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A Comparative Evaluation and Toxicity Assessment of Heavy Metals in Commonly Smoked Cigarette Brands and Local Tobacco Snuff Purchased and Consumed in Nigeria

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ABSTRACT

The concentration levels of some heavy metals were investigated in ten different brands of commonly smoked cigarettes in Nigeria and compared with the results of similar heavy metals determined in tobacco snuff consumed in Nigeria with the aim of evaluating and comparing the level of heavy metal contamination in them as well as assessing their toxicity levels. Samples were representatively collected from the thirty six states of Nigeria and determined for heavy metal contents using conventional analytical methods. The mean concentration range of Pb in snuff and cigarette brands was 0.12-3.10 mg kg^{-1}. Pb values found in cigarette samples fell within the recommended standards except for snuff (3.10 mg kg^{-1}) which exceeded the limit. The mean concentration range of Cd in snuff and cigarettes was 0.02-3.55 mg kg^{-1} with samples such as benson and hedges, yes, lemon and butter, green sport, sweet menthol and snuff exceeding safe limit indicating significant pollution in Cd for these samples. Cu has a mean concentration range of 6.02-15.85 mg kg^{-1} in all the samples with most samples exceeding the recommended standards except for St. moritz, marlboro and benson and hedges which fell within the limit. The concentrations of Ni (0.11-0.17 mg kg^{-1}), Cr (0.14-0.16 mg kg^{-1}) and Zn (7.30-24.02 mg kg^{-1}) all fell within the recommended standard. Significant variations were observed in the concentrations of all the metals studied except for Chromium which gave similar results (0.14 mg kg^{-1}) for all the samples. A quantification of the contamination/pollution index for heavy metals in the snuff and different brand of cigarette samples studied in Nigeria shows that the samples are highly contaminated and polluted in some of the metals studied and therefore constitutes major health risk to the local population since the physical health of consumers is being threatened. Most of the results in this study were in the same range and in some cases found to be lower except for Cd concentration in snuff which was higher when compared to the result of similar studies in cigarettes commonly smoked in Germany, Greece, India Australia, China, Canada, Russia and USA. The significant concentration levels of heavy metals in the different cigarette brands and tobacco snuff studied were attributed to primary factors which influence the level of heavy metals already in the

growing tobacco plant. The presence of such toxic metal contaminants in an already deadly consumer product demonstrates the need for strong regulation of tobacco products.

Key words: Heavy metals, cigarettes, snuff, tobacco, contamination/pollution index, concentration

INTRODUCTION

The consumption of tobacco through smoking of cigarettes and sniffing of snuff has been a source of concern to the whole world because of its toxic effect on humans. Nigeria just like other developing and developed nations are major consumers of snuff, cigarettes and other tobacco products. Snuff is finely grinded tobacco, which comes in dry or moist forms and is sometimes packaged in ready-to-use pouches. Dry snuff is usually sniffed or swallowed, whereas moist snuff is placed between the gum and the lip or cheek and slowly absorbed. It is a smokeless tobacco mainly consumed by the local folk in Nigeria. Millions of Nigerian smokes with a good percentage of them leaving in urban areas. Smokers claim that cigarette is a social drug that helps them to relax and serve as anti-depressants but this however comes at a high price. In economically developed countries, about 10% of death could be attributed to the diseases associated with inhaling product of the combustion of tobacco plant "*Nicotiana tobaccum*". For example China has more than 320 million smokers and a million Chinese in the country die each year from tobacco-related illnesses. According to a 1996 report on 44 countries, smoking was responsible for 23% of male deaths and 9% of female deaths in developed countries in 1990 (Peto, 1996). Smoking has been causally linked to hypertension, stroke, diabetes, cancer, heart and respiratory diseases, among others. One of the important cash crops which is mostly used in the manufacture of cigarettes world-wide is tobacco (Stanley, 1993). Tobacco is an annual or bi-annual plant growing 1-3 m tall with large sticky leaves that contain nicotine. Native to the Americans, tobacco has a long history of use as an inebriate and stimulant. It is extremely popular and well-known for its addictive potential. Several food products have recommended certain limits for some heavy metals. However, smokeless tobacco products are classified under foods for regulatory purposes. The limits for metals have not been specified. Cigarette and tobacco smoke contains over 60 known carcinogens (Hecht, 2003), including radioisotopes from the radon decay sequence, Nitrosamine, Benzopyrene nicotine, tars, Carbon monoxide, Hydrogen cyanide, formaldehyde and heavy metals. Toxic heavy metals are metals and metal compounds that have the potential to harm our health when absorbed or inhaled. In very small amounts, some of these metals support life but when taken in large amounts, can become toxic. Heavy metals are one of the asymptomatic but lethal pollutants and are toxic when their natural concentrations are exceeded. Some of these heavy metals are essential for enzymatic activities in living organisms. But the bioaccumulation of heavy metals in man, animal and plants result in metal poisonings and toxicities, the health effect of these poisonings and toxicities in man have been known (Boeckx, 1986). There are a couple of toxic metals in cigarette smoke that carry an extra punch of danger for anyone breathing it in and most are radioactive. Lead-210 (Pb-210) and polonium-210 (Po-210) are poisonous radioactive heavy metals that research has shown to be present in cigarette smoke. Commonly used in rat poison, arsenic finds its way into cigarette smoke through some of the pesticides that are used in tobacco farming. However, presence of mercury or Lead in the product is far more dangerous as it can be lethal to kidneys, blood producing cells and human organs. Cadmium is also extremely toxic and causes prostate cancer, renal cancer, breast cancer, testes cancer and bladder cancer. Smokers typically have twice as much Cadmium in their bodies as non smokers (http://wiki.answers.com, 2011).

Studies have indicated that smoking is a primary risk factor for accelerated decline in respiratory function (Fevi, 1991). Smoking, particularly of cigarettes, is by far the main contributor to lung cancer (Biesalski *et al*., 1998). Across the developed world, almost 90% of lung cancer deaths are caused by smoking (Peto *et al*., 2006). In the United States, smoking is estimated to account for 87% of lung cancer cases with 90% in men and 85% in women (Samet *et al*., 1998). Among male smokers, the lifetime risk of developing lung cancer is 17.2% among female smokers, the risk is 11.6%. This risk is significantly lower in nonsmokers: 1.3% in men and 1.4% in women (Villeneuve and Mao, 1994). The inhalation of smoke from another smoker is a cause of lung cancer in nonsmokers. A passive smoker can be classified as someone living or working with a smoker. Recent investigation of side-stream smoke suggests that it is more dangerous than direct smoke inhalation (Schick and Glantz, 2005). Smoking is associated with gene damages, cancer in the lungs, oesophagus, respiratory tracts, bladder, pancreases and probably cancer of the stomach, liver and kidney. Additionally, nicotine appears to depress the immune response to malignant growths in exposed tissue (Sopori, 2002). It is imperative and pertinent to state in this study that the principal researcher usually experiences persistent irritating cough every night in the past when he was an addicted smoker of Dorchester which corroborates the fact that cigarette smoking is highly associated with severe respiratory problem. However, this wasn't noticed when the principal researcher changed his brand of cigarette to London which explains the view that the physiological effects of tobacco cigarette intake varies from one cigarette brand to another depending on the toxic content present and its concentration level. Though, the overall effect of tobacco intake cannot be ruled out as its manifestation is just a function of time depending on the smoker's body resistance and the degree of toxicity in the particular cigarette itself. The increased risk of contracting tobacco related diseases depends on the length of time that a person continues to smoke and or sniff snuff as well as the amount consumed. Tobacco cigarettes have been implicated in the environmental pollution of toxic heavy metals. The presence of toxic substances such as heavy metals in tobacco products and their toxicity has been drawn into much tobacco research and the controversy about whether changes in cigarettes design and production can change their pathogenicity. Cigarette of different brands contains different levels of heavy metals depending on the tobacco type, source and concentration. This research is aimed at determining the levels of heavy metals in different brands of commonly smoked tobacco cigarettes consumed by the local population in Nigeria and locally produced tobacco snuff commonly sniffed by our local folks so as to compare their concentration levels and toxicity degrees.

MATERIALS AND METHODS

Study area: Samples of raw tobacco snuff and cigarette brands for this study were purchased from commercial markets located in the state capitals and other major cities and towns of each of the thirty six states of the federal republic of Nigeria.

Sampling procedure and sample preparation: Ten different brands of cigarettes produced by different tobacco companies and locally processed smokeless tobacco known as snuff were randomly purchased from commercial markets situated in the state capitals and other major cities and towns of each of the thirty six states of the federal republic of Nigeria. The cigarette brands are St.moritz, Dorchester, benson and hedges, marlboro, yes, sweet menthol, lemon and butter, rothmas, green sport and white London. The samples were labeled according to their respective states were they were obtained and kept, while the snuff samples were labeled same and stored in air tight

polythene packs in the laboratory. All cigarettes of the same brand obtained from the thirty six states were bulked and mixed together in a clean plastic bucket. Their filters and papers were removed; grinded and homogenised to form a composite representative mix from which aliquot portion was taken for analysis. The same procedure was done for the other cigarette brands. The local tobacco snuff purchased from the thirty six states were also bulked, mixed and homogenised to form a composite mix. One gram of each sample was measured into a 250 mL beaker, respectively. Two milliliter of perchloric acid ($HCLO_4$) and 10 mL of Nitric acid (HNO_3) were added to the samples respectively. The mixtures were swirled for even mixing. Each of the beakers were placed on a hot plate in a fume cupboard at a temperature of 120° to 150° C for about 15 min until a clear digest was obtained. It was then removed from the hot plate, allowed to cool, filtered into a 100 mL conical flask and made up to the mark with distilled water. The sample solutions were then transferred into containers and well labeled according to the brand of cigarettes. The snuff sample was digested the same way and labeled as well. The digested cigarettes and snuff sample solution were taken for elemental analysis using Atomic Absorption spectrophotometer (PYE UNICAM SP 2900 MODEL).

Quality control: All reagents used in this study were of pure analytical grade and were checked for possible trace metal contamination. All glass wares for metal analysis were previously soaked in 14% nitric acid (v/v) for 24 h to remove all entrained metals, washed with detergents and rinsed with deionised water. Procedural blank and working standard solutions for Nickel, Chromium, Lead, Cadmium, Zinc and Copper were prepared by diluting concentrated stock solution with distilled water. A known standard was run after every five samples to check the reliability of the analytical instrument. The reliability of the entire procedure was carried out by spiking already analysed samples with a known metal standard and re-analysed. The percentage recovery achieved for each metal were 89.7, 91.2, 81.8, 86.7, 96.3 and 93.7% for Nickel, Chromium, Lead, Cadmium, Zinc and Copper, respectively. Triplicate analyses were performed on the samples to yield a mean which was used to determine trueness and also standard deviation of the mean to measure precision (Stanton, 1966; Valcarel, 2000).

RESULTS AND DISCUSSION

Table 1 shows the mean concentration of heavy metals and their standard deviations in snuff and the different cigarette brands, while Table 2 shows the mean concentration range of heavy metals in the samples.

Data treatment: Contamination/Pollution index (CPi) was calculated as follows:

$$\text{Contamination/Pollution Index (CPi)} = \frac{\text{Concentration of parameter}}{\text{Standard or Target Value}}$$

It is expressed as a function of the concentration of individual parameter as against the baseline standard or target value. It shows the relative level of contamination and or pollution contributed by each metal in the sample. The critical value is 1.0, values greater than 1.0 indicates varying degree of pollution and defines the pollution range, while values less than 1.0 shows varying level of contamination and defines contamination range. The data's obtained from

Table 1: Mean concentrations of heavy metals in cigarette and snuff samples (mg kg^{-1})

Samples	Ni	Cr	Pb	Cd	Zn	Cu
Dorchester	0.12±0.00	0.14±0.00	2.00±0.00	0.02±0.00	14.22±1.60	10.19±1.75
St. Moritz	0.14±0.10	0.14±0.00	0.87±0.14	0.16±0.05	17.21±0.33	8.04±1.40
Benson and hedges	0.12±0.40	0.14±0.00	0.70±0.03	0.51±0.06	13.30±0.00	6.34±0.00
Marlboro	0.11±0.20	0.14±0.00	2.10±0.50	0.40±0.06	20.32±0.00	6.02±1.76
Yes	0.13±0.00	0.14±0.00	0.81±0.05	0.56±0.00	21.30±1.60	12.45±1.04
Sweet menthol	0.13±0.00	0.14±0.00	2.77±1.34	1.74±2.45	10.35±0.26	12.60±0.00
Lemon and butter	0.12±0.40	0.14±0.00	2.25±0.15	2.11±0.00	8.20±1.34	11.21±1.03
Rothmans	0.13±0.00	0.14±0.00	0.14±0.00	2.00±0.00	7.30±2.10	10.65±0.00
Green sport	0.12±0.40	0.14±0.00	0.12±0.00	2.00±0.00	22.77±0.11	15.02±0.00
White London	0.13±0.00	0.14±0.00	2.24±0.17	0.23±0.00	17.30±0.00	11.08±0.00
Snuff	0.17±0.35	0.14±0.00	3.10±1.44	3.55±0.00	24.02±1.50	15.85±0.00

Table 2: Concentration range of heavy metals in cigarette and snuff samples (mg kg^{-1})

Samples	Ni	Cr	Pb	Cd	Zn	Cu
Dorchester	0.11-0.12	0.14-0.14	1.00-3.00	0.02-0.02	14.11-13.99	10.18-10.20 St.
Moritz	0.13-0.15	0.14-0.14	0.85-0.88	0.18-0.18	16.20-18.21	7.03-9.05
Benson and hedges	0.10-0.14	0.14-0.14	0.60-0.80	0.51-0.51	13.30-13.30	6.34-6.34
Marlboro	0.11-0.11	0.14-0.14	2.10-2.10	0.35-0.44	20.32-20.32	6.01-6.03
Yes	0.13-0.13	0.14-0.14	0.71-0.90	0.56-0.56	20.30-20.30	12.44-12.46
Sweet menthol	0.12-0.12	0.14-0.14	1.77-2.77	1.64-1.83	10.33-10.37	12.60-12.60
Lemon and butter	0.11-0.13	0.14-0.14	1.36-3.14	2.11-2.11	7.21-9.19	11.20-11.22
Rothmans	0.14-0.15	0.14-0.14	0.14-0.14	0.14-0.14	6.31-8.29	10.65-10.65
Green sport	0.10-0.13	0.14-0.14	0.12-0.12	2.00-2.00	20.55-24.99	15.02-15.02
White London	0.13-0.13	0.14-0.14	2.22-2.25	0.23-0.23	17.30-17.30	11.08-11.08
Snuff	0.16-0.18	0.14-0.14	4.09-3.11	3.55-3.55	24.01-24.03	15.85-15.85

calculation of the contamination/pollution index were grouped into seven categories ranging from very slight contamination to excessive pollution. Values<0.1 were classified as very slight contamination, 0.1-0.5 as moderate contamination, 0.51-0.99 as high contamination, 1.0-2.0 as moderate pollution, 2.1-3.0 as high pollution, 3.1-4.0 as very high pollution, values>4.0 as excessive pollution. The target value was obtained by using standards formulated by Kabata-Pendias and Pendias (1992) and Enthrington (1982) for maximum allowed concentration of heavy metals in plants as shown in Table 1. Since there are no global standards on heavy metal concentration in tobacco products, the researchers chose to adopt regulatory limits of heavy metals in plants and foodstuffs of plant origin as standards for this study since cigarettes and tobacco are substances of plant origin.

The values of contamination/pollution index and their significance are shown in Table 4 and 5, respectively.

The results showed the presence of the heavy metals investigated. The mean concentration range of Lead in snuff and cigarettes was 0.12-3.10 mg kg^{-1}. The highest concentration level of Lead (3.10 mg kg^{-1}) was found in sample 11 (snuff) and the lowest level found in sample 9 (Green Sport) (Table 3). Lead values found in cigarette samples fell within the standard recommended by Kabata-Pendias and Pendias (1992) but that found for snuff exceeded the limit. The contamination/pollution index for Lead in the studied samples shows very slight contamination in sample 8 (rothmas) and sample 9 (green sport), moderate contamination in sample 2 (St. moritz), sample 3 benson and hedges) and sample 5 (yes), high contamination in Sample 1 (Dorchester), Sample 6 (sweet menthol), Sample 4 (Marlboro), Sample 7 (lemon and butter) and Sample 10

Table 3: Standard regulatory limits of heavy metals in plants[15,16]

Metals	Concentration (mg kg^{-1})
Lead (Pb)	0.05-3.0
Cadmium (Cd)	0.1-0.5
Copper (Cu)	1-10
Zinc (Zn)	1-50
Chromium (Cr)	0.1-0.5
Nickel (Ni)	0.1-5.0

Table 4: Summary of contamination/pollution index in samples

Samples	Ni	Cr	Pb	Cd	Zn	Cu
Dorchester	0.024	0.28	0.67	0.04	0.28	1.019
St. Moritz	0.028	0.28	0.29	0.32	0.34	0.804
Benson and hedges	0.024	0.28	0.23	1.02	0.27	0.634
Marlboro	0.022	0.28	0.7	0.8	0.41	0.602
Yes	0.026	0.28	0.27	1.12	0.43	1.245
Sweet menthol	0.026	0.28	0.92	3.48	0.21	1.260
Lemon and butter	0.024	0.28	0.75	4.22	0.16	1.121
Rothmans	0.026	0.28	0.047	4.0	0.15	1.065
Green sport	0.024	0.28	0.04	4.0	0.46	1.502
White London	0.026	0.28	0.75	0.46	0.35	1.108
Snuff	0.034	0.28	1.03	7.1	0.48	1.585

Table 5: Significance of interval of contamination/pollution index

Cpi range	Significance
<0.1	Very slight contamination
0.1-0.5	Moderate contamination
0.51-0.99	High contamination
1.0-2.0	Moderate pollution
2.1-3.0	High pollution
3.1-4.0	Very high pollution
>4.0	Excessive pollution

(white London) with moderate pollution in Sample 11 (snuff) (Table 4). The values of Lead obtained in this work were in the same range with those studied in cigarettes commonly smoked in Germany, Greece, India Australia, china, Canada, Russia and USA. Muller *et al.* (2000) except for sample 3 (benson and hedges), sample 5 (yes), sample 2 (St. moritz), sample 8 (rothmas) and sample 9 (green sport) which were lower. Lead is known to induce reduced cognitive development and intellectual performance in children it also increases blood pressure in adult (Commission of the European Communities, 2002). Nickel and Chromium had the lowest concentration of heavy metals in both snuff and refined cigarettes, having a concentration range of 0.11-0.17 and 0.14-0.16 mg kg^{-1}, respectively with sample 11 (snuff) having the highest concentration of 0.17 and 0.16 mg kg^{-1} in Nickel and Chromium, respectively. Chromium was found to have the same concentration levels in all the samples. The values detected for both metals fell within the limits recommended by Enthrington (1982) and Kabata-Pendias and Pendias (1992). The concentration range of Chromium in this study was found to be lower when compared to the result of similar studies in cigarettes commonly smoked in Germany, Greece, India Australia, China, Canada, Russia and USA (Muller *et al.*, 2000). Calculation of the contamination/pollution index shows the

samples were very slightly contaminated in Nickel and moderately contaminated in Chromium. The concentration levels of Cadmium in both refined cigarettes and snuff were in the range of 0.02-3.55 mg kg^{-1} with sample 11 (snuff) having the highest concentration of 3.35 mg kg^{-1} and sample 1 (Dorchester) having the lowest concentration of 0.02 mg kg^{-1}. Significant variations were observed in the concentrations of Cadmium found in the refined cigarettes. The values obtained for sample 1 (Dorchester), sample 2 (St. moritz), sample 4 (marlboro), sample 10 (white London) and sample 8 (rothmas) fell within the acceptable standard except for the concentrations in sample 3 (benson and hedges), sample 5 (yes), sample 7 (lemon and butter), sample 9 (green sport), sample 6 (sweet menthol) and sample 11 (snuff) which exceeded the limit stipulated by Enthrington (1982) and Kabata-Pendias and Pendias (1992) indicating significant pollution in Cadmium for these samples; the values also agreed with the mean contents of Cadmium which had been declared as carcinogenic to humans from the International Agency for the Research on Cancer (IARC, 1993) of the World Health Organization (WHO). Concentration of Cadmium in the samples expressed in terms of their contamination/pollution index shows that sample 1 (Dorchester) is very slightly contaminated, sample 2 (St. moritz), sample 10 (white London) and sample 4 (marlborough) are moderately to highly contaminated, sample 3 (Benson and hedges) and sample 5 (yes) moderately polluted, sample 9 (green sport), sample 8 (rothmas) and sample 6 (sweet menthol) very highly contaminated while sample 7 (lemon and butter) and sample 11 (snuff) are excessively polluted in Cadmium. The results for sample 3 (Benson and hedges), sample 5 (yes), sample 7 (lemon and butter), Sample 9 (green sport), sample 6 (sweet menthol) were similar and in the case of sample 11 (snuff) higher than those previously reported for cigarettes commonly smoked in Germany, Greece, India Australia, China, Canada, Russia and USA (Muller *et al*., 2000). Substances contaminated with Cadmium can cause irritation of the stomach, vomiting and diarrhoea, lung damage, fragile bone, abdominal pain and choking and (ASTDR, 2005). Elevated levels were found for Zinc and Copper with Zinc having the highest metal concentration in both snuff and refined cigarettes, except for sample 6 (Sweet Menthol), sample 7 (lemon and butter) and sample 8 (rothmas). Zinc has a concentration range of 7.30-24.02 mg kg^{-1} with the highest concentration found in sample 11 (snuff). Copper has a concentration range of 6.02-15.85 mg kg^{-1} with the maximum concentration of 15.85 mg kg^{-1} found in sample 11 (snuff), followed by sample 9 (Green Sport) with 15.03 mg kg^{-1}. There were little inter brand differences in the concentration of Zinc and Copper in the refined cigarettes. The values for Zinc in all the samples fell within the standard giving by Enthrington (1982) and Kabata-Pendias and Pendias (1992). Most samples for Copper exceeded the recommended standards except for sample 2 (St. Moritz), sample 4 (Marlborough) and sample 3 (Benson and hedges) which fell within the limit. All the samples were moderately contaminated in Zinc, while those for Copper ranged from high contamination in sample 2 (St. Moritz), sample 3 (Benson and hedges) and sample 4 (Marlborough) to moderate pollution for the others from the calculation of their contamination/pollution index. The values for Copper were within the range while those for Zinc were lower than the range obtained in previous studies conducted in cigarettes commonly smoked in Germany, Greece, India, Australia, China, Canada, Russia and USA (Muller *et al*., 2000). Exposures to high levels can cause vomiting, diarrhoea, stomach cramps, intestinal irritation, nausea, hemolytic anaemia, cardiovascular diseases, brain, kidney and Liver damage. The values obtained showed an abundance trend of Zinc>Copper>Cadmium>Lead>Nickel>Chromium with snuff sample having the highest concentration of all the metals studied when compared to the refined cigarettes. The high levels of heavy metals observed in the snuff samples can be attributed

to the fact that snuff which is a smokeless tobacco substance in its crude form of the tobacco plant is the primary recipient of this metals from the contaminated soil in which the tobacco leaf is grown unlike cigarettes which have been subjected to refining and processing thereby possibly reducing contaminant concentration. The significant concentration levels of heavy metals in the different cigarette brands and tobacco snuff studied were attributed to primary factors which influence the level of heavy metals already in the growing tobacco plant such as composition of soil and dust, application of fertilizers, species of the tobacco plant itself, mixing of different tobacco species differing in metal composition, "treatment" during fermentation among others during processing. Most of these metals finds their way into tobacco products through some of the pesticides that are used in tobacco farming. Tobacco like other crops absorbs minerals and other things from the soil, so if the soil has Cadmium, Lead, arsenic or other metals they will be absorbed into the tobacco. Metal contents in tobacco which comes from the contaminated soil in which the tobacco leaf is grown cannot be under the control of the tobacco producer. Some experts think a major reason for the high content of toxic metal in cigarettes is the land pollution which can affect the health of tobaccos (Green, 2010). The content of heavy metals like Cadmium, Nickel and Lead in tobaccos keeps a close relationship with the pH value of the land. In addition, the minor ingredients of cigarettes production like pine tar, carbon monoxide and arene also contain heavy metals to cause the production of toxic substances. The artificial essence can also accelerate the production of toxic substances (Green, 2010). The different metal compositions in various brands of cigarettes are associated with peculiarity of tobacco plant varieties and tobacco processing (Zulfiqar *et al.,* 2006). It could therefore be inferred from the results that the snuff and different cigarette brands consumed in Nigeria are contaminated and polluted in most of the metals well known to be highly dangerous to human health. These metals get into smokers and snuff consumers along with a cocktail of other toxicants. The effect of cumulative exposure to multiple toxicants, including metals, is the public health question that needs to be sorted out.

CONCLUSION

This study revealed varying levels of heavy metals in the different brand of tobacco cigarettes and snuff samples investigated in Nigeria. A quantification of the contamination/pollution index for heavy metals in the snuff and different brand of cigarette samples studied in Nigeria shows that the samples are highly contaminated and polluted in some of the metals studied and therefore constitutes major health risk to the local population. It also showed that the locally produced tobacco snuff has a relatively higher concentration of all heavy metals studied than the refined cigarettes sold in the Nigerian market. These results unequivocally indicates that the addicts of local tobacco snuff which are usually the old folks (especially in Nigeria) are more susceptible to tobacco related diseases since the concentration of toxic heavy metals were higher in it than the refined cigarette. Even if the concentration of heavy metals analysed in some cigarettes samples were relatively low as against background standards it does not rule out the health risk associated with cigarette and tobacco intake because inhaling heavy metal particles at low levels well below those considered non toxic can have serious health effect. While the per-stick levels of metals are what we measured, the real issue is repeated exposure. Smokers don't smoke just one cigarette, but 3, 4, 5 or so a day every day for years because cigarettes are addictives. This will Lead to the bioaccumulation of these toxic heavy metals over time in humans making consumers of these cigarettes stand a great potential health risk. The presence of high levels of heavy metals in Nigerian cigarettes and tobacco snuff may constitute a potential global public health problem as the production, imports and exports of

Nigerian cigarettes and snuffs continue to increase. The presence of such toxic metal contaminants in an already deadly consumer product demonstrates the need for strong regulation of tobacco products, therefore smokers and non-smokers in Nigeria and elsewhere deserves to know the toxic contents in their cigarettes.

RECOMMENDATION

The danger and implications of tobacco addiction (whether cigarette or snuff) has been unveiled in this study from the concentration levels of toxic heavy metals detected. The smoke from cigarettes also contaminates the environment and endangers the health of non-smokers, therefore there is need for caution in smoking in public places and governments should intensify efforts toward public enlightenment about the dangers of tobacco consumption. It is fundamentally wrong that consumers of food products and even drugs in Nigeria knows about the content of the food they eat and the drugs they take but know nothing about what is in the cigarettes they smoke. They are oblivious and kept in the dark about the harmful substances found in cigarettes. The inscription 'Federal ministry of health warns that tobacco smokers are liable to die young' on the packets of cigarettes sold and consumed in Nigeria does not provide adequate and sufficient information about the toxicity and toxic contents of the cigarettes thereby misleading consumers into believing they are less harmful. Unless stronger actions is taken by the government to make the toxic contents and their degree of toxicity known to its consumers. Furthermore, in order to decrease the harms caused by the excessive content of toxic metals contained in cigarettes and tobacco, government should as a matter of public health importance supervise and regulate manufacturing industries in Nigeria and importers of these products and ensure that they are required to test for metals content in tobacco so as to reduce the risk of threatening the physical health of consumers since the intake of cigarettes and snuff cannot be prohibited and eradicated in Nigeria. Finally, there is need for more of such studies that measures the content of heavy metals and other toxic substances in tobacco products to help consumers, governments and even manufacturers around the world make positive and informed decisions.

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