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Genotoxic Effect Of Arsenic Trioxide On Mitotic Cells Of Mus musculus And Its minimization Through Guava Fruit

[1]Andalib Iqbal, [2]Dharmshila Kumari
[1]PhD, [2]Professor
[1,2,] University Department of Zoology, Tilka Manjhi Bhagalpur University, Bhagalpur,Bihar,India
Email - [1]andalibiqal.bgp@gmail.com, [2] andalibiqbal.bgp@gmail.com

Abstract: *The cytogenetic effect of arsenic trioxide was evaluated by investigating by mitotic chromosome study of bone marrow cells of Mus musculus. Exposure of mice to the arsenic trioxide (0.003g/kg.b.wt/day/animal) and its amelioration through guava fruit extract (47g/kg.b.wt/day/animal) orally for 15 continuous days to four different groups. In the group of animal treated with guava showed a total of 1.66% abnormality. In the animal treated with concurrent treatment of guava with arsenic trioxide showed a total of 11.3% abnormality. These values were significantly lower than that of arsenic trioxide treated group i.e 38%. The result suggested that dose of guava fruit extract with arsenic trioxide also significantly decreased the arsenic produced genotoxicity*

Key Words: *mitotic chromosome,arsenic trioxide,guava,water pollutant,amelioration*

1. INTRODUCTION: Arsenic trioxide is an exclusive human carcinogen and one of the most toxic environmental toxicants. Arsenic is a semi-metal or metalloid with two biologically important oxidation states, As (V) (arsenate) and As (III) (arsenite). This metalloid is ranked first in the list of 20 hazardous substances by the Agency for Toxic substances and Disease Registry and USEPA. Arsenic is widely prevalent in our environment. It is released in water, soil and air from natural and anthropogenic sources. Arsenic poisoning has become a major worldwide environmental concern because as millions of persons have been exposed to excessive arsenic through contaminated drinking water. Arsenic (As) exposure is a major pandemic concern, with the number of arsenic-affected nations rising to seventy, including India, Bangladesh, Japan, China, USA, Argentina, Chile, Mexico, and Taiwan, among others (1). In India, 7 states are reported to be affected by ground water arsenic contamination, and approximately 30 million individuals are consuming arsenic laden drinking water (2). Arsenic is a non-mutagenic compound but can induce significant cytogenetic damage as measured by chromosomal aberrations, sister chromatid exchanges, and micronuclei formation in human systems. These genotoxic end points are extensively used to predict genotoxic potentials of different environmental chemicals, drugs, pesticides, and insecticides. These cytogenetic end points are also used for evaluating cancer risk(3). In the trivalent methylated form, arsenic has been shown to be a potent genotoxic carcinogen that induces DNA damage, including chromosome breakage and numerical chromosome changes (aneuploidy). However, arsenic is not a point mutagen (4). The one of the most important parameter for evaluating the genotoxicity of environmental pollutants is mitotic choromosome study. The advantage of this parameter is availability of large number of dividing cell which routinely pass through the S-phase which is very much important for the induction of chromosome aberration by environmental pollutants. Although, the somatic cell damage are not transmitted to the offspring, but it may cause the neoplasia and malignancy. Bone marrow have a special place where haemopoiesis takes place which produce erythrocytes, platelets and granular leucocytes. Chromosomal aberration and other forms of DNA damage are the cause of many human genetic diseases and considered to be highly sensitive test for recognizing the genotoxicity induced by chemicals (5,6). Failure of properly segregated chromosome at metaphase to anaphase transition may be a consequence of defeats in its regularity mechanism resulting in abnormalities (7). This chromosome aberration test is especially relevant in assessing mutagenic hazard in that it allows consideration of factors of in vivo metabolism, pharmaco-kinetics and DNA repair processes although these may vary among species and tissues. Arsenic not only damage DNA in the cells of testis,liver and kidney but also produce genetics defects in other organs.

In the same time some natural products are also found to produce antigenotoxic effect fortunately (8,9,10,11). Members of Food and Nutrition Board of National Council (USA) recently defined a dietary antioxidant as a substance in food which significantly decrease the adverse effect of ROS, RNS or both in human. Reactive oxygen species are an important factor in DNA damage, oxidative stress-induced damage and many other cellular processes (12,13). Fruits and vegetables contain high amount of antioxidant such as ascorbic acid, beta-carotene and folic acid which are useful to the body. Various antioxidant have been shown to some protective role against arsenic toxicity (14,15). Therefore, the present work was under taken to evaluate the ameliorative effect of guava fruit (*Psidium guajava)* on arsenic induced genotoxicity.) Guava is a very common fruit,rich in vitamin C and easily available for low socio economic group of people who are suffering more due to intake of arsenic contaminated drinking water.

2. MATERIAL AND METHOD: Four to five week albino swiss mice of both sexes obtained from an inbred laboratory stock were used as test animal. They were fed upon grains, seeds, foods, pellets etc .all animal treatment and protocols employed in their study received prior approval of the Institutional Ethical Committee and met the standard laid down by the Govt.Of India.

2.1 Treatment: Mice are separated to four groups and subject to treatment for 15 continuous days. Arsenic trioxide used as water pollutant and guava fruit extract used as an ameliorating agent.

2.2 Slide preparation and staining: Cytological preparation for mitotic metaphase chromosome study was made by colchicine – hypotonic solution – acetoalcohal – flame drying – giemsa staining technique suggested by.Preston *et al.* (16).

2.3 Screening of Slides: Well spread metaphase plate from each group of animals were screened after random selection @ 40-50 plates per animal. In each group,a total of 300 metaphase were selected for the detection of chromosomal aberrations. The data from each group were kept together in respective groups and expressed as mean frequency per 100 cells for chromosomal aberrations. An equality of proportion test (Z-test) was used for the evaluating of the data.

2.4 Analysis of chromosomal abnormalities: Metaphase showing various types of abnormalities which were put into two broad categories (17), stuructural and mitosis disruptive changes.

Table 1: Summary of the experimental group and treatment protocol

Experimental Group	Symbol	Dose
Control	C	No Dose
Arsenic Trioxide	AT	0.003g/kg.b.wt/day
Guava	G	47.0g/kg.b.wt/day
Arsenic Trioxide and Guava	AT + G	As per above

3. RESULT AND DISCUSSION:

In the group of animal treated with guava showed 1.33% structural changes, 0.33% mitosis disruptive changes and a total of 1.66% total abnormality. In the animal treated with concurrent treatment of guava with arsenic trioxide showed 8.33% structural abnormality, 2.33% mitosis disruptive abnormality and a total of 11.3% in total abnormality. These values were significantly lower than that of arsenic trioxide treated group(Table3.3). The result showed that dose of guava fruit extract with arsenic trioxide also significantly decreased the arsenic produced genotoxicity.

Table 2: Incidence of chromosomal abnormalities in mitotic cell of mice treated with arsenic trioxide and guava fruit:

Experimental variant	*Structural abnormalities*		*Mitosis-disruptive changes*		*Total abnormality*	
	No.	*% ± S.E.*	*No.*	*% ± S.E.*	*No.*	*% ± S.E.*
C	13	4.33 ± 1.17	3	1 ± 0.57	15	5.33 ± 1.25
AT	89	29.66 ± 2.63^{a}	25	8.33 ± 1.59^{a}	110	38 ± 2.78^{a}
G	4	1.33 ± 0.65^{b}	1	0.33 ± 0.31^{b}	5	1.66 ± 0.73^{b}
AT+G	25	8.33 ± 2.02^{bc}	7	2.33 ± 0.86^{b}	30	10 ± 1.73^{b}

a, b, c indicates significant differences with corresponding value in the control, arsenic trioxide and guava variants, respectively.

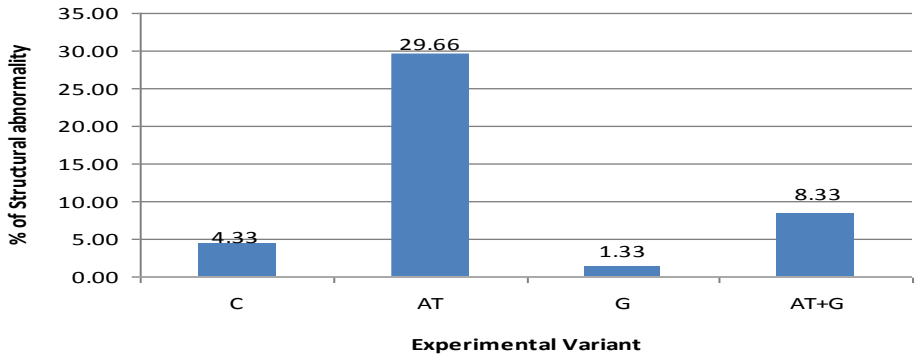

Figure 1.1

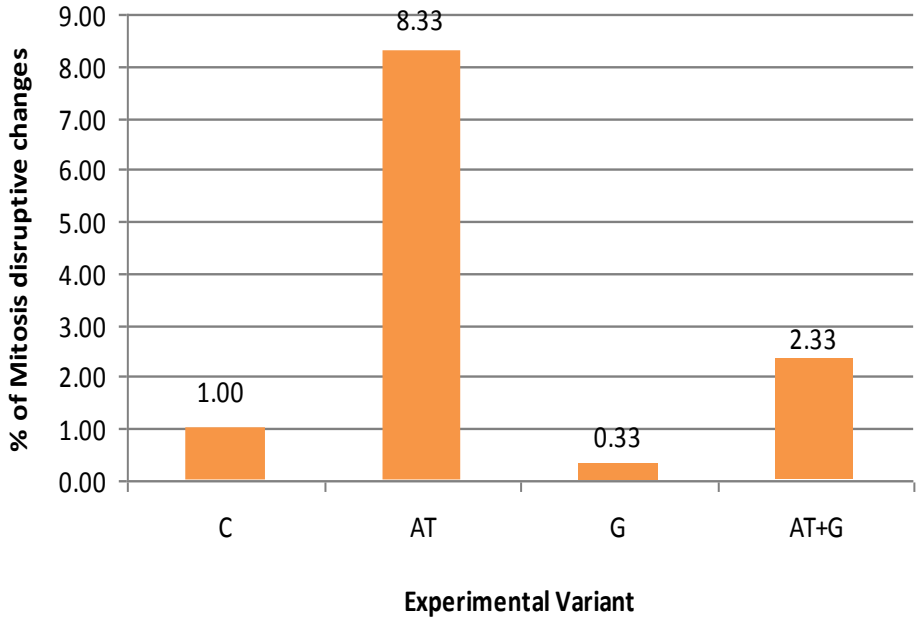

Figure 1.2

Figure 1.3

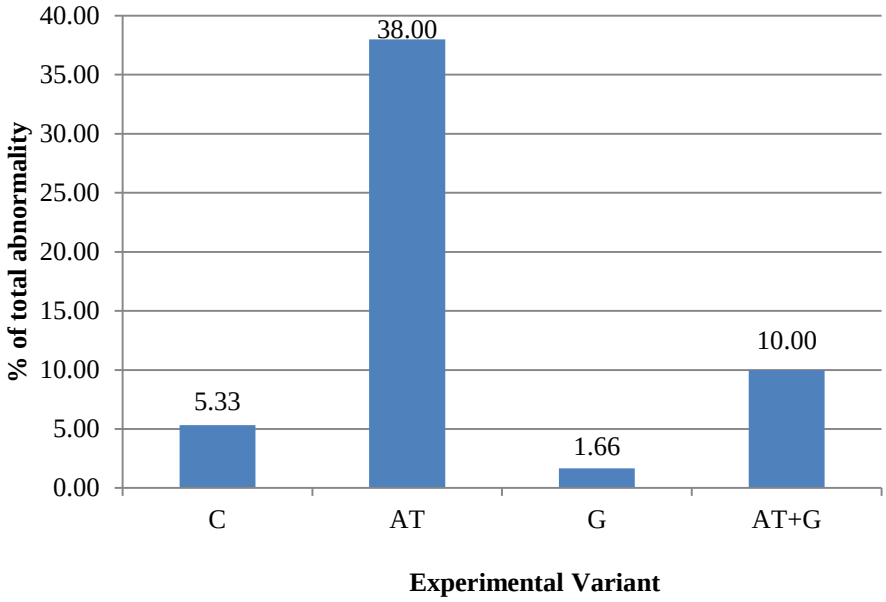

Figure 1.1, 1.2, 1.3:Total structural and mitosis disruptive changes in the four different group of mice.

4. CONCLUSION: Natural antioxidant found in guava was observed to minimize mitotic chromosome abnormalities in arsenic treated mice.Thus we can conclude that fruit can be a good natural sources to reduce the genotoxic effect of arsenic trioxide. Guava fruit is a very cheaper and easily available fruit which can be used by the low socio economic group of people for minimizing the dreadful effect of arsenic contaminated drinking water consumption. Therefore, from the above finding it is suggested that guava fruit in diet are beneficial for reducing the genotoxic effect of arsenic contaminated drinking water.

REFERENCES:

1. Polya, D. and Charlet, L. (2009) Environmental science: rising arsenic risk? Nat. Geosci.,2,(383-384)
2. Ghosh, P., Basu, A., Mahata, J., Basu, S., Sengupta, M., Das, J.K.,Mukherjee, A., Sarkar, A.K., Mondal, L., Ray, K. and Giri, A.K. (2006),Cytogenetic damage and genetic variants in the individuals susceptible to arsenic-induced cancer through drinking water.Int. J. Cancer, 118, (2470-2478).

3. Jinia Sinha Roy, Debmita Chatterjee, Nandana Das and Ashok K. Giri, (2018)*Toxicol.Res.*Vol.34,No.4,pp.311324.(https://doi.org/10.5487/TR.2018.34.4.311).
4. Kligerman, A.(2013). Arsenic Is A Genotoxic Carcinogen. Env. Mutagenesis Geneomics Society Meeting (Sep 21-25), Monterey, CA.17).
5. Chaurasia OP and Sinha SP. Effects of urea on mitotic chromosome of mice and onion. Cytobios. 79: (229-234).
6. Chaurasia OP (1992). Induction of mitotic chromosome anomalies by distillery effluents. Prespective in cytology and genetics. 7: (441-447). Edited by Manna GK and Roy SC; Indian society of cytology and genetics. Calcutta.
7. Chachill DP, Lengaur C, Yu J, Riggins GJ. Willson JK, Markowitz SD, Kinzier KW and Vogeistein B (1988). Mutation of mitotic checkpoint genes in human cancer. *Nature*. 392(6673): (300-303).
8. Prasenjit Maity, Surajit Samanta, Ashish K Nandi, Ipsita.k.Sen,Soumitra Paloi, Krishnendu Acharya, Syed.S.Islam.(2014). Structure elucidation and antioxidant properties of a soluble β-D-glucan from mushroom Entoloma lividoalbum. International Journal of Biological Macromolecules.Volume 63**,** February 2014, Pages (140-149).
9. Singh S, Rana SV (2007). Amelioration of arsenic toxicity by L-Ascorbic acid in laboratory rat. *J.Environ.Biol*. (28): 377.
10. Bhattacharjee S, Sarkar C & Pal S (2013). Additive beneficial effect of folic acid and Vitamin B12 Co-administration on Arsenic-induced Oxidative Damage in Cardiac Tissue *in vivo. Asian Journal of Pharmaceutical and Clinical Research*. Vol 6, Suppl 1.
11. Singh N and Kumari D(2012), Genotoxicity of water pollntant and is amelioration. The Ecoscan An International Jouranl of Environmental science, special issue 1, 2012, (209–212).
12. Fahmy B, Cormier SA(2009), Copper oxide nanoparticles induce oxidative stress and cytotoxicity in airway epithelial cells, Toxicol In Vitro, 2009, 23, (1365-1371).
13. Ye JS, Li J, Yu YM, Wei Q, Deng WF, Yu LXL(2010), Carnitine attenuates oxidant injury in HK-2 cells via ROS-mitochondria pathway. Regul Pept, 161, (58–66).
14. Gupta R, Sharma M and Flora SJS(2005), Therapeutic effect of Moringa olifera on arsenic induced toxicity in rats. Environ. Toxicol. Pharmacol, ,20, (456- 464).
15. Sahu AP and Paul BN(2006), Arsenic and human health effects: Prevention by dietary modification \with functional food jiggery. 25th International Conference on crop. Hlth. Milan. Italy,92.
16. Preston, R. J., Dean, B. J., Galloway, S., Holden, H., McFee,A.F., and Shelby, M. (1987). Mammalian in-vivo, cytogenetic assay. Analysis of chromosome aberrations in bone marrow cells. Mutat. Res. 168, (47±65).
17. Bose S. and Sinha SP. (1994). Modulation of ochratoxin produced genotoxicity by Vitamin C in mice. *Fd.Chem.Toxicol*. 32: (533-537).