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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

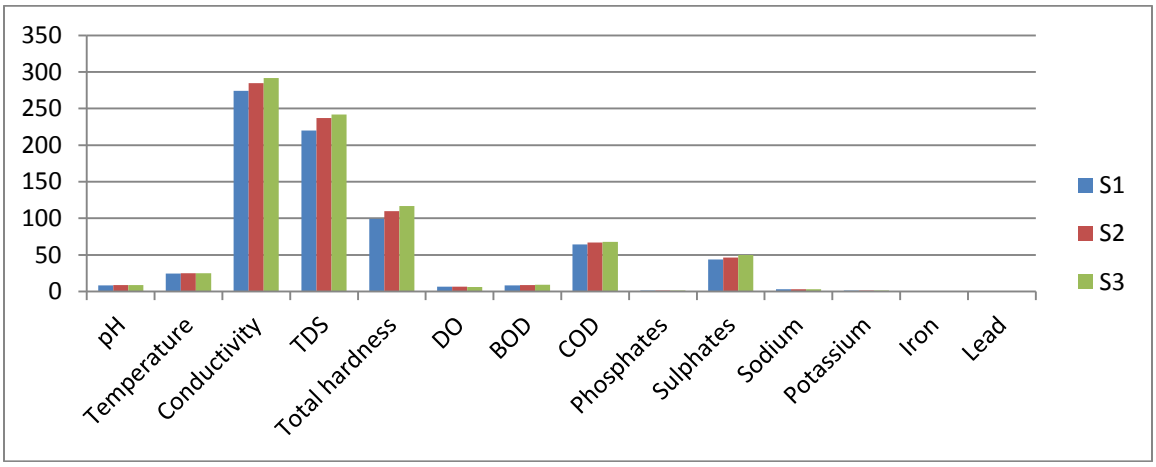

Fig.1 Mean variation of physico-chemical parameters at three stations (S1,S2,S3) of Godavari river at Nasik during Nov.2008-Oct.2009.

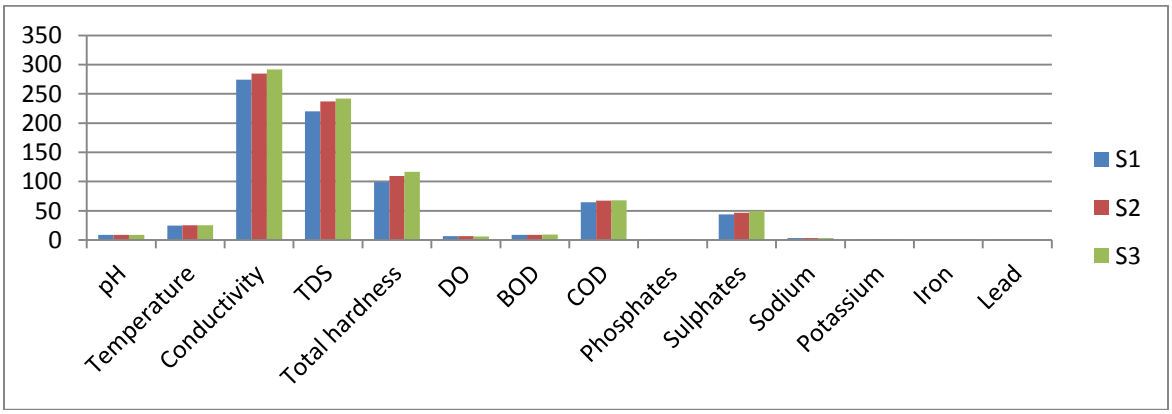

Fig.2 Mean variation of physico-chemical parameters at three stations (S1,S2,S3) of Godavari river at Nasik during Nov.2009-Oct.2010.

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.

References

APHA, AWWA, WPCF, 1989. *Standard Methods for the examination of Water and Waste Water*,17th Ed.,Washington D.C.

Ajay, D. Chavan, M.P. Sharma and Renu Bhargava, 2009. *Water Quality Assessment of the Godavari River*, Hydro Nepal issue no.5.

Resham, Bhalla, V.S. Lomte and M.B. Mule, 2006. Variations in the Water Quality of Godavari river at Nashik (Maharashtra) ***Bull.Env.Sci***.(2nd issue) pp.159-164.8)

Resham, Bhalla, V.S. Lomte and M.B. Mule, 2006. Physico-Chemical Assessment of water in relation to the primary production of planktons of Godavari river at Nasik. ***Bull.Env.Sci***. vol.xxiv (2nd issue) pp. 165-169.9)

Resham, Bhalla and Yadav, B. S., 2010. *Monthly variations in DO, BOD, and COD parameters in Godavari river at Nasik.* Reference book entitled "Recent Advances in Aquatic Biology and Toxicology" pp 3-10.10)

Resham, Bhalla, 2010. *Hydrobiological Studies of Godavari River from Nasik region (Maharashtra*). Reference Book Entitled "Recent Advances in Aquatic Biology and Toxicology" Pp 61-73.11)

Resham, Bhalla and Balwinder, Sekhon, 2010. *Seasonal Distribution of Hydrobiological parameters in relation to primary productivity and their correlation of Godavari river water, Nasik.* Reference book entitled "Recent Advances in Aquatic Biology and Toxicology"pp 74-83.12)

Resham, Bhalla and Balwinder, Sekhon, 2010. Seasonal Physico-chemical characteristics assessment and primary production in the Planktonic community of Godavari river water, Nashik (Maharashtra) ***Environment Conservation Journal*** 11 (1&2) pp 41-45.13)

Sharma, Shraddha, Vishwakarma, Rakesh, Dixit, Savita and Jain, Praveen, 2011. Evaluation of Water Quality of Narmada River with reference to Physico-chemical parameters at Hoshangabad city, MP, India, ***Res. J. Chem. Sci***. Vol. 1 (3).14)

Trivedy, R.K. and Goel, P.K. , 1986. Chemical and Biological methods for water pollution studies. Environ. Pub., Karad (India).