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EXTENDED ABSTRACT

Heavy Metals (Pb, Cd, As) Content in Instant Noodles From Malaysian Market

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SUMMARY

Instant noodles had been found to be contaminated with heavy metals such as lead (Pb), cadmium (Cd) and arsenic (As). This study aims to determine the heavy metals (Pb, Cd, As) concentration in popular instant noodles from Malaysian market. Seven different brands of commercially popular instant noodles were randomly sampled from the market. The samples were prepared by dry ashing method prior to analysis by using Inductively Coupled Plasma Mass Spectrophotometer (ICP-MS). Results showed that all seven samples detected with heavy metals which the concentration for Pb in two samples exceeded the maximum permitted level of Malaysian Food Act and Regulation of 2 mg/kg. This finding indicated that instant noodle can be one the sources of chronic exposure to toxic heavy metals through food consumption which later might cause health effects. Instant noodles in Malaysian market need to be closely monitored to ensure the food quality and safety for consumption. Further study which focuses on the source of contamination as well as the health risk of consuming this contaminated noodles is strongly recommended.

Keywords: Instant noodles, Heavy metals, ICP-MS, Food consumption, Food safety

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INTRODUCTION

Noodle is considered as one of the most important food in Asia. Instant noodle which was derived from Japan by Momofuku Ando in 1958 was then spread to Asia, America and Europe. Instant noodle is consumed in more than 80 countries around the world and has become an internationally recognized food. In 2012, instant noodles demand was exceeded 100 billion serving and still rising. It is made of simple ingredients such as water, salt, carbohydrate, protein and small amount of fatty acids. Besides that, acid regulators, flavour enhancers, thickeners, humectants, colours, stabilizers, anti-oxidants, emulsifiers, flour treatment agents, preservatives and anti-caking agents were allowed to use in the making of instant noodles which make it long shelf life (1). Each instant noodle is conveniently packed with flavoured ingredients, and simple preparation thus makes it highly preferred by busy consumers such as university students. A single serving of instant noodles is high in carbohydrates and fat, but low in protein, fibre, vitamins and minerals (2). In addition, it is unhealthy due to their ingredients made up of a low nutritive value and contaminated with heavy metal, especially during food processing. Previous study found that instant noodles were contaminated with heavy metals (3,4,5,6). Heavy metals such as Pb, Cd and As may pose health effects with long duration chronic exposure especially from food sources. This is because the ability of heavy metal to accumulates in target organ and tissue where it will exert its effect. Pb can affect several organs such as kidney, central nervous system, liver, hematopoietic system, endocrine system and reproductive system (7). The long-term effect of Cd exposure was it can cause adverse effect on kidney, respiratory system and bone disease (8). Prolong exposure to As can cause cancer, skin lesions, developmental effects, cardiovascular disease, neurotoxicity and diabetes (9).

In Malaysia about 3.6 million packages of instant noodle were consume by people per day. Malaysia was listed in Top 15 countries highly consumed instant noodles with the rate of consumption is about 1360 million of cups or packets instant noodle in year 2015 (1). Considering the increasing trend in the consumption of instant noodles in Malaysia, the quality of the product that is being sold to the consumer need to be constantly monitored as it is very important to ensure that they are safe for consumption. This study was carried out to determine the Pb, Cd and As concentration in commercially popular brands of instant noodle. To the best of our knowledge, there is no published literature on heavy metals contamination in instant noodles available in

Malaysian market. This study is essential to fill in the gap of knowledge regarding this issue.

MATERIALS AND METHODS

Seven commercially popular brands of instant noodles were randomly purchased from the market. The instant noodle samples were brought to the laboratory to be digested by a dry ashing method. The noodles were analysed together with the seasoning. Firstly, the samples of instant noodles were clean with distilled water. Then, the sample was soaked in water and mixed with the seasoning and flavouring powder. After that, the sample was homogenized by using food blender. Then, one gram of the samples was weighted on analytical balance and placed in the crucible. After that, the sample was put in furnace. The temperature of furnace was slowly increased from room temperature to 450°C in one hour. Then, the samples were ashed in 480°C for about four hours until white or gray ash residue obtained. Then, the sample was left to cool for one night in the furnace. After that, five mL of 0.24M nitric acid (HNO3) was added into the residue and heated slowly to dissolve the residue by using hot plate. Next, the residue was dissolved in 25ml distilled water. The solution was filtered using 0.45µm Whatmann filter paper and transferred to a 25ml of volumetric flask. Then the samples were analysed by ICP-MS model Perkin Elmer Elan Dre-e to determine the heavy metals concentration. Ten millilitre of standard solution were prepared and diluted to 5 ppb, 10 ppb, 20 ppb, 50 ppb, 100 ppb and 300 ppb to build the calibration curve. Lastly, the standard solution and a blank were analysed with ICP-MS to obtain the standard curve value of ±0.999 prior to the sample analysis. The food standard reference material, SRM 1640a for lead, cadmium and arsenic element were analysed to obtain the standard curve prior to the samples analysis and good recoveries were observed. The value of heavy metals concentration in instant noodle was applied into following equation to obtain the actual concentration of heavy metals present in the samples:

Heavy metal concentration in instant noodle,

$$mg/kg = \frac{[(AxB)]}{W} \times C$$

Where, A = Volume of extraction (digested sample, g); B = Dilution factor (volume of diluted sample/volume of extract); C = Heavy metal concentration in instant noodle (µg/mL); W = weight of sample (g).

RESULTS

Table I shows the concentration of heavy metals in all seven instant noodle samples and maximum permitted level in certain food types according to Malaysian Food Act and Regulations (10) and Codex Alimentarius (11). The Pb concentrations in instant noodles were ranged between 0.27 to 2.94 mg/kg. Cd was detected which ranged between 0.03 to 0.37 mg/kg and As ranged between 0.25 to 0.81 mg/kg. Sample A, which is the most popular brand, showed the highest concentration of Pb, Cd and As. Overall, Pb concentration was highest in 5 out of 7 samples as compared to Cd and As. Based on Malaysian Food Regulation 1985 (10), two samples, A and C, exceeded the maximum permitted level for Pb while Cd and As were not exceeded the permitted level in all samples. However, if referred to Codex Alimentarius standard (11), all seven samples were exceeded the maximum permitted level for Pb, and three samples exceeded the limit for Cd. There was no maximum permitted level available for As for the related type of food.

Table I: Mean heavy metals concentration (mg/kg) in instant noodle samples (N = 7)

Instant Noodle Sample and flavour	Pb	Cd	As
A - Curry	2.94*#	0.37#	0.81
B - Tom Yam	1.53#	0.16	0.81
C – Original Fried noodle	2.52*#	0.26#	0.56
D - Tom Yam	0.27#	0.10	0.69
E - Chicken	0.47#	0.22#	0.75
F - Original seafood	0.98#	0.10	0.44
G - Curry	0.58#	0.03	0.25
Maximum permitted proportion by Malaysian Food Act (10)	2[a]	1[a]	1[a]
Permitted level by Codex Alimentarius (11)	0.2[c]	0.2[b]	n.a

*Exceed the maximum permitted level for Malaysia (10)
#Exceed the maximum permitted level of Codex Alimentarius (11)
[a]Maximum permitted level in all food, preserved and salted except pickles
[b]Maximum permitted level in wheat
[c]Maximum permitted level in cereal grain
n.a = not available

DISCUSSION AND CONCLUSION

Previous studies reported that heavy metals were detected in instant noodle samples from Bangladesh, N=5 (3), Nigeria, N=7 (4); N=8 (5), and Iran, N=27 (6). In this recent study, we found the Pb concentration detected in instant noodles was in the range of 0.27 to 2.94 mg/kg, is higher than previous studies. In Bangladesh, Jothi and Uddin (3) found that Pb concentration was between 1.17 to 1.67 mg/kg, lower than the maximum permissible levels for lead in noodles in Bangladesh national legislation but higher than Codex Alimentarius standard (11) level of 0.2 mg/kg. Onyema et al, (4) reported a study done in Nigeria where the Pb concentration ranged from 0.025 to 0.106 mg/kg in which surpassed the international standard limit (11). Another study in Nigeria revealed Pb level between n.d. to 0.55 mg/kg (5) also exceeded the international standard. A recent study in Iran found that Pb in instant noodles was in the range of 1.004 to 1.57 mg/kg (6), also exceeding the permitted limit of Codex Alimentarius (11) in several samples of instant noodles. In this study, Cd was detected in instant noodles which ranged between 0.03 to 0.37 mg/kg. The maximum concentration found in this study is comparable to an Iranian study (6) which reported the

Cd concentration in their samples ranged from n.d. to 0.34 mg/kg. Besides that, the concentration of Cd in this study was higher than Onyema et al (4) (0.001 to 0.008 mg/kg) and Emujejaye et al., (5) (nd to 0.01) but lower than Jothi and Uddin (3) (0.53 to 0.82 mg/kg). The As concentration in instant noodles in this study was ranged between 0.25 to 0.81 mg/kg which was higher than previous studies (3,5). Jothi and Uddin (3) found that the As level found in their samples ranged from 0.17 to 0.41 mg/kg while Emumejaye, et al (5) reported the As level ranged from n.d. to 0.14 mg/kg.

The heavy metals found in instant noodle might come from the raw or processed ingredients used in the making of instant noodles. Wheat flour is the main raw materials in making and processing of noodles. Studies pointed out that legumes and cereals were contaminated with different levels of heavy metals (12). Wheat flour can be contaminated with Pb, Cd and As from the environment due to industrial and traffic emission, agriculture activities through irrigation with contaminated water, application of fertilizer and metal based pesticides, as well as method of harvesting and storage (13). Since instant noodle is highly processed food, heavy metals might be introduced into the food from the added flavours or ingredients during the preparation of instant noodle and its seasoning. In food industry, As was widely used as food preservative while Cd was used as colour pigment. This might contribute as one of the contamination sources of heavy metals in instant noodle consumption. Adding of water during instant noodle preparation also can be the source of contamination (14). While this current study did not analyse the heavy metals content in the noodle and in the seasoning separately, there is a need to do so in the future researches. Therefore, proper prevention plan can be suggested to lower the risk of heavy metals exposure through instant noodle intake.

In order to ensure food safety and quality, the Malaysian authority has enacted the Malaysian Food Act 1983 and Food Regulation 1985 to protect the public against health hazards and fraud in the preparation, sale and use of food, and for matters incidental thereto or connected therewith (10). Under the Malaysian Food Regulation 1985, a maximum permitted level in all food was set at 2, 1 and 1mg/kg for Pb, Cd and As respectively (10). This local permitted level is higher than the international standard by Codex Alimentarius (11) which are 0.2 mg/kg for Pb and Cd. Since there is no standard limit specifically for instant noodle in Codex Alimentrius (11), a permitted level for Pb in cereal grains, and for Cd in wheat, is used as the reference. No permissible level is available for As in Codex Alimentarius for the related food type.

This study conclude that Pb, Cd and As were detected in all instant noodle samples. Based on Malaysian Food Act (10), only Pb exceeded the permitted level of 2mg/kg. However, from the international standard of Codex Alimentarius standard (11), all samples surpassed the permitted level for Pb, while 3 samples exceeded the permitted limit for Cd. These findings indicated that instant noodle can be one the sources of chronic exposure to heavy metals through food consumption which later might cause health effects related to heavy metals toxicity. Further steps should be considered to prevent the continuous intake of heavy metals from food particularly instant noodles. Regular monitoring of heavy metals in food samples conveniently available to public followed by withdrawal of affected food from the market need to be done by the authority to assure only high quality and safe foods reach the public. Public awareness should be increased to educate them to wisely choose only quality foods for consumption for the own health benifits. Further studies which focuses on the specific sources of contamination as well as the health risk of consuming this contaminated food is strongly recommended.

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