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Study of the Possible Impact of Water of Potteru Irrigation Project on Structure of DNA

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ABSTRACT

In order to meet growing needs of increased population, the present society has undertaken several measures like rapid industrialization, extensive cultivation, unplanned mining activities etc. Which cause pollution of water resources. The extensive cultivation using water of Potteru irrigation project causes pollution of the water resources of the locality which has detrimental impact on living organisms of the locality. The polluted water may directly interact with DNA (Deoxyribo nucleic acid), an important biomolecule known for performing and regulating a number of biochemical functions of living organisms. The present work aims at studying the physicochemical characteristics of water resources at the vicinity of Potteru irrigation project during monsoon, pre monsoon and post monsoon periods and possible impact of these water sources on structure of DNA. The study reveals that all the water samples except water samples from ground water have significant impact on DNA structure which may lead to genetic problems in the locality.

Keywords: Agricultural water pollution, DNA structure, DNA degradation.

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INTRODUCTION

Potteru Irrigation Project is situated in the district of Malkangiri of the southern end of ODISHA, at a latitude of 18° 28'N and longitude at 82° 01' E. The project site is around 600km from the state capital BHUBANSWAR. Nearly 65 resettled villages (refugee of Bangladesh) and 133 tribal villages involving 25072numbers of families are benefited from this project [1]. The inhabitants of the area are using the project water for various purposes like extensive irrigation and their day to day work. The extensive irrigation makes water polluted due to frequent addition of fertilizers and different pesticides [2]. It is seen that the local inhabitants at the vicinity of potteru irrigation project are suffering from a number of diseases and malnutrition. The use of water of potteru irrigation project may be one of the causes for such incidents.

DNA (Deoxyribo Nucleic Acid) is a very important bimolecular which contains the genetic instructions used in the development and functioning of all living organisms [3-4]. The configuration and conformation of DNA is influenced by a number of factors like radiation (UV) chemical species at its vicinity, generation of ROS (Reactive Oxygen Species) [5-9].In the present work an attempt has been made to evaluate seasonal variation in the physicochemical characteristics of water from different sources at the vicinity of potteru irrigation project and its possible impact on the structure of DNA. The extent of DNA damage is monitored by measuring the change in pH of DNA solution in presence and absence of polluted water.

MATERIALS AND METHODS

Sample Collection

The water samples have been collected from different Villages (Table – 1) at the vicinity of Potteru Irrigation Project. Prior to sampling the collection bottles have been rinsed well and then filled up to neck and Stoppard immediately to prevent any accidental entry or escape as well as interaction with outside atmosphere [10].In anticipation of possible changes in certain water quality parameters with respect to time pH, temperature, dissolved oxygen (DO) and conductivity have been measured immediately after the collection of samples.

The irrigated area consists of four blocks of the Malkangiri district covering large number of the villages. Out of several villages, ten villages have been selected from six blocks as sampling stations. The name of block, G.P, and villages selected for the purpose of sampling station of water is given in Table -1.One sample from each of reservoir, ponds, wells and bore wells have been collected from each villages (i.e. four samples) and in total forty samples from all the selected villages coming under the irrigated area.

Physicochemical Analysis

Procedures as Laid down in (APHA) have been followed for the analysis of different parameters such as pH, total suspended solids (TSS), total dissolved solids (TDS), conductivity, dissolved Oxygen (DO), Biochemical Oxygen Demand (BOD),Chemical Oxygen Demand (COD),

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Total Hardness (TH), calcium hardness (CaH), alkalinity, chloride and fluoride of the water samples [10-11](Table–2). An average of three observations in a season with respect to each monitoring station and parameters has been determined and the results have been compared with the Indian standards (ISO 10500) for portable water [9]. The data given in the Table-2 is an average value of the observations in 10 sampling stations / villages.

Study on DNA Structure

To 100ml of source of water 0.5 gm of DNA is added and mixed by vigorous shacking and it is kept in that water for a period of half an hour. Then the pH of the resultant solution is measured with the help of Orion ion on selective meter (Model No 720A Plus). The pH value of the same source of water of equal volume is also determined without the DNA. The difference in pH of these samples indicates that the pollutants in the water sample have damages the structure of DNA. Following the same procedure the pH of different water samples of the project area have been determined both with and without DNA at room temperature.

The pH has been determined for a period of one year (2010) season wise and the average of different season; pH values are recorded in Table – 3.

TABLE – 1: Different sampling stations at the vicinity of Potteru irrigation project.

Sl. No.	Name of Block	Name of Grampanchyat	Name of Village Sample Station
1	Malkangiri	Goudaguda	Goudaguda
2	Malkangiri	Tamasa	Tamasa
3	Kalimela	Bhajangiguda	Bhajangiguda
4	Kalimela	Gompakonda	Gompakonda
5	Kalimela	Gumuka	Gumuka
6	Korukonda	Kamweda	Kamweda
7	Korukonda	Mariwada	Mariwada
8	Korukonda	Nilakamberu	Nilakamberu
9	Podia	Bhubanpali	Bhubanpali
10	Podia	Tandabai	Tandabai

RESULTS AND DISCUSSION

The physicochemical parameters of water samples collected from different sampling areas are given in Table – 2. It is found that all the parameters studied are within or nearer to the prescribed range. In Table – 2 & Table – 3, it is seen that the average pH of water samples of reservoir, pond & well is more than 7.0 (i.e. in alkaline range). But the pH of water sample collected from bore well is less than 7.0(i.e. in acidic range). The impact of water samples on DNA structure as monitored by the change in PH is shown in Table -3. It is found that exogenous addition of water samples to DNA solution causes higher changes in pH value in case of reservoir sample than pond than well than bore well. The pH difference of the sources of water with out and with DNA is the following order.

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Reservoir water > Ponds water > Well water > Bore well water
1.25 1.13 1.04 0.86

The higher difference in pH in case of reservoir, pond and well may be due to damage of DNA in alkaline medium. The damage of DNA due to water treatment is maximum during post monsoon period (Table-3), which may be correlated with the accumulation of unused fertilizers and pesticides in water after harvesting.

TABLE – 2: Physicochemical parameters of water samples collected from potteru irrigation project area during pre monsoon, monsoon & post monsoon period

Sl. No.	Parameters	Standard as per ISO 10500	pre monsoon				monsoon				post monsoon			
			Reservoir	Pond	Well	Bore well	Reservoir	Pond	Well	Bore well	Reservoir	Pond	Well	Bore well
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	pH	6.5 – 8.5	7.84	7.25	7.92	6.93	7.45	7.65	7.84	7.09	7.61	7.79	7.80	6.90
2	TSS	100 - 300	47.0	60.0	48.0	6.0	122.0	110.0	72.0	6.0	18.0	16.0	14.0	6.0
3	TDS	500 - 2000	97.0	166.0	231.0	270.0	200.0	235.0	285.0	590.0	73.0	193.0	128.0	470.0
4	Conductance	200 – 700	171.1	287.0	141.0	50.0	222.6	347.0	200.0	65.0	126.0	168.0	125.0	50.0
5	DO	4 – 6	12.2	9.4	6.0	2.1	8.6	7.6	4.9	2.9	10.4	18.1	7.4	4.4
6	BOD	30	1.3	2.2	4.0	0.6	3.2	3.9	7.0	0.2	2.0	20.0	4.0	1.0
7	COD	10	17.2	12.4	26.0	8.0	24.9	36.2	26.8	9.2	18.4	11.5	39.0	4.4
8	T.H.	300 – 600	64.4	110.0	72.0	210.0	41.5	104.0	88.0	460.0	66.0	70.0	78.0	360.0
9	Ca. H	75 – 200	43.0	90.0	52.0	180.0	29.1	72.0	60.0	120.0	38.0	46.0	56.0	142.0
10	Alkalinity	200 – 600	65.8	76.0	88.0	140.0	42.5	48.0	96.0	368.0	56.0	72.0	108.0	290.0
11	Chloride	250 – 1000	20.0	20.0	16.0	128.0	18.6	12.0	18.0	22.0	16.0	11.0	18.0	112.0
12	Fluoride	0.6 – 1.2	0.96	0.429	0.926	0.168	0.64	0.421	0.889	0.618	0.92	.0414	0.357	0.627

N.B.-All values are in mg/l except pH and conductivity.

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TABLE – 3: Effect of water samples of Potture Irrigation Project area on structure of DNA.

Sl. No.	SOURCE	TREATMENT	pH VALUE			
			PRE MONSOON	MONSOON	POST MONSOON	AVERAGE
1	2	3	4	5	6	7
1	Reservoir Water	Without DNA	7.80	7.50	8.07	7.79
		With DNA	6.59	6.28	6.39	6.42
		Difference	1.21	1.22	1.32	1.25
2	Pond water of Irrigated Area	Without DNA	7.25	7.65	7.79	7.56
		With DNA	6.16	6.51	6.62	6.43
		Difference	1.09	1.14	1.17	1.13
3	Well Water of Irrigated Area	Without DNA	7.92	7.84	7.80	7.85
		With DNA	6.81	6.75	6.87	6.81
		Difference	1.11	1.09	0.93	1.04
4	Bore well water of Irrigated Area	Without DNA	6.93	7.09	6.90	6.97
		With DNA	6.12	6.43	5.88	6.14
		Difference	0.81	0.66	1.12	0.86

CONCLUSION

The above experimental findings suggest that bore well water is least polluted where as reservoir water is most polluted. However the water of the reservoir, ponds and wells are generally good for human activities, but for drinking purpose they can be used after treatment with a recommended method. Further the stability of the DNA structure is maximum in bore well water since that is least polluted having pH $\leq$ 7.0.

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