

# Dietary exposure of Nigerians to mutagens and estrogen-like chemicals

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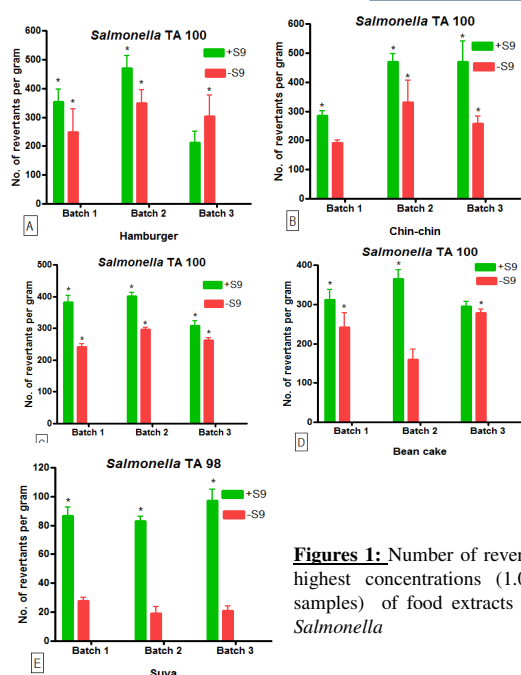
## Introduction

Food and drinking water are poorly delineated sources of human exposure to both mutagens and endocrine-disrupting chemicals (EDCs) globally. This is alarming in view of the fact that food and water are prerequisites of human life. In this study, we investigated the presence of mutagens and estrogen-like compounds, found in the daily diet of Nigerians, using *In vitro* assays.

## Materials and methods

- Twelve varieties, representing commonly consumed commercially processed food items, and sixteen samples of pure water sachets, both in 3 lots each, were investigated for their mutagenic and estrogenic potential, respectively.
- Food and water samples were extracted as described by Tikkanen (1991) and Barber et al., (2000) respectively.
- Mutagenicity studies were initially determined by the standard plate incorporation assay (Maron and Ames, 1983) and subsequently, by "treat-and-wash" as well as methylcellulose overlay assays (Thompson et al., 2005) using two strains of *Salmonella* (TA 100 and TA 98), with and without metabolic activation
- The estrogenic activities of both water samples and packaging material were determined by a yeast bioluminescent assay using 2 recombinant yeast strains (*Saccharomyces cerevisiae* BMAEReluc/ERA and *S. cerevisiae* BMA64/luc) as described by Omoruyi et al., (2013)
- The mutagenic potency of the food samples was determined from the slope of the linear portion of the dose-response curve and by at least, 2-fold increment, when compared with the negative control (DMSO)

## Results



**Figures 1:** Number of revertants generated by the highest concentrations (1.0 per gram of food samples) of food extracts on different strains of *Salmonella*

**Table 1.** Number of revertants in the treat-and-wash as well as methylcellulose overlay assays generated by the highest concentrations (1.0 per g of food sample) of food extracts showing mutagenic potential on *Salmonella* TA 100 (mean  $\pm$  SD) in the standard plate incorporation assay.

Food Product	Batch	Revertants per Gram			
		Treat-and-Wash Assay		Methylcellulose Overlay Assay	
		+S9	-S9	+S9	-S9
Hamburger	1	633.0 $\pm$ 23.3 *	124.7 $\pm$ 10.6	330.0 $\pm$ 10.4 *	166.7 $\pm$ 28.3
Chin-chin	1	192.7 $\pm$ 17.5	58.7 $\pm$ 7.8	128.3 $\pm$ 9.8	95.0 $\pm$ 11.4
Suya	1	366.0 $\pm$ 22.6 *	113.0 $\pm$ 1.4	382.0 $\pm$ 17.2 *	271.7 $\pm$ 9.4 *
Bean cake	1	736.3 $\pm$ 85.1 *	156.0 $\pm$ 13.9 *	401.0 $\pm$ 28.4 *	238.2 $\pm$ 12.1
Hamburger	2	397.7 $\pm$ 21.2 *	408.0 $\pm$ 32.5 *	304.7 $\pm$ 19.4 *	263.3 $\pm$ 9.3 *
Chin-chin	2	618.7 $\pm$ 58.7 *	32.3 $\pm$ 12.5	126.0 $\pm$ 8.5	125.7 $\pm$ 10.6
Suya	2	181.0 $\pm$ 16.9	240.0 $\pm$ 42.4 *	165.0 $\pm$ 10.6	76.0 $\pm$ 5.0
Bean cake	2	470.0 $\pm$ 16.3 *	260.7 $\pm$ 33.2 *	324.7 $\pm$ 28.6 *	271.3 $\pm$ 19.4 *
Hamburger	3	135.0 $\pm$ 18.4	126.3 $\pm$ 9.2	166.7 $\pm$ 0.7	162.0 $\pm$ 22.6
Chin-chin	3	126.3 $\pm$ 12.0	131.7 $\pm$ 10.6	183.3 $\pm$ 9.9	164.0 $\pm$ 16.3
Suya	3	179.0 $\pm$ 9.9	209.0 $\pm$ 19.7 *	194.3 $\pm$ 7.8	271.0 $\pm$ 14.4 *
Bean cake	3	371.3 $\pm$ 12.1 *	228.0 $\pm$ 23.3 *	267.7 $\pm$ 14.3	290.0 $\pm$ 21.9 *

Note: \*: Significantly different from control ( $p < 0.05$ ).

**Table 2.** Estradiol (EEQ) and bisphenol A (BPAEQ) equivalent concentrations of positive sachet water samples.

Sample Code	Water Samples		Sachet/Packaging Material	
	EEQs (ng/L)	BPAAEQs (ng/L)	EEQs (pg/L)	BPAAEQ (pg/L)
W1	0.79	124.2	14.5	224.0
W2	44.0	1000.8	< LOD	< LOD
W3	28.0	597.8	10.2	186.1
W4	23.0	442.8	< LOD	< LOD
W5	15.0	269.7	< LOD	< LOD
Median	23.0	443.0	12.4	205.0
Average	7.0	152.0	2.0	26.0

## Discussion and conclusion

- Commercially processed food items and sachet-packed pure water sold in Nigeria, are sources of mutagen and estrogen-like chemicals, respectively
- A third of the food varieties investigated (chin-chin, hamburger, suya and bean cake) were mutagenic in all three assays, either in the presence or absence of S9 mix.
- Five out of the sixteen investigated (31%), were found to be estrogenic, with estradiol and bisphenol A equivalents ranging from 0.79 to 44.0 ng/L and 124.2 to 1,000.8 ng/L, respectively
- Although their concentrations are not alarming in the light of food and water analyses from other countries, measures should be taken to reduce them further and monitor their levels regularly.

## References

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