentration was determined against the two above species for the three heavy metals. Pretreatment of live cells of *Aspergillus* strain was carried out .This dried biomass was then used for optimization of various parameters like concentration of metals, biomass concentration, pH, temperature of incubation and contact time. The filtrate was then analyzed after proper digestion and dilution by Atomic Absorption Spectrophotometer. The availability of variety of biomass and their metal binding potential makes it economical and sustainable option for developing effluent treatment process for removal and recovery of heavy metals.

Keywords*: Biosorption, Lead, Aspergillus flavus, atomic absorption spectrophotometer*

Introduction

In developing countries like India, wastewater treatment is of utmost importance. The degree of treatment may range from a main process for seriously polluted industrial waste to a polishing process for removing the trace concentrations which remain after the main treatment. In this light, biological materials have emerged as an ecofriendly and economic option.For a long time, peat has occupied the place of prominence among biosorbents, but since it is not available everywhere, microbial biomass is the other option. Treatment of effluents with heavy metals following biotechnological approaches is simple, comparatively inexpensive and environment-friendly. Biosorption can be defined as the selective sequestering of metal soluble species that result in the immobilization of the metals by microbial cells. Metal sequestering by different parts of the cell can occur via various processes: complexation, chelation, coordination, ion exchange, precipitation, reduction. It is a process with some unique characteristics and can effectively sequester dissolved metals from very dilute complex solutions with high efficiency. This makes biosorption an ideal candidate for the treatment of high volume low concentration complex waste-waters.Fungal cell walls are typically composed of the polysaccharides chitin and cellulose, and the cell walls of algae and plants are composed mainly of the polysaccharide cellulose. These biopolymers, constituents of the cell wall and the other parts of the cell possess functional groups that have a significant potential for metal binding. Furthermore, intracellular biopolymers such as proteins and DNA may also contribute to metal immobilization. In many cases, extra cellular polymeric substances such as exo- polysaccharides (EPS) that are closely related to the cell membrane can also participate in metal immobilization.The appropriate selection of metals for biosorption studies is dependent on the angle of interest and the impact of different metals, on the basis of which they would be divided into four major categories: toxic heavy metals, strategic metals, precious metals and radio nuclides. In terms of

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environmental threats, it is mainly toxic heavy metals and radio nuclides that are of interest for removal from the environment and/or from point source effluent discharges.(Sanyal et al ., 2005).
Lead(Pb), a heavy metal produced as a byproduct of fossil fuel combustion in its organic compound form, as well as a variety of industries and at solid waste dump sites , has a debilitating effect on the human body. Lead even in low doses, may cause development disorders in fetuses, infants and the young as well as brain damage, behavior changes/abrupt mood swings with violent tendencies , juvenile delinquency, irritation of the respiratory tract, intoxication of the central nervous system, and gastrointestinal complications. In some cases elevated Pb levels in the blood and seminal fluids has been linked to unexplained male infertility. (Tamer Akar *et al*. 2006).The current study is aimed to carry out biosorption of lead using pretreated cells of *Aspergillus* species.

2. Material and Methods

2.1 Isolation of Fungal strains

The composite soil samples (10gm) and the industrial effluent samples (10ml) from pharmaceutical and chemical industry each were suspended in 100 ml of sterilized Normal saline solution (NSS). Subsequently 1 ml of this suspension was serially diluted to 10^6 with NSS. Different dilutions (0.1 ml) was spread on Sabouraud's dextrose agar(SDA) plates containing 100 µg of broad spectrum antibiotic (chloramphenicol) to inhibit bacterial growth. The inoculated plates were incubated at 29^{o}C for 72 hrs and fungal colonies were isolated. Fungal isolates were maintained in the laboratory by sub-culturing and refrigerating at 4^{o}C.

2.2 Identification of Fungal strains

Slide culture Technique: An agar block (7 x 7) mm) small enough to fit under a coverslip was cut using a sterile scalpel. The block was flipped up onto the surface of the agar plate. The four sides of the agar block were inoculated with spores or mycelial fragments of the fungus to be grown. A flamed coverslip was placed centrally upon the agar block. The plates were incubated at 26^{o}C until growth and sporulation occurred.

Lacto phenol Cotton blue mount: The cover slip was removed from the agar block. A drop of 95% alcohol was applied as a wetting agent. A flamed coverslip was gently placed onto a drop of Lacto phenol cotton blue on a clean glass slide and observed under high power objective.

2.3 Screening and Selection of Heavy metal resistant fungi

Purified isolates were screened on the basis of their tolerance to Cr^{6+}, Pb^{2+}, Zn^{2+}, Cd^{2+} and Cu^{2+}. Metal salts used were potassium dichromate, lead nitrate, zinc sulphate, cupric sulphate, and cadmium sulphate.A disk of mycelium was inoculated aseptically on SDA plates supplemented individually with 1mM of heavy metal. The inoculated plates were incubated at 29^{o}C for 7 days.

2.4 Determination of Minimum Inhibitory Concentration

Resistance of the selected isolates to Pb^{2+}, $Zn^{2+}$and Cu^{2+} was determined by the dilution plate method. Metal ions were added separately to SDA plates at concentrations of 1mM to 25mM.The plates were inoculated with 8mm agar plugs from young fungal colonies pre-grown on SDA. Three replicates of each concentration and controls were used. Inoculated plates were incubated at 29^{o}C for at least 5 days. Minimum inhibitory concentration was observed as the lowest conc. of metal that inhibits visible growth of the isolate.

2.5 Biomass Harvestation and Pretreatment of Live Biomass

Spores of 6-7 day old culture grown in Sabourauds agar plate was inoculated in SAB broth. The culture on incubation under shaker conditions formed spherical pellets. After 3-4 days the harvested broth was washed with deionised water. Live harvested mycelial biomass was treated with 0.5 N NaOH for 30 mins.It was followed by washing with adequate amount of distilled water until the pH reached to neutral range (pH 6.8-7.0).It was then autoclaved at 15 lb/inch^2 for 20 min. The pretreated biomass was dried at 60^{o}C for 24 hr in hot air oven and converted into powder form by grinding in mortar or pestle.

2.5 Optimization of Various Parameters for Biosorption

0.02 grams of powdered biomass was inoculated into 20 ml metal solution containing (2, 5, 10 15 mM) lead nitrate in deionised water. The flasks were kept on rotary shaker for 24 hrs at 30°C. Solution along with dead biomass was centrifuged. Content of the supernatant was analyzed after proper digestion and dilution by Atomic Absorption Spectrophotometer. The experiments were repeated by using various biomass concentrations. (0.02, 0.05 & 0.1gms) and contact time. (24, 48 & 72hrs

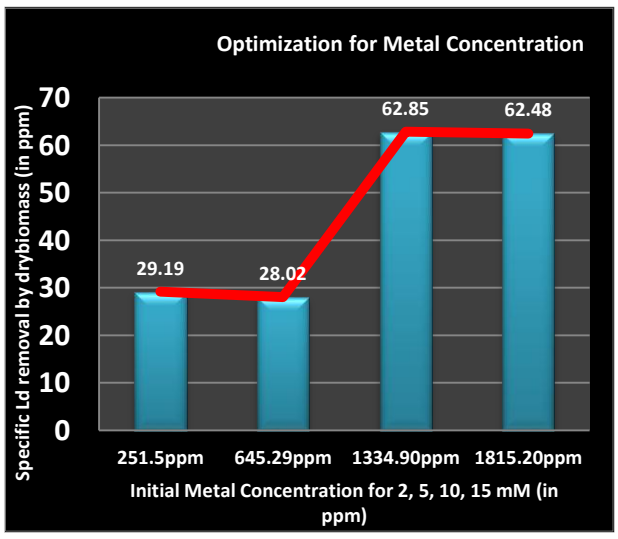
2.6 Digestion Procedure for Atomic Absorption Spectrophotometer

1ml of supernatant /centrifuged biomass was treated with concentrated HNO_3 for 30 mins. Digestion was carried out inside the fumehood. Then 60%perchloric acid was added until the volume reduced to half the total volume. Small amount of volume was then subjected to Atomic Absorption Spectrophotometer analysis.

Results and Discussion

Four fungal species were isolated from waste water effluent of chemical and pharmaceutical industry and soil. On the basis of slide culture technique, lacto phenol cotton blue mounting and colonies obtained on Sabourauds dextrose agar the isolates were identified to be *Aspergillus niger and Aspergillus flavus*. Heavy metal tolerance was showed by *Aspergillus flavus* isolated from waste water effluent of chemical industry and *Aspergillus niger* isolated from soil and waste water of chemical industry.The higher amounts of heavy metals in the soil are likely due to long-term application of the wastewater containing the heavy metals. Soil fungi able to grow in the presence of heavy metals were isolated. The fungi most frequently encountered from the soil samples are *A.niger*, *P. chrysosporium* and *T.viride*. (E. Parameswari et al.,2010).In the present study, isolation of two species of fungi was done namely three isolates of *Aspergillus niger* and one isolate of *Aspergillus flavus* from waste water industrial effluent and soil. They were found to be resistant to heavy metals like lead, zinc and copper.Amongst the microbial flora present in the effluent, fungi were selected for the present study, due to the ease they offer for removal from liquid substrates. *A. niger RH 17* and *A. niger RH 18* showed the highest tolerance, 6000 and 7000 mg/L, respectively, warranting them to be successful candidates for metal detoxification. (Rani faryal et al., 2007).Both the *Aspergillus* species were checked to determine minimum inhibitory concentration .It was found that the order of resistance of the isolates to heavy metals was Pb>Zn>Cu. *Aspergillus flavus* showed more tolerance to lead than *Aspergillus niger*, the highest tolerated concentration being 8000 mg/L which is quite comparable and promising.Assessments revealed that the fungal biomass exposed to alkaline supplements/salts exhibited significantly higher biosorption efficiency in comparison to untreated biomass. In current research work, an increase in biosorption of Pb (II) ions was noticed as a result of alkali pretreatments, particularly NaOH. Similar enhancement in metal uptake capacity of the fungal biomass regarding alkali pretreatment was recorded in comparison to live cells used for preliminary testing.The biosorption of Pb(II) and Cu(II) ions by A. flavus increased with increasing initial concentration of metal ions, becoming saturated at 200 and 150 mg/l for Pb(II) and Cu(II) ions, respectively.(Tamer Akar et al.,2005).Initial metal concentration plays an important role in determining the biosorptive capacity of the absorbent. The initial metal ion concentration used which shows maximum biosorption is at 3300 ppm i.e.10mM.

Fig 1- Optimization for metal concentration



The experiment on metal uptake reveals that the metal uptake decreases when biomass concentration rises. Therefore it is not useful to increase the biomass beyond 0.02-0.25 grams per 100 ml to sequester metal ions from 100 ppm of lead solution.

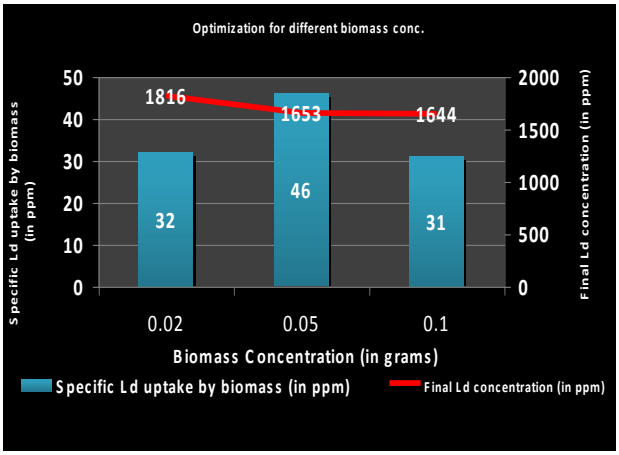


Fig 2-Optimization for biomass concentration

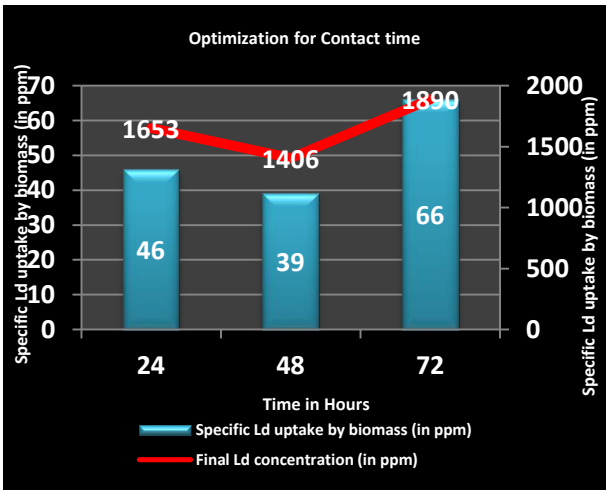


Fig 3- Optimization for contact time

Removal of lead by dead biomass of *Aspergillus flavus* showed maximum removal at pH 4-5.The results indicated that maximum adsorption of different metal species occur at different pH. However, from practical point of view pH of 5-6 was adequate.Temperature also played an important role in Pb biosorption. The temperature ranges used were 28°C, 35°C and 40ºC. Efficient Pb removal was observed at 28ºC, although Pb removal was also remarkable at the other two temperatures, but the Pb biosorption per gram of the biomass was reduced.

For the same metal different adsorbents had different removal rates. The adsorption of metal ions was greatest at 48 hrs at the specific pH and room temperature by a specific amount of powdered biomass in 20ml of metal solution with a continuous agitation at 120 rpm. This experiment showed that the removal rate is maximum after 24 hrs of contact time.Thus the current study suggests that these fungal strains may be used in future for bioremediation of wastewater and heavy metal contaminated soils.

Conclusion

The present study thus focuses on ability of pre-treated and dead biomass of fungi to bind to metal like lead which was analyzed using atomic absorption spectrophotometer. Thus we can conclude that dead cells can be preferred over live cells as it has advantages with regards to no toxicity, nutrient requirements and other maintenance conditions. Biosorption appears to be suitable as secondary or polishing application for metal removal from dilute waste streams, which would be competitive with ion-exchange resins based on cost-effectiveness.

Acknowledgement

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Alteration in oxygen consumption of fresh water fish *Puntius stigma* exposed to sublethal concentrations of insecticide Phytofos

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Abstract

Now a days large number of new insecticide formulations are used to protect the crops from various insects. Water pollution caused by insecticide is a serious problem it affects the aquatic animals adversely. Static bioassay experiments were conducted to find out 96 hr LC 50 value for fish *Puntius stigma*. For finding out respiratory response, the fishes of average length 3.7 Cm. were exposed to 0.4 mg/l (1/10 96 hr LC 50) and 0.8 mg/l (1/5 96 hr LC 50) concentrations of Phytofos. The respiratory response in terms of oxygen consumption was recorded at 24,48,72 and 96 hours.At the end of first 24 hours there is an increase in oxygen consumption is noted at 0.4 mg/l and 0.8 mg/l concentrations. At 48 hours exposure there is decrease in oxygen consumption at concentration 0.4 mg/l and at concentration 0.8 mg/l. At the end of 72 hours, there is a fall in oxygen consumption rate at both the concentration is recorded. At the end of 96 hours exposure, a reduction in oxygen consumption rate at concentration 0.4 mg/I and a just a little more fall in oxygen consumption at concentration 0.8 mg/l is noted. On transfer to toxicant free water (after 96 hours to 120 hours exposure) fishes showed recovery. Oxygen consumption in fishes are discussed with respect to time of exposure and sub lethal concentrations of insecticide Phytofos.

Keywords*: Oxygen consumption, Puntius stigma, Phytofos*

Introduction

Insecticide formulations are used to protect the crops from various insects. These toxic insecticides with agricultural field run off, percolation through soil and through faulty handling reaches in the aquatic ecosystem and causes harm to aquatic animals. Phytofos is a insecticide which is widely used in central India. Change in the oxygen consumption is a good parameter to asses the toxicity. So in the present study respiratory response of fish *Puntius stigma* exposed to sublethal concentrations of insecticide Phytofos is studied.

Material and Methods

The fishes *puntius stigma* were collected from Green lake Umrer and were acclimated to the laboratory conditions for 7 days, in the glass aquaria filled with chlorine free tap water.

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The physic-chemical parameters of water showed following ranges pH 6.8 to 7.2, dissolved oxygen 7.5 to 7.8 mg/I, CO_2 Nil, total hardness (as $CaCO_3$)170 to 174 ppm, total alkalinity 150 to 166 mg/I, temperature 26 ^oC to 28 ^oC. the average length of fish was 3.8 cm. the static bioassay experiments were performed by using the toxicant Phytofos (Phytofos: Monocrotophos 36% SL. Manufactured by Phyto Chem INDIA Ltd. Bonthapally, A.P.).various concentrations were prepared by dilution method. Initially bioassay experiments were set with wide ranges of toxicant concentrations and finally with closer ranges to find out 96 hr LC50 value. The fishes were exposed to 0.4 mg/l ($1/10^{th}$ of 96 hr LC 50) and 0.8 mg/l ($1/5^{th}$ of 96 hr LC 50) concentrations for 24, 48, 72 and 96 hours. The solutions were renewed after every 24 hours. A closed chamber method was used for measurement of oxygen consumption. The oxygen content of water was determined by Winkler method, at the end of 24,48,72 and 96 hours. The recovery rates were

determined by transferring the experimental fishes (those were exposed to the toxicant for 96 hours). In the toxicant free water. In each experiment about 08 fishes were used. Oxygen consumption was calculated in terms of mg/gm body weight of fish/hour. Oxygen consumption curves were drawn after calculating the percent normal oxygen consumption rates.

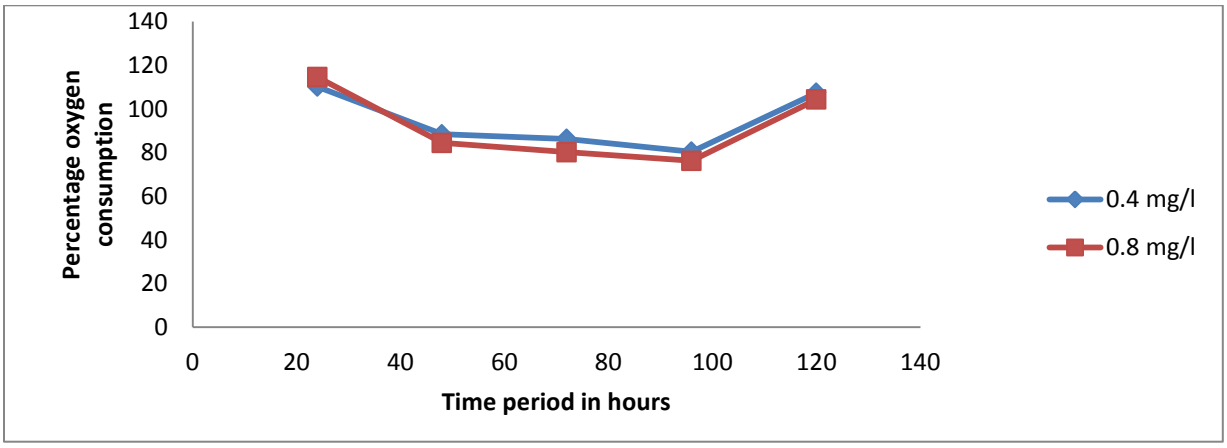
Results and Discussion

At the end of first 24 hours, there is an increase in oxygen consumption at 0.4 mg/l and 0.8 mg/l concentrations are noted values are 110.12% and 114.48% respectively. At 48 hours exposure there is decrease in oxygen consumption at concentration 0.4 mg/l, the value being 88.30% and at concentration 0.8 mg/l a decrease in oxygen consumption rate is noted (84.40%). At the end of 72 hours, there is again fall in oxygen consumption 86.18% and 80.10% at 0.4 mg/l and 0.8 mg/l respectively. At the end of 96 hours exposure a reduction on oxygen consumption rate at concentration 0.4 mg/l and a little more fall in oxygen consumption at concentration 0.8 mg/l is noted, the value are 80.34% and 76.14% respectively.On transfer to toxicant free water (after 96 hours to 120 hours exposure) recovery in oxygen consumption is noted. The oxygen consumption reaches to 107.34% and 104.20% in the fishes which were previously exposed to 0.4 mg/l and 0.8 mg/l concentration respectively (Table-1and Fig-1).

Table 1. : Alteration in the oxygen consumption of *Puntius stigma* exposed to sublethal concentration of Phytofos

Concentration of Phytofos in mg/l	Exposure period in hours				Recovery in tap water	Oxygen consumption
	24	48	72	96		
Normal fish	0.4230	0.4269	0.4260	0.4209	0.4290	Rate mg/hr/gm body weight
	100%	100%	100%	100%	100%	Taken as 100%
0.4mg/l Phytofos	0.4658	0.3769	0.3929	0.3373	0.4604	Rate mg/hr/gm body weight
	110.12%	88.30%	86.18%	80.34%	107.34%	Percent of normal
0.8 mg/l Phytofos	0.4842	0.3603	0.3412	0.3204	0.4470	Rate mg/hr/gm body weight
	114.48%	84.40%	80.10%	76.14%	104.20%	Percent of normal

Fig.1: Alteration in the oxygen consumption of *Puntius stigma* exposed to sublethal concentration of insecticide Phytofos



In the present investigation, the effects of exposure of sub lethal concentrations of Phytofos on the oxygen consumption rate (respiratory response) at 24, 48, 72 and hours, for fish Puntius stigma have been studied. Recovery after 96 hours to 120 hours in the toxicant free water also have been evaluated. It has been observed that in fish *Puntius stigma* the insecticide treatment resulted in a change in oxygen consumption or respiratory response. In the present study decrease in oxygen consumption is noted at 48 hours in lower and higher sublethal concentration (0.4mg/l and 0.8 mg/l) in both the concentrations at 72 hours. At the end of 96 hours exposure, a reduction in oxygen consumption rate at concentration 0.4 mg/l and just a little more fall in oxygen consumption rate at concentration 0.8 mg/l is noted. Wodne and Rocz (1976) noted reduction in oxygen consumption in fish *Lebistes reticulatus* for 6 and 12 hours treated with different concentrations of Malathion, Foschlor and Dichlorphos. Reddy and Gomathy (1977) reported that exposure to a sublethal conscentration of Thiodon lead to 40% decline in oxygen consumption rate of *Mystes vitatus*. Rao *et al.* (1981) noted reduction in oxygen consumption rate in fish *Macrognathus aculeatum* treated with Endosulphon. Manoharan and subbiah (1982) noted that *Barbus stigma* treated with sublethal concentrations of Endousulphon showed 10% to 16% reduction in respiratory rate. Rao *et al.* (1985) studied effecr of sublethal dose of Methyl parathion on respiration of fish *Tilapia mossambica*. Reddy (1988) recorded decrease in the oxygen consumption in fish cyprinus carpio exposed to sublethal concentration of Malathion. Thosar and Lonkar (1999) noted decrease in respiratory response in female fish *Lebistes reticulatus* at 24,48,72 and 96 hours exposed to 0.118 mg/l of insecticide Fenval. Thosar and Lonkar (2004) reported reducation in the respiratory response in male fish *Lebistes reticulatus* at 24, 72 and 96 hours exposed to 2.15 mg/l and at 72 and 96 hours exposed to 4.30 mg/l of Metasystox. Contrarary to above made observation in the present study increase in oxygen consumption rate is also nothed at 24 hours at 0.4 mg/l and 0.8 mg/l concentration. Venugopal *et al.* (1989) reported increase in the rate of respiration in fish *Cyprinus carpio* communis exposed to sublethal concentration 180 ppm and 220 ppm of Monocrotophos. Gopal *et al.* (1989) showed an increase in the oxygen consumption when the fishes *Channa puctatus* were exposed to sublethal concentration of Lindane. Thosar and Lonkar (1999) noted increase in oxygen consumption in female fish *Lebistes reticulatus* at 24 and 48 hours exposed to 0.118 mg/l of Fenval. Thosar and Lonkar (2004) also noted increase in the oxygen consumption in male *L.reticulatus* at 48 hours exposed to 4.30 mg/l of Metasystox. Sarnoraj *et al.* (2005) observed the respiratory alteration induced by Parrysulfon (an orgsnochlorine) and Sicocilcon (an organophosphate) pesticide in the fresh water fish *Mystus vitatus* the fishes were exposed to the two sublethal concentration of Pyrysulfon (0.1072 and0.3345 ppm) and Silcocilcon (0.3358 and 0.5717 ppm) then the oxygen consumption of exposed fish to different sublethal concentration was analysed on 1^{st} , 10^{th}, 30^{th} and 60^{th} day of exposure it showed an elevated consumption of oxygen on the first day. As duration of exposure extends beyond 24 hours the rate of oxygen consumption showed decreasing trends. The same trend was noted in Silcocilcon exposed fish. Kannedi *et al.* (2007) exposed fish *Channa punctatus* to insecticide Monocrotophos and noted initial increase with lower concentration and decrease with increasing concentration, this is attributed to gill damage. Remia *et al.* (2008) studied the effect of Monocrotophos on fish *Tilapia mossambica* for 24, 48, 72 and 96 hours exposure. The oxygen consumption was increased by 40.97%, 49.02%, 42.96% and 46.53% respectively. It may be due to respiratory distress as a consequence of the impairment of oxidative metabolism due to toxicant stress.ecovery in toxicant free water in noted in the fishes which were previously exposed to both sublethal concentrations for 96 hours. Similar kind of recovert was noted by Thosar and Lonkar (1999, 2004) in female fish *L.reticulatus* previously exposed to sublethal concentrations of Fenval, and also in male *L.reticulatus* exposed to sublethal concentration of Metasystox. In the present study it is noted that varied respiratory response in fish *Puntius stigma* is may be due to insecticide stress and the damage to gill of the fish.

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Some reproductive studies in *Clarias batrachus* with reference to different thermal conditions

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Abstract

Eco-physiological study indicates the Clarias batrachus is a eurythermal fish and able to tolerate the wide range of climatic conditions. The quantitative analysis of nutritional components in gonadal region, such as glucose, proteins and fats showed the variations during exposure of fish to hot and cold temperatures. The fresh water catfish exhibits distinct phases of reproduction and also showed the changes in the levels of energy precursors with change in the excretory products, with respect to adaptability towards different environmental temperature conditions. Gradual increase of glucose, proteins, and cholesterol is observed in the male gonadal tissues. Rectal gland and clasper tissues showed, decreased of urea levels during the exposure of fish to the higher tolerable temperature. However, in female fish, the levels of proteins are significantly enhanced during the high temperature exposure. The levels of urea significantly decreased in the tissues of uterus and brain during the study period, while the lowering of glucose levels in brain indicates the extent of rate of physiological activity of the brain.

Keywords*: Clarias, Temperature, Gonad, Biochemical composition*

Introduction

At present all the ecosystems are subjected to slow changes because of the increased atmospheric temperature particularly the green house effect. However, rapid changes can have undesirable consequences. According to Fry (1970), degradation of an ecosystem is a change from a more productive to less productive state. There are many environmental factors such as temperature, light, salinity, etc., which influence as limiting factors for the growth and distribution of animals and plants. It also controls the reproduction, rate of embryonic development, migration, number of behavioral and metabolic characteristics of the organisms. Out of these environmental factors, temperature factor is taken in to consideration. With the increased population and industrial development, use of water resources and recycling became invariable. The warm water if released in to fish reservoirs, may elevate the water temperature, which may prove fatal to aquatic life. Therefore besides the thermal tolerance of fishes, the reproductive and biochemical study in accordance with the environmental temperature ranges is very necessary.Fishes inhabiting heterothermal environment can regulate their internal body temperature by behavioural means, which can be achieved by swimming in to the desired habitats. On the other hand, in case of eurythermal fishes, maintenance of constant body temperature is achieved by decreasing or increasing the rate of biochemical reactions occurs in side the body tissues. However, rate of biochemical activities of body cells may affect the rate of gonadal activities of fishes, intern influence the fish reproduction. The temperature beyond which animals cannot carry their normal activities constitutes the lethal temperature. The thermal limits of an animals and the tolerance limits are mainly genetically controlled thus constituting the genetic resistance adaptation of animal, (Precht, 1973). Temperature tolerance is an experimental criterion for the demonstration of physiological changes, which has been repeatedly recorded by Nagabhushanam and Sarojini (1969) and by various workers. Such eco-physiological studies world be the important means for condensing and transmitting the information based on scientific evidence and also would be needed by the decision makers for accomplishing

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future policy decisions. (Fry *et al*, 1942).

The essence of seasonal reproduction is that animals deliver their young ones during a period of year when the conditions are maximal for the survival of the species. Breeding activities of animals are related to the climatic conditions of their habitats. Many physical environmental factors such as temperature, photoperiod, rainfall and food supply also affects the regulation of seasonal reproductive cycle. There are nevertheless certain experimental results showing temperature induced metabolic changes in some vertebrates thereby indicating that pituitary, pineal and gonadal functions are temperature dependants, however the temperature controls the neuro-endocrine axis and intern gonadal functions.

Material and methods

For the present study, river dwelling fish *Clarias batrachus* is used. The live fishes were collected from the market and acclimatized for lentic habitat in 3' x 2' sized aquarium. The acclimation for cold and hot temperature is done by gradual decrease and increase of water temperature by 1o C, by using ice flakes and thermostatically controlled heaters respectively. Lethal temperatures are recorded (10^oC-minimum and 38^oC–Maximum lethal temperature). Digital Hick made thermometer is used to record the water temperature. (APHA, AWWA and WPCF, 1975).For microscopic studies of testis and ovaries, male and female fishes were dissected to acquire the gonads. The permanent preparations of the gonads, associated organs and brain were made by micro technique slide preparation and double stating method. Ocular and stage micrometer were used to measure the size of different cells. Biochemical estimation is done by the preparation of tissue homogenate in proper quantity, by using appropriate methods of estimation given by Wybenga and Pilleggi (1979), Wybenga Donald (1971) and Crocker (1967).

Results and Discussion

The data harvested during the present study indicate single layer of primary gonial elements are present in the form of large cells in the gonads of one week old fish. Each cells are characterized by predominant oval and vesicular nucleus having distinct nucleolus and granular chromatin matter. Some of the cells showed active mitotic divisions. After one week the proliferation of preceding stage by mitosis, forms a double layer of cells. The sexes are distinguished at first time this stage. The germinal cells proliferated and increase in number and undergo differentiation. The present investigation on the gonads showed that progressive maturational changes occurs during the first three weeks and the differentiation of mitotic cellular pattern occurs in one month. The hypothalamic neurosecretary system becomes differentiated relatively late in the development as described by Olivereau, (1967). The occurrence of mitotic process in the gonads is dependent on the hypothalamic nurosecretory control.After two months of age spermatogenetic wave becomes advanced up to the formation of spermatids. Spermatids are very small cells with 1.75 to 1.4 µ diameter. The primary and secondary spermatocytes are having more cell size than spermatids. (Table- 1.4). The ovary is characterized by the presence of several primary and secondary oogonia and numerous primary oocytes and secondary oocytes. Secondary oocytes are having well marked nuclei with one or two nucleoli in nucleoplasm towards the periphery, (Table-1.3). Vivian (1939) have studied the similar pattern in male and female Gobius paganellus.A great proliferation of the germinal elements with four and five fold increase of primary and secondary spermatogonia are observed in three month old fish. Infact the secondary spermatocytes increased double in number than the primary spermatocytes. The newly formed spermatozoa are evident as a aggregation of smaller cells of size 1.05 µ. In ovary the secondary oocytes are quite predominant and underwent multiplication are observed.Testis of six month old fish showed marked degree of maturation a evidenced by the reduction in percentage of pre-spermiogenic elements and appreciable increase in the number of spermatids and spermatozoa. But the testis was not considered as completely mature as the testicular endocrine cells and leydig cells were indistinguishable. In female of this age group showed noticeable increase of secondary oocytes with presence of small lipoid vesicles in their cytoplasm. In adult fish the size of testis greatly increased. A great depletion of spermatogonia was noticed. Although the spermatocyte and spermatids multiplied in number.

Table – 1.1:Effect of Temperature on Biochemical Composition of Different Reproductive organs in Male *Clarias batrachus*, exposed to different temperature conditions.

Organs	Temp. Range	Glucose	Total Protein	Cholesterol	Urea
Testis	22 to 24 ^{o}C	0.0054±0.0039	7.61 ± 2.49	.020 ± 0.02	0.0035±0.0004
	33.5 to 36 ^{o}C	.0073 ± .0085	8.21 ± 2.27	0.064 ± 0.05	0.0059±0.004
	10 to 13 ^{o}C	0.0045±0.003	2.40 ± 2.02	0.048 ± 0.034	0.003 ± 0.001
Seminal vesicle	22 to 24 ^{o}C	0.031 ± 0.006	19.31 ± 8.80	0.19 ± 0.069	0.014 ± 0.003
	33.5 to 36 ^{o}C	0.034 ± 0.029	20.47 ± 4.87	0.20 ± 0.08	0.015 ± 0.01
	10 to 13 ^{o}C	0.027 ± 0.024	16.07 ± 5.63	0.24 ± 0.10	0.010 ± 0.004
Vas deference	22 to 24 ^{o}C	0.026± 0.0053	17.23 ± 3.52	0.34 ± 0.004	0.021 ± 0.001
	33.5 to 36 ^{o}C	0.067 ± 0.010	20.79 ± 6.1	0.39 ± 0.05	0.029 ± 0.01
	10 to 13 ^{o}C	0.023± 0.0034	13.23 ± 2.19	0.34 ± 0.05	0.018 ± 0.002
Rectal gland	22 to 24 ^{o}C	0.054 ± 0.008	14.04 ± 4.07	0.044 ± 0.017	0.0048±0.0007
	33.5 to 36 ^{o}C	0.066 ± 0.0021	15.68 ± 9.25	0.26 ± 0.14	0.021 ± 0.01
	10 to 13 ^{o}C	0.045 ± 0.016	12.90 ± 5.43	0.034 ± 0.004	0.04 ± 0.006
Clasper	22 to 24 ^{o}C	0.027 ± 0.0071	10.89 ± 2.05	0.044 ± 0.01	0.014 ± 0.01
	33.5 to 36 ^{o}C	0.039 ± 0.0085	11.89 ± 3.02	0.018± 0.036	0.017 ± 0.002
	10 to 13 ^{o}C	0.023 ± 0.0051	9.75 ± 0.46	0.026 ± 0.003	0.0088±0.0006
Brain	22 to 24 ^{o}C	0.0031±0.0025	35.15 ± 21.09	0.015 ± 0.012	0.0046±0.002
	33.5 to 36 ^{o}C	0.0043±0.0022	35.99 ± 0.14	0.016 ± 0.007	0.0074±0.0003
	10 to 13 ^{o}C	0.0011±0.0005	16.05 ± 0.44	0.010 ± 0.004	0.0027±0.002

Table – 1.2:Effect of Temperature on Biochemical Composition of Different Reproductiveorgans in Female *Clarias batrachus* exposed to different temperature conditions.

Organs	Temp. Range	Glucose	Total Protein	Cholesterol	Urea
Overy	22 to 24 ^{o}C	0.036 ± 0.01	13.15 ± 4.87	0.15 ± 0.10	0.018 ± 0.015
	33.5 to 36 ^{o}C	0.039 ± 0.01	20.22 ± 4.71	0.30 ± 0.11	0.020 ± 0.002
	10 to 13 ^{o}C	0.015 ± 0.01	12.21 ± 5.34	0.12 ± 0.08	0.017 ± 0.005
Epigonal Organ	22 to 24 ^{o}C	0.006 ± 0.004	0.88 ± 0.011	0.011 ± 0.009	0.0025±0.0031
	33.5 to 36 ^{o}C	0.008 ± 0.006	13.44 ± 4.42	0.022 ± 0.002	0.0045±0.0011
	10 to 13 ^{o}C	0.002 ± 0.001	0.64 ± 0.36	0.01 ± 0.002	0.001 ± 0.0002
Uterus	22 to 24 ^{o}C	0.017 ± 0.008	5.82 ± 1.38	0.062 ± 0.03	0.0068±0.0006
	33.5 to 36 ^{o}C	0.017 ± 0.003	23.17 ± 3.12	0.12 ± 0.03	0.0084±0.0016
	10 to 13 ^{o}C	0.014 ± 0.007	4.21 ± 1.67	0.044 ± 0.02	0.0059±0.0022
Rectal Gland	22 to 24 ^{o}C	0.041 ± 0.01	10.98 ± 2.74	0.18 ± 0.05	0.016 ± 0.005
	33.5 to 36 ^{o}C	0.050 ± 0.01	21.32 ± 10.03	0.24 ± 0.013	0.017 ± 0.010
	10 to 13 ^{o}C	0.039 ± 0.016	10.40 ± 6.22	0.048 ± 0.021	0.011 ± 0.005
Brain	22 to 24 ^{o}C	0.0046±0.0016	2.42 ± 1.18	0.024 ± 0.012	0.003 ± 0.001
	33.5 to 36 ^{o}C	0.0053±0.0015	5.9 ± 2.73	0.030 ± 0.016	0.0045±0.0026
	10 to 13 ^{o}C	0.0020±0.0008	0.62 ± 0.19	0.17 ± 0.002	0.0008±0.0001

Table 1.3: Gonadal cell size during the progressive growth of gonads in female *Clarias batrachus*

Age of fish	*Diameter of overy*	*Size of cytes / ovum*	*Size of nucleus*
30 days	40.6 µ	POG – 17.5 µ	10.5 µ
60 days	91.46 µ	POG – 37.16 µ, SOG – 62.2 µ	26.6 µ, 38.9 µ
90 days	118.3 µ	SCO – 100 µ	49.6 µ
180 days	725.3 µ	Follicle – 183.5 µ	56.75 µ
Adult fish	2708.1 µ	Follicle – 395.3 µ	93.3 µ
Mature fish	2708.1 µ	Follicle – 802.4 µ	99.3 µ

Table 1.4: Gonadal cell size during the progressive growth of gonads in male *Clarias batrachus*

Age of fish	**Diameter of Testis**	**Size of cytes / spermatozoa**	**Size of nucleus**
30 days	42.28 µ	PSC – 7.56 µ, SSC – 8.75 µ	4.38 µ, 7.0 µ
60 days	76.54 µ	PSC – 5.95 µ, ST – 1.75 µ	3.15 µ, 1.4 µ
90 days	99.23 µ	SZ – 1.06 µ	1.05 µ
180 days	424.8 µ	SZ – 2.1 µ	1.98 µ
Adult fish	1420.6 µ	SZ – 3.6 µ	3.41 µ
Mature fish	1438.9 µ	SZ – 3.6 µ	3.62 µ

The leydig cells were distinguished for the first time and occupying interlobular areas up to 9 cells in thickness. These cells are having round to oval nuclei and basophilic cytoplasm. Dadzie (1969) has studied the testis of mature fish Clarias batrachus. In female ovary, maturing oocytes are observed with appearance of minute yolk globules in the cytoplasm .

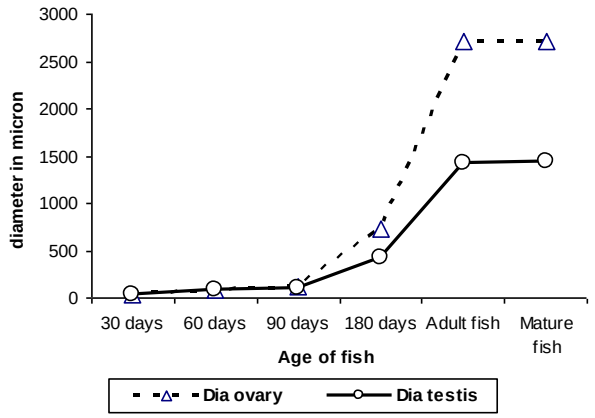

Fig.1 - Rate of development of gonads in *Clarias batrachus.*

The spermiogenesis in C. batrachus is completed at the end of three months, the male is in sexual readiness only when it attains the adult stage. Similarly in the females, although oocytes continue to enlarge the mature ova are formed in the adult condition. In the process of vitallogenesis storage of nutritive material in the age is involved. It is possible that such extra nutritive material cannot be made available to the ova till the maturational changes in them, Vivian (1939). However, the actual rate of growth of testis and ovary enhances, when, male and female attains the age of 90 days. It is evidenced by the microscopic studies and from the increased size of gonads after 90 days. (Fig. & Graph). The gonadal activities are influenced by the hypothalamus, however before the two month age of fish the activity of adeno-hypophysis is not seen apparent due complete development of hypothalamo – pituitary axis. After 90 days age of fish complete development of adeno-hypophysial function intern enhance the rapid development of gonads.

Effect of Temperature on Biochemical Composition :

Present investigation indicates that the Indian cat fish Clarias batrachus is a eurythermal fish as it is able to tolerate a wide range of temperature change, due to natural climatic changes between summer and winter. There is much relationship between temperature and composition of glucose, protein, cholesterol and urea. (Kulkarni, 1987) Glucose and Proteins are the chief nutritional constituents of any tissues. The actions of several cellular enzymes influence the synthesis of glucose, protein, fats and urea. Certain seasonal changes of

nutritional constituents in H. fossilis were recorded by Shrivatava and Shrivastava, (1994). Increased levels of glucose and proteins during the hot exposure of fish may attribute to increased cellular enzymatic activities, also enhance basal metabolism. The cellular byproducts in the rapid enzymatic activities may also increased during the hot environmental conditions, that intern enhance the formation of urea. The organs having active cellular activities such as gonadal cells and brain cells exhibit higher nutritional components. On the other hand various enzymes shows less activity during the cold condition caused the depletion of glucose, protein, cholesterol and urea levels in the reproductive organ tissues. The lesser rate of metabolic activities in the tissues with less quantity of cellular byproducts may lower the urea levels in the tissues in male and female fishes. Ananthakrishnan and Kutti, (1979) has carried the similar type of studies on Channa punctatus. During the reproductive cycle of C. batrachus, the biochemical levels of glucose, protein, cholesterol and urea increases with respect to environmental temperature conditions from low to high temperatures. (Lal, and Singh, 1987).

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Phytosociology and species diversity in the catchment of Ratle hydro-electric project, District Kishtwar –J&K (India)

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Abstract

This study deals with the phytosociology and plant diversity in the 10 km radius influence zone of Ratle hydro-electric catchment area in district Kishtwar (J&K). Quadrats of varying sizes were laid to record the parameters like frequency, density, abundance and IVI for trees, shrubs and herbs. The data obtained was further computed to analyse the species diversity using Shannon- Wiener's index. The results revealed the dominance of *Quercus baloot, Vitex negundo and Viola pilosa* for trees, shrubs and herbs, respectively. The computation of diversity index showed that species richness and evenness remained relatively lower for trees and shrubby flora whereas relatively higher in case of herbaceous vegetation.

Keywords*: IVI, Phytosociology, Ratle H.E. project, species diversity, species richness, species evenness*

Introduction

Phytosociology, the study of aspects of communal relations of plant, is important for understanding the functioning of community. The study of plant community implies knowledge of structure and composition of the component species. Phytosociological investigations cover all life forms and involve measurement of analytic characters like frequency, density, basal area and Importance Value Index (IVI) as well as Diversity indices in order to compare different sites and identify richer locations. Differences in data of species distribution and richness collected reveals changes and shifts in population structure, the appearance and disappearance of species and changes in habitat factors. Species richness is a simple and easily interpretable indicator of biological diversity (Peet, 1974). Many types of environmental changes influence the processes that can both augment or erode diversity (Sagar *et al*., 2003). The catchment area of Ratle Hydro Electric Power Project, a run-of-river scheme proposed to be constructed in the district Kishtwar of J&K, is going to be exposed to various anthropogenic activities that might disturb the species structure and composition of the area. The area is mountainous and falls mostly between sub-tropical to temperate zone. The catchment area of Ratle Hydro Electric-Power Project, a run-of-theriver scheme proposed to be constructed in the district Kishtwar of J&K, is going to be exposed to various anthropogenic activities that might disturb the species structure and composition of the area. The area is mountainous and falls mostly between sub-tropical to temperate zone. Though, several workers (Kumar, 1987; Kumar, 1997; Kour 2001; Singh, 2002; Kesar, 2002; Sharma, 2003; Jhangir, 2004; Dutt, 2005; Rai, 2007 and Sharma, 2009) have studied the phytosociology and species diversity of different nearby areas yet the work on this aspect in the present area of district Kishtwar has not been done so far. Therefore, the present work has been carried out to document the species diversity and dominance in the catchment of Ratle H. E. Power Project.

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Material and Methods

The study area is spread over 314 sq km which includes 10 kms radius influence zone with its centre point at proposed dam site (Latitude 32°06' N to 34°12.5'N and longitude 75°23'E to 77°48'E) located at village Drabshalla. The area falls between 75^0 41' 49.43" E to 75^0 54' 38.62" E longitude and 33^0 05' 19.21" N to 33^0 16' 06.54" N latitude and exhibit altitudinal variation from 900 m asl to 3800 m asl. Regular visits from October

2007 to March 2010 during different seasons have been conducted for identification and enlisting of the floral diversity by using "Flowers of the Himalaya" (Polunin and Stainton, 1984) and "Flowers of the Himalaya- A Supplement" (Stainton, 1988) and also through consultation of the local herbaria of department of Botany, University of Jammu. Random sampling method was adopted for recording the phytosociological parameters and quadrats of 400 (10 X 10m), 200 (5 X 5m) and 100 (1 X 1m) were placed for trees, shrubs and herbs, respectively in the study area. Parameters like frequency, density, basal area has been recorded as per methods given by Misra (1969) to compute the secondary data in the form of relative frequency, relative density, relative dominance and IVI. Species Diversity was also computed by using Shannon- Wiener's index (1949).

Results and Discussion

The data recorded for the different phytosociological parameters have been computed and represented in Tables 1, 2 and 3. Similarly, data computed for Shannon- Wiener's index has been represented in Table 4. The perusal of tables 1, 2 and 3 reveals that among the arboreal elements, highest values for both relative frequency and relative density was exhibited by *Quercus baloot* with percent values of 7.27 and 13.82, respectively whereas highest value for relative dominance was exhibited by *Cedrus deodara* (8.34%).

Table 1: Phytosociological parameters of different tree species of the study area (quadrats=100)

S. No.	Trees Name	Basal area	Freq.	Density	Abundance	R.F.	R.D.	R. Dom.	I.V.I.
1.	***Quercus baloot***	312.5	76	6.57	8.64	7.27	13.82	6.08	27.17
2.	***Cedrus deodara***	428.5	67	5.9	8.81	6.41	12.41	8.34	27.16
3.	***Quercus semicarpifolia***	328.9	71	5.23	7.37	6.79	11.00	6.4	24.19
4.	***Pinus wallichiana***	189.1	48	5.32	11.08	4.59	11.19	3.68	19.46
5.	***Dalbergia sissoo***	306.4	41	3.2	7.80	3.92	6.73	5.96	16.61
6.	***Pinus roxburghii***	183.3	41	4.09	9.98	3.92	8.60	3.57	16.09
7.	***Robinia pseudoacacia***	168.5	39	3	7.69	3.73	6.31	3.28	13.32
8.	***Prunus domestica***	189.6	36	1.79	4.97	3.44	3.77	3.69	10.90
9.	***Ficus palmata***	308.5	38	0.37	0.97	3.63	0.78	6	10.41
10.	***Populus ciliata***	150.6	31	1.81	5.84	2.96	3.81	2.93	9.70
11.	***Olea ferruginea***	109.6	61	0.78	1.28	5.83	1.64	2.13	9.60
12.	***Alnus nitida***	197.6	38	0.68	1.79	3.63	1.43	3.85	8.91
13.	***Salix alba***	210.2	38	0.56	1.47	3.63	1.18	4.09	8.90
14.	***Ulmus wallichiana***	268.1	26	0.55	2.12	2.49	1.16	5.22	8.86
15.	***Prunus persica***	130.4	38	1.25	3.29	3.63	2.63	2.54	8.80
16.	***Juglans regia***	143.6	47	0.67	1.43	4.49	1.41	2.79	8.69
17.	***Pyrus pashia***	139.3	40	1.02	2.55	3.82	2.15	2.71	8.68
18.	***Zizyphus mauritiana***	150.2	34	0.89	2.62	3.25	1.87	2.92	8.04
19.	***Toona ciliata***	167.2	35	0.67	1.91	3.35	1.41	3.25	8.01
20.	***Celtis australis***	178.1	29	0.78	2.69	2.77	1.64	3.47	7.88
21.	***Melia azaderach***	168.4	29	0.6	2.07	2.77	1.26	3.28	7.31
22.	***Aesculus indica***	154.5	32	0.52	1.63	3.06	1.09	3.01	7.16
23.	***Lannea coromandelica***	180.4	25	0.45	1.80	2.39	0.95	3.51	6.85
24.	***Morus alba***	125.6	32	0.47	1.47	3.06	0.99	2.44	6.49
25.	***Grewia optiva***	120.3	35	0.17	0.49	3.35	0.36	2.34	6.04
26.	***Pistasia integerrima***	129.5	19	0.2	1.05	1.82	0.42	2.52	4.76

Table 2: Phytosociological parameters of different shrubs of the study area (quadrats=200)

S. No	Shrubs Name	Basal area	Freq.	Density	Abundance	R.F.	R.D.	R. Dom.	IVI
1.	***Vitex negundo***	13.4	92	3.5	3.8	13.86	25.93	8.3	45.53
2.	***Dodonaea viscosa***	15.5	88	2.03	2.31	13.25	15.04	9.6	35.45
3.	***Lantana camara***	6.4	76	2	2.63	11.45	14.81	3.97	28.12
4.	***Justicia adhatoda***	20.3	33	0.49	1.48	4.97	3.63	12.58	20.26
5.	***Berberis lycium***	10.6	35	0.9	2.57	5.27	6.67	6.57	17.53
6.	***Viburnum grandiflorum***	8.4	58	0.69	1.19	8.73	5.11	5.2	17.44
7.	***Indigofera heterantha***	11.4	38	0.57	1.5	5.72	4.22	7.06	15.95
8.	***Indigofera tinctoria***	10.2	31	0.43	1.39	4.67	3.19	6.32	13.31
9.	***Rubus hoffmeisterianus***	9.3	35	0.37	1.06	5.27	2.74	5.76	12.8
10	***Buddleja asiatica***	7.5	33	0.49	1.48	4.97	3.63	4.65	12.33
11	***Sarcococca saligna***	7.3	32	0.46	1.44	4.82	3.41	4.52	11.86
12	***Nerium indicum***	8.1	28	0.35	1.25	4.22	2.59	5.02	11.05
13	***Rosa brunonii***	10.7	20	0.25	1.25	3.01	1.85	6.63	10.94
14	***Desmodium gyrans***	8.4	25	0.33	1.32	3.77	2.44	5.2	10.72
15	***Desmodium elegans***	5.8	28	0.37	1.32	4.22	2.74	3.59	9.77
16	***Rhabdosia rugosus***	8.1	12	0.27	2.25	1.81	2	5.02	8.49

In case of shrubby elements, highest relative frequency (13.86%) and relative density (25.93%) has been exhibited by *Vitex negundo.* However, *Justicia adhatoda* has been observed to have the highest value of relative dominance (12.58%). The highest values of relative frequency and relative density for herbaceous flora have been represented by *Cynodon dactylon* with respective percent values of 5.64 and 4.53, whereas *Duchesnea indica* represented the highest relative dominance (12.58%).In case of IVI, *Quercus baloot* (27.17%) followed by *Cedrus deodara* (27.16%), *Quercus semicarpifolia* (24.19%), *Pinus wallichiana* (19.46%), *Dalbergia sissoo* (16.61%) and *Pinus roxburghii* (16.09%) have been found to be dominant among the arboreal elements. However, studies conducted in adjoinings revealed *Pinus roxburghii* to exhibit highest IVI in Trikuta hills (Kour, 2001), Jammu (Sharma, 2003), Kathua (Jhangir, 2004) and Mansar-Surinsar wildlife sanctuary (Rai, 2007) in sub-tropical forest areas whereas in case of temperate vegetation, the highest IVI values have been reported for species like *Quercus floribunda* in Kathua (Jhangir, 2004) and *Quercus dilatata* and *Quercus leucotrichophora* in Bhaderwah (Dutt, 2005). For shrubby elements, the highest IVI has been represented by *Vitex negundo* (45.53%) followed by *Dodonaea viscosa* (35.45%), *Lantana camara* (28.12%) and *Justicia adhatoda* (20.26%). Similar findings have also been presented by Kumar (1997), Kour (2001), Kesar (2002), Sharma (2003), Jhangir (2004), Rai (2007) and Sagar and Singh (2005). The herbaceous flora has indicated the highest IVI for *Viola pilosa* (18.32%) followed by *Verbascum thapsus* (16.47%), *Solanum nigrum* (13.55%), *Duchesnea indica* (13.26%) and *Geranium ocellatum* (12.32%).

Table 3: Phytosociological parameters of herbs of the study area (quadrats=400)

S.No	Herbs Name	Basal area	Freq.	Density	Abun-dance	R.F.	R.D.	R. Dom	I.V.I
1.	***Viola pilosa***	0.98	53	0.65	1.23	5.16	4.53	8.63	18.32
2.	***Verbascum thapsus***	1.109	36	0.46	1.28	3.5	3.21	9.76	16.47
3.	***Solanum nigrum***	1.025	31	0.37	1.19	3.02	2.58	9.02	14.62
4.	***Duchesnea indica***	1.13	17	0.28	1.65	1.65	1.95	9.95	13.55
5.	***Geranium ocellatum***	1.04	20	0.31	1.55	1.95	2.16	9.15	13.26
6.	***Datura stramonium***	1.001	16	0.28	1.75	1.56	1.95	8.81	12.32
7.	***Cynodon dactylon***	0.003	58	0.65	1.12	5.64	4.53	0.03	10.2
8.	***Ipomoea purpurea***	0.021	43	0.59	1.37	4.18	4.11	0.18	8.48
9.	***Artemisia cina***	0.041	38	0.6	1.58	3.7	4.18	0.36	8.24
10.	***Solanum surratense***	0.502	15	0.32	2.13	1.46	2.23	4.42	8.11
11.	***Bergenia ligulata***	0.061	38	0.47	1.24	3.7	3.28	0.54	7.51
12.	***Achillea millefolium***	0.032	35	0.46	1.31	3.4	3.21	0.28	6.89
13.	***Taraxacum officinale***	0.28	22	0.3	1.36	2.14	2.09	2.46	6.7
14.	***Arisaema jacquemontii***	0.1	31	0.39	1.26	3.02	2.72	0.88	6.62
15.	***Anagallis arvense***	0.095	30	0.39	1.3	2.92	2.72	0.84	6.47
16.	***Androsace rotundifolia***	0.121	25	0.4	1.6	2.43	2.79	1.07	6.29
17.	***Aquilegia pubiflora***	0.011	34	0.41	1.21	3.31	2.86	0.1	6.26
18.	***Tridax procumbens***	0.012	32	0.4	1.25	3.11	2.79	0.11	6.01
19.	***Cirsium arvense***	0.024	32	0.38	1.19	3.11	2.65	0.21	5.97
20.	***Aster pseudamellus***	0.023	30	0.39	1.3	2.92	2.72	0.2	5.84
21.	***Poa aunua***	0.006	31	0.38	1.23	3.02	2.65	0.05	5.72
22.	***Sonchus arvensis***	0.13	18	0.35	1.94	1.75	2.44	1.14	5.34
23.	***Bistorta amplexicaulis***	0.013	23	0.42	1.83	2.24	2.93	0.11	5.28
24.	***Euphorbia hirta***	0.069	20	0.28	1.4	1.95	1.95	0.61	4.51
25.	***Cannabis sativa***	0.078	19	0.24	1.26	1.85	1.67	0.69	4.21
26.	***Sassurea heteromalla***	0.045	17	0.26	1.53	1.65	1.81	0.4	3.86
27.	***Stellaria media***	0.17	13	0.15	1.15	1.26	1.05	1.5	3.81
28.	***Oenothera lamarckiana***	0.091	17	0.19	1.12	1.65	1.32	0.8	3.78
29.	***Euphorbia heliscopia***	0.052	17	0.22	1.29	1.65	1.53	0.46	3.65
30.	***Rumex hastatus***	0.025	14	0.26	1.86	1.36	1.81	0.22	3.4
31.	***Duchesnea indica***	0.065	13	0.21	1.62	1.26	1.46	0.57	3.3
32.	***Silene conoidea***	0.081	12	0.19	1.58	1.17	1.32	0.71	3.21
33.	***Galium elegans***	0.081	13	0.17	1.31	1.26	1.19	0.71	3.16
34.	***Valeriana wallichii***	0.036	12	0.21	1.75	1.17	1.46	0.32	2.95
35.	***Urtica dioica***	0.051	12	0.19	1.58	1.17	1.32	0.45	2.94
36.	***Galium asperifolium***	0.062	10	0.18	1.8	0.97	1.26	0.55	2.77
37.	***Micromeria biflora***	0.011	11	0.18	1.64	1.07	1.26	0.1	2.42
38.	***Ranunculus arvensis***	0.019	9	0.19	2.11	0.88	1.32	0.17	2.37
39.	***Plantago lanceolata***	0.011	10	0.11	1.1	0.97	0.77	0.1	1.84
40.	***Tagetus minuta***	0.076	5	0.09	1.8	0.49	0.63	0.67	1.78
41.	***Thymus serphyllum***	0.018	1	0.04	4	0.1	0.28	0.16	0.53

Table-4: Diversity index of vegetation in the study area

Type	Trees	Shrubs	Herbs
Shannon-Wiener's Index	2.78	2.38	3.61

Species diversity is an index that incorporates the number of species in an area and also their relative abundance. It has been calculated on the basis of total number of individuals of species and total number of species. Typically the value of the index ranges from 1.5 (low species richness and evenness) to 3.5 (high species evenness and richness), though values beyond these limits may also be encountered.The perusal of the Table-4 revealed that value of Shannon Wienner's index to be 2.78 for trees, 2.38 for shrubs and 3.61 for herbs. This interprets that species richness and evenness in the study area is high with respect to its tree and shrubby vegetation whereas it is sufficiently low in terms of herbaceous flora. Comparison of the diversity indices of the present study revealed that values of Shannon Wienner's index were higher than the values calculated by Rai (2009) for Mansar-Surinsar area (sub-tropical area) and lower than that calculated by Dutt (2005) for Bhaderwah region (temperate area) in Jammu province.

Conclusions

The phytosociology studies conducted in the study area revealed the predominance of tree species like *Quercus baloot, Q. semicarpifolia, Cedrus deodara, Pinus wallichiana, P. roxburghii* along with under storey species of shrubby vegetation like *Justicia adhatoda, Dodonaea viscoa* and herbaceous species like *Viola pilosa, Verbascum thapsus, Solanum nigrum* etc. The results of the secondary data analysis revealed that species diversity exhibited relatively higher values for herbs.

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A comprehensive report on therapeutic potential of *Elaeocarpus ganitrus* Roxb. (Rudraksha)

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Abstract

Members of family Elaeocarpaceae are known for its medicinal properties since long back in traditional medicinal systems. Along with its medicinal usage it has also got spiritual importance due to its electromagnetic nature and mythological convictions. Elaeocarpus ganitrus Roxb. is commonly known as Rudraksha in India. Phytochemical analysis has revealed the presence of many pharmaco-active constituents like tannins, flavonoids, alkaloids, carbohydrates and acids in different extracts of plant parts. Several studies have been done to explore the pharmacological activities of different extracts of the members of Elaeocarpaceae family specially Rudraksha. In this review, we have tried to consolidate the available reports on the phytochemical constituents, and pharmacological properties of Elaeocarpus species.

Keywords*: Rudraksha, Elaeocarpus ganitrus, Antioxidant property, Antihypertensive agent, Antifungal property, Anxiolytic property, phytochemical constituents, MIC*

Introduction

Elaeocarpus species belong to the family Elaeocarpaceae.This family contains approximately 350 species, which are distributed in India, Southeast Asia, Malaysia, Southern China, Japan, Australia, New Zealand, Fiji and Hawaii. It is a large evergreen broad leaved tree which grows in the area from the gangetic plain to the foothills of great Himalaya. Tree has a pyramidal shape. Flowers are white and inflorescence is raceme. Tree starts giving fruits in 7 years. Fruit is drupe. Stone beads are enclosed by a outer shell of blue colour, on ripening hence sometimes it is also called as blueberry beads. Beads are hard in nature. It is growing in suitable climatic regions with temperature ranges of 25-30^{0}C. *Elaeocarpus ganitrus* (syn. *E. sphaericus*) is the most studied members of the family for their pharmacological properties. *E. ganitrus* is grown in Assam and Himalayan region in India. Here, we have consolidated the pharmacognostic and pharmacological information available in research articles on the members of family Elaeocarpaceae mainly *Elaeocarpus ganitrus* (Rudraksha). *E. mastersii* is the native of Malaysia and Indonesia is known for its anti tumour properties.

Systemic Classification-

Kingdom	Plantae
Division	Magoliophyta
Class	Magnoliopsida
Order	Oxalidales
Family	Elaeocarpaceae
Species	*E. ganitrus*

Traditional therapeutic significance:

Different parts of plant are being used in Ayurveda since long back for the treatment of mental diseases, epilepsy asthma, hypertension, arthritis and liver diseases. It is also used for skin diseases, leprosy, hysteria, coma, leucorrhoea etc. Due to its electromagnetic nature, wearing a Rudraksha is also helpful in controlling B.P., stress, anxiety and depression. Fruits are also used as antipyretic agent to control the fever, to treat malaria *(Bhattacharya SK et al., 1975),* dysentery, diarrhea and typhoid. Leaves of Rudraksha are used in the treatment of rheumatism and its bark is useful in vomiting of blood. It also helps women during conceiving a child and also useful for those female which are prone to abortion. It is also used to cure for prolonged cough. Powder of the plant with black

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pepper is also used to cure smallpox *(Shah G. et al., 2010)*. Rudraksha fruits are also useful in cough, bronchitis, neuralgia cephalgia, anorexia, migraine manic conditions and other brain disorders. Flesh of drupes is also used in treatment of epilepsy *(Dasgupta A. et al., 1984)*.

Active constituents

Active constituents present in Rudraksha are elaeocarpidine, elaeocarpine, rudrakine, flavonoids quercetin (Johns SR., et al., 1971, Ray AB., et al., 1979, Chand L., et al., 1977). Extracts shows presence of phytosterols, fat, alkaloids, flavonoids, carbohydrates, ethanol, proteins and tannins, gallic acid and ellagic acid. It contains 50.03% C, 0.95% N, 17.89% H, and 30.53% O_2. Phytochemical investigation with different extracts shows different kind of chemicals. extraction with petroleum ether shows presence of fixed oil fats and phytosterols. Extraction with ethanol ether shows presence of alkaloids, flavonoids, carbohydrates, proteins, tannins. Extraction with water shows presence of, carbohydrates, proteins, tannins. Elaeocarpus sphaericus yields mainly indolizidine alkaloids. Alkaloids including isoelaeocarpine, epiisoelaeocarpiline, epielaeocarpiline, alloelaeocarpiline and pseudoepiisoelaeocarpilline. (Singh & Chopra et al., 2011).

Pharmacological Activities:

Antioxidant properties:*Elaeocarpus ganitrus* are reported to possess promising antioxidant capacity. Phytochemical analysis has revealed that different extracts contain constituents like flavonoids, polyphenols, biflavones, tanins and phenolic compounds etc. Experiments have shown that etanolic extract (EE) is found to have 24.18 mg ascorbic acid equivalents at 500 µg/ml extract concentration proving antioxidant activity of extracts. Reducing power of a compound also reflects its potential of antioxidant capacity Reducing power of tannins prevents liver injury by inhibiting the formation of lipid peroxides. Reducing power of EE ranged from 1.112 to 1.973 Abs (arbitrary unit) for 100□g/ml to 400□g/ml concentration. Metal chelating agents reduce the concentration of catalyzing transition metal in lipid peroxidation by forming sigma bonds with metals, reducing redox potential thereby stabilizing the oxidized form of the metal ion. There is a positive relationship with antioxidant properties and concentrations of flavonoids & polyphenols. Maximum the quantity of flavonoids and polyphenols maximum the antioxidant capacity. Total phenolic compounds of *E.ganitrus* are 56.79 mg gallic acid equivalent/g of dry material. Total flavonoids present are 18.58 mg equivalent/g of dry material. (Kumar TS., et al., 2008)

Antifungal activity: Different extracts of dried Rudraksha beads [petroleum ether extract (PE), chloroform extract (CE), ethanol extract (EE) and water extract (WE)] have shown different Minimum Inhibitory Concentrations (MIC) for different strain of fungi like *Candida albicans*, *Candida tropicallis* and *Aspergilus niger*. MIC for CE was found to be 1.5 mg/ml followed for EE i.e. 4.0 mg/ml for *C. albicans.* MIC for CE was 5.0 mg/ml when investigated for *C. tropicallis*. *C. tropicallis* did not show any sensitivity against WE and EE. MIC of CE and EE for *A. niger* was 3.0 mg/ml followed by WE (MIC 5.0 mg.ml) and no inhibition was shown for *C.glabrata* and *G.candidum* even at higher concentrations (Singh et al 2010).

Antibacterial activities: Extracts of fruits of Elaeocarpus sphaericus in petroleum ether (PE), benzene (BE), chloroform (CE), acetone (AE), and ethanol (EE) were tested for its bactericidal properties. Several bacterial strains (*Staphylococcus aureus, Enterococcus faecalis, Bacillus subtilis, Salmonella typhi and paratyphi, Salmonella typhimurium, Vibro cholera, Aeromonas hydrophila, Shigella sp., Klebsilla pneumonia, Enterobacter sp. And Pseudomonas sp.* etc.) were found to be sensitive to the exposure of these extracts (Singh RK and Nath G, 1999).

Anxiolytic effects: Shah Gagan et al., 2010, have investigated the anxiolytic effect of methanolic extract (ME) of Rudraksha fruit by Elevated plus-maze (EPM) assay and found that magnitude of the anxiolytic effects of 200mg/kg of ME of Rudraksha fruit was close to that observed with 0.5 mg/Kg of diazepam. ME prolonged the ketamine-induced latency to sleep. ME was also found to affect locomoter activities. Thus these results support the traditional use of plant in management of anxiety. *(Shah G. et al., 2010).*

Anticancer agent:Chloroform soluble extract from bark of *Elaeopcarpus mastersil* from Malaysia has shown significant cytotoxic activity against human cancerous cell lines (human oral epidermoid carcinoma cell line). Phytochemical analysis revealed the presence of ellagic acid and curarbitacin from bark which have shown an effective cytotoxicity against tumour cells (Ito A. et al., 2002).

Antihypertensive agents: Aqueous extract of seeds of *Elaeocarpus ganitrus* have decreased the mean arterial blood pressure at the dose level of 25, 50 and 100 mg/kg in models Male Wister rat and Swiss albino mice. The activity may be due to the action on rennin angotensin system. (Sakat SS et al., 2009).

Antidiabetic activity: Extract of plant has been shown to have anti hyperglycemic activity in a dose dependent manner. STZ (Streptozotocin) induced hyperglycemia in rats was shown to be reduced by the extract but was not able to restore the blood glucose level to the baseline value. The results were given so as to use the plant extract with alternative for diabetic control. (Hule & Juvekar et al, 2011).

Anti-asthmatic activity: Different extracts of E. sphaericus fruit (PE, BE, CE, AE and EE) are reported to have protective role in bronchial asthma. In vitro experiments have shown that fruit extracts have rat mesenteric mast cells stabilizing activities (Singh RK, et al., 2000).

Anti-inflammatory and Analgesic activities: Jaspreet Nain and group (Jaspreet N. et al., 2012) have investigated the analgesic and anti-inflammatory properties of different extracts of *E. sphaericus* leaves by carrageenan-induced paw oedema in rats and tail flick tests in mice. Methanolic and aquous extracts have shown promising anti-inflammatory activities at the doses of 50, 100 and 200mg/kg. Diclofenac sodium at an concentration of 5mg/kg was used as positive control.

Some studies have also reported the cardio-protective *(Sarkar PK et al., 1972 and 1973)* and nootropic (increasing learning and memory) activities of methanolic extract of *E. ganitrus* in animal models.

Conclusion

It is clear from the above mentioned pharmacological properties of Rudraksha that the different extracts from different parts of the plant have got enormous therapeutic potential. Now the studies are required to establish the biological/pharmacological roles of specific active principal of the extracts by in vitro and in vivo assays. Toxicological assays, as per the regulatory guidelines (ICH version 2, 2008, WHO and Indian guidelines) should be followed to develop the novel drug product. Guidelines and protocols are available in Ayurvedic Pharmacopoeia of India 2011 to develop an Ayurvedic drug.

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Studies of Ground water quality assessment at industrial belt of Kashipur, Uttarakhand, India

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Abstract

Pollution of ground water is one of the areas of major concern to environmentalists. Water quality is an index of health and well being of a society. Industrialisation, urbanisation and modern agriculture practices have direct impact on ground water resources. These factors influence the ground water quantitatively and qualitatively. Ground water is an important source of potable water supply for Kashipur as well as adjoined areas of the U. S. Nagar district for all purposes. Ten different locations were selected for the study and compared. Attempts were made to study and analyze the physico-chemical characteristics of the water. The parameters studied were temperature, pH, total alkalinity, total hardness, chloride, sulphate, total dissolved solids, calcium, magnesium and conductivity. By observing the result it can be concluded that the parameters of the water quality are found below the pollution level for ground water which satisfy the requirement for the use of various purposes like domestic, agricultural, industrial etc.in Kashipur area.

Keywords*:Ground water, dissolved oxygen, water quality, kashipur, monitoring.*

Introduction

India has experienced substantial increases in industrial growth and expansion in recent years. The industry has resulted in increased pollutant emissions and the deterioration of environmental quality and human health in major cities in India. After formation of Uttarakhand as a new State rapid industrialization and urbanization took place due to this there is great pressure on the environmental components. Kashipur is an old industrial town of Uttarakhand State, earlier belonging to Uttar Pradesh. This town experienced industrialization with few major type of industries working in this area belongs to distillery, chemical, paper and other small industries.Human needs are growing rapidly and the need for water is also growing. Much of the current concern with regards to environmental quality is focused on water because of its importance in maintaining the human health and health of the ecosystem. The availability of water determines the location and activities of humans in an area and our growing population is placing great demands upon natural fresh water resources (Oladipo*et al*., 2011).The natural aquatic resources are causing heavy and varied pollution in aquatic environment leading to water quality and depletion of aquatic biota. Water sources were polluted by domestic wastage in rural areas whereas industrial wastages discharged into natural water sources in urban areas (Sayyedand Bhosle*et al*., 2010). It is therefore necessary that the quality of drinking water should be checked at regular time interval because due to use of contaminated drinking water, human population suffers from a variety of water borne diseases (Ogbonna*et al*., 2011). Fresh water is a finite resource, essential for agriculture, industry and even human existence, without fresh water of adequate quantity and quality, sustainable development will not be possible (Kumar, 1997). Fresh water resource is deterotating day-by-day at the faster rate and the water quality is now a global problem (Mahanand*aet al*., 2005). Discharge of toxic chemicals, over pumping of aquifer and contamination of water bodies with substance that promote algae growth are some of the today's

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major cause for water quality degradation. Direct contamination of surface water with metals in discharges from mining, smelting and industrial manufacturing, is a long-standing phenomenon. Today there is trace contamination not only of surface water but also of groundwater bodies, which are susceptible to leaching from waste dumps, mine tailings and industrial production sites (Moore *et al*., 1998). Water quality reflects the composition of water as affected by natural cause and man's cultural activities expressed in terms of measurable quantities and related to intended water use (Kumar, 1997). The composition of surface and groundwater is dependent on natural factors (geological, topographical, meteorological, hydrological and biological) in the drainage basin and varies with seasonal difference in runoff volumes, weather conditions and water levels (Muller *et al*.,2001). One of the major reasons of ground water pollution in India is unplanned urban development without adequate attention to sewage and waste disposals (Yadavand Kumar, 2011).Pollution caused by fertilizers and pesticides used in agriculture, often dispersed over large areas is a great threat to fresh groundwater ecosystems. Pollution of groundwater due to industrial effluents and municipal waste in water bodies is another major concern in many cities and industrial clusters in India. Hence there is a need and concern for the protection and management of ground water quality. The major problem with the ground water is that once contaminated, it is difficult to restore its quality. The natural aquatic resources are causing heavy and varied pollution in aquatic environment leading to water quality and depletion of aquatic biota. It is well known that no straightforward reasons can be advanced for the deterioration of water quality, as it is dependent on several water quality parameters. It is therefore necessary that the quality of drinking water should be checked at regular time interval because due to use of contaminated drinking water, human population suffers from a variety of water borne diseases. Water quality is based on the physical and chemical soluble constituents due to weathering of parent rocks and anthropogenic activities (AkinbileandYusoff, 2011). The main object of the physicochemical analysis of water is to determine the status of different chemical constituents, which are present in the natural and disturbed aquatic ecosystem. The quality of water may be affected in various ways due to pollution.The present investigation aims towards analysis of the water quality of the 10 different sites in Kashipur city/ industrial area, Udham Singh Nagar district, Uttarakhand, India with special reference to total dissolved solids, total hardness, total acidity, total alkalinity, pH, calcium, magnesium, sulphates, and chlorides.

Description of Study area

Kashipur has been identified as one of the potential Industrial developing area in Uttarakhand. The study area located in the industrial area of Kashipur in Udham Singh Nagar district of Uttarakhand between 29°10'32.1798' North latitude and 79°0'24.3457" East longitude. Major industries in the study area can be categorized broadly into three: viz., Pulp & Paper, Chemical and Steel as given below in Table 1.This town experienced an industrialization way back in 1988 – 1989. Few major type of industries working in this area belongs to Distillery, Chemicals, Paper and other small industries. After formation of Uttarakhand in the year 2000 and due to fiscal benefits various kinds of industries are coming up in this area, which includes paper, distillery, chemical, and gas based thermal power.The major sources of pollutants of Kashipur are domestic wastage due to unplanned urban development and industrial waste from the process of chemical plant, paper industries and mining activity without adequate attention to sewage and waste disposals.

Selection criteria of siting the monitoring station

Total of 10 different location were identified to collect the ground sample. Each such sited station represents a unique category of microenvironment. Sampling point selected based on the criteria mentioned below:

1. Zone of possible pollutant concentration.
2. Area of population exposure.
3. Dispersion of pollutants from other sources located outside the study area.
4. Non-Industrial reference station providing background level

Table 1. Industrial Activity in Kashipur Area

Industry	Location	Product
India Glycols Limited	Bazpur Road	Chemicals
Goraya Straw Board Mills Pvt Ltd	Bazpur Road	Paper
Multiwal Pulp & Board Mills (P) Ltd.	Bazpur Road	Paper
Prolific Papers (P) Limited	Village Girdhai, Aliganj Road,	Paper
Cheema Papers Ltd	Nainital Road	Paper
Shravanti Energy	Aliganj Road	Electricity (yet to start)
Gama Energy	MahuaKheraGanj	Electricity (yet to start)
Beta Energy	MahuaKheraGanj	Electricity (yet to start)
Naini Paper	Ramnagar Road	Paper
SRF	Ramnagar Road	Chemical
KashiVishwanth Steels Ltd	Bazpur Road	Steel, Special Alloys
Jindal Baverages	Bazpur Road	Frozen Foods, Edible Oils

Sampling points were selected within the 10 Kms radius of study area. These samples were selected on the basis of even distribution over the study area taking in to consideration various factors like topography of the region, proximity of sensitive establishment and human settlements, industrial activities in the area and its proximity etc. Location plan of the sited Ground water monitoring point is presented in Figure 1 and each station site is briefly described below:

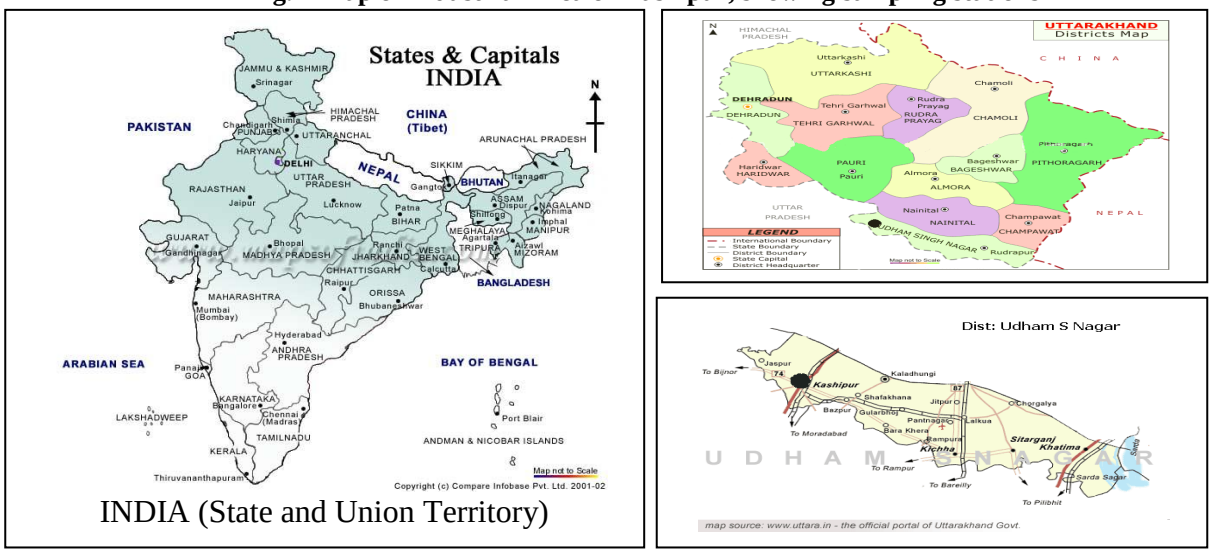
A-1 Industrial area is located around 7 km east of Kashipur city. Uniqueness of this sampling point is the fact that all other samples are collected within 10 km radius of this sampling point. *GinniKhera*is a very small village located around 3 km of Prolific Papers (P) Limited. Uniqueness of this station is that, it is away from industries (except a paper plant) and city. The selected sampling point is considered to be agriculture land and exhibit intense agri-business and rural activity. *Nandrampur*is a village located near A-1 industrial area Kashipur. *DhakiaKalan*is a village located around 7 km north east of A-1 industrial area. Uniqueness of this station is it is away from industries but mining activity has been noticed near this area, thus it can give impact of leaching from dumps, mine tailings. *DabhauraMustahkam*is a village located around 3.5 km south east of India Glycols and around 2.5 and 2 km east of Chima Paper and Multiwall Paper respectively. *Barkheri*is a village located around 2 km west of Chima Papers and around 2 km South of A-1 industrial area. Uniqueness of this station is the fact that it is affected with pollution load of paper and chemical industry and unpaved road. *KharakpurDevipura* is a village located around 4 km west of India Glycols Limited and in between A-1 Industrial area and Kashipur City. Uniqueness of this station is that, it is away from industries and city. The selected study station is considered to be agriculture land and exhibit intense agri-business and rural activity. *Kashipur sampling point* will represent the pollution load domestic sewage penetrate to round water. Gangapurgosain is located in aproximaely 6 km north of A-1 Industrial area. The sampling point is considered to be agriculture land and exhibit agri-business.

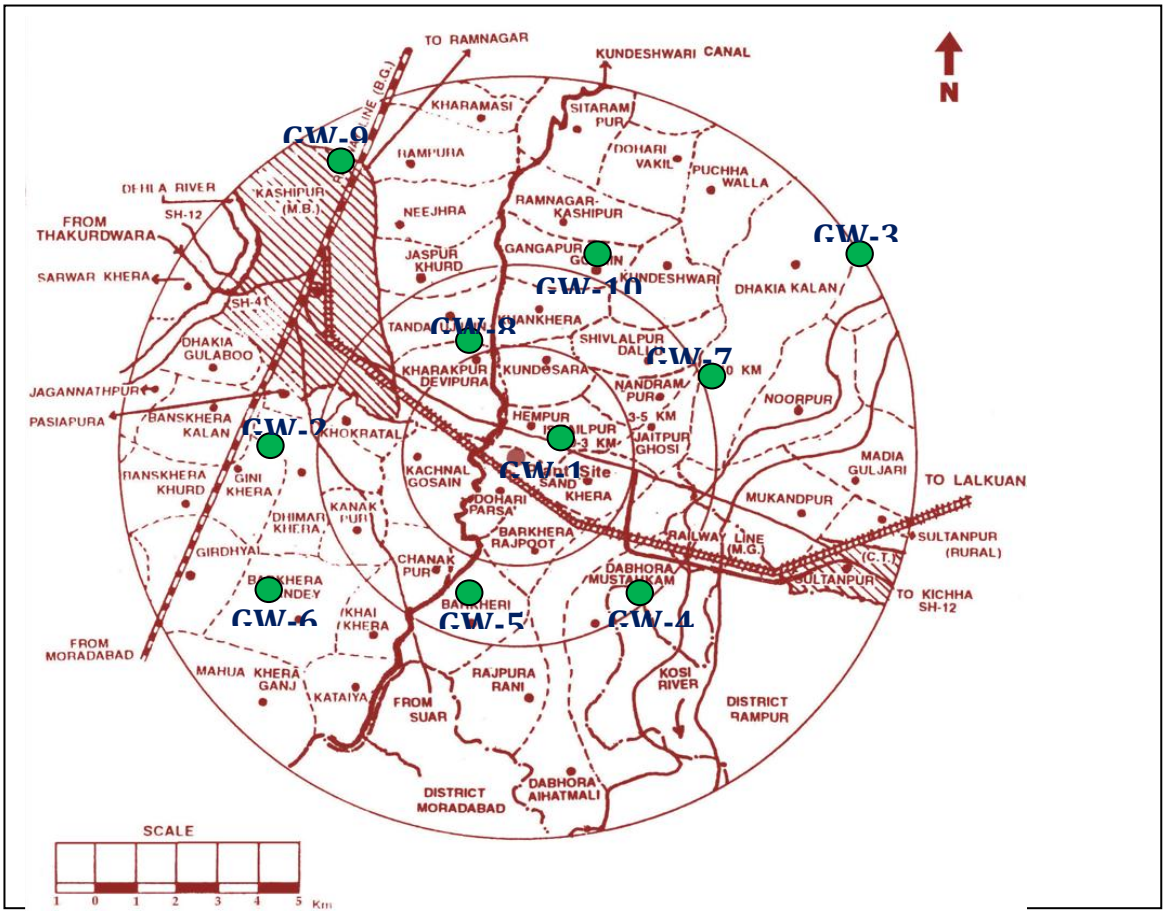
Water Sampling

The samples were collected in pre-cleaned and sterilized polyethylene bottles of two litre capacity. The depth of the bore wells varied between 250 and 700 feet. The groundwater samples were analyzed using APHA (1995) procedure, and suggested precautions were taken to avoid contamination.The various parameters determined were pH, color, EC (electrical conductivity), total dissolved solids (TDS), total hardness (TH), calcium (Ca^{2+}), magnesium (Mg^{2+}), carbonate (CO_3^{2-}), bicarbonate ($HCO3^{-}$), chloride (Cl^{-}), sulfate ($SO4^{2-}$), Sodium (Na^{+}), potassium (K_{+}), Nitrate ($NO3^{-}$), BOD(3 days at 27 degC), COD. Various physicochemical parameters such as pH, electrical conductivity, total alkalinity, total hardness as well as calcium, magnesium, sodium, potassium,

chloride, nitrate, carbonate, and bicarbonate were analyzed with the determination of BOD, COD, total coliform and Fluoride. In general, the ground water had no colour, odour and turbidity except few samples.

Fig. 1 Map of Industrial Area of Kashipur, showing sampling stations





Methodology (Sampling and Analysis)

Table 2: Techniques used for water quality monitoring

Parameter	Technique
1. Water temperature	Water temperature was recorded in the field using mercury thermometer.
2. pH	The pH of the samples was determined by using digital pH meter
3. Turbidity	Turbidity was determined by Naphelo-turbidity meter
4. Total hardness	Total hardness was determined tetrimetrically using EDTA method
5. Total alkalinity	Total alkalinity was determined by tetrimetrically method.
6. BOD	BOD was determined as per standard method. (3days at 27 degC)
7. COD	COD was determined by potassium dichromate open reflex method
8. Chlorides	Chlorides were determined by Mohr's argentometry method.
9. Nitrate and phosphate	Nitrate and phosphate content is determined per standard method
10. Fluoride	Fluoride content is determined using ELICO-52 UV spectrophotometer

Results and Discussion

The maximum value of pH of the water samples was recorded as 7.61 at station GW6 and minimum value of pH was recorded as 6.86 at station GW7. In general pH was within the limits of standard value. For drinking water source, a pH range of 6.5-8.5 is recommended.The present study shows the turbidity in the range of 0.2 -1.1 NTU. World Health Organization prescribed the highest desirable limit 5.0 NTU and maximum permissible limit 25.0 NTU. The value of turbidity present is within permissible limits.The alkalinity of water is its capacity to neutralize acids. The maximum alkalinity was recorded as 172 mg/l at station GW1 and minimum value is recorded as 121 mg/l at station GW7. BIS has set a desirable level of alkalinity in drinking water to be 200 mg/l where as its value has been prescribed to be 600 mg/l in the absence of alternative source. So in maximum stations value of total alkalinity present in water are within limit. In the present study water samples of different locations was observed in the range of 115-240 mg/l. The amount of dissolved calcium and magnesium in water determines its "hardness." The hardness of water is not a pollution parameter but indicates water quality. Hardness has no known adverse effects on health. However, maximum permissible level prescribed by WHO for drinking water is 500 mg/L.Biochemical oxygen demand is usually defined as the amount of oxygen required by bacteria in stabilizing the decomposable organic matter. BOD gives an idea about the extent of pollution. In present study BOD was found in the range of 1.5-2.5 mg/l, it indicatesthat the pollution affects the water quality. As water can be use as drinking water without conventional treatment but after disinfection if BOD is 2 mg/l or less.The chemical oxygen demand is a measure of oxygen equivalent to the requirement of oxidizing organic matter contents by a strong chemical agent. The COD test is helpful in indicating toxic conditions and the presence of biologically resistant organic substances. The maximum COD value was recorded 52.8 mg/l at GW1 and the minimum values was recorded as 25 mg/l at GW3. The high value of COD due to high level of pollutants present in water samples.In water, total dissolved solids (TDS) are composed mainly of carbonates, bicarbonates, chlorides, phosphates and nitrates of calcium, magnesium, sodium, potassium and manganese, organic matter, salt and other particles. The maximum TDS value was recorded 414 mg/l at GW7 and the minimum values was recorded as 258 mg/l at GW6. The permissible limit of TDS of drinking water is 500 mg/L. The observation shows that the TDS is within the permissible range as prescribed by WHO (2004).Chlorides occur in all natural waters in widely varying concentrations. The chloride contents normally increases as the mineral content increases. In present study the chloride concentration were found in the range of 13-28 mg/l. The maximum chloride contents were due to addition of natural contaminants and pollutants at A-1 industrial area. According to WHO, maximum permissible limit for chloride is 500 mg/L. The value observed in present study is in the range of permissible limit.The nitrate content of

water bodies was found in the range of 0.13-0.32 mg/l. The highest value of 0.32 mg/l was recorded at station GW1 (A-1 industrial area) while minimum at station GW6 (BarkheraPande). The value observed in present study is in the range ofpermissible limit of drinking water standards of ICMR. (Limit of Drinking water as per ICMR 20 ppm and ISI 45 ppm).The sulphate content varies between 7.2 to 21.5 mg/l. The sulphate value was also found to be within the prescribed limits.The fluoride content in water is below detectable limit.

Table 3: Average value of pollutants in 2011

S. No	Parameter	Unit	GW1	GW2	GW3	GW4	GW5	GW6	GW7	GW8	GW9	GW10
			A-1 industrial area Ginnikhera		Dhakiakalan	Dhaboramustakham	Barkheri	Barkerapande	Nand Rampur	Kharakpur Devipura	Kashipur	Gangapurgosain
1.	pH	-	7.42	7.54	6.95	7.42	7.39	7.61	6.86	7.33	7.46	7.24
2.	Color	Hazen	C.L.	C.L.	C.L.	C.L.	C.L.	C.L.	C.L.	C.L.	C.L.	C.L.
3.	Conductivity	µδ/cm	42.8	46.1	22	41.4	32.2	24.8	52.2	45.1	47.1	45.8
4.	Total Coliform	MPN/100 ml	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
5.	B.O.D. (3days at 27 deg C)	mg/l	1.5	2	2.2	1.8	2	1.6	2.5	2.5	1.8	2
6.	COD	mg/l	52.8	41.1	25	38.4	26.2	18.8	36	45.1	28.2	32.4
7.	Total Dissolved Solids	mg/l	378	370	387	330	376	258	414	315	358	347
8.	Turbidity	NTU	0.4	0.3	0.5	0.2	0.6	1.1	0.4	0.4	0.6	0.5
9.	Total Alkalinity as CaCO3	mg/l	172	122	136	132	143	142	121	140	135	141
10.	Total Hardness as CaCO3	mg/l	211	115	205	168	182	221	228	240	224	198
11.	Calcium Harness as CaCO3	mg/l	136	152	153	118	136	130	162	180	131	141
12.	Chlorides as Cl ion	mg/l	28	15	16	13	17	10	14	14	15	13
13.	Sulphates as SO4-	mg/l	12	21.5	9	7.2	15.2	17.8	10.2	14.4	20.4	18.2
14.	Nitrates as NO3	mg/l	0.25	0.32	0.19	0.17	0.23	0.13	0.26	0.15	0.28	0.16
15.	Sodium	mg/l	31.6	37.2	24.7	30.8	36.3	38.6	23.7	30.8	27.9	30.7
16.	Potassium	mg/l	22.2	16.4	19.8	26.6	23	28.1	20.6	23.7	21.3	26.4
17.	Iron as Fe	mg/l	0.07	0.15	0.16	0.12	0.13	0.13	0.08	0.1	0.18	0.15
18.	Fluoride as F	mg/l	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
19.	Zinc as Zn	mg/l	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

Conclusion

The result revealed that there was significant variation in some physicochemical parameters and most of the parameters were in the normal range and indicates better quality of water. It has been found that the water is best for drinking purpose in all the areas. In general all the parameters arewithin the range of standard values prescribed by various agencies.

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Dissipation of chlorpyriphos on Okra (*Abelmoschus esculentus* L.)

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Abstract

Indiscriminate use of insecticides to combat the insect pests has led to accumulation of residues in okra which are harmful to consumers. In the present study, an attempt has been made to study the dissipation of chlorpyriphos on Okra fruits under agro-climatic conditions of Jammu where no study has been carried out earlier. Field experiments have been conducted for two consecutive years 2004 and 2005 to work out the safe preharvest interval. The average initial deposits of 0.91 mg kg^{-1} and 1.46 mg kg^{-1} have been recorded on okra fruits treated with the recommended (500g a.i. ha^{-1}) and double the recommended dose of chlorpyriphos (1000g a.i. ha^{-1}) respectively, showing percentage dissipation of 97.80 and 98.63% correspondingly. On the basis of dissipation and prescribed MRL of 0.20 mg kg^{-1} of chlorpyriphos for okra, the half-life for the recommended and double the recommended dose has been worked out to be 1.33 and 1.41 days, respectively. The safe waiting period of 2.92 and 4.06 days have been suggested for the recommended and double the recommended dose of chlorpyriphos, respectively.

Keywords*: Chlorpyriphos, Dissipation, Okra, Maximum Residue Limit, Pesticide, Safe waiting period.*

Introduction

Use of pesticides to control pests is unavoidable as pests cause heavy loss to yield and quality of the food items including the vegetables, which forms a very important component of agriculture in India. Various insect pests viz. shoot and fruit borer, leaf rollers, jassids, aphids, moths, mites, fruit flies, caterpillars, weevils and hoppers etc. cause considerable losses to the vegetables which along with fruits and spices have been estimated to be of Rs. 30,000 crores in India only (MOCF, 2002). Several kinds of pesticides are being applied to control the pests, sometime close to the harvest or picking time of vegetables, thereby, leaving little or no time for their adequate dissipation. The presence of pesticide residue or their metabolites is a matter of great concern as it is directly related to the health of the human beings. Use of pesticides cannot be avoided but their quality, quantity and safe waiting period after the spray can be regulated so that minimum level of residues are left on the vegetables at the time of consumption. Supervised trials provide useful information for determining the waiting period which are considered safe interval between the last application of pesticide and harvest of edible part of the vegetables. This also facilitates the growers to adjust their crop harvest intervals accordingly in the interest of vegetable consumers.Okra, commonly called as "Bhendi", is an important vegetable crop grown all round the year and throughout the country for fresh market consumption as well as for preservation, as the fruit is very rich in fiber, proteins, vitamins and minerals (Pawar and Jadhav, 1993). Several studies have indicated the contamination of market samples of okra with different kinds of pesticides including chlorpyriphos.(Dahiya and Chauhan ,1982; Chauhan *et al.*,1983; Saxena *et al.*, 1990; Chahal *et al.*, 1997; Agnihotri, 1999; Chahal *et al.*, 1999; Rao and Rao ,2000; Kole *et al.*, 2002 and Shah *et al*., 2000).Chlorpyriphos (0, 0-diethyl 0-3, 5, 6-trichloro-2-pyridyl phosphorothioate) is a broad-spectrum organophosphorous insecticide used against a number of important arthropod pests in

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the study area. Till date no studies have been conducted on dissipation pattern of chlorpyriphos on okra under agro climatic conditions of J&K. The present studies were, therefore, undertaken to determine the residues of chlorpyriphos on *Abelmoschus esculentus* L.(Variety: Pusa Sawani) following its application at the recommended and double the recommended dosages to find out the desirable waiting period between the last spraying and harvesting of vegetable.

Material and Methods

The field experiments were conducted at village Jessore (32^0 38' N latitude and 74^0 45' E longitude; altitude: 271meters above mean sea level, located in Low- altitude subtropical agro climatic zone characterized by the monsoon concentration of precipitation, hot summers and relatively dry but pronounced winters and preponderance of alluvial soils) located in Tehsil R.S. Pura of District Jammu for the two consecutive years. The okra crop was raised by sowing the certified seeds procured from J & K Agriculture Department, directly into the prepared field in the form of ridges placed at a distance of 60cm with plant to plant spacing of 30cm (recommended by Directorate of Extension Education, SKUAST-Jammu) in starting April 2004 and 2005 and thereafter normal agronomic practices were followed.Chlorpyriphos 20EC, purchased from local market was sprayed twice at the rate of 500g a.i. ha^{-1} (recommended dose) and 1000g a.i. ha^{-1} (double the recommended dose) with Knapsack sprayer. First spray was done at the onset of flowering followed by second spray at an interval of twenty days. The sampling was done on 0(2 hr), 1, 2, 3, 4, 5, 7, 9 and 15 after the second spray for both the years. Samples from each experiment plot consisted of about 8-10 okra fruits and were brought to the laboratory in polythene bags with minimal finger touching for residue analysis.

Extraction and Partitioning: Representative sample of chopped okra fruits (50g) after proper mixing and quartering was blended in an electric grinder and rinsed with Acetone AR. The macerated sample was immersed in 100-150 ml Acetone AR and kept over night. The sample was filtered into 1 liter separating funnel using whatman's filter paper No. 1. After adding 600ml of 5% NaCl solution to the above extract, partitioning was done twice with 100 ml of dichloromethane AR. The lower layer was collected over 30g of anhydrous sodium sulphate and concentrated to about 5ml using rotary vacuum evaporator.

Clean Up: The cleanup of the extract was performed by adsorption column chromatography. Glass column of 2.5 cm (i.d.) x 60 cm (length) was packed with mixture of 20g silica gel (60-120 mesh size) activated at 130°C for 2 hrs and activated animal charcoal (300mg) sandwiched between 5g of anhydrous sodium sulphate layers. The drip tip of the column was plugged with cotton. After pre washing the packed column with 40ml of dichloromethane AR the sample extract was added to it and eluted with 150 ml solvent mixture of Acetone: dichloromethane (2:1). The eluate was evaporated to dryness and the residue was dissolved in 5ml of Acetonitrile (HPLC grade) and the sample was filtered using membrane filter media.

Estimation: The residues of chlorpyriphos was estimated by using High Pressure Liquid Chromatography (Shimadzu HPLC model LC-10A) equipped with dual pump (LC-10 AT) , auto injector (SIL-10 A) , UV detector(SPD-10 A) set at a wavelength of 225 nm. The column used for the separation was Shim pack CLC-ODS (M) 4.6 X 25 cm. long stainless steel tube packed with totally porous, spheric silica particles (5 µ m particle diameter, 100^0A pore diameter).The solvent system used was acetonitrile: water (90:10) at a flow rate of 1ml/min and the retention time of chlorpyriphos was 6.1 minutes. The method offered a sensitivity of 0.5 ng and limit of detection of 0.01mg kg^{-1} (on 50g sample basis).The average recoveries from okra fortified with concentrations ranging from 0.20 to 1.0 mg kg^{-1} were found to be in the range of 83%-93% with an average of 88.42$\pm$2-31%. All the solvents used for extraction and cleanup were glass distilled and chemicals i.e. silica gel, anhydrous sodium sulphate etc. along with glassware were washed with distilled solvents before use. The suitability of all the solvents for residual analysis was ensured by running reagent blanks.

Statistical Analysis: The data was analyzed to work out half life value (RL_{50}) and safe waiting period (T_{tol}) according to Hoskins formula (1961).

Results and Discussion

The quantitative estimates of residues of chlorpyriphos on okra fruits for two consecutive years i.e. 2004 and 2005 at various sampling intervals (0, 1, 2, 3, 4, 5, 7, 9 and 15 days after the second spray) have been presented in the Table 1. The residues of chlorpyriphos on okra fruits collected from control plots has been always found to be below the detectable limits (0.01mg kg^{-1}) during both the years of study period.The average initial deposits of chlorpyriphos on okra fruits after the second spray were found to be 0.86 and 1.80 mg kg^{-1} at the recommended 500g a.i. ha^{-1}) and double the recommended dose (1000g a.i. ha^{-1}), respectively, for the first year (i.e. 2004). About 98% of initial deposits dissipated within 7 days after its application at recommended dose while at double the dose about 99% of the initial deposits get dissipated within 9 days. The time required (T_{tol}) for dissipation of residues below the maximum residue limit (MRL) of 0.2 mg kg^{-1} were found to be 2.82 and 4.45 days, respectively, for lower and higher dosages while the corresponding values for half life (RL_{50}) were found to be 1.3413 and 1.4039 days (Table 1).

Table 1: Dissipation of Chlorpyriphos on Okra fruits during 2004 and 2005

Days after treatment	*Residues of chlorpyriphos (mg kg^{-1})			
	1st Year (2004)		2nd Year (2005)	
	R.D. (500g a.i. ha^{-1})	Double R.D. (1000g a.i ha^{-1})	R.D. (500g a.i. ha^{-})	Double R.D. (1000g a.i ha^{-1})
0 (2hr)	**0.86**	**1.80**	**0.96**	**1.12**
1	**0.51** (40.69)	**0.95** (47.22)	**0.55** (42.71)	**0.80** (28.57)
2	**0.43** (50.0)	**0.59** (67.22)	**0.46** (52.08)	**0.66** (41.07)
3	**0.21** (75.58)	**0.31** (82.78)	**0.22** (77.08)	**0.33** (70.53)
4	**0.12** (86.05)	**0.23** (87.22)	**0.11** (88.54)	**0.24** (78.57)
5	**0.04** (95.35)	**0.07** (96.11)	**0.04** (95.83)	**0.06** (94.64)
7	**0.02** (97.67)	**0.04** (97.78)	**0.02** (96.87)	**0.03** (97.32)
9	BDL	**0.02** (98.89)	BDL	**0.02** (98.21)
15	BDL	BDL	BDL	BDL
RL_{50}(days)	**1.3413**	**1.4039**	**1.3254**	**1.4388**
T_{tol} (days)	**2.820**	**4.450**	**2.999**	**3.576**
Regression Equation	Y=2.8782-0.2244x r = -0.9443	Y=3.1632-0.2144x r = -0.9946	Y=2.9023-0.2271x r = -0.9444	Y= 3.0948-.2092x r = -0.9905

Control Samples showed residue level =BDL; Figures in parenthesis represent %age dissipation. *Average of three replicates; BDL = Below detectable limit (0.01mgkg^{-1}); R.D. = Recommended dos

Similarly for the second year (i.e. 2005) average initial deposits of chlorpyriphos on okra fruits were found to be 0.96 and 1.12 mgkg^{-1} following treatments of recommended and double the recommended dosages. Dissipation of residues was found to be about 97% within 7 days and about 98% within 9 days respectively for lower and higher dosages. The safe waiting periods (T_{tol}) at recommended and double the recommended dosages were found to be 2.999 and 3.576 days, respectively, and for half life (RL_{50}) these values were 1.3254 and 1.4388 days correspondingly (Table 1).On an average (of the two years) initial deposits of 0.91 mg kg^{-1} on okra fruits, treated with the recommended dose (500g a.i. ha^{-1}) of chlorpyriphos, dissipated to 0.53, 0.44, 0.21, 0.11, 0.04 and 0.02 mg kg^{-1} on 1, 2, 3, 4, 5 and 7th day after the spray, respectively showing corresponding percentage dissipation of 41.75, 51.64, 76.92, 87.91, 95.60 and 97.80 percent, whereas average (of the two years) initial deposits of 1.46 mg kg^{-1} recorded on okra fruits treated with double the recommended dose of chlorpyriphos (1000g a.i. ha^{-1}), dissipated to 0.87, 0.62, 0.32, 0.23, 0.06, 0.03 and 0.02 on 1, 2, 3, 4, 5, 7 and 9th day after the spray, respectively showing corresponding percentage dissipation of 40.41, 57.53, 78.08, 84.24, 95.89, 97.94 and 98.63 percent (Table 2).An average, the rate of dissipation on okra fruits has been observed to be rapid during initial days and is almost similar at both the doses of chlorpyriphos which is in close consonance with the works of Hinduja *et al.,* 1979 and Samant *et al.,* 1997 on dissipation of chlorpyriphos.

Table 2: Dissipation of Chlorpyriphos on Okra fruits. (Average of 2004 and 2005).

Days after treatment	Average chlorpyriphos residues (mg kg^{-1})for two years ± S.D.	
	500g a.i. ha^{-1} R.D.	1000g a.i. ha^{-1} Double R.D.
0 (2hr)	0.91±0.07	1.46 ± 0.48
1	0.53±0.02 (41.75)	0.87±0.04 (40.41)
2	0.44±0.02 (51.64)	0.62±0.04 (57.53)
3	0.21±0.007 (76.92)	0.32±0.01 (78.08)
4	0.11±0.007 (87.91)	0.23±0.007 (84.24)
5	0.04±0 (95.60)	0.06±0.007 (95.89)
7	0.02±0 (97.80)	0.03±0.007 (97.94)
9	BDL	0.02±0 (98.63)
15	BDL	BDL
RL_{50}(days)	1.3348	1.4151
T_{tol} (days)	2.918	4.058
Regression Equation	Y = 2.885 - 0.2255x r = -0.9446	Y = 3.1227 – 0.2127x r = -0.9914

Control Samples showed residue level =BDL; Figures in parenthesis represent %age dissipation. *Average of three replicates; BDL= Below detectable limit (0.01mgkg^{-1}); R.D. = Recommended dose.

On the basis of present study, the safe waiting period of 2.92 and 4.06 days have been suggested for the recommended and double the recommendeddosages of chlorpyriphos on okra, respectively. Various workers have reported different safe waiting periods for different pesticides used on okra fruits. Rajabaskar *et al.,* 2001 suggested waiting periods of 2.09 and 4.5 days for okra fruits treated with recommended and double the recommended doses of endosulphan, while Iiango and Devraj, 2003 suggested waiting periods of 3.51 - 5.73 days for okra fruits treated with imidacloprid for different concentrations. Patel *et al.,* 2001 have suggested waiting periods of only

one day for okra fruits treated with lindane while Singh, 1999 recommended waiting periods ranging from 3.93 to 9.22 days for okra fruits sprayed with different doses of monocrotophos. Biswas *et al*., 1991 recommended waiting periods ranging from 4.7 to 6.3 days to be observed between spraying of monocrotophos and harvesting of okra fruits. Thus, the safe waiting periods of 2.92 days (with recommended dose) and 4.06 days (with double the recommended dose) which have been suggested in the present study, are in fair agreement with the findings of some of the workers who have worked on the okra with some other pesticides.

Conclusion

On the basis of dissipation and prescribed Maximum Residue Limit of 0.20 mg kg^{-1} of chlorpyriphos for okra, the safe waiting period of 2.92 and 4.06 days have been suggested for the recommended and double the recommended dosages of chlorpyriphos, respectively.

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Assessment of water quality of River Ganges during Kumbh mela 2010

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Abstract

In the present study the water quality of Ganga River was assessed during Maha Kumbh-2010. River water samples were collected from five sites. Various Physico-Chemical and microbiological parameters were analysed. It was observed that all parameters were within the permissible limit according to WHO (2009) and BIS (2004) except most probable number that is the indication of low sanitary condition and it can further lead to the outbreak of diseases. During this mass bathing two sites were found to be more affected than the other three sites. These were noted to Har-ki-pauri and Mayapur ghat at Haridwar, at these sites parameters are observed to be slightly raised in comparison to other three sites.

Keywords*: Mass bathing; water quality, physicochemical parameters, microbiological parameters*.

Introduction

Water is the most precise thing in this world, which we can not live without. Water is super abundant on the planet as a whole, but fresh potable water is not always available at the right time or the right place for human or ecosystem use. The water being an important part of environment occurs as solid, liquid and gas forms on the earth. As a liquid, it forms hydrosphere, which covers approximately three-fourth of the earth's surface. About 97% of the total available water on earth is saline, and hardly 3% is fresh. A small portion of this fresh water fulfills the fresh water requirements of human beings (Sharma, 2006). Rivers play a significant role in fulfilling the fresh water requirements in the world. In spite of their wide-ranging role, presently rivers are under severe threat due to various anthropogenic pressures (Singh *et al.* 2007). Humans frequently exert rapid, large scale influence on their immediate environment, including modification of water courses, pollution, hunting and fishing (Ehrlich *et al.* 1973). Biologists consider pollution as a change in aquatic environment which brings about a reduction in the diversity of aquatic life and eventually destroy the balance of life in a stream. So far as our country is concerned, plight of surface water is not hidden. Last Maha Kumbh mela in Haridwar was held in 1998. Three other places where Kumbh appears time to time are Nashik, Ujjain, and Allahabad. Maha Kumbh mela 2010 was the first of the century and the first at Haridwar after the creation of the Uttarakhand state (Source: Times of India 26-07-10).

Bathing Days: The main bathing dates at the Haridwar Kumbh were: January 14th 2010- Makar Sakranti, January 15th – Mouni Amavasya, (Solar eclipse), January 20th- Basant Panchami, January 30th-Magh Poornima, February 12th–Mahashivratri (First Sahi snan), March 15th–Somwati Amavasya (Second Sahi snan), March 16th–Nav Samvatharambh Snan. March 24th– Ramnavmi Snan, March 30th –Chaitra Poornima Snan (Third Sahi snan), April 13th–Baishakhi, April 14th – Mesh Sakranti (Fourth Sahi snan) (Source: The Tribune 15-01-10).

Material and Methods

During this study period various physico-chemical and microbiological parameters of river Ganges were studied. The water samples were collected

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from five sites "Triveni ghat", "Pashulok barrage", "Dhudhiya Dam", "Har-ki-Pauri" and "Mayapur". First site, that is Triveni ghat is situated in the city Rishikesh, second site, Pashulok barrage is located 5 Km Southward from the first one. Third site, Dhudhiya Dam is 17-18 Km far from the second site. Har-ki-Pauri the fourth site is approximately 1-2 Km distant from the third site. This site has the maximum anthropogenic activities happening throughout the year. There is a distance of 2 Km in between fourth and fifth site, later one is Mayapur. All these five sites are located in Haridwar-Rishikesh region. This region is situated in the western part of Uttarakhand state of India. Its latitude and longitude are 29°58' to 30° 7' 0''degree north and 78°13' to 78° 19'02'' degree east respectively. The height from the sea level is 249.7 mt. The parameters which were analysed during course of study includes temperature (°C), turbidity (N.T.U), total dissolved solids (mg/l),total suspended solids (mg/l), total solids (mg/l), pH, conductivity (siemens/cm), free CO_2 (mg/l), alkalinity (mg/l), dissolved oxygen(mg/l), chemical oxygen demand COD (mg/l), biochemical oxygen demand BOD (mg/l), most probable number (MPN). The physico-chemical and microbiological parameters were determined according to procedures outlined in Trivedi and Goel (1986), APHA (1998), Khanna and Bhutiani (2008).

Results and Discussion

The mean values of all the physico-chemical and microbiological parameters obtained during course of study are shown in the table number 1. Whenever the values of any parameter go beyond the permissible limit it adversely affects the aquatic ecosystem and organism by making other corresponding parameters fluctuate up to a fatal level. Thus increasing pollution causes ecological balance of the system to spoil. As water temperature increases, the rate of chemical reactions generally increases together The minimum value of temperature during Kumbh Mela was noted to be 17.11±2.09 °C at site 4th and the maximum value of temperature was noted to be 17.38±2.20°C at site 3rd. Average value was found to be 17.26±2.16 °C during whole study period. Turbidity in water is caused by suspended and colloidal matter such as clay, silt, finely divided organic and inorganic matter and plankton and other microscopic organisms. During Kumbh Mela the minimum value of turbidity was noted to be. 8.45 ± 4.13 NTU at Ist site and the maximum value of Turbidity was noted to be 10.00±3.71 NTU at site 4th. Average value of turbidity was found to be 9.32±3.68 NTU. Bhatt *et al.* (1984) reported the similar trend in the river Kosi. Turbidity was found to be more than permissible limit at few sites that is 5 NTU according to BIS (2004). High turbidity can leads to decrease photosynthetic activities and dissolved oxygen affecting the aquatic organism. The minimum value of total solids during Kumbh Mela was noted to be 169.40±24.00 mg/l at site 2nd and the maximum value of total solids was noted to be 191.16±22.74 mg/l at site 5th. Average value was found to be 182.87±10.70 mg/l. (Semwal *et al*. 2006) found the same pattern while working on the rivers of Uttarakhand. In natural waters, the major contributors to total dissolved solids are carbonate, bicarbonate, chloride, sulfate, phosphate, and nitrate salts. The minimum value of total dissolved solids during Kumbh Mela was noted to be 30.03 mg/l at 2nd site and the maximum value of total dissolved solids was noted to be 44.45 mg/l at site. Average value of total dissolved solids was found to be 39.17±9.51 mg/l which was well within permissible limit (500 mg/l). More or less similar results were observed by Khanna and Bhutiani (2006) in River Suswa. The minimum value of total suspended solids during Kumbh Mela was noted to be 138.57±22.34 mg/l at site 1st and the maximum value of total suspended solids was noted to be 147.88±28.77 mg/l at site 3rd. Average value was found to be 143.85±11.32 mg/l. Khanna and Bhutiani (2003) noted the similar trend in river Ganges at Haridwar. During Kumbh Mela the minimum observed value of pH was noted to be 7.42±0.12 at site 1st and the maximum value was noted to be 7.58±0.14 at site 2nd. Average value of pH was found to be 7.53±0.09, it was well within the permissible limit (6.5-9.2) according to WHO (2009). Deshmukh *et al*. (1964) in Kanhan River and Badola (1981) in Alaknanada River noted the matching results. Alkalinity in waters is beneficial because it minimizes pH changes, reduces the toxicity of many metals by forming complexes with

them and provides nutrient carbon for aquatic plants. It is mostly taken as an indication of the concentration of carbonate, bicarbonate and hydroxide, but may include contributions from borate, phosphates, the minimum value of Alkalinity during Maha Kumbh was observed to be 121.09±15.82 mg/l at site 4th and the maximum value of Alkalinity was noted to be 125.54±20.23 mg/l at site 2nd.

Tabel 1: Showing values of various water quality parameters during Kumbh mela 2010

Sampling sites / Parameters	Sampling site 1st	Sampling site 2nd	Sampling site 3rd	Sampling site 4th	Sampling site 5th	Average±SD
Temperature (°C)	17.19±2.23	17.25±2.13	17.38±2.20	17.11±2.09	17.36±2.33	17.26±2.16
Turbidity (N.T.U)	8.45±4.13	9.00±3.43	9.90±4.82	10.00±3.71	9.27±3.92	9.32±3.68
TDS (mg/l)	37.01±16.18	30.03±12.26	41.79±14.82	42.56±14.34	44.45±13.19	39.17±9.51
TSS (mg/l)	138.57±22.34	139.37±21.08	147.88±28.77	146.75±20.34	146.70±18.47	143.85±11.329
TS (mg/l)	175.59±24.14	169.40±24.00	189.67±27.54	188.57±24.02	191.16±22.74	182.87±10.70
Conductivity (siemens/Cm)	182.03±27.18	177.05±33.53	179.07±31.68	179.21±16.19	178.81±17.60	179.24±19.58
pH	7.42±0.12	7.58±0.14	7.55±0.16	7.57±0.16	7.55±0.13	7.53±0.09
Free CO_2 (mg/l)	2.75±1.19	3.49±0.91	3.70±1.39	2.98±0.99	3.44±0.89	3.27±0.83
Alkalinity (mg/l)	124.81±21.60	125.54±20.23	121.90±15.94	121.09±15.82	124.00±21.76	123.47±15.88
DO (mg/l)	9.36±0.94	9.74±0.73	9.49±1.00	9.60±1.07	9.48±1.07	9.53±0.87
BOD (mg/l)	1.67±0.87	1.62±0.68	1.70±0.78	1.86±0.81	1.90±0.64	1.75±0.31
COD (mg/l)	6.72±2.24	7.09±2.07	6.36±1.96	6.72±2.24	5.81±1.40	6.54±1.28
Total hardness (mg/l)	131.24±26.97	131.46±19.78	124.14±20.58	130.94±33.91	128.70±23.34	129.30±21.20
Chloride (mg/l)	33.12±6.10	33.40±6.11	32.25±7.65	32.87±7.79	31.80±6.46	32.68±6.18
Fluoride (mg/l)	0.10±0.01	0.11±0.01	0.09±0.01	0.09±0.01	0.10±0.01	0.10±0.00
Nitrate (ppm)	0.079±0.0250	0.052±0.0231	0.055±0.02049	0.09±0.0690	0.07±0.0261	0.07±0.0274
Phosphate (ppm)	0.07±0.0317	0.06±0.0206	0.06±0.01857	0.07±0.0261	0.05±0.0203	0.06±0.0172
Sulphate (ppm)	21.51±2.0907	20.26±2.9563	20.79±2.71044	23.54±2.3786	20.77±2.1041	21.37±1.9541
MPN/100 ml	1163.63±478.06	1181.81±501.63	1145.45±550.20	1363.63±651.57	1272.72±596.80	1225.45±530.96

Average value was found to be 123.47±15.88 mg/l. Same observation were also made by Holden and Green (1960) and Venkateswarlu and Jayanti (1968). During Kumbh Mela the minimum value of dissolved oxygen was noted to be 9.36±0.94 mg/l at site 1st and the maximum value was observed to be 9.74±0.73 mg/l at site 2nd. Average value of dissolved oxygen was found to be 9.53±0.87 mg/l it was far more than the minimum permissible limit (6.00 mg/l). Semwal *et al*. (2006) worked on the rivers of Uttaranchal and found dissolved oxygen in between 9.53 mg/l and 0.87 mg/l. The minimum observed value of biochemical oxygen demand during Maha Kumbh was noted to be 1.62±0.68 mg/l at site 2nd and the maximum value was found to be 1.90±0.64 mg/l at site 5th. Average value of biochemical oxygen demand was observed to be 1.75±0.31 mg/l, far lesser than the maximum permissible limit according to BIS (2004). During Maha Kumbh the minimum observed value of Chemical oxygen demand was noted to be 5.81±1.40 mg/l at site 5th and the maximum value of chemical oxygen demand was found to be 7.09±2.07 mg/l at site 2nd. Average value was observed to be 6.54±1.28 mg/l. Singh et al. (2006) while working on river Ganges concluded the same thing.Abdo (2005) reported almost equivalent trend. The minimum value of total hardness was noticed to be 124.14±20.58 mg/l at site 3rd during Kumbh Mela and the maximum value was noted to be 131.46 ± 19.78 mg/l at site first site. Average value of total hardness was found to be 129.30±21.20 mg/l. During Kumbh Mela the minimum value of Chloride was found to be 31.80±6.46 mg/l at site 5th and the maximum value was noted to be 33.40±6.11 mg/l at site 2nd.

Average value of Chloride was found to be 32.68±6.18 mg/l which was far lesser than the maximum permissible limit (250 mg/l) according to WHO (2009). (Khanna *et al*. 2007) found average value of Chloride around 7.39 mg/l in the river Ganges. Mishra and Saxena, (1984) while working on Kshipra River and Sengar et al (1985) working on river Yamuna reached to the similar results. During Kumbh Mela the minimum value of fluoride was noted to be 0.09±0.01 mg/l at site 4th and 5th and the maximum value was noted to be 0.11±0.01 mg/l at site 2nd. Average value of Fluoride was found to be 0.10±0.00 mg/l which is far lesser than the maximum permissible limit for fluoride according to WHO (2009). During Kumbh Mela the minimum observed values of ions (nitrate, phosphate and sulphate) were noted to be 0.07±0.02, 0.05±0.02 and 20.26±2.95 ppm at fifth, fifth and second sites respectively and the maximum values were noted to be 0.09±0.06, 0.07±0.03 and 23.54±2.37 ppm at fourth, first and fourth sites respectively. Average value of these ions during Kumbh Mela were found to be 0.07±0.02, 0.06±0.01 and 21.37±1.95 ppm. All these three ions were observed well within the permissible limits according to WHO (2009) for these above mentioned ions.It is customary to report results of the coliform test by the multiple-tube fermentation procedure as a Most Probable Number (MPN) index. This is an index of the number of bacteria. Faecal contamination of water is routinely detected by microbiological analysis. The minimum observed value of most probable number during Kumbh Mela was noted to be 1145.45±550.20 MPN/100ml at site and the maximum value was noted to be 1363.63±651.57 MPN/100ml at site. Average value of most probable number (MPN) was found to be 1225.45±530.96 MPN/100ml; it was far beyond the minimum permissible limit (50 MPN/100ml).

Conclusion

The present study is aimed to assess the water quality during the Maha Kumbh, 2010 at the five located stations. The physico-chemical, microbiological characteristics during this Maha Kumbh were analysed. It has been revealed that Mass bathing exerts some spoiling effects on the water quality but it is constrained to few parameters, namely total solids, total suspended solids, hardness, dissolved oxygen and chemical oxygen demand etc. These above mentioned parameters were observed to be slightly increased during the Bathing days. Other parameters are also disturbed temporarily but that too negligible. The average values of all the parameters were found to be in the permissible limit during whole occasion except microbial parameters. So it can be concluded that this Mass bathing has not an alarming effect on the water quality of river Ganges but it should be considered seriously so far as microbiological parameters and disesase outbreak is concerened. Finally it can be concluded that during this mass bathing two sites were found to be more affected than the other three sites. These were noted to Har-ki-pauri and Mayapur ghat at Haridwar, at these sites parameters are observed to be slightly raised in comparison to other three sites. The main reason behind this is huge influx of all sorts of waste and organic matter during the holy occasion at these vary sites as these are the sites where mainly bathing and other customs were performed. Regular monitoring at times should be performed and appropriate mitigation measures and sanitation strategies must be practically implemented.

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Some physicochemical characteristics of River Bakulahi within Pratapgarh District

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Abstract

The rivers of India play an important role in the lives of the Indian people. The river systems provide irrigation, potable water, cheap transportation, electricity, and the livelihoods for a large number of people all over the country. This easily explains why nearly all the major cities of India are located by the banks of rivers. The rivers also have an important role in Hindu mythology and are considered holy by all Hindus in the country. The water-rich areas of the world are truly the richest place on Earth.Bakulahi River originates from Bharatpur Lake of Rae Bareli district of Uttar Pradesh. The Bakulahi river flows through Rai bareili district and Pratapgarh district of Uttar Pradesh. Bakulahi river falls down in Sai river (Tributary of Gomti river) in Kajurni village of Mandhata block.Water samples have been collected from a part of Bakulahi River along different points and analyzed for various water quality parameters. This study involves determination of physical, biological and chemical parameters of surface water at different point. A systematic study has been carried out to assess the water quality index of River Bakulahi in Pratapgarh District. water samples from five sampling stations were collected and analysed for physico-chemical parameters (Temp, pH, dissolved oxygen, C.O.D., B.O.D., Carbonate, Bicarbonate, total alkalinity, hardness, turbidity, calcium, magnesium, sodium, potassium, nitrate, phosphate, chloride, sulphate, electrical conductivity, total dissolved solids and total suspended solids.)The study area experiences a seasonal climate and broadly divided into three seasons as winter (November to February), Summer (March to June) and rainy (July to October). The samples were collected and analysed for two consecutive years 2009 and 2010. Each parameter was compared with the standard desirable limit of that parameter in river water as prescribed by different agencies.The analytical data of various physicochemical parameters indicates that some parameters like pH, electrical conductivity, total dissolved solids , total suspended solids, turbidity and sodium are found to be in excess than the prescribed limit in some water samples of the study areas. The WQI value indicates that water samples of some sampling stations are quite unfit for drinking purpose because of high value of dissolved solids and sodium. It was also observed that the water in the year 2009 was of a better quality than in the year 2010. Suitable suggestions were made to improve the quality of river water.

Keywords*: Water pollution, Bakulahi river water, physicochemical analysis, Water quality index, potability.*

Introduction

With the rapid development in agriculture, mining, urbanization, and industrialization activities, the river water contamination with hazardous waste and wastewater is becoming a common phenomenon. The water quality and human health are closely related. The domestic waste from each building along with the effluent of small scale industries is disposed off into the open drains and gutters which ultimately enter into the rivers. The quality of water is mainly deteriorated by human activities[1]. They use dispose the waste directly or indirectly into the river water, which affects the BOD, COD, turbidity and also causes the physico-chemical changes. Rivers are getting contaminated due to waste disposing into them. Waste comprises liquid waste discharged by domestic residences. Most of the Indian rivers and their tributaries viz., Ganges, Yamuna, Godavari, Krishna, Sone, Cauvery Damodar and Brahmaputra are reported to be grossly polluted due to discharge of untreated sewage disposal and industrial effluents directly into the rivers sharma *et al*. (1996). The indiscriminate dumping and release of wastes containing the hazardous substances into rivers might lead to environmental disturbance which could be considered as a potential source of stress to biotic community.Similarly many rivers were surveyed during past two decades with respect to

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their pollution status. In addition to domestic and industrial discharge into the rivers, there were continued surface run off of agricultural areas, mines and even from cremation on the river banks Mishra and Patel (2005). According to a report, over 32 thousand dead bodies were cremated at the major burning Ghats per year in Varanasi alone in the year 1984.The present study is carried out to get an attention of public and government towards eco management of water. As the pollution load on the water of Bakuahi River has been enhanced tremendously at Pratapgarh, thus this river has been selected for study to improve the quality of Bakulahi by having the study of physicochemical parameters certain cheap, best and convenient methods have been applied to get water purified for drinking purposes. The Bakulahi water get polluted through the number of ways subjected to the problem we have. The District that forms a part of Faizabad Division is named after its headquarters town Belha Pratapgarh, commonly known as Pratapgarh. Pratap Singh, a raja of the locality who flourished between 1628–1682, fixed his headquarters at Rampur near old town of Aror. There he built a garh (fort) and called it Pratabgarh after his own name. Subsequently the locality around the fort came to be known as Pratapgarh. When the district was constituted in 1858, its headquarters was established at Belha, which came to be known as Belha Pratapgarh, the name Belha presumably being derived from the temple of Belha Bhawani on the bank of river Sai. It is popularly known among the masses as "Belha Devi" - meaning mother goddess belha. Most popular historical shivling temple "bhayaharan nath dham' katra gulab sing, Pratapgarh. The District lies between the parallels of 25°34' and 26°11' north latitude and between the meridians of 81°19' and 82°27' east longitude extending for some 110 km. from west to east. It is bounded on the north by district Sultanpur, on the south by district Allahabad, on the east by district Jaunpur and on the west by Fatehpur and north-east by district Rae Bareli. In the south-west the Ganges forms the boundary of the district for about 50 km. The water samples were collected from six spots. Sampling station (Vishwanathganj) Sampling station B (kharwaibadi) Sampling station C(khajurni) Sampling station D (Chandaipur) Sampling station E (Nurpur) Sampling station F (Pirthiganj) .Accurate and timely information on the quality of water is necessary to shape a sound public policy and to implement the water quality improvement programmes efficiently. One of the most effective ways to communicate information on water quality trends is with indices. Water quality index (WQI) is commonly used for the detection and evaluation of water pollution and may be defined as "a rating reflecting the composite influence of different quality parameters on the overall quality of water." WHO, (1993).The indices are broadly characterized in to two parts: the physico-chemical indices and the biological indices Villanveva (2008). Here attempt has been made to calculate the water quality index of the Ganga river water in Haridwar on the basis of Harkins Bhoi *et al.*(2005), Lohani Bhandari *et al.* (2008) and subsequently modified by Tiwari based on physico-chemical data Manivaskam N. (1986).

Material and Methods

Water samples were collected from six different spots during different seasons over a period of two years (November 2009 to October 2010). The samples were taken in BOD bottles and plastic jerry canes and brought to the laboratory with necessary precautions. All samples were labelled properly. Some parameters like temperature, pH and dissolved oxygen were measured on site. Grab sampling was generally applied during the sampling. Water samples were analysed by standard methods APHA (1995).The samples were analyzed for following physico chemical parameters:Water Temperature (ºC),pH, hardness (mg/l), turbidity (JTU), total dissolved solids (mg/l),total suspended solids (mg/l), electrical conductivity (µmho/cm),dissolved oxygen (mg/l),B.O.D(mg/l), C.O.D. (mg/l), alkalinity (mg/l), chloride (mg/l), calcium (mg/l), magnesium (mg/l), sodium (mg/l), potassium (mg/l),carbonate (mg/l), bicarbonate (mg/l) and sulphate (mg/l).Eleven parameters were taken for calculation of water quality index : Ca, Mg, Na, K, NO_3^-, SO_4^{2-}, Cl^-, hardness, TDSD, B.O.D. and total alkalinity. It is an established fact that the more harmful a given pollutant is the smaller is its standard permissible value recommended for drinking water. It is an

established fact that the more harmful a given pollutant is, the smaller is its standard permissible Value recommended for drinking water. Therefore the "Weights" for various water quality characteristics are assumed to be inversely proportional to the recommended standards for the corresponding parameters. that is,

$$W_i = K\backslash S_i$$

Where W_i is the unit weight and Si is the recommended standard for the ith parameter P_i. The constant of proportionality K in equation can be determined from the condition

$$\Sigma W_i = K\Sigma\ (1\backslash\ S_i)$$

The quality rating q_i for the ith parameter P_i is calculated from the following equation:

$$q_i = 100(V_i/\ S_i)$$

Where V_i is the observed value. The subindex S_i for the the parameter P_i is given by $(S_i) = (q_i w_i)$

The overall WQI can be calculated by aggregating the quality rating (q_i) or subindices, linearly, and taking their weighted mean, i.e.

$$WQI = [(\Sigma q_i w_i/\Sigma w_i)]$$

Results and Discussion

The results obtained from analysis of water samples of river Bakulahi are shown in table 1 and table 2.

The reported values refer to the mean value of water samples collected in different seasons at different areas along the stretch of Bakulahi river. The results indicate that the quality of water varies considerably from location to location. A summary of the findings is given below:

Table 1:

S.No.	Parameters	Range	Mean
1	pH	7.4 - 8.8	8.05
2	Turb (JTU)	11 -224	86.278
3	Cond (µmhos/cm)	223 -766	479.667
4	TH (mg/l)	78 – 245	180.167
5	T.Alk. (mg/l)	56 – 283	185.889
6	CH (mg/l)	64 – 224	113.667
7	MH (mg/l)	44 – 198	87.861
8	Cl (mg/l)	5.8 – 24	12.072
9	TDS (mg/l)	198 – 760	337.931
10	D.O (mg/l)	3.4 - 7.1	5.1556
11	T.fe (mg/l)	0.0081 - 0.089	0.0619
12	Silica (mg/l)	9 - 18.5	13.975
13	NO_3 (mg/l)	0.074 - 1.8	1.053
14	NO_2 (mg/l)	0.24 - 0.75	0.425
15	Na (mg/l)	12 -355	35.417
16	K (mg/l)	5.5 – 17	10.11
17	SO_4 (mg/l)	9.0 – 26	18.625
18	B.O.D (mg/l)	1.75 – 38	12.754
19	C.O.D (mg/l)	2.0 – 24	6.706
20	O.M (mg/l)	1.9 – 23	6.188

It may be stated that the water quality requirements differ from one age to another and thus any polluted water may be considered suitable for some of the beneficial uses but may remain unsuitable for other purposes. Maruthi (2004) gave the rating of water quality as shown below

Sampling Station	Vishwanathganj		Kharwaibadi		Khajurni		Chandaipur		Nurpur		Pirthiganj	
Parameters	Mean	S.D	Mean	S.D	Mean	S.D	Mean	S.D	Mean	S.D	Mean	S.D
pH	7.942	0.39802	7.975	0.25642	8.1	0.20000	8.017	0.16330	8.317	0.40702	7.952	0.25396
Turb	83.500	66.46729	106.667	69.35609	90.667	76.65681	55.333	51.79060	85.500	75.67232	96.000	84.24488
Cond	462.167	182.752	470.16667	144.87845	478.8333	151.6224	468.3333	137.6106	496.8333	197.2413919	501.6667	174.2075391
TH	177.833	50.456	177.66667	42.73016	187.8333	58.08758	183.8333	43.92	182.3333	50.03065727	171.5	54.85890994
T.Alk.	184.833	62.646	178.66667	69.86463	192.5	65.54006	180.8333	71.35942	195.1667	68.71511236	183.3333	62.5672971
CH	142.167	54.20117	99.333	13.72103	102.333	10.98484	130.333	48.94350	106.167	15.45855	101.667	15.12173
MH	113.333	42.96821	80.833	23.66784	83.833	15.14486	85.167	18.81932	79.500	15.64289	84.500	15.82087
Cl	13.833	6.62319	12.450	4.59032	11.967	3.50466	11.350	3.68985	11.750	3.37387	11.083	3.38255
TDS	338.587	76.95889	313.500	81.60821	370.500	208.35907	284.833	85.00686	346.833	173.52281	373.333	212.10061
D.O	4.017	0.45350	6.250	0.72319	4.017	0.45350	3.817	0.27869	6.717	0.29269	6.117	0.90203
T.fe	0.063	0.01365	0.061	0.02857	0.064	0.00915	0.063	0.01213	0.060	0.01087	0.061	0.00987
Silica	14.917	2.97349	14.667	3.83858	14.000	1.78885	13.333	2.44268	13.933	1.68127	13.000	2.36643
NO3	1.213	0.47878	1.080	0.51521	0.938	0.19374	1.090	0.33220	1.082	0.30109	0.916	0.42290
NO2	0.460	0.17833	0.488	0.19020	0.343	0.08687	0.456	0.14766	0.365	0.12708	0.437	0.15319
Na	23.667	4.76095	78.667	135.62989	28.000	5.32917	27.500	9.37550	28.000	11.08152	26.667	8.26236
K	9.342	3.15443	9.400	2.64197	10.667	1.63299	11.167	1.60208	10.750	4.23969	9.333	1.63299
SO4	14.500	5.08920	17.750	5.27551	21.167	2.13698	21.167	2.56255	18.500	5.68331	18.667	6.31401
B.O.D	2.440	0.53610	2.623	0.67592	20.000	2.36643	20.500	3.08221	28.333	6.50128	2.625	0.69264
C.O.D	2.342	0.29735	2.445	0.56846	7.667	2.33809	9.633	3.35956	15.000	6.13188	3.150	0.88713
O.M	2.342	0.35835	2.475	0.33928	6.400	1.52315	6.333	1.11295	16.667	5.31664	2.913	0.63013

Table2: Mean and standard deviation of different parameters at different sampling Stations

WQI Level	Water Quality Rating
0 - 25	Excellent
26 - 50	Good
51 - 75	Poor
76 - 100	Very Poor
> 100	Unfit for Drinking Purpose

Table 3:

In the present study water of river Bakulahi was found to be in excellent quality in winter season at all the six sampling sites as the WQI ranged from 22.80 to 30.32 for both the years. Water of River Bakulahi was found to be of poor quality in rainy season as WQI at all sampling stations ranges from 32.30 to 49.81. The WQI starts increasing from winter to summer and it further increases from summer to rainy season.

Conclusion

From present investigations we concluded that the quality of most of the water samples under study was suitable for drinking purpose except in rainy season. In rainy season WQI increases due to increased concentration of sodium and dissolved solids. Because of high concentration of sodium, there is potential Mean and Standard deviation of different parameters at different sampling Stations risk of getting cardiovascular diseases and in women toxemia associated with pregnancy. From WQI values, it is suggested that further improvement is required to treat the Bakulahi water at Pratapgarh.

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