DETERMINATION OF SELECTED HEAVY METALS IN STREET FOOD AROUND JENGKA AREA

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Abstract

High consumption of street food may cause harmful health effects due to contamination of heavy metal. Two items of street food, namely: i) fried banana and, ii) *Keropok Lekor* were collected from stalls nearby Bandar Pusat Jengka area to determine and compare selected metals (Al, Cd, Cu and Pb) concentrations to the permissible limit set by Food and Agriculture Organization (FAO) and World Health Organization (WHO). Both fried banana and *Keropok Lekor* samples were prepared by wet digestion using a mixture of HNO_3 and H_2O_2. These prepared samples were then analysed using Inductively Coupled Plasma Optical Emission Spectroscopy (ICP-OES). All concentrations of selected metals were below the maximum standard set by FAO/WHO. The highest concentration for Al, Cd, Cu and Pb in both samples were 0.270 mg/kg, 0.093 mg/kg, 0.077 mg/kg and 0.327 mg/kg, respectively. In comparison with its permissible limit, all samples did not exceed the limits which are Al (1 mg/kg), Cd (0.2 mg/kg), Cu (2.0 mg/kg) and Pb (0.5 mg/kg) for fruit and Al (1 mg/kg), Cd (0.5 mg/kg), Cu (3 mg/kg) and Pb (0.5 mg/kg) for fish. Nevertheless, it should be noted that consuming the street food for a long time with excess amount may contribute to health effects.

Keyword: heavy metal, permissible limit, street food.

Introduction

Street food are very popular among general population due to its price affordability and convenience (Bakircioglu et al., 2011). This reasonable price turns out to be the main reason for most of low-income family in hunting everyday meals. It also provides business opportunity with minimum costs capital (Abdulmajid et al., 2014). Often, street food is perceived as major public health risk due to reasons such as poor vendors, inadequate education and lack of knowledge plus appreciation of basic food safety (Nuapia et al., 2018). Street food are only considered as contaminated with heavy metals if it is greater than 5 mg/cm^3 as a result of exposure to the open air and other sources. Aluminium (Al), copper (Cu), lead (Pb), cadmium (Cd), chromium (Cr), nickel (Ni), zinc (Zn) and other rare metals are examples of heavy metals exposed (Avijit & Anindya., 2018).

The presence of heavy metal at an unacceptable level in food will contribute to negative effects to human health (Abdulmajid et al., 2014). Foods that are being sold near roads especially are the one easily exposed to these heavy metals. High concentration of heavy metal in human body will possibly damage several biochemical processes, leading to kidney, bones, liver, brain, nervous system and cardiovascular problems (Nuapia et al., 2018).

Nuapia et al., (2018) also stated that the major source of heavy metal contamination in food is not only from vehicle emission and atmospheric deposition but also from exposure to the chemicals and microbes. Not just sold near roads, but overcrowded areas such as taxi ranks and busy street pavements is also the reason why these street foods are easily contaminated

with heavy metals. According to Asiegbu et al., (2016), people who consume street food may be potentially expose to the foodborne hazard such as salmonellosis, listeriosis, typhoid fever, cholera and nausea. High concentration of heavy metal in the human body can lead to damage for several biochemical processes, leading to kidney, bones, liver, brain, nervous system and cardiovascular problem (Nuapia et al., 2018).
This study was conducted to assess the concentration of heavy metals in street food and to make sure the level of metals in street food is lower than permissible limit proposed by World Health Organization (Nuapia et al., 2018). The samples that were chosen for this study were randomly selected around Jengka area as a pilot study.

Materials and Methods

Sample Collection and Preparation

Food samples were purchased from three selected locations. They are stalls nearby Pasaraya Darul Makmur (PDM), U Mart and behind Ten Ten store. The sample points were labelled as S1, S2 and S3, respectively. **Figure 1** shows the samples collected.

Figure 1 Samples Collected

The samples, *Keropok Lekor* and fried banana were being wiped using oil paper sheet and tissue before being frozen in freezer overnight to remove excess oil. The samples were then cleaned with tap water to remove any dirt and rinsed with distilled water. The *Keropok Lekor* and fried banana were cut using a clean knife into small pieces and homogenized using a laboratory miller before dried in an oven at 75℃ for 5 days. Next, the samples were being ground using a grinder into a powder form and placed into labeled polyethylene containers (Altundag & Tuzen, 2011).
The samples were prepared by wet digestion technique. About 1 gram of each samples was digested with 6 mL HNO_3 and 2 mL H_2O_2 and homogenized on a hot plate. A mixture of HNO_3: H_2O_2 in the ratio of 6:2 (v/v) for 1 g samples is better than HNO_3: hydrochloric acid (HCl) for the whole of dissolution in a short time for wet digestion (Bakircioglu et al., 2011). The samples were heated on the hot plate for 1 hour in the fume hood. After that, both were cooled down to room temperature. The residues were filtered through a Whatman filter paper into a 100 mL volume flask. The *Keropok Lekor* and fried banana were diluted until the calibration mark of the volumetric flask with distilled water.

Sample Analysis

An Inductively Coupled Plasma Optical Emission Spectroscopy (ICP-OES) was used to determine the concentration of metals. Multiple elements standard solutions of 100 ppm were used as analytical calibration solutions to calibrate ICP-OES. The standard solution was

serially diluted to give the concentrations of 2, 4, 6, 8 and 10 ppm from multi-element standard solution into 5 different volumetric flasks (Wiviane et al., 2018). The standard solutions were used for calibration of instrument with R^2 value was 0.99989 whereas the distilled water was used as a blank solution. All experiments were carried out in three replicates (n=3).

Results and Discussion

Heavy Metal Concentrations in Analysed Street Food Samples

Table 1 and **Table 2** shows the concentration of selected heavy metals in both fried banana and *Keropok Lekor* in mg kg^{-1}. From **Table 1**, the concentration of Al was the highest in fried banana samples from all sampling points taken. The heavy metal concentration ranges for the studied metals were observed as follows: 0.120 – 0.137 mg kg^{-1} for Al, 0.067 – 0.073 mg kg^{-1} for Cd, 0.040 – 0.077 mg kg^{-1} for Cu and 0.020 – 0.033 mg kg^{-1} for Pb. The highest average Al content in sample point S1 was 0.137 mg kg^{-1}. Meanwhile, from **Table 2**, Pb content was recorded as the highest value among other metals for *Keropok Lekor* samples. For the *Keropok Lekor* samples, the heavy metal concentrations were as follows: 0.130 – 0.270 mg kg^{-1} for Al, 0.067 – 0.073 mg kg^{-1} for Cd, 0.030 – 0.053 mg kg^{-1} for Cu and 0.020 – 0.327 mg kg^{-1} for Pb. Sample point S2 was recorded as the highest values for all metals in *Keropok Lekor* samples.

Table 1 Concentration of Heavy Metals in Fried Banana in mg kg^{-1} (mean ± SD)

Sample points	Al	Cd	Cu	Pb
S1	0.137 ± 0.023	0.067 ± 0.006	0.063 ± 0.006	0.033 ± 0.015
S2	0.107 ± 0.012	0.070 ± 0.010	0.077 ± 0.006	0.020 ± BDL
S3	0.120 ± 0.010	0.073 ± 0.015	0.040 ± BDL	0.023 ± 0.006

Table 2 Concentration of Heavy Metals in *Keropok Lekor* in mg kg^{-1} (mean ± SD)

Sample points	Al	Cd	Cu	Pb
S1	0.237 ± 0.047	0.077 ± 0.021	0.030 ± BDL	0.020 ± BDL
S2	0.270 ± 0.074	0.093 ± 0.012	0.053 ± 0.023	0.327 ± BDL
S3	0.130 ± 0.017	0.083 ± 0.006	0.050 ± BDL	0.033 ± 0.006

Notes: BDL = below detectable limit, SD = standard deviation. Data represented in mean of three replicates.

According to Men et al., (2018), Al metal was caused by human activities that can accumulate in road dust directly or indirectly, through absorption and atmospheric deposition. The metals can be distributed into surface water and underground water via precipitation. High level of Al content in food may cause health problems such as neuromuscular disorder, autism and Alzheimer's disease (Ekhator et al., 2017). Based on tables above, both samples recorded high values of Al concentration.

The presence of Cd in these samples is because, compared to water and air, food and agricultural activities are major contributor to Cd exposure (Islam et al., 2015). Modern

agricultural practices can cause Cd to enter the food chain via plant roots through the cortical tissue and subsequently translocate to above-ground tissues (Wu et al., 2018). The metal also can affect fishes as the major ingredient in making *Keropok Lekor* through the absorption via digestive tract, skin and gills (Garnero et al., 2018).

Cu is required in a sufficient amount due to its important role in human health. The metal acts as a cofactor for enzymes involved in glucose metabolism, synthesis of haemoglobin and connective tissue (Bilandzic et al., 2012). However, an excessive amount of Cu intake can cause nausea, vomiting, kidney damage and able to inhibit central nervous system (Zhong et al., 2016). The existence of Cu might be due to the fish feed before it was being processed into *Keropok Lekor* or it could also be caused by a natural occurrence in soil during mineralization by banana crop (Mahesar et al., 2010).

Pb showed the least concentrations among other metals in fried banana samples. However, in *Keropok Lekor* samples, Pb showed the highest concentration especially in sample point S2. This might be due to the location of S2, which was situated near the city area (frequently exposed to vehicle emission used by the locals). Emission from vehicles contributed to pollutant release to the surrounding and thus, affect the street food (Ab Manan et al., 2018). Exposure of Pb can lead to health damages such as anaemia, weight loss and depression (Arulkumar et al., 2017).

Comparison with Permissible Limit

The results of metal concentrations were compared with standard permissible limit provided by World Health Organization and Food and Agriculture Organization (WHO/FAO, 2011). Based on **Table 3** and **Table 4**, the results obtained in this study showed the concentration of heavy metals in fried banana and *Keropok Lekor* were below than standard limit. This finding indicated that the street food at the studied area are safe to be consumed. However, exposure to heavy metals content in the long term will potentially affect our health if consume in excessive amount for a long time.

Table 3 Comparison of Analysed Heavy Metals in Fruit (Fried Banana) with Standard Permissible Limit (mg kg^{-1})

Permissible limit by WHO/FAO (2011) (mg kg^{-1})	**Al**	**Cd**	**Cu**	**Pb**
	1.0	**0.2**	**2.0**	**0.5**
S1	0.137	0.067	0.063	0.033
S2	0.107	0.070	0.077	0.020
S3	0.120	0.073	0.040	0.023

Table 4 Comparison of Analysed Heavy Metals in Fish (*Keropok Lekor*) with Standard Permissible Limit (mg kg^{-1})

Permissible limit by WHO/FAO (2011) (mg kg^{-1})	**Al**	**Cd**	**Cu**	**Pb**
	1.0	**0.5**	**3.0**	**0.5**
S1	0.237	0.077	0.030	0.020
S2	0.270	0.093	0.053	0.327
S3	0.130	0.083	0.050	0.033

Conclusion

From this study, the concentrations of selected heavy metals were within acceptance limit. Street foods are among the food that is highly consumed by people in the daily life. However, this study only emphasizes on two types of street food which are fried banana and *Keropok Lekor*. More studies on other street foods would be recommended as it would be a guideline for any future study.

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Conflict of Interests

The authors declare that there is no conflict of interest.

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