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Determination of Heavy Metal Contamination in Street Foods of Madurai District, Tamil Nadu

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Abstract—*Heavy metals are naturally occurring elements and prolonged consumption of unsafe concentrations of heavy metals from contaminated food stuffs can cause damage in animals, humans, and plants. The aim of this study was to determine the concentrations of heavy metals in street foods of Madurai district, Tamil Nadu, India. Therefore, 15 Samples were randomly purchased from three different areas of Madurai district and the samples were subjected to heavy metal analysis using Atomic Absorption Spectrophotometer (AAS). This study presents the data on the levels of Pb, Cd and Ni in street foods from three different regions of Madurai district. The result obtained indicated that the concentration of heavy metal analyzed were all within the permissible limit as recommended by WHO/FAO except lead (Pb). The relative concentration of the metals decreased in the order Pb > Ni > Cd. The study concludes that environmental pollution plays a vital role in elevating concentrations of certain heavy metals in street foods which in turn cause serious health hazards to the consumers.*

Keywords*: heavy metal, street foods, contamination.*

1. INTRODUCTION

Street vended foods, or its shorter equivalent street foods, are defined as those ready-to-eat foods and beverages prepared and/or sold by vendors and hawkers in the streets and other public places for immediate consumption or consumption at a later time without further processing or preparation [1,2,14]. There is increasing recognition that street food vending plays an important socio-economic role in terms of employment potential, providing special income particularly for women and provision of food at affordable costs to mainly the lower income groups in the cities [13]. Many urban dwellers obtain a significant portion of their diet from street foods which increase the street food demand in major cities. Most handlers of street foods are ignorant of basic food safety measures. Consequently, street foods are commonly exposed to various contaminants at different stages of handling [11].

Laboratory analysis of samples of certain street-vended foods have shown high levels of total coliforms and in some cases, the presence of pathogenic bacteria such as *Salmonella* spp., *Staphylococcus aureas*, *Clostridium perfringens*, and *Vibrio cholera* [2]. Street vended foods may not only be exposed to pathogenic microorganisms, but to hazardous chemicals as well. Nowadays, hundreds of pollutants are discharged into the environment, among these; heavy metals are regarded as serious pollutants [14]. Vehicular emission is a major source of pollution of most street vended foods [8].

Contamination with heavy metals is a serious threat because of their toxicity, bioaccumulation and biomagnifications in the food chain [14, 17]. As human activities increase, especially with the application of modern technologies, pollution and contamination of human food chain has become inevitable. In particular, human exposure to heavy metals has risen dramatically in the last 50 years as a result of an exponential increase in the use of heavy metals in industrial processes and products. Heavy metals have been reported to have positive and negative roles in human life [4-6, 16].

Heavy metals composition of foods is of interest because of their essential or toxic nature. For example, iron, zinc, copper, chromium, cobalt, and manganese are essential, while lead, cadmium, nickel, and mercury are toxic at certain levels [3]. Cadmium, lead and mercury are major contaminants of food supply and may be considered the most important problem to our environment while others like iron, zinc and copper are essential for biochemical reactions in the body [9]. Excessive amount of lead and cadmium in food is associated with etiology of a number of diseases especially with cardiovascular, kidney, nervous as well as bone diseases. They have also been implicated in causing carcinogenesis, mutagenesis and teratogenesis [10]. Nickel is the main known contaminant resulting from the manufacturing process of chocolate, when its hardening is done by hydrogenation of unsaturated fats using nickel as catalyst [7, 12].

Most analytical methods for metal analyses require the chemical decomposition of samples, followed by instrumental detection of the metals. Typically, heavy metals may be extracted from products with different oxidizing acids using a variety of techniques. Some of these acids include nitric acid, hydrochloric acid and perchloric acid, with wet digestion and dry ashing [15]. The instrumental detection of heavy metal can be done by using different technology, which includes Atomic absorption spectroscopy (AAS), inductively coupled plasma optical emission spectrometry (ICP-OES), inductively coupled

plasma mass spectrometry (ICP-MS), X-ray fluorescence spectrometry and Ion chromatography.

The present study aimed to determine the levels of selected heavy metals in street foods of Madurai district. In this study, heavy metal assessment was done by using wet digestion method followed by instrumental detection using atomic absorption spectrophotometer. This study therefore, presents data on the levels of Pb, Cd and Ni in street foods from three different regions of Madurai district.

2. MATERIALS AND METHODS

2.1. Collection of samples

A total of 15 samples were bought from three different areas of Madurai district. The randomly purchased samples were stored in sterile polyethylene bags; adequately labeled and transported to the testing laboratory for analysis within two hours from the time of purchase. Standard operating procedures were followed for processing of food samples.

Table 1: List of street foods included in the study

Samples	Street foods
A	Sweet corn
B	Panipoori
C	Paniyaram
D	Pasta
E	Boli
F	Roasted peanut
G	Thatu vadai
H	Samosa
I	Appam
J	Milk bun
K	Pav baji
L	Valakai baji
M	Roasted Bengal gram
N	Soan papdi
O	Pulse vada

2.2. Analytical Procedure

2.2.1. Powdered sample. The collected food samples were finely powdered by using pestle and mortar .The powdered samples of about 0.1 gram from each sample was taken in a 250 ml conical flask.

2.2.2. Wet digestion. New wet digestion mixture was developed to digest the samples. The triple acid mixture viz., Nitric acid (HNO_3), conc. sulphuric acid (H_2SO_4) and Perchloric acid ($HClO_4$) were mixed in the ratio of 9:2:1.

2.2.3. Overnight digestion. The samples with triple acid mixture were covered with a funnel and undergo an overnight digestion for about 16 hours. After the digestion was completed, the conical flask containing the sample turns to brown colour.

2.2.4. Hot plating. The digested sample is placed in hot plate till the colour changes from brown to colourless and evaporated to near dryness.

2.2.5. Filtration. After cooling, the samples were filtered by using whatman no 42 filter paper to remove any residues or turbidity present in the sample and it was made up to the volume of 100ml in a volumetric flask. If the samples having any dust particles were found, it was refiltered.

2.2.6. Determination of Heavy metals in AAS. The clear sample was then taken for the determination of heavy metals Lead (Pb), Cadmium (Cd), and Nickel (Ni) using Atomic Absorption Spectrophotometer [20].

3. RESULT AND DISCUSSION

Results of selected heavy metal concentrations in street foods of Madurai district were shown in Table 2. The results are means of three replicates and the values are given as mean ± SD and. On comparison with WHO/FAO safe limits; levels of cadmium and nickel were found to be the lowest for while the level of lead was found to be the highest in the selected samples.

The analysis showed that the levels of lead in all the samples varied between 0.6568±0.007687 mg/kg and 1.187984±0.013903 mg/kg with the lowest in sample C and the highest in sample I which was found to be higher than safe limits set by WHO/FAO. And this concentration in the area may be due to high vehicular emissions. Pb being a serious cumulative body poison enters into the body system through air, water and food and cannot be removed by washing fruits and vegetables. The high levels of Pb in some of these plants may probably be attributed to pollutants in irrigation water, farm soil or due to pollution from the highways traffic [9]. The provisional tolerable weekly intake (PTWI) of lead is set to 25 µg/kg of Body weight for infants and young children, extended to all age groups as per WHO/FAO which is equivalent to 214 µg/ day for an individual of 60 kg.

Ni levels in the tested samples varied between 0.126203±0.001477 mg/kg & 0.231013±0.002704 mg/kg with the lowest observed in sample C and highest observed in sample L which was found to be within the permissible limit. Nickel also plays some role in body functions including enzyme functions. It occurs naturally more in plants than in animal flesh. It activates some enzyme systems in trace amount but its toxicity at higher levels is more prominent [9]. Nickel is considered to be a normal constituent of diet and its compounds are generally recognized as safe when used as a direct ingredient in human food [12].

Cd observed in all the samples varied between 0.010549±0.000123 mg/kg and 0.03917±0.000458 mg/kg with the lowest observed in sample C and the highest observed in sample A which was found to be very low than the permissible limit. Cadmium is a non-essential element in foods and natural waters and it accumulates principally in the kidneys and liver.

Various sources of environmental contamination have been implicated for its presence in foods [9]. WHO/FAO decided to express the tolerable intake as a monthly value in the form of a provisional tolerable monthly intake (PTMI) and established a PTMI of 25μg/kg of Body weight.

Table 2: Heavy metal average concentration in different street foods (mg/kg)

Food samples	Lead	Cadmium	Nickel
Sample A	1.002294±0.01173	0.03917±0.000458	0.157655± 0.001845
Sample B	0.801269±0.009377	0.033993±0.000398	0.161563± 0.001891
Sample C	0.6568±0.007687	0.010549±0.000123	0.126203± 0.001477
Sample D	1.831695±0.021436	0.018657±0.000218	0.144664± 0.001693
Sample E	0.744126±0.008709	0.027057±0.000317	0.166154± 0.001945
Sample F	0.661391±0.007741	0.037607±0.00044	0.191355± 0.00224
Sample G	0.921709±0.010787	0.033407±0.000391	0.192039± 0.002248
Sample H	0.665103±0.007784	0.025299±0.000296	0.175726± 0.002057
Sample I	1.187984±0.013903	0.019048±0.000223	0.179927± 0.002106
Sample J	0.800781±0.009372	0.031453±0.000368	0.212454± 0.002486
Sample K	1.138753±0.013327	0.0379±0.000444	0.210696± 0.002466
Sample L	0.750378±0.008781	0.036239±0.000424	0.231013± 0.002704
Sample M	0.980903±0.011479	0.037607±0.00044	0.219096± 0.002564
Sample N	0.811916±0.009502	0.033895±0.000397	0.224469± 0.002627
Sample O	0.721367±0.008442	0.020317±0.000238	0.226324± 0.002649

4. CONCLUSION

This study therefore presents the data on the concentrations of selected heavy metals in street foods of Madurai district. Heavy Metal Concentration is observed in all the samples. The lead concentration in the selected food samples was found to higher than the permissible limits.

The heavy metals such as Cadmium and Nickel Concentration in the samples were found to be lower than the permissible limits, therefore, pose no threat to public health. It was inferred that the prolonged intake of lead through these street foods could cause adverse effects on health. This shows that street vended foods were highly contaminated. The daily intake of these foods must be reduced to keep the PTWI for lead, cadmium and nickel within the prescribed limits. Raw materials having lower content of these elements should be used to decrease the concentrations of these metals in preparation of foods.

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REFERENCES

[1] World Health Organization (WHO), Essential safety requirements for street vended food (Revised edition), 1996.

[2] World Health Organization (WHO), "Safety of street-vended food: Basic steps to improve safety of street-vended food", International Food Safety Authorities Network (INFOSAN), 2010.

[3] Onianwa, P. C., Adetola, I. G., Iwegbue, C. M. A., Ojo, M. F., and Tella, O. O., "Trace heavy metals composition of some Nigerian beverages and food drinks", *Food Chemistry*, 1999, 66: 275–279.

[4] Divrikli, U., Saracoglu, S., Soylak, M., and Elci, L., "Determination of trace heavy metals contents of green vegetables samples from Kayseri-Turkey by flame atomic absorption spectrometry", *Fresenius Environmental Bulletin*, 2003, 12: 1123–1125.

[5] Dundar, S. M., and Saglam, B. H., "Determination of cadmium and vanadium in tea varieties and their infusions in comparison with 2 infusion processes", *Trace Element Elect*., 2004, 21: 60–63.

[6]Colak, H., Soylak, M., and Turkoglu, O., "Determination of trace metal content of herbal and fruit teas of Populus nigra L. from Western Anatolia, Turkey", *Journal of Environmental Biology*, 2005, 26: 665–668.

[7] Dahiya, S., Karpe, R., Hegde, A. G., and Sharma, R. M., "Lead, cadmium and nickel in chocolates and candies from suburban areas of Mumbai, India", *J. Food Comp. Anal*., 2005, 18: 517-522.

[8] Opeolu, BO., Adebayo, PA., Okunneye, PA., and Badru, FA., "Physicochemical and microbial assessment of road side food and water samples in Lagos and environs", *Journal of Applied Science and Environmental Management*, 2010, 14: 29-34.

[9] Sobukola, O. P., Adeniran, O. M., Odedairo, A. A., and Kajihausa, O. E., "Heavy metal levels of some fruits and leafy vegetablesfrom selected markets in Lagos, Nigeria", *African Journal of Food Science*, 2010, 4: 389 – 393.

[10] Doherty, V. F., Sogbanmu, T. O., Kanife, U. C. and Wright, O., "Heavy metals in vegetables collected from selected farm and market sites in Lagos, Nigeria", *Global Advanced Research Journal of Environmental Science and Toxicology*, 2012, 1: 137-142.

[11] Oyelola, O. T., Afolabi, M. I., Ajiboshin, I. O., and Banjoko, I. O., "Heavy Metal and Microbial Contents of Roadside Roasted Corn and Plantain in Alimosho Local Government Area of Lagos State, Nigeria", *International Journal of Research in Medical and Health Sciences*, 2013, 3: 28-32.

[12] Prakash, P., Rajan, G., Elavarasi, V., Poornima Priyadharsani, T K., and Thamaraiselvi, K., "Assessment of Heavy Metal Contamination (Nickel and Arsenic) using GF-AAS in Local Brand Chocolates and Candies from Tiruchirappalli, India", *International Journal of Computer Applications, 2014, pp. 25-28.*

[13] Tavonga Njaya, "operations of street food vendors and their impact on sustainable urban life in high density suburbs of harare, in zimbabwe", *Asian Journal of Economic Modelling*, 2014, 2: 18-31.

[14] Abdulmajid, N., Bautista, M. K., Bautista, S., Chavez, E., Dimaano, W., and Barcelon, E., "Heavy metals assessment and sensory evaluation of street vended foods", *International Food Research Journal*, 2014, 21: 2127-2131.

[15] Ramtahal,G., Yen, I.C., Bekele, I., Bekele, F., Wilson, L., Sukha, B., and Maharaj, K., "Cost-effective Method of Analysis for the Determination of Cadmium, Copper, Nickel and Zinc in Cocoa Beans and Chocolates", *Journal of Food Research,* 2015, 4: 193-199.

[16] John Siame, Kabanda Masenga, and James Mulwanda, "Study of Heavy Metal Contaminations in Green Leafy Vegetables and Fruits of Kitwe District, Zambia", *International Journal of Environmental Protection and Policy*, 2016, 4: 120-125.

[17] Mohamed A. Helaly, Azza A. Said, Maha M. El-Kholy, and Khalid H. Zaghloul, "Physiological and Biochemical Studies on Albino Rats Administered Contaminated Water and Fish Supplemented With Fennel", *Journal of Environmental Science, Toxicology and Food Technology*, 2016, 10: 67-74.

[18] World Health Organization [WHO], Evaluation of Certain Food Additives and Contaminants. In: Forty-First Report of the Joint FAO/WHO Expert Committee on Food Additives, WHO, Geneva, Switzerland. (WHO Technical Series, 1993, 837.

[19] World Health Organization [WHO], Evaluation of certain food additives and Contaminants. In: Sixty-First Report of the Joint FAO/WHO Expert Committee on Food Additives. WHO, Geneva, Switzerland. (WHO Technical Series, 2004, 922.

[20] Association of Official Analytical Chemist (AOAC). Official Methods of Analysis of AOAC International. 17th edn. Maryland, USA: AOAC International, 2000.