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Trace Metals Content of Some Brands of Cigarette Found Within Makurdi Metropolis

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Abstract

Ten brands of cigarette were randomly sampled and analysed for heavy metals. The brands include (Excel, Pall mall menthol, Kasmal, Aspen, Yes, Benson and Hedges, Rothmans, London Menthol, Dorchester and Three Rings). The samples were randomly labeled A-J with respect to the in which the appeared in the text. Results of the analysis indicate the concentration of Zn was found to range between 61.80-16.20 $mgkg^{-1}$, Cu had 30.80-18.40$mgkg^{-1}$, and Cd was 2.12-0.19 $mgkg^{-1}$. Pb was found to range between 3.91-0.16$mgkg^{-1}$, while Cr and Ni levels were in the range 3-81-0.94 $mgkg^{-1}$ and 4.01-0.98 $mgkg^{-1}$respectively. Zinc concentration was highest in all the brands compared to the other metals; while cadmium concentration was lowest in all the ten brands of cigarette analysed. Chromium was ot detected in sample H. Generally the levels of the content of the metals in all the brands were low compared with the world standards. It is believe that continuous bioaccumulation through smoking of cigarette may led to additional health complication apart from the inherent danger to which cigarette is known for.

Keywords: Trace metal, Cigarette, Brands, Analysis and Makurdi

Introduction

Cigarette looks deceptively simple; as it is found to consist of paper tubes containing chopped-up tobacco leaf, usually with a filter at the mouth end. In fact, they are highly engineered products, designed to deliver a steady dose of nicotine. Cigarette tobacco is blended from two main leaf varieties: yellowish 'bright', also known as Virginia which is known to contained about 2.5-3% nicotine; and 'burley' tobacco which has higher nicotine content of about 3.5-4%.

The chemical composition of cigarette varies markedly with brand. It is known to

compose of over 4,000 different chemicals including tar, nicotine, carbon monoxide, formaldehyde, polyaromatic hydrocarbons, and specific nitosamine and trace metals [1]. As much as 600 – 1400 additives are added to cigarette during manufacturing, many of these additives are known to be a source of trace metals apart from the paper and the filter which have been found to be major sources of trace metals in cigarette [2]. Besides, the cultivation of tobacco involves the application of large amount of fertilizers, herbicides and insecticides, these chemicals are well known sources of trace metals and may be added sources [3]. Environmental factors may also contribute to the levels of these metals in cigarette, that is, the type of the soil in which the plant is cultivated.

It has been observed that cigarette smoking is not only responsible for cancer related diseases but a major cause of heart diseases, aneurysms, bronchitis, emphysema, strokes and cataracts. Smoking of tobacco had been implicated in higher rate of infertility, miscarriage, premature birth and infant deaths [4]. Osman [5] reported that smoking of cigarette induced oxidative stress in the body of the smoker, as such, the levels of antioxidants like vitamin C, vitamin E and carotenoids decreases with corresponding increase in cyanides, thiocyanides, free radicals and aldehydes levels. The reaction of these highly unstable substances with other biochemical components of the body like proteins and enzymes usually result to serious health complications. For example, higher concentrations of cadmium compete with copper in the body causing copper homeostasis of blood and copper containing proteins. Copper which is necessary for normal physiological functioning of numerous enzymes such as cytochrome oxidase, superoxides dismutase and uricase, if its metabolism denatured, it result to changes in its concentration within tissues and body fluids the consequence of which is pathological state. Babalola [6] reported that cadmium also increases peripheral artery disease. According to Nnorom[7], the negative effect of smoking on semen quality in smokers is attributed to the accumulation of cadmium in their genital tract.

Similarly, all known effects of lead on biological systems are deleterious. Many physiological systems including those of the renal, nervous heamopoietic, immune, reproduction and endocrine are principal targets of this environmental toxicant [8]. Generally, it has been found that the mixture of metals and oxidants constitutes the crucial endothelium damaging noxa. These combinations usually lead to chain reaction of protein oxidation, functional impairment of the microtubule system, contraction of endothelial cells, endothelial dysfunctions, and denudation of the inner vascular surfaces[9]

Studies have shown that human exposure to trace metals is by ingestion of water, food and inhalation. The amount of inhaled metals depends on the concentration of the metal in the air, the retention of the 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. Most crops are known to accumulate high concentrations of these metals in root tissue, seeds followed by leaves, but for other crops like cabbage (Brassica oleracca L) and tobacco (Nicotiana tabacum L) conversely, accumulate the metals in high proportion in their leaves rather than their roots and seed tissueS [2]. Therefore,

considering the high rate of smoking worldwide especially among the youths, the assessment of these metals in tobacco products is indispensable for the protection of environment and hence provide more information about the inherent dangers associated with smoking. In view of the above, the present study therefore considered it relatable to determine the levels of zinc, copper, cadmium, lead, chromium and nickel in the most available brands of cigarette within Makurdi metropolis.

Materials and Methods

Ten most available brands of cigarette sold within Makurdi were purchased for the analysis. The brands include Excel, Pall mall menthol, Kasmal, Aspen, Yes, Benson and Hedges, Rothmans, London Menthol, Dorchester and Three Rings and were randomly labeled A to J. In each packet, five sticks were taken dried in an oven at 105^{o}C to constant weight. The samples were then ground with porcelain mortal and piston to fine particle size and stored in plastic containers for analysis. The samples were digested using the method reported by Allen [10] and analysed for trace metals by atomic absorption spectrophotometer (AAS) using UNICAM 696 AA Spectrophotometer.

Results and Discussion

The result of Table 1.0 indicates the concentration of Zn to be highest (61.80 $mgkg^{-1}$) in sample D, followed by sample F (50.10 $mgkg^{-1}$), while Zn concentration in sample B, G, J, E, I, H, C and A was 48.40$mgkg^{-1}$, 44.30($mgkg^{-1}$), 42.60($mgkg^{-1}$), 32.50($mgkg^{-1}$), 30.70($mgkg^{-1}$), 29.50($mgkg^{-1}$), 28.30($mgkg^{-1}$) and 16.20($mgkg^{-1}$) respectively. The result indicates that sample A to hah the lowest level of Zn. 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. Concentration level above $100^{mgkg\text{-}1}$ in diets, may result in anemia, neurological degeneration, alteration in iron function and reduced immune function. Similarly, Yanagisawa[11] observed that excessive intake of zinc result in the induction of the pathological condition that is found associated with oxidative stress.

The result of Zn analysis showed the level in all the samples is lower than the threshold value. Though, continues accumulation over time may result to some health risk [2].

The levels of copper in the ten brands of cigarette were obtained as 21.40, 27.60, 18.40, 30.80, 24.70, 22.50, 19.50, 29.30, 30.20 and 25.60($mgkg^{-1}$) for A, B, C, D, E, F, G, H, I and J respectively. The result showed brand D to contain the highest level (30.80$mgkg^{-1}$) of copper, while sample C contained the lowest level of 18.40$mgkg^{-1}$. Copper is known to play essential roles in the proper functioning of various enzymes and other circular proteins may become toxic on excessive accumulation in intracellular tissues by initiating the generation of detoxification of reactive oxygen species and apoptotic processes [12].

Cadmium content of the ten samples of cigarette studied was found to be 1.94, 2.12, 0.19, 2.24, 1.05, 0.82, 1.12, 2.13, 0.83and 1.72 ($mgkg^{-1}$) for A, B, C, D, E, F, G,

H, I and J respectively. The results indicate cadmium content to be highest in brand H (2.12 $mgkg^{-1}$) and B (2.12 $mgkg^{-1}$).the lowest level was observed in samples C with 0.19 $mgkg^{-1}$. According to ATSDR [13], smoking of cigarette is an important source of cadmium exposure, since smokers have been found to contain about twice the level of cadmium in their bodies than do nonsmokers. Calabrese [14] observed that acute inhalation exposure to high levels of cadmium in humans may result in effects on the lung, such as bronchial and pulmonary irritation. A single acute exposure to high levels of cadmium can result in long-lasting impairment of lung function; while chronic inhalation and oral exposure of humans to cadmium results in a build-up of cadmium in the kidneys that can cause kidney disease, including proteinuria, a decrease in glomerular filtration rate, and an increased frequency of kidney stone formation. Cadmium had also been implicated for the low sperm density among smokers [15].

Lead concentrations was found to be 3.24, 2.13, 0.93, 3.11, 2.22, 3.91, 0.83, 0.16, 1.62 and 1.66 ($mgkg^{-1}$) in A, B, C, D, E, F, G, H, I and J respectively. The highest value of lead was observed in sample F, while sample H was found contain the lowest value of lead. Generally, the ten brands of cigarettes were found to have lower concentrations of lead. A higher concentration 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 characterised by blindness, deafness, hypertension, impairment of kidney function and neurological disorder [16].

Chromium content of the ten brands of cigarette was found to be 1.83, 2.14, 2.11, 0.94, 3.01, 2.81, 3.811.34 and 1.56 ($mgkg^{-1}$) for A, B, C, D, E, F, G, I and J respectively, while chromium was not detected in sample H. The nutritional effect of chromium is that it appears to assist insulin in regulating blood sugar (glucose) levels. Insulin is a small protein hormone that is released into the blood when blood glucose levels get too high. Insulin then binds to a receptor on the outside of cells, causing them to absorb more glucose from blood, returning blood glucose levels to normal. If glucose levels fall too low, other signals in the body prompt cells to release glucose to the blood. This "seesaw" glucose regulation is disrupted in people with diabetes, usually due to a lack of insulin production or a failure of cells to properly respond to insulin. It enhances the effects of insulin once insulin binds to its receptor. The most common health effect from exposure to chromium is contact dermatitis - skin inflammation or rash. A small fraction of the population, between 5 and 10 percent, has an allergic skin reaction to chromium. Much like other allergies - to foods, bee stings, cotton, and wool, this allergic response is genetically based. When genetically predisposed individuals are exposed to chromium compounds their skin can become reddened and swollen; the condition clears up once exposure stops. Cigarette smoking has been shown to synergistically increase the risk of lung cancer for people exposed to certain metals, such as arsenic, cadmium and nickel as well as other chemicals. That is, the risk of lung cancer in a smoker exposed to one of these agents is much higher than what would be predicted by simply adding the two individual risks together. But recent studies suggest that, unlike the case with these and many other lung carcinogen combinations, chromium and cigarette smoking do not act synergistically with each other. The reason for this is not clear, but this supports the

idea that chromium is a relatively weak carcinogen even at very high occupational doses [17].

The concentration of nickel in the brands was 4.01, 1.91, 2.10, 3.10, 0.98, 1.81, 2.64, 3.56, 0.99 and 2.27($mgkg^{-1}$) for A, B, C, D, E, F, G, H, I and J respectively. The results indicate higher levels of nickel when compare with the 5.5μgg^{-1}reported by Chiba [18] for Egyptian cigarettes and 2.78-4.84 μgg^{-1} for some foreign brands of cigarettes. Tobacco plants are known to strongly absorb nickel from the soil and accumulate it in the leaves. Continuous smoking of cigarette may lead to bioaccumulation of this metal beyond threshold limit; this may react with some biochemical substances in the body resulting to highly toxic compounds that may pose some health threat to the individual. Nickel had been observed to form toxic carbonyl compounds. It react with the highly abandon carbon monoxide content of tobacco thus producing nickel carbonyl compound, a substance which is known to be potentially carcinogen.

Table 1.0 concentrations ($mgkg^{-1}$) of trace metal in the ten brands of cigarette

Brands	Zn	Cu	Cd	Pb	Cr	Ni
A	16.20±3.10	21.40±1.50	1.94±0.08	3.24±0.14	1.83±0.07	4.01±0.20
B	48.40±5.50	27.60±2.40	2.12±0.15	2.13±0.16	2.14±0.14	1.91±0.15
C	28.30±7.70	18.40±1.90	0.19±0.10	0.93±0.10	2.11±0.12	2.10±0.17
D	61.80±3.60	30.80±6.40	2.24±0.12	3.11±0.12	0.94±0.10	3.10±0.19
E	32.50±2.80	24.70±4.10	1.05±0.06	2.22±0.11	3.01±0.17	0.98±0.03
F	50.10±3.30	22.50±3.10	0.82±0.11	3.91±0.13	2.81±0.13	1.81±0.12
G	44.30±5.70	19.50±4.00	1.12±0.13	0.83±0.10	3.81±0.18	2.64±0.18
H	29.50±7.60	29.30±6.10	2.13±0.09	0.16±0.12	ND	3.56±0.19
I	30.70±1.00	30.20±6.30	0.83±0.12	1.62±0.15	1.34±0.10	0.99±0.04
J	42.60±3.50	25.60±4.50	1.72±0.09	1.66±0.15	1.56±0.11	2.27±0.18

Values are Mean ±SE, ND means not detected

Conclusion

The study has revealed that most of the cigarettes found in Makurdi metropolitan city contained substantial levels of trace metals. Though the levels were lower than threshold values, constant bioaccumulation may result to adverse health effects. Before now, attention was given more to other toxic chemicals in tobacco like carbon monoxide, nicotine, tar, formaldehyde, polyaromatic hydrocarbons, nitosamine, irritants and other noxious gases without regards to the presence of trace metals content of tobacco and their possible biochemical processes in the body. 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 manufactures of cigarettes check the levels of these metals during processing before final packaging.

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