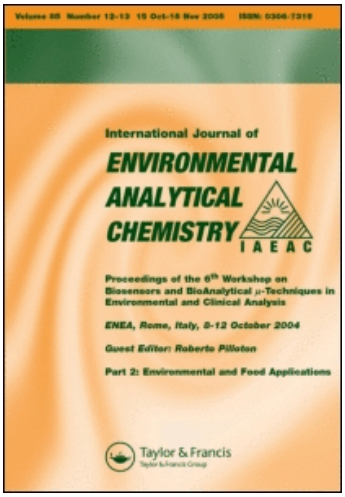

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DETERMINATION OF THE TOTAL LEVEL OF NITROSAMINES IN SELECT CONSUMER PRODUCTS IN THE MAJOR METROPOLITAN REGIONS OF NIGERIA

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Over 200 local consumer products obtained from different points of the three major regions of Nigeria (i.e. the northern, eastern and western regions), were screened for contamination by N-nitroso compounds. Dairy products present the lowest level of nitrosamine contamination while locally made spiced pre-grilled meat and fish products present the highest level of nitrosamine contamination. Also local beverages made from guinea corn show high levels of nitrosamine contamination. Products of the western region of the country seem to be more contaminated that products of other regions. The possible sources of the contaminants and their implication as health hazards are discussed.

KEY WORDS: Nitrosamine, consumer products contamination, carcinogenicity, Nigeria.

INTRODUCTION

There has been a considerable concern over the extent of contamination of food items by *N*-nitrosamines because of the known carcinogenicity and mutagenicity of these toxic chemicals.[1] Extensive reviews on carcinogenicity and the reaction mechanisms of organic *N*-nitroso compounds have been published.[2,3] Nitrosamines have been detected in meats cured with nitrite and other foods such as fish, cheese, alcoholic beverages and in many aspects of our immediate environment.[4,5] Nitrosamines can be derived from the interaction of organic secondary and tertiary amines with nitrites and nitrates under reducing conditions, low pH values or nitrous gases. The formation of dimethylnitrosamine (up to 100 ppm) has been demonstrated in nitrate-treated fish meal.[6,7] Minute amounts of nitrosamines have been detected in tobacco smoke.[8] In addition to the information available on the presence of *N*-nitroso compounds in foods, beverages and tobacco products, other chemicals of this group are used as intermediates in certain chemical and paint industries, and some of these derivatives are sold as pesticides, rubber additives as well as for many other applications.

In Nigeria, the present harsh economic conditions have somewhat influenced the emergence of different kinds of socio-economic attitudes in Nigerians. There is now a high incidence of adulteration of many consumer products. Faking of assorted consumables and pharmaceuticals, notably beverages, drugs and chemicals is a common feature, all in attempt to cut corners. It is a common practice amongst the

local people to use certain chemicals as preservatives, colourants and flavourants without taking cognizance of the long-term health and toxicological hazards posed to the citizenry by these foreign agents. For example the substitution of industrial salt for common cooking (edible) salt by some unscrupulous Nigerians has now caught the awareness of the health authorities.

Recent preliminary work in our laboratory had shown the presence of *N*-nitrosamines in some consumer products and it was therefore thought that a more comprehensive investigation and survey of as many foods and beverages as possible in the major regions (the north, west and eastern) of Nigeria for contamination by nitrosaomines might present a more revealing picture.

EXPERIMENTAL

Materials

The consumer products used in this study were obtained from about 20 different locations and market places in each region of the country; these included meat products, fish products, alcoholic beverages, drinking water, industrial effluents, tobacco products, body creams and lotions and hair creams. All the reagents and chemicals used were analar grade products of British Drug Houses (BDH), Poole, England.

Method

The detection and quantification of nitrosamines were carried out by a modification of the method of Telling and Dunnett.[9] About 20 g of sample were weighed out (homogeinised, for meat and fish products) and transferred into a 100-ml conical flask. To this was added ammonium sulphamate, 0.5 g, and the mixture was thoroughly stirred. Sodium chloride solution, 20 ml (2% w/v) was added, stirred for about 15–20 min and the mixture completely transferred to a 200-ml separatory funnel. The flask was rinsed with 2 portions of 5 ml sodium chloride solution and these were added to the contents of the separatory funnel.

The combined aqueous layer was extracted with 2 × 50 ml hexane and the hexane layer discarded. The aqueous phase was further extracted with 3 × 50 ml ethyl acetate and the combined organic phase dried over anhydrous sodium sulphate and concentrated to about 1 ml on a rotary evaporator using a water bath at 50°C.

The organic phase was divided in two reaction tubes, each containing 0.5 ml of the mixture. While one tube served as the test sample, the other served as the control blank. 0.2 ml of the denitrosation reagent, 3% v/v HBr in glacial acetic acid, was added to the test sample portion and the tube placed in a water bath (50°C) for about 5 min. To the control blank was added 0.2 ml of distilled water. A 0.2 ml portion of sulphanilamide solution (0.2% w/v in HCl) was added to each tube and the contents mixed by shaking intermittently for about 5 min. A 0.1-ml portion of naphthyl reagent (0.1% w/v *N*-1-naphthylethylenediamine dihydrochloride) was added to each tube.

After about 25 min the absorbance of the test sample was measured at 540 nm wavelength against the control blank. Using a sodium nitrite standard (calibration graph regression), the total level of *N*-nitroso compounds in the test samples measured as nitrosodiethanolamine (NDELA) was obtained by means of the expression:[9]

$$\frac{\mu g\ ml^{-1}\ of\ NaNO_2\ from\ calibration\ graph}{mass\ of\ sample\ (g)} \times \frac{1}{0.5} \times \frac{30}{69} \times \frac{100}{2.4}\ \mu g g^{-1}$$

RESULTS AND DISCUSSION

The results on total levels of *N*-nitroso compounds in various regions of Nigeria are summarized in Table 1.

The dairy products seemed to have the lowest levels of nitrosamine contamination suggesting that products of this group pose little or no danger in terms of health hazards. Powdered milk samples and baby food mixtures were found to contain little or no nitrosamine contamination; however, traces of nitrosamine were detected in dairy products such as liquid milk and yoghourt preparations. The inclusion of ascorbic acid (vitamin C), an antioxidant, in some infant food preparations has been sited as a possible militating factor against nitrosamine formation.[10]

Raw tobacco leaves showed quite little contamination compared to finished products such as pipe tobacco and tobacco snuff, giving an indication that nitrosamine precursors may be due to additives and the mode of tobacco processing.

The examination of borehole water and industrial effluents presents interesting results of nitrosamine contamination. Borehole water was obtained from different

Table 1 Total level of *N*-nitroso compounds obtained in three major regions of Nigeria

Products	*Brands*	*N-nitroso Compounds as NDELA, mg/g*		
		West	*East*	*North*
Alcohol beverages	20	0.0063–0.0199	0.007–0.025	0.0073–0.025
Raw meat products	15	0.135–0.300	0.120–0.305	0.15–0.30
Cooked meat products	20	0.0077–0.0097	0.0069–0.0091	0.005–0.015
Cooked fish product	20	0.0144–0.0452	0.009–0.015	0.012–0.035
Smoked fish products	20	0.060–0.315	0.055–0.256	0.065–0.364
Pre-grilled meat (spiced)	30	0.715–1.79	0.700–1.565	0.755–1.452
Post-grilled meat (spiced)	30	0.905–2.01	0.851–1.640	0.800–1.545
Tobacco products	10	0.005–0.032	0.006–0.030	0.0065–0.035
Dairy products	20	0.002–0.008	0.005–0.008	0.005–0.015
Borewhole water	15	0.017–0.098	0.015–0.095	0.012–0.091
Indisutrial effluent	10	1.5–1.89	—	—
Treated industrial effleuent	10	0.0194–0.0528	—	—
Guinea corn products	10	0.0144–0.277	—	0.015–0.0190
Skin cream product	20	0.210–1.24	—	—
Body lotions	20	0.03–0.24	—	—
Hair creams	20	0.004–0.03	—	—

locations. Low values of nitrosamine were obtained in borehole water from outside the city, while samples obtained from within the city showed higher values, more so when such boreholes are close to industries. Industrial effluents running into open rivers and seas showed very high levels (1.50–1.89 mg/kg). Highest values of nitrosamines were found in effluents from chemicals, paint and oil-related industries. However, on treatment, the level of contamination of certain industrial effluents was found to decrease.

Virtually all of the brands of alcoholic beverages (beer, stout, and spirits) examined showed the presence of nitrosamine contamination. Similar findings have been published by Basir *et al.*[11] who reported the occurrence of nitrate, nitrite, diethylamine dimethylnitrosamine in some fermented beverages.

In our analysis of meat and fish products we found that roast meat and smoked fish contained very high levels of nitrosamine: raw meat, 0.135–0.300 mg/kg; smoked fish, 0.064–0.224 mg/kg; spiced grilled meat (locally called suya), 0.82–1.55 mg/kg. The source of nitrosamine contaminants was the coating spices thought to be made of peanut powder, pepper, vegetable oil and salt mixture. A wide range of bacterial flora in suya has been reported[12] and the possibility of bacterial-accentuated nitrosation reactions leading to high levels of nitrosamine in cold meat products has been suggested.[13] Another source of nitrosamine formation could be the prevalent use of nitrite, nitrate and industrial salts as preservatives for cold meat and fish products, an attitude that has become customary with our local people.

Natural products like guinea corn extracts showed the presence of nitrosamine contamination. The analysis of the different types of guinea corn extracts showed different levels of contamination (0.0144–0.27777 mg/kg).

The present investigatory studies were extended to include some externally used preparations. We found that nitrosamine contamination of locally made body creams and lotions, and hair creams ranged from 0.004 to 1.24 mg/kg. The probable source of nitrosamine contents in such preparations is not too clear to us; work in this direction is continuing.

On the whole our results showed that the analysed samples from the western region of the country had relatively higher values of nitrosamine contamination than those from the northern and eastern regions. The most probable reasons for this is the fact that the western region is far more industrialised than other regions, hence the greater level of pollution.

CONCLUSION

Our obvious inference from the above study is that Nigeria may have a lot of waste-disposal problems and industrial pollution which invariably give rise to environmental contamination by toxic substances. However, it is gratifying to note that the Health Authorities have now embarked on measures to curb environmental pollution in the country.

References

1. H. Bartsch, I. K. O'Neill and R. Schulte-Herman, Proceedings IX International Symposium on *N*-Nitroso compounds, Baden, Austria. Sept. 1986.
2. P. N. Magee and J. M. Barnes, *Adv. Cancer Res.*, **16**, (1967) 163–246.
3. H. Druckrey and R. Preussmann, *Naturwissenschaften*, **49**, (1962) 498–499.
4. I. S. Krul, G. Edwards, M. H. Wolf, T. Y. Fan and D. H. Fine, Nitrosamines, *Amer. Chem. Soc. Proc.*, p. 175, 1979.
5. F. C. Okiemen, T. C. A. Anucha and S. R. Harry, *Nig. J. Pharm.*, **18**(4), (1987) 17–18.
7. J. Sakshaug, E. Sognen, M. A. Hansen and N. Koppang, *Nature*, **206**, (1965) 1261–1262.
8. W. J. Serfontein and P. Hurter, *Cancer Res.*, **26**, (1966) 575–579.
9. G. M. Telling and P. C. Dunnett, *Int. J. Cosmet. Sci.*, **3**, (1981) 241–248.
10. C. L. Walters, in: *Vitamin C. Recent Aspects of its Physiological and Technological Importance*, Eds. G. G. Birch and K. J. Parker, Applied Science Publishers, p. 60, 1974.
11. O. Basir and E. N. Maduagwu, *J. Agric. Food Chem.*, **26**, (1979) 200–203.
12. J. O. Ingene, *Trop. Veterinarian*, **1**, (1983) 85–91.
13. J. O. Ingene and E. O. Abulu, *J. Food Protect.*, **47**(3), (1984) 193–196.