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Levels of selected heavy metals in some brands of Cigarettes marketed in University of Port Harcourt, Rivers State.

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ABSTRACT: Four commonly smoked brands cigarette from Abuja campus in the University of Port Harcourt were randomly sampled and analyzed for heavy metals using Atomic Adsorption Spectrometry (AAS). The brands include Benson and Hedges, Rothmans, Dorchester, and St. Moritz. The results of the analysis indicated that the concentration of Zn was found to be in range of 27.48-64.29mgkg^{-1}, Cu had 11.27-13.28mgkg^{-1}, and Cd was 0.53-0.59mgkg^{-1}. Pb was found in the range of 5.22-7.99mgkg^{-1}, Mn concentrations were in the range of 87.42-106.22mgkg^{-1}, and the values for Fe were in the range of 167.49-230.47mgkg^{-1} while Cr and Ni levels were in the range of 16.82-25.99mgkg^{-1} and 2.65-4.67mgkg^{-1} respectively. Iron concentrations were highest in all the brands compared to the other metals; while the cadmium concentration was lowest in all the four brands cigarette analyzed. Generally the levels of content of the metals in all the brands except Zinc were high compared with the WHO threshold values. In addition to emphasizing the danger of cigarette smoking, the results highlighted the heavy metals toxicity potential of each brand of cigarette. ©JASEM

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Studies have shown that human exposure to trace metals is by ingestion of water, food and inhalation (WHO, 1990). The amount of inhaled metals depends on the concentration of the metal in the air, the retention of particles in the lungs and from the chemical compound inhaled, the physiological status of respiratory system and particularly for smokers the strength of smoking habit and the concentration of the metals in the cigarette. During the last several decades, there have been increasing concerns regarding the accumulation of heavy metals in the environment (Nortier, 1997). Tobacco cigarette are widely used throughout the world by men and women. A great number of people have become victims of Environmental Tobacco Smoke (ETS) as they participate passively. The presence of additive compounds like nicotine is the main reason for cigarette habituation. Other factors that have impact on cigarette smoking habits include mass production, social acceptance, availability, relative cheapness and its light weight.

By now, it is well established that cigarette smoking is dangerous to human health. Tobacco-related illnesses remain the leading cause of preventable deaths. Approximatively 4 million annual deaths worldwide are attributed to tobacco use (Corrao *et al*., 2000)

MATERIALS AND METHODS

The cigarette samples used in this study were sourced from Abuja campus, University of Port Harcourt Rivers State. Four (4) popular brand cigarettes i.e St. Moritz, Rothmans, and Benson and Hedges were chosen. Composite samples of each brand were made by removing the papers and filters of five cigarettes taken randomly from the pack of 20 cigarettes and five cigarettes from each pack of the same brand with different batch numbers were mixed together. Atomic Adsorption Spectrophotometer (AAS) – GBC AvantaVer 2.02/Analysis 1 and pyrex glass wares were used.

Ashing was carried out by putting tobacco from each brand of cigarette into crucible in a muffle furnace at the temperature of 105^{o}C for 3 hours. When the ashing was complete, it was put into a foil paper and weighed. Digestion was carried out by dissolving 3g of the ashed sample in 10ml concentrated hydrochloric acid and was heated on electro-thermal heater hotplate. The digest was filtered through Whattman filter paper into a volumetric flask and the solutions of the ash were diluted to 50ml with distilled water. Metals concentration in each sample of cigarette was determined using atomic adsorption spectrophotometer. This analytical procedure provides a quick, sensitive and precise method for determination of metal ions in solution.

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RESULT AND DISCUSSION

The result in table I, indicates that the concentrations of Manganese were the highest in the four cigarette brands after the concentration levels of Iron. Mn level had values ranging between 90.28-106.23mg/kg. The cigarette brand Rothmans had the highest value (106.23mg/kg) among the four brands while Benson and Hedges had the lowest Mn value (87.42mg/kg). The values for Dorchester and St. Moritz were 90.28 and 94.18mg/kg respectively. The values for all the brands analyzed are far more than the permissible limit (6.61mg/kg).

Although manganese is required nutritionally at low concentrations, it is neurotoxic at high concentrations. The symptoms of neurotoxicity may not be observed immediately but often become clinically detectable with long-term exposure. (ATSDR, 1997). High levels of Manganese in the human system causes psychiatric syndromes like hallucination, emotional liability and other manganese madness. (Barceloux, 1999).

Iron concentrations were shown to be the highest in the entire four brands cigarette. Fe concentration in Rothmans was highest (230.47mg/kg) compared to other brands, this was followed by (224.19mg/kg) in St. Moritz while Fe concentrations in Benson and Hedges and Dorchester were 209.94 and 167.49mg/kg respectively. The results show that Dorchester has the lowest of Fe. The concentrations of Iron in all the four brands of cigarettes are greater than the permissible limit which is 100mg/kg.

Iron required nutritionally at low concentrations however, it is known to catalyze highly reactive hydroxyl radical formation from superoxide ion and hydrogen peroxide by the two-step Fenton reaction (Halliwell and Gutterridge, 2004). As a consequence, inhaled iron contributes to free radical-induced lung injury.

Chromium content of the four brands of cigarette was found to be 21.21, 22.82, 16.82, and 25.69mg/kg for Dorchester, Benson and Hedges, St. Moritz and Rothmans respectively. The nutritional effect of Chromium is that, it appears to assist insulin in regulating blood sugar (glucose) levels. The most common health effect from exposure to Chromium is contact dermatitis-skin chromium and cigarette smoking do not act systematically with each other. The reason for this is not clear, but this supports the idea that chromium is relatively weak carcinogen even at very high occupational doses. Chromium at toxic level is known to cause lung cancer and allows cancer causing chemicals to stick more strongly to DNA and damage it. (Liu, 1999)

The concentrations of Nickel in the four brands were 3.35, 4.67, 2.65, and 3.43mg/kg for Dorchester, Benson and Hedges, St. Moritz and Rothmans respectively. The results indicated high levels of Ni when compared to 0.2mg/kg (the permissible limit). Continuous smoking of cigarette may lead to bioaccumulation of this metal beyond the threshold limit, this may react with some biochemical substances in the body resulting to highly toxic compounds that may pose some health threat. Kreyberg, in 1978 reported that workers at a Norwegian nickel refinery easily developed lung cancer. Nickel carbonyl at low concentration is considered to be potential carcinogen. (Sunderman, 1961).

Cadmium concentrations were found to be lowest in all the four brands following a particularly trend of 0.59mg/kg in St Moritz, Benson and Hedges and Rothmans but 0.53mg/kg in Dorchester. The concentrations of Cd in all the brands were above the permissible limit (0.05mg/kg) Cd is number 7 on ASTDR's "Top 20 list" hence, it is a well known carcinogen. Chronic exposure to cadmium can result in chronic obstructive lung disease, renal disease, and fragile bones. Cd had also been implicated for the low sperm density among smokers.

Lead concentrations were found to be 7.99, 5.98, 8.02 and 3.22mg/kg in Dorchester, Benson and Hedges, St Moritz and Rothmans respectively. The highest value of lead was observed in St Moritz, while Rothmans was found to contain the lowest value of lead. Generally, the four brands of cigarette were found to have concentrations higher than the permissible limit (0.05mg/kg). Continuous accumulation of lead in the body is known to be harmful and may lead to what is described as lead poison, a disease condition which is characterized by blindness, deafness, hypertension, impairment of kidney function and neurological disorder. (Anhwangeet al., 2009). Symptoms of lead toxicity are headache, irritability, abdominal pain and various symptoms related to the nervous system. (Preuss, 1993).

The concentration of Zinc ranged between 27.48-64.29mg/kg. The concentration of Zn was highest (64.29mg/kg) in Benson and Hedges, followed by Rothmans (34.92mg/kg). Dorchester had the least concentration (27.48mg/kg) Zinc is known to aid a lot of biochemical reactions in the body, for

example, it supports healthy immune system, synthesis of DNA, alcohol and sugar metabolism. Consequently, concentration level above 100mg/kg in diets may result in anemia, neurological degeneration, and alteration in iron function and reduced immune function. The result showed that Zn level in all the brands were lower than the threshold value. Though, continuous accumulation over time may result to some health risk.

The levels of Copper in those four brands of cigarette were obtained as 13.28, 11.78, 11.33 and 11.27mg/kg for Dorchester, Benson and Hedges, St Moritz and Rothmans respectively. The values showed very little variations, Dorchester had the highest concentration of Cu while Rothmans had the lowest level of Cu. Copper is known to play essential roles in the proper functioning of various enzymes. Since the level of Copper in all the brands were more than the permissible limit (10mg/kg), continuous accumulation may lead to chronic exposure and this will result in making circular proteins become toxic in intracellular tissues by initiating by generation of detoxification of reactive oxygen species. There are a lot of disorder associated with Copper toxicity and include Wilson's disease, Merker's disorder, and Indian childhood cirrhosis (Gitlin, 1998).

Conclusion And Recommendations: The study has revealed that most of the cigarettes found in Abuja campus, University of Port Harcourt, Rivers State contained substantial levels of trace metals, although Zinc level was lower than the threshold value, constant bioaccumulation may result to adversely have health effect. Since heavy metals once absorbed, have long biological half-life, their presence in tobacco may result to chronic adverse effects on the individual. It is therefore pertinent that manufacturers of cigarettes check the levels of these metals during processing before final packaging, and legislative arm of governments should enact laws that will control cigarette smoking.

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Table 1: Concentration (mg/kg) of heavy metal in the four brands of cigarette

Brands	Mn	Fe	Cr	Ni	Cd	Pb	Zn	Cu
Dorchester	90.28	167.49	21.12	3.35	0.53	7.99	27.48	13.28
Benson & Hedges	87.42	209.94	22.82	4.67	0.59	5.98	64.29	11.78
St. Moritz	94.18	224.19	16.82	2.65	0.59	8.02	43.92	11.33
Rothmans	106.23	230.47	25.69	3.43	0.59	5.22	36.29	11.27
WHO Permissible limit	6.61	100	0.5	0.2	0.05	0.05	100	10

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