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TOXIC METALS IN DIFFERENT BRANDS OF SHISHA FLAVOUR TOBACCO AND RELATED HEALTH ISSUES

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ABSTRACT

The physiological processes in human body require some essential metals within permissible limits set by standard organizations/bodies. However, above the recommended limits, they can be detrimental to health.Mean concentration of lead, copper, iron, zinc, manganese, cadmium, nickel and arsenic in different brands of Shisha flavour tobacco were compared with five different brands of cigaretteafterdetermination using atomic absorbance spectrophotometry (AAS). The results showed that iron has higher concentration of the heavy metals at 60.1, 81.4, 43.0, 88.2, 59.2, 33.9, 43.6, 68.7, 40.7 and 55.5 kg/mg. The pearson's correlation, regression, R = 0.99, R^2 = 0.985, P-value, 8.9×10^{-7}, 0.00<0.05and p-value, 4.12×10^{-7}, 0.00<0.05, R=0.99, R^2= 0.99 using Ms-excel and SPSS (2.3) shows that there is strong relationship between the heavy metals of the Shisha flavor tobacco and cigarette. Also strong relationship existed between the mean concentration and the weight of the Shisha flavour. The results indicated that smoking and exposure to Shisha smoke is a serious problem to human health.

Keywords: Cigarette, heavy metal, Shisha flavor, tobacco.

INTRODUCTION

Heavy metals occur naturally but due to anthropogenic activities their exposure in to soil, air and soil may increase. Some plants have the ability of absorbing the environmentally exposed heavy metals which arein turn transferred to the consumer of the plant [1]. Tobacco plant is one of the plants that can absorb the stored heavy metal in the soil which can be transferred to its leaveswhich are used for the preparation of tobacco [2].

Tobacco is a product prepared from the leaves of the tobacco plant by curing. The plant is part of the genus *Nicotiana* and of the *Solanaceae* (nightshade) found in North, South America,

Australia, South west Africa and the South Pacific [3]. Tobacco contains stimulants known as the alkaloid nicotine, and harmala alkaloids [4]. Dried tobacco leaves are mainly used for smoking in cigarettes, cigars, pipe tobacco and flavoured shisha tobacco. They can also be consumed as snuff, chewing tobacco, dipping tobacco and snus[5].

Mu'assel (Arabic: meaning "honeyed") is a syrupy tobacco mix containing molasses and vegetable glycerol which is smoked in a hookah. It is also known as "**shisha"** in the United States [6]. Typical flavours of Mu'assel include apple, watermelon, guava, lemon, mint, as well as many other fruit based mixes [7].

Hooker is a single or multistemmed often glass or plastic based water pipe for smoking. It was used in India and Persia; and hasnow gained popularity especially among youths in many countries of the world [8]. Rates of smoking continue to rise in the developing countries, but have leveled off or declined in developed countries [9].

Tobacco smoking poses a risk to health due to the inhalation of poisonous chemicals such as carbon monoxide, cyanide, and carcinogens which have been proven to cause heart, lung diseases and cancer. According to the World Health Organization (WHO), tobacco is the single greatest cause of death globally [9]

Tobacco smoking harms nearly every organs of the body, causes many diseases and reduces the health of smokers in general [8].

The purpose of this research is to determine some toxic metals (heavy metals) in shisha flavour tobacco of different brands and related health issues

MATERIAL AND METHOD

Instruments

An atomic absorption spectrometer (*Ultaviolet – 2500S*, Shimazu), was used for the determination of heavy metals (Pb, Cu, Fe, Zn, Cd, Mn, Ni and As).

Preparation of Shisha flavour samples

Ten different brands of commonly sold shisha flavor in Nigeria were randomly purchased which are mostly imported. For the purpose of analysis of trace elements in the shisha flavors, all the components were separated. The weight of each was confirmed to be 50 grams. The samples were dried in an oven at 106 ^{O}C for 3 hours, grounded and then sieved for further analysis

Description of the Shisha flavour sample

Ten different brands (with quantity in brackets) of Shisha flavour: Blueberry with mint (70), Grape with mint (38), Grape (7), Mojito (80), Strawberry (50), Double Apple (25), Kiwi (31), Cherry (23), Mango (34) and Peach (44) manufactured by United Arab Emirate, obtained in Zaria local government, Kaduna State, Nigeria.

Conventional acid digestion method

For the determination of metals, the digestion procedure of Campbell and Plank [10] was used. 0.5 g of the prepared sample was placed in 100 ml flat bottom flask, 5.0 ml of concentrated HNO_3 acid was added which was covered with watch glass and allowed 24 hours (overnight). The covered flask was heated at 200 ^{O}C for 30 minute, removed and allowed to cool and 2 ml of 30 % H_2O_2 was added and digested which was allowed to dry at 150 ^{O}C then 5.0 ml of 1 % HNO3 was added to digest residue and filtered through Whatman filter paper in to 25 ml volumetric flask made up to the volume with deionized water.

Statistical Analysis

The difference between the heavy metal of the different brand of Shisha flavor tobacco, cigarettesamples were carried out using Student's t-test, relationship between the mean concentration of the heavy metal of Shisha flavor tobacco and cigarette was carried out using regression and correlation analysis while the mean comparison between the concentration of the heavy metals of Shisha flavor and cigarette was carried out using Analysis of variance. The statistical evaluation was carried out using Microsoft Excel (2010) and Statistical Package for Social Science (SPSS, version 23). All analysis were determined at significant level $P>0.05$

Atomic Absorption Spectrophotometry analysis

The digested Shisha flavor tobacco sample was analyzed using Atomic absorbance spectroscopy, AAS 220 model. Any liquid trapped below was blown out by turning on the fixed acetylene gas and compressor. The extractor and the AAS 220 model were turned on. Cleansing wire and alignment card were used in cleaning the capillary tube, nebulizer block and opening of the burner respectively. Hollow cathode lamp was inserted in the lamp holder by opening the worksheet of the AAS software on the attached computer. The lamp was turned on; ray from the cathode aligned to hit target area of the alignment card for optimal light throughout, then the machine was ignited. Aspiration rate was measured by placing the capillary in a 10 ml graduated

cylinder containing deionized water and set to 6 ml per minute. The blank analyte was prepared and series of calibration solutions of standard were made. A calibration graph was plotted for each solution, after which the sample solutions were atomized and measured. The various metal concentrations from the sample solution were determined from the calibration, based on the absorbance obtained for the unknown [11].

RESULTS AND DICUSSION

Table 1: Permissible Intake Level of Tobacco

Metals	Intake per week (mg/kg/week)	Intake per day (mg/kg/week)	Organization/Body
Pb	25	5	FOA/WHO
As	15	3	FOA/WHO
Cu	500	100	WHO
Cd	3.5	0.2 – 1	FOA/WHO (29)

Table 2: Trace Metal Contents (mg/kg, dry weight) of Different Brand of cigarettes

Brand	Pb	Cu	Fe	Zn	Mn	Cd	Ni	As
Aspen	11.31±0.98	15.70±1.26	50.31±0.47	40.40±3.02	8.900±0.51	2.36±0.10	12.3±o.o7	1.00±0.05
Rothmans	7.12±0.53	13.47±0.22	71.30±0.50	26.85±2.71	12.60±0.31	2.44±0.02	8.70±0.60	0.89±0.04
Donhill	5.99±0.89	6.41±0.050	58.30±0.60	31.76±0.56	10.30±0.42	7.00±0.05	9.53±0.80	0.99±0.03
Benson	12.53±0.69	10.30±2.01	43.86±0.22	25.60±1.73	15.60±0.54	3.0±0.19	10.0±0.42	1.3±0.05
Marlboro Red	6.00±1.00	21.32±0.56	69.7±0.89	23.40±2.45	11.20±0.44	2.30±0.05	8.20±0.36	1.23±0.056

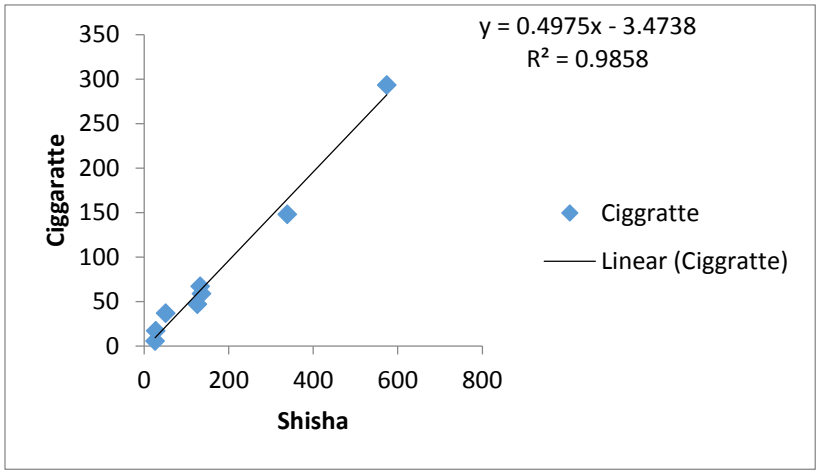
Data are mean value ± S.D of three replicas

Table 3: Trace Metal Contents (mg/kg, dry weight) of Different Brand of Shisha Flavor Tobacco

S/N	Sample code	Pb	Cu	Fe	Zn	Mn	Cd	Ni	As
1	SFB1	5.23±0.40	19.00±1.02	60.1±1.00	30.50±0.61	6.00±0.4	2.41±0.10	13.4±0.27	3.01±0.5
2	SFB2	5.31±0.62	11.01±1.60	81.4±0.82	27.5±2.70	30.1±0.34	7.50±0.06	20.8±0.38	1.00±0.05
3	SFB3	4.2±0.50	11.8±1.34	43.0±0.90	38.6±0.60	12.1±0.52	2.42±0.02	6.01±0.1	2.07±

								3	0.07
4	SFB4	4.2±0.60	15.21±0.81	88.2±1.10	30.15±0.55	11.1±0.41	2.01±0.21	20.3±0.3	2.06±
								1	0.03
5	SFB5	5.5±0.23	12.3±0.80	59.2±0.32	25.60±1.20	30.2±0.34	2.30±0.03	9.9±0.50	1.00±
									0.05
6	SFB6	6.0±0.71	12.23±0.81	33.9±0.82	20.40±1.23	8.0±0.47	1.65±0.05	8.4±0.50	1.00±
									0.06
7	SFB7	1.47±0.37	14.52±0.72	43.6±0.21	31.90±1.70	7.9±0.53	1.50±0.05	10.70±0.	0.9±0.
								33	03
8	SFB8	8.0±0.50	10.02±0.27	68.7±0.89	54.4±2.00	12.3±0.39	2.77±0.28	12.02±0.	1.4±0.
								45	05
9	SFB9	7.2±0.50	16.23±1.20	40.7±0.38	37.8±0.91	12.7±0.13	2.38±0.13	3.9±0.50	1.00±
									0.04
10	SFB10	3.8±0.69	10.35±2.47	55.5±0.50	31.35±2.90	4.9±0.38	2.26±0.05	10.5±0.4	2.03±

SFB= Shisha Flavour Brand. Data are mean value ± SD of three replicas



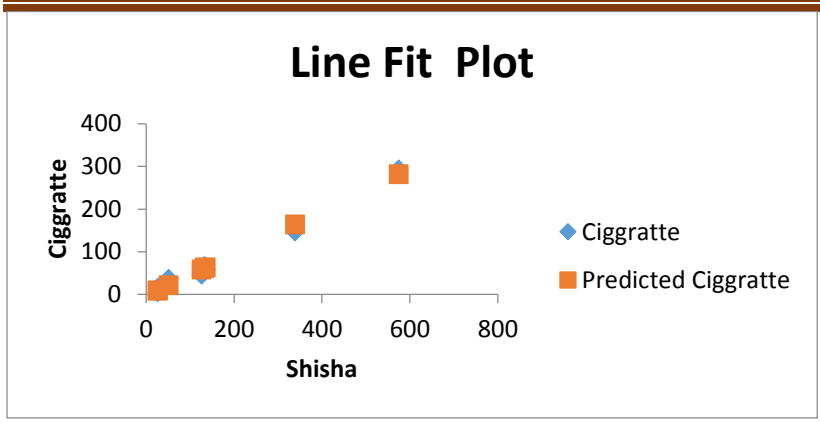
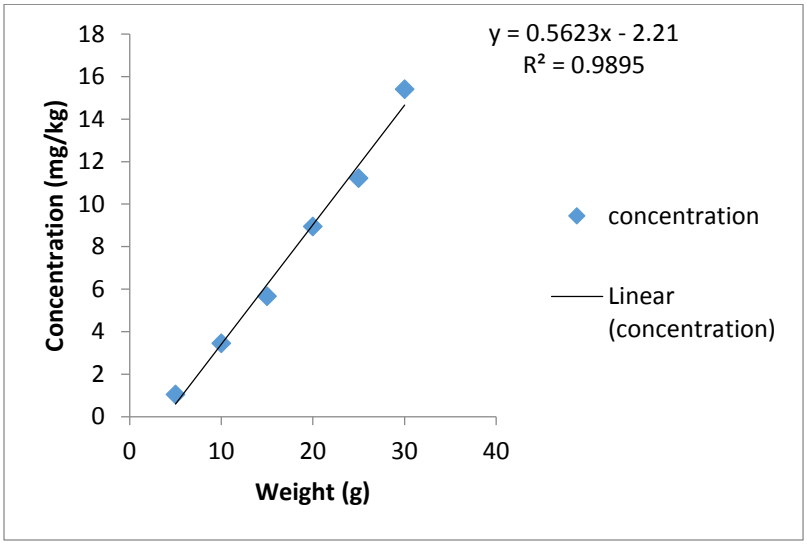


Figure 1a and b: Relationship between the Heavy Metal of Shisha Flavor Tobacco and Cigarette using (a) Microsoft excel (b) Statistical Package for Social Science



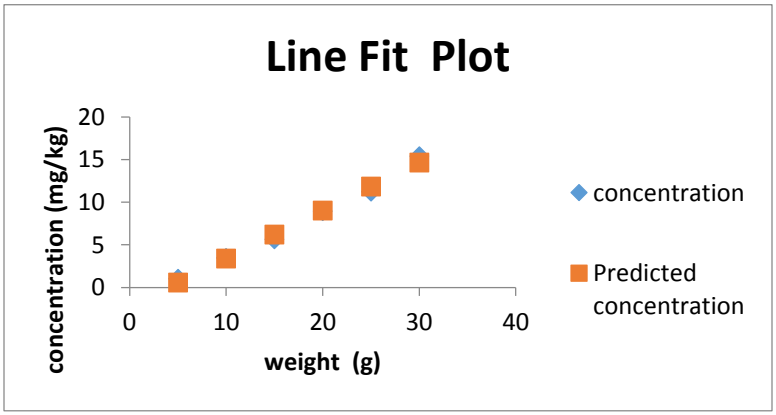


Figure 1c and d: Relationship between the Mean Concentration of Heavy Metals and Shisha Flavor Tobacco

This study showed the levels of Pb, Cu, Fe, Zn, Mn, Ni and As content of ten different brands Shisha flavours obtained in Zaria Local Government Area of Kaduna state, Nigeria, (Table 3) which was compared with five different brands of cigarette consumed in same area (Table 2), the results showed that Fe and Zn are slightly higher in both the Shisha flavour tobacco sample and the cigarette.

In the work of [12], it was reported that the concentration of heavy metals in different brands of cigarette werein the order of Zn>Ni>Cu>Co>Cd>Pb. The mean lead concentration found in the cigarette samples were lower than Indian cigarette [13, 14], UK cigarette [15] and Ethiopian cigarette [16].

Lead: The mean value of the Pb content of Shisha flavour tobacco has a minimum content of 1.47 mg/kg and maximum value of 8 mg/kg as noted in Table 3. It was found that the samples: SFB1, SFB2, SFB5, SFB6 SFB8 and SFB9 has a lead content above the recommended daily intake by WHO/FOA for daily and weekly tolerable intake of 5 mg/kg and 25 mg/kg respectively.This implies that taking (smoking) Shisha flavour tobacco of more than 5 mg/kg per day and accumulation of more than 25 mg/kg per week can lead to: epidemiological diseases, attention-deficit hyperactive disorder, while exposure to pregnant woman can lead to fetal miscarriage, stillbirth, premature birth, e.t.c [17, 18].

Copper: The mean value of copper content found in the different brand of Shisha flavour tobacco has maximum value of 19.0 mg/kg and minimum value of 10.02 mg/kg (Table 3). All the samples copper content were found to be with the daily and weekly intake recommendation by the WHO/FOA (1).

Iron: Iron has the highest mean concentration (mg/kg) in all the different brands of the Shisha flavour tobacco samples (Table 3), which was also observed in Table 2

During the 17^{th} century, iron was used on its medicinal purpose for treating chlorosis (green disease) which a condition often resulting from lack of iron in human body system [19]. Iron is also needed for hemoglobin synthesis [20]. Low iron intake account for anaemia in most developing countries [21] where infectious and inflammatory diseases (especially malaria), blood loss from parasitic infections, and other nutrient deficiencies are also important causes of the anaemia [22].

Zinc: The mean value of zinc content where found to be the second highest value apart from iron in all the different brand of Shisha flavour tobacco with maximum of 54.4 mg/kg and minimum of 20.4 mg/kg shown in Table 3.

Cadmium: The mean value Cd content of Shisha flavour tobacco has a minimum content of 1.50 mg/kg and maximum value of 7.5 mg/kg as noted in Table 3it was found that the samples all the samples has a cadmium content above the recommended daily tolerable intake with sample SFB2 above the weekly tolerable intake as provided in Table 1. According to [23] and WHO [24] lead and cadmium are highly toxic metals which can cause serious effect on the brain, kidneys, nervous system etc. [25] and red blood cells. In these organs cadmium is bound to a small protein called metallothionin [26]. Acceptable concentrations of Pb and Cd in human blood are below 100 and 10 µg/l, respectively, depending on the subject's age and gender [27].

Arsenic: The mean concentrations of the arsenic were found to be within the recommended daily and weekly intake by WHO/FOA with the exception of sample SFB1 with maximum value of 3.0 mg/kg.

Mean comparison of the heavy metal found in Shisha flavor tobacco showed p-value, $2.66\times10^{-26}< 0.05$, this implies that there is significant different between the various heavy metals found in the different brand of the Shisha flavor tobacco. Different brands of cigarette sample have p-value, $6.66\times10^{-26}> 0.05$, which also signified that, there is significant different between the heavy metal found in the different brand of the cigarette.

The mean comparison between the various heavy metals of Shisha flavour tobacco and Cigarette were obtained as: p-values Pb (0.06), Cu (0.93), Fe (0.89), Zn (0.373), Mn (0.684), Cd (0.490), Ni (0.403) and As (0.079) > 0.05. These implied that, there is no significant different between the heavy metals found in the cigarette and the Shisha flavour tobacco samples. The relationship between the mean value of cigarette and shisha flavour using Microsoft excel (Figure 9a and b), p-value, $8.9\times10^{-07} < 0.05$, $R = 0.99$, $R^2 = 0.985$ conformed with statistical package for social science p-value, $0.00 < 0.05$, $R = 0.99$, $R^2 = 0.983$. This implies that there is strong relationship between the heavy metal of the cigarette and the Shisha flavour. The implication is that taking Shisha flavour tobacco has no difference with taking pure cigarette.

Relationship between the weights and heavy metal of shisha flavor tobacco using Microsoft excel (Figure 1c and d), p-value $4.12\times10^{-07} <0.05$ means thatthere is significant relationship between the weight (g) of the Shisha flavour tobacco and the concentration of heavy metal which

conformed with statistical package for social science, R=0.99, R^2 = 0.989, p-value >0.05. Since there is strong relationship between the heavy metal concentrations of Shisha flavour tobacco and cigarette, strong relationship between the weight of the Shisha flavor tobacco and the cigarette, this implies that smoking one packet of Shisha flavor tobacco is equivalent to smoking 25 pieces of cigarette.

CONCLUSION

The research showed that there is a relationship between the mean concentrations of the heavy metals of cigarette and Shisha flavor tobacco which implies that smoking Shisha flavor has no difference health wise with smoking cigarette. The relationship between the weight of the sample and the mean concentration of the heavy metal indicated that smoking one pack of Shisha flavour has no difference with smoking twenty five sticks of cigarette.

REFERENCES

1. Memon, A.R.; Aktoprakligül, D.; Demur, A.; Vertii, A.; Bütak, T. Heavy Metal Accumulation and Detoxification Mechanisms in Plants, *Turkish Journal Botany*. 2001, 25, 111-121
2. Myers, J.A.1990. "The Hazards of Smoking". *The Pharmaceutical Journal*. 12:14-16
3. Lewis, A. (1931). Tobbaco in New Guinea. *The American Anthropologist*, 33(1): 134 – 139.
4. Rudgley, R. Little, B. and Company, N. (1998). Tobbaco from the Encyclopedia of psychoactive substance. Retrieved 26 November, 2017.
5. Baverly, S. (2007). Stinging and biting pest of people. Achieved 2007 at the wayback Machine Extension Entomologist of the University of Georgia College of Agricultural and Environmental Sciences Cooperative Extension Service
6. Morris, D. S. (2012). Opportunities for Policy Interventions to Reduce Youth Hookah Smoking in the United State. Preventing the Chronic Disease. 9: E165.
7. Al Fakher (2017). Our range. Tobacco Trading Ajman, United Arab Emirate. Retrieved 27 June, 2018. *Turkish Journal Botany*, 29(4): 143 -156
8. American Lung Association (ALA) (2013). The Emerging Deadly Trend: Water pipe Tobacco Use. Page 800

9. World Health Organization (WHO) (2008). WHO Report on the Global Tobacco Epidermic. The Mpower Package, Geneva: World Health Organization. Page 14
10. Campbell, C.R. Plank, C.O. (1998). Preparation of plant tissue for laboratory analysis. In Kalra, Y.P. (ed.) *Handbook of reference method for plant analysis.* CRC Press, Boca Raton, FL.PP:33
11. Association of Official Analytical Chemists (AOAC) (2006*). Official Methods of Analysis.Gaithersburgs, MD. Page 35.*
12. Alireza Pourkhabbaz & Hamidreza Pourkhabbaz (2012). Investigation of toxic metals in the tobacco of different Iranian cigarette brands and related health issues. *Iran Journal of Basic Medical Science*. 15(1): 636 – 644
13. Nnorom, I. C. Osibanjo, O. & Oji-Nnorom, C.G. (2005). Cadmium determination in cigarettes available in Nigeria. *African Journal of Biology* .4:1128–1132
14. Galas, W. & Kita, A. (1997). Determination of ten elements in the spice samples using an inductively coupled plasma-atomic emission spectroscopy. *Chemical Analysis (Warsaw)*. 42:403–409
15. Stephens, W.E. Calder, A. & Newton, J. (2005). Source and health implications of high toxic metal concentrations in illicit Tobacco products. *Environmental Science Technology*. 39:479–488
16. Engida , A.M. (2007. Levels of trace metals in cigarettes commonly sold in Ethiopia. Ethiopia: Addis Ababa university, page 134
17. IARC (2006).Summaries & evaluations: Inorganic and organic lead compounds Lyon, International Agency for Research on Cancer(IARC Monographs for the Evaluation of Carcinogenic Risks to Humans, Vol. 87;117
18. IPCS (1995). Inorganic lead. Geneva, World Health Organization, International Programme on Chemical. PP.123
19. Guggenheim, K. Y. (1995). Chlorosis: the rise and disappearance of a nutritional disease. *Journal of Nutrition*. 125: 1822 -5
20. Yip, R. & Danllman, P. R. (1996). Iron. In: Ziegler EE, Filer LJ, editors. Present knowledge in nutrition. 7th edition. Washington DC: ILSI press. Pp. 278- 92
21. Underwood, E. J and Suttle, N.F (1999). 3RD edition Wallingford: CABI International Publishing. The mineral nutrition of Livestock. pp. 614.

22. Brabin, B. J (2001). Analysis of anaemia and pregnancy related mortality. *Journal of Nutrition.* 28: 643 -648
23. Harrison, R. H. & Laxen, D. P. H. (1984). Human exposure to lead and its effect in lead pollution causes and control. New York: Chapman and Hall; pp. 133–158.
24. World Health Organization (1977). Environmental Health Criteria: 3, Lead. Geneva: Page: series no 19.
25. Kazi, T.G Jalbani, N. Arain, M. B. Jamali, M.K. Afridi, H.I. Sarfraz, R.A. & Shah, A.Q. (2009). Toxic metals distribution in different components of Pakistani and imported cigarettes by electrothermal atomic absorption spectrometer. J Hazardous Materials.16:302–307.
26. Kazi, T.G Jalbani, N. Arain, M. B. Jamali, M.K. Afridi, H.I. Sarfraz, R.A. & Shah, A.Q. (2009). Toxic metals distribution in different components of Pakistani and imported cigarettes by electrothermal atomic absorption spectrometer. J Hazardous Materials.16:302–307.
27. Borges, D.L.G. Veiga, M.A.M.S. Frescura, V.L.A. Welz, B. & Curtis, A.J. (2003). Cloud-point extraction for the determination of Cd, Pb, and Pd in blood by electrothermal atomic absorption spectrometry, using Ir or Ru as permanent modifier. J Anal At Spectrom.18:501–507.
28. World Health Organization (WHO) (1989). Lead-environmental Aspects. Geneva: (WHO Environmental Health Criteria Series No.85).
29. FAO/WHO (2001). Report on the 32nd Session of the Codex Committee on Food Additives and Contaminants, ALINORM 01/12, Beijing, China, 20 -24 March 2000. Joint FAO/WHO food Standard Programme, Codex Alimentarius Commission, 24th Session, 2 -7 July, Geneva, Switzerland.