

# ENVIRONMENTAL XENOBIOTICS AND BIOLOGICAL “SPIRAL STAIRCASE”: FOR GOOD OR FOR ILL?

by

**PROF. A. A. BAKARE**

*Department of Zoology, Faculty of Science, University of Ibadan, Ibadan, Nigeria*

*Abstract of inaugural lecture delivered at the University of Ibadan on Thursday, 20 February, 2020*

## **ABSTRACT**

Genetic toxicology or environmental mutagenesis is a subspecialty of general toxicology which addresses the problems of toxicity to the genetic material, i.e. deoxyribonucleic acid (DNA). Xenobiotics are substances/chemicals found but not produced in organisms or the environment. Environmental mutagenesis research in the Department of Zoology, University of Ibadan, Nigeria dated back into the 70's with pioneering studies on genotoxicity of metals, pesticides, food additives, antimalarial drugs and contraceptives. Over the years, I have investigated the mutagenic and genotoxic potentials of xenobiotics such as municipal, industrial and domestic waste leachates, electronic waste leachates, industrial effluents, contaminated waters, medicinal herb extracts, drugs, pesticides, metal and metal oxides nanoparticles. I have used in my investigations the *Allium cepa* L. macroscopical and microscopical indices; murine sperm morphology, bone marrow chromosomal and micronucleus assays; piscine, amphibian, aves and human micronucleus assays; UMU assay, SOS chromotest on *Escherichia coli* PQ37 and the Ames *Salmonella* fluctuation test on *Salmonella typhimurium* strains TA98 and TA100, with and without metabolic activation. These are assays that best reflect the delicate balance between pathways for activation and inactivation of chemicals in human beings. My findings showed that the tested xenobiotics induced genotoxicity and mutation (ranging from frame shift mutation to chromosomal aberrations) in the somatic and germ cells of test organisms. At the molecular level using the Comet assay, solid and electronic waste leachates induced DNA damage in somatic and germ cells of the mouse and peripheral blood lymphocytes of man. Likewise, some of the detected metals in solid waste leachates tested for their individual and mixture interactive effects caused increasing DNA damage *in vitro* using cytokinesis block micronucleus cytome assay with WIL2-NS human B lymphoblastoid cell line. Mechanistically, I noted that the tested substances induced oxidative stress and histological changes in organs of test animal models. This is in addition to *in vitro* cytotoxicity and apoptosis induced by solid and e-waste leachates in different cell lines. In other studies, I showed that the toxic effect of 4-methylthiobutyl isothiocyanate has a definite selectivity for cancer cells over normal liver cells and its cytotoxicity even applies for chemo-resistant cancer initiating cells. Using conventional and advanced analytical techniques, I have shown the presence of toxic heavy metals and organics at different concentrations in different complex mixtures. Other studies on mosquito genetics and population genetics of Nigerians have provided data showing genetic variability in the Nigerian environment. These studies suggested that environmental xenobiotics contribute to the incidence of genetic mutation in Nigeria. This however, does not mean that individual with mutant genes will suffer adverse health or negative effects, as DNA damage is for good and for ill. From the available information, appropriate regulatory measures, education, environmental awareness and adequate funding of teaching and research in genetics, cell and molecular biology in Nigeria are recommended.