

GENOTOXICITY OF WATER SAMPLES FROM 'OBA' RIVER DETECTED IN *Allium cepa* CHROMOSOME ABERRATION ASSAY

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Abstract

The genotoxic effects of water samples from 'Oba' river, 'Odo Oba' via Ogbomoso in South-West of Nigeria, on *Allium cepa* were investigated. Pollution of this river are from 3 principal sources: Seepage of leachate from nearby landfill, wastewater from a nearby local 'garri' (cassava flakes) industries and dumping of human faeces and livestock's waste materials into the river. Water samples were collected from 5 different points along the shore of the river during rainy season for 3 consecutive months: June, July and August 2000. The genotoxicity test was carried out at 5 different concentrations of 1%, 2.5%, 5%, 10% and 25% of the water samples. Cytological analysis of the root tips after exposure to different concentrations for 48hrs showed reaction in frequency of mitosis in the meristematic zones. Various forms of chromosome aberration recorded in the samples. Physico-chemical analysis of the water samples showed that it contained anions and cations at concentrations considered to be toxic to drinking water. These constituents through their individual, synergistic and or antagonistic interactions might have responsible for the observed effects.

Key words: *Allium cepa*, Chromosome, Cytological, Genotoxicity, Leachate, meristematic

Introduction

Water is an absolute necessity for the survival of life on earth and on it depends much of man's food including fish and other aquatic animals. The significant of water to human and other biological systems cannot be over emphasized, and there are numerous scientific and economic facts that, water shortage or its pollution can cause severe decrease in productivity and deaths of living species (Garba *et al.*, 2008). Reports by Food and Agricultural Organization (FAO, 2007) of USA revealed that in African countries, particularly Nigeria, water related diseases had been interfering with basic human development. The common sources of water that are available to local communities in Nigeria are fast being severed by a number of anthropogenic factors, of which pollution remain the most dominant problem.

Although the demand for fresh water is fast increasing at a rate greater than the world's population growth, access to safe water supply is a serious issue across the globe. Recent statistic indicates that 1.2 and 2.4 billion people suffer from lack of safe water supply and secure sanitation respectively. In many developing countries, Nigeria in particular, more than half of the population is affected (Garba *et al.*, 2008).

Having these in mind, and in order to extend current knowledge of the genotoxicity of polluted water samples Oba' river on *Allium cepa*, 'Oba' river is located in 'Odo Oba' via Ogbomoso South – West Nigeria. Pollution of

this are from 3 principal sources; seepage of leachate from a of nearby refuse dump (Bakare, 1999), waste water from a nearby local 'Gari' (Cassava flakes) industries, and dumping of human faeces and livestock waste materials into the river. Due to insufficient supply of potable water in villages around this river, inhabitants of 'Odo Oba' areas uses water in the river for irrigation, drinking and carry out their domestic purposes without considering the pathogenic, hazardous and genotoxic effect that may affect them later.

Plant bioassay is widely used to study the mutagenic effect of ionizing radiation since the early 1930s, with the increasing concerns on genotoxicity of hazardous chemicals and pollutants in water.

Materials and methods

Water samples were collected from 5 different points covering the shore line of 'Oba' river 'Odo Oba' in Ogo Oluwa Local government area of Oyo State, Nigeria for 3 consecutive months of June, July and August, 2000 {Rainy Season}.

Five different concentrations of 1%, 2.5%, 5%, 10% and 25% of each sample were prepared in 50ml beakers for onion planting. The outer scales of onion bulbs and brownish bottom plates were removed carefully leaving the ring of root primordial intact. The scarped base was placed in contact with different concentrations for each sample in 50ml beakers for 48hrs at room temperature in the dark. Each sample was changed after 24hrs. Tap water, well water and rain water

The student t- test was used to test for significance or non-significance in the number of aberrations and in the treated samples (Clarke, 1980)

Results and Discussion

In this study, 'Oba' water samples taken in the month of June, July and August, 2000 were found to be mutagenic at some concentrations. With various concentrations different types of aberrations were observed at metaphase and anaphase. In all the samples, restricted growth observed indicated the toxicity of the treatments, as evidenced by the reduction in mitotic index observed at each treatment level (Table I). Lower mitotic index detected in treated samples than for the controls indicated that the pollutants present in the samples were mitodepressant. During the experiment root tips turned brownish which could

be due to colour of the samples. Result of the frequency of aberrations observed in July samples as shown in Table I are relatively higher than for June and August samples. This may be related to the dilution factor of the large amount of rain water to the river during the months of June and August. The metallic constituents of the samples may be responsible for the observed genotoxic effects. This is based on earlier observations on some of the metals (Table II). The metallic constituents were implicated in a study by Bakare *et al.*, (2000). In this study the tested waste water contained cations (as observed in this study) that caused inhibition of root growth and also induced various types of chromatic and chromosome aberrations in *Allium cepa*.

Table I: Summary of frequency and spectrum cytological effects of treatment with different concentration of 'Oba' water samples

JUNE SAMPLE					JULY SAMPLE				AUGUST SAMPLE			
Conc. %	No of cell dividing	Mitotic index	Mitotic inhibition %	Freq of Aberrant cells %	No of cell dividing	Mitotic index	Mitotic inhibition %	Freq of Aberrant cells %	No of cell dividing	Mitotic index	Mitotic inhibition %	Freq of Aberrant cells %
Well H ₂ O	688	13.76	-	-	688	13.76	-	-	688	13.76	-	-
Tap H ₂ O	680	13.60	-	-	680	13.60	-	-	680	13.60	-	-
Rain H ₂ O	685	13.70	-	-	685	13.70	-	-	685	13.70	-	-
1	685	8.96	-	-	685	7.04	-	-	685	7.98	-	-
2.5	448	12.34	34.60	3.99	352	8.32	48.61	7.10	399	6.96	41.75	4.76
5	617	7.80	9.93	6.65	419	6.80	39.27	7.45	348	8.16	49.20	3.45
10	390	9.08	43.07	9.23	340	8.28	50.36	9.71	408	8.54	40.44	6.86
25	454	9.50	33.72	7.27	414	8.72	36.35	9.18	427	8.14	37.66	8.43
Total	475		30.66	8.21	436			8.03	407		40.58	9.34
								41.47				
Total	2,384			35.35	1,958				1,989			32.84

Table II: Heavy metal concentration in 'Oba' water samples, rain water, well water and tap water.

HEAVY METALS	JUNE	JULY	AUGUST	RAIN	WELL	TAP	WHO/EU(1998)
Cu	1.80	1.80	0.90	0.90	1.80	1.80	2.00
Fe	0.41	0.41	0.48	0.03	0.08	0.05	NG
Zn	2.60	2.60	3.00	5.80	4.60	2.80	3.00
Mn	4.20	4.20	3.20	0.70	2.80	4.20	0.05
Pb	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.05

Note: all values are in mgL⁻¹ except Fe which is in % gives an indication that the river may serve as a source of a potential environmental hazard. More work using other plant species and animals are needed to further evaluate the safety of this river water since it serves as a major source of water for 'Odo Oba' community.

*N.G: No Guideline

Conclusion

This study evaluated the effects of water sample from 'Oba' river on the chromosome and cell divisions in *Allium cepa*. Results obtained showed that the tested samples contained constituents capable of inducing mutation and also inhibit mitotic activity in *Allium cepa*. This

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