DETERMINATION OF CADMIUM AND ZINC CONTENTS IN DIFFERENT BRANDS OF CIGARETTES AND CHEWING TOBACCOS

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ABSTRACT

The key object of this study was to govern whether chewing and cigarette brands used in Pakistan, have prominent levels of heavy metal or not. Two metals Zinc (Zn) and Cadmium (Cd) were determined in twenty one brands (chewing and cigarettes) used in Pakistan by Atomic absorption spectrophotometry. The analytical results showed that the average concentration of Cadmium in Karachi, Pakistani brands of cigarettes analyzed was 0.099 ppm ranging from 0.174 ppm to 0.077 ppm. The average content of Cd in chewing brands of tobacco was observed to be 0.101 ppm, while the Extreme and lowest concentrations of Cd were found to be 0.115 ppm and 0.081 ppm respectively. The average concentration of Zinc in brads of cigarettes analyzed was found to be 0.247 ppm within the range of 0.422 to 0.140 ppm. The mean strength of Zinc in different chewing brands analyzed was found to be 0.196 ppm within the range of 0.269 to 0.114 ppm. In over all brands, both highest and lowest concentration of Cd recorded in brands of cigarette was 0.174 ppm and 0.037 ppm respectively. Maximum and minimum concentration of Zn recorded in over all brands was 0.422 ppm in chewing tobacco and 0.123 ppm in cigarettes tobacco respectively.

Key words: cigarettes and chewing tobaccos, Cadmium, Zinc, Atomic absorption spectroscopy

INTRODUCTION

The toxicity and dangerous effects of trace heavy metal on human health and on the environment has attracted considerable attention and concerns in current years. Heavy metal is characterized as environmentally toxic materials that cause of the natural environment at minute concentrations. The primary sources of heavy metals are air, water and the soil. (Chojnackaa *et al.,* 2005).

Cadmium is one of the potentially toxic metals that can easily accumulate in the human body having a half-life exceeding 10 years (Klaassen *et al.,* 2003). Minute amounts of Cadmium accumulated over several years may cause fragile bones and kidney damage, since Cd is stored in bone, liver and kidneys (Jarup *et al.,* 1998). The Cadmium inhalation can cause numerous respiratory illnesses, including acute pneumonitis and emphysema, and exposure to Cd is attached with a dominantly risk of developing lung cancer (Brzo and M-Jakoniuk, 2005). In the environment main source of cadmium exposure is, besides smoking is food (sea foods, meat, dairy products and whole grain), drinking water and atmospheric air (Jarup 1998, Armenta and Camilo 2007, Massadeh *et al*., 2005). Of these sources tobacco smoking is the most important single source of Cd exposure in the general population (Jarup *et al*., 1998). A harmful effect on the reproductive system, the developing embryo has also been noticed. The oxidative stress and disruption of the blood–testis barrier have been noted in testis (Watanabe et al., 2009).

Higher (2 to 8 mg Zinc/ kg/ day) concentration of Zn or its compounds causes various Zinc for several months may cause pancreas damage, anemia, and decrease the level of high density lipoprotein (HDL) cholesterol. While Zn deficiency causes various diseases like cancer, skin diseases, growth retardation, infection and slow wound healing (Fosmire, 1997).

MATERILS AND METHODS

Apparatus and Reagents

Flame atomic absorption spectrometer (Perkin Elmer, Model 3100), Analytical balance (Model SHIMADZU-AUW220, UNI Bloc PAT 1987), Hot plate and stirrer (Model 1000 Design and manufactured in UK by Jenway Ltd.), Oven (Model 854-schwabach Made in western Germany), Thermometer and *etc*. were used. The Nitric acid HNO_3, Perchloric acid $HClO_4$ and de-ionized water was used.

Collection of Samples

Sample was purchased of different famous brands of chewing tobacco and cigarette tobacco from the local market of Karachi, Pakistan. The total tobacco sample including chewing and cigarette were 21. Both branded chewing and cigarette tobacco samples were mostly prepared in Pakistan.

Digestion of Samples

Sample was digested using the method of wet ashing (wet ashing is the process of oxidative decomposition of organic samples by liquid oxidizing agents such as nitric acid, sulphuric acid, perchloric acid or mixture of these acid) was used (Skoog, 1992). Sample was transferred to the 100.0 mL beaker; 25 mL of 65 % HNO_3 and 15 mL of 60 % $HClO_4$ were added to the beaker (Ajab *et al*. 2008). The vigorous reactions were observed at the addition of acid; therefore beaker was placed in fuming hood for 18 hours. The sample beaker was place at hot plate. The beaker was heated at 80 ˚C until the volume of sample became 10 to 20 mL. The sample solution was diluted to 50 mL with de-ionized water. Again sample solution was heated at constant temperature of 80 ˚C until the volume of sample became 10-20 mL. If the solution of color did not disappear, then repeat it again until volume of solution became 10-20 mL as well as colorless. The sample solution was allowed to cool at room temperature. The sample solution was filtered with whattman-541 filter paper into a 50 mL volumetric flask and made up to the mark. The solution was transferred to the sample bottles and stored at room temperature until the analysis.

Standard Solution of Cd and Zn

The standard solutions of Cd and Zinc were purchased from Merck. The concentration of each the standard solutions was 1000 ppm. The Working Standard of cadmium and Zn were prepared from Standard Solutions.

Analysis of Sample

Cadmium was quantitatively determined at flame atomic absorption spectrometer by using calibration curve method. The working standards were aspirated first and then sample in triplicate.

Statistical Analysis of Data for Cadmium and Zn

The data was analyzed statistically for determination of means and the t-tests using Microsoft Excel.

RESULTS

Determination of the Concentration of Cadmium in Chewing and Cigarette Tobaccos

Table 1 shows that maximum concentration of cadmium in chewing and cigarette tobaccos is observed to be 0.115 and 0.174 µg/g, the minimum concentration is observed to be 0.0819 and 0.077µg/g, the average concentration is found to be 0.10 and 0.099 µg/g and the standard deviation is observed to be ±0.011 and ±0.0366 µg/g respectively.

Determination of the Concentration of Zinc in Chewing and Cigarettes tobaccos

Table 2 shows that maximum concentration of Zinc in chewing and cigarette tobaccos is observed to be 0.269 and 0.422 µg/g, the minimum concentration is observed to be 0.114 and 0.140 µg/g, the average concentration is found to be 0.196 and 0.274 µg/g and the standard deviation is observed to be ±0.530 and ±0.101 µg/g, respectively.

A Microsoft Excel was used for the statistical analysis of Cd between brands of cigarettes and the chewing brands. For the statistical analysis of data the student t-test was used because the population (n) is less than 30. There are nine brands of cigarettes and twelve chewing brands. The t-calculated value is 0.4433 that is less than the t-critical value (1.86) at 90 % confident level while the degree of freedom is 8. The t-calculated value is lies in acceptance region. From this result, we concluded that there is insignificant difference between the Cd concentration of cigarettes brand and chewing brands.

In case of Zn, the t-calculated value is 0.099 that is less than the t-critical value (1.796) at 90 % confident level while the degree of freedom is 11. The t-calculated value is lies in acceptance region. From this result, we concluded that there is insignificant difference between the Zn concentration of cigarettes brand and chewing brands.

DISCUSSION

Atomic absorption spectroscopy has been successfully used for the analyzing of two trace heavy metals. The concentration of cadmium and Zinc exist in trace level. Many of the scientists recommended to this technique due to good sensitivity, accuracy and reproducibility (Massadeh *et al.*, 2005, Lewis *et al.*, 1972, Watanabe *et al.*, 1987).

The smoke of cigarettes occupies mutually organic and inorganic compounds which are carcinogenic for humans. The WHO officials predicted, every tenth person died due to use of tobacco (Chojnackaa *et al*., 2005). Approximately 4000 chemical compounds have been identified; the smoke of cigarette is very hazardous and toxic for human body and its health (IARC, 1986). Toxic materials pointing to heavy metals, chiefly cadmium, lead and zinc via breath of smoking.

Table 1. Shows the Average and standard Deviation of the Concentration of Cadmium in Chewing and Cigarettes Tobacco.

Cigarettes Tobacco			
Serial #	**Sample Code**	**Average Conc.** (µg/g)	**Standard Deviation SD** (± µg/g)
1	Capstan	0.096	4.611
2	Morven Gold	0.093	7.660
3	Gold Leaf	0.102	14.685
4	Gold Flake	0.174	6.593
5	Benson and hedges	0.121	7.052
6	Melburn	0.037	7.165
7	Gold Leaf special	0.107	16.506
8	Capstan by pall mall	0.086	11.515
9	Red and white	0.077	6.848
Chewing Tobacco			
10	Najma zafrani zarda	0.083	25.014
11	Zahoor zafrani Patti	0.113	6.929
12	Najma nayab Mushki	0.109	8.598
13	Shazadi zafrani Patti	0.108	22.565
14	Noor mix patti	0.096	8.222
15	Raj supreme (600)	0.09	21.883
16	Insaf electric tobacco	0.0819	0.090
17	Shazadi patti special	0.11	6.872
18	Najma patti	0.115	3.496
19	Nawab zafrani patti	0.106	17.125
20	Ali baba zafrani patti	0.095	21.092
21	Rajajani zafrani patti	0.106	24.085

Table 2. Shows the Average and standard Deviation of the Concentration of Zinc in Chewing and Cigarettes Tobacco.

Cigarettes Tobacco			
Serial #	**Sample Code**	**Average Conc.** (µg/g)	**Standard Deviation SD** (± µg/g)
1	Capstan	0.197	0.013
2	Morven Gold	0.218	0.023
3	Gold Leaf	0.422	0.018
4	Gold Flake	0.238	0.012
5	Benson and hedges	0.164	0.010
6	Melburn	0.383	0.024
7	Gold Leaf special	0.302	0.040
8	Capstan by pall mall	0.161	0.016
9	Red and white	0.140	0.018
Chewing Tobacco			
10	Najma zafrani zarda	0.221	0.013
11	Zahoor zafrani Patti	0.182	0.013
12	Najma nayab Mushki	0.130	0.013
13	Shazadi zafrani Patti	0.202	0.013
14	Noor mix patti	0.195	0.004
15	Raj supreme (600)	0.123	0.013
16	Insaf electric tobacco	0.263	0.191
17	Shazadi patti special	0.182	0.031
18	Najma patti	0.269	0.017
19	Nawab zafrani patti	0.235	0.008
20	Ali baba zafrani patti	0.114	0.012
21	Rajajani zafrani patti	0.247	0.011

Too many heavy metals are observed in tobacco smoke such as Cr, Pb, Cd, Ni and Zn get into the tissues and fluids way of smoking. Only the smoking of tobacco is single source of Cadmium exposure in generally. Chojnackaa *et al.* (1999) reported, the smoking and foods are the most important sources of Cd. Accumulation of Cadmium into the body have several ways like tobacco smoking, inhaling, drinking water, from the air and diet. Continuous in taking of tiny quantity of Cd over several years may be possible cause of fragile bones and kidney damage and while Cadmium is especially deposited in liver, kidneys and bones. Moreover, Cd intake have possible causes diarrhea, irritation, vomiting and stomach irritation and a research institute of "The International Agency for Research on Cancer" (IARC) has depicted that Cd have vital chance of carcinogenic to humans (IARC, 1986) (Gorzata *et al.* 1998, Armenta and Camilo 2007). The cancer kill the about half of the deaths related to smoking. Other major disease associated strokes and cataracts, Bronchitis, Emphysema and heart diseases aneurysms. Use of tobacco may also damage a woman's reproductive system. Now infertility is linked with tobacco use. Some other greater risk of infant death, stillbirth, miscarriage, cause of low birth weight in infants and early delivery (premature birth). The probability of HIV diffusion in people who use to smoke tobacco is greater than those who do not (Godt *et al*., 2006).

It has been noted the smoke of cigarettes have substantial quantity of Cadmium. The mean rang of cadmium reported is 1000 to 3000 ppb. Two to four micro gram of Cd deposited into the lungs of human after the smoke of whole pack of cigarettes and rest of the smoke passes into the air. It is easy to calculate that after the smoked of 20 cigarettes, about 2–4 µg of Cadmium is taken by smoker and appropriate amount transfer into the environments. Few countries reported mean content of cadmium in filter cigarettes tobaccos, Finland have 1.7 µg/g, Jordon cigarettes have 2.64 µg/g, 0.90 µg/g for United Kingdom and 1.02 µg/g in Korean cigarettes.

In Rawalpindi, Pakistan a research was performed that determined the concentration of heavy metal in cigarettes tobacco of local and imported brands. The different concentrations range of the heavy metal was observed in cigarettes tobacco. They reported the concentration range of Cd that was found to be 0.260 to 0618 µg/g and the concentration range of Zn was found to be 10.16-7.33 µg/g (Ajab *et al.* 2008).

The mean Strength of Cadmium in Pakistan, Karachi cigarettes analyzed is 0.099 ppm and Maximum and minimum are 0.174 ppm to 0.077 ppm respectively. It does not match with the Watanabe *et al.* (1987) Chojnackaa *et al.* (2005) sampled the cigarettes from different countries and reported a range from 0.29 to 3.38 ppm. it is comparable with 0.9 ppm observed in United kingdom, 2.64 ppm the Jordan cigarettes and 1.02 ppm the Korean cigarettes. The average Cd content in Karachi, Pakistan are 10.3 and 26.6 and 3.2 times lower than that of Korean, Jordan and United kingdom respectively.

On the whole chewing brands reflected greater concentration of Cd in relative to the equivalents from the cigarettes brands, while cigarettes tobacco brands reflected greater concentration of Zn in relative to the equivalents from the chewing brands.

CONCLUSION

Two metals Zinc (Zn) and Cadmium (Cd) were determined in twenty one brands (chewing and cigarettes) used in Pakistan by Atomic absorption spectrophotometry afterward a digestion technique known as wet digestion with nitric acid and perchloric acids. The analytical results showed that the mean concentration of Cd in Karachi, Pakistani brands of cigarettes tested was 0.099 µg/g ranging from 0.174 µg/g to 0.077 µg/g. The average content of Cd in chewing brands of tobacco was observed to be 0.1012 µg/g, while the Maximum and minimum concentrations of Cd were found to be 0.115 µg/g and 0.0819 µg/g respectively. The mean concentration of Zinc in brands of cigarettes analyzed was found to be 0.247 µg/g within the range of 0.422 to 0.140 µg/g. The mean concentration of Zinc in different chewing brands analyzed was found to be 0.196 µg/g within the range of 0.269 to 0.114 µg/g. In over all brands, both highest and lowest concentration of Cd recorded in brands of cigarette was 0.174 µg/g and 0.037 µg/g respectively. Maximum and minimum concentration of Zn recorded in over all brands was 0.422 µg/g in chewing tobacco and 0.123 µg/g in cigarettes tobacco respectively.

Hence it is clear that toxic metal are mainly sourced by the smoking and their quantitatively allocation is above the tolerable limits as depicted by the WHO. (Chojnackaa *et al.* 2005)So, elevating in biological levels of at carcinogenic metals represent risk on health with active smoker as well as passive smoker and also for those who takes chewing tobacco.

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