



UNIVERSITI PUTRA MALAYSIA

LEAD CONCENTRATION IN INSTANT NOODLES AND HEALTH RISK ASSESSMENT AMONG A PRIVATE UNIVERSITY STUDENTS

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ABSTRACT

LEAD CONCENTRATION IN INSTANT NOODLES AND HEALTH RISK ASSESSMENT AMONG A PRIVATE UNIVERSITY STUDENTS

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Introduction: Food safety has emerged as a global issue with the growing of international trade including the safety of food contaminated with lead. Malaysia was ranked at 13th place for the global demand of instant noodles. Instant noodles might be contaminated with lead that present in soil, air and water. However, the safety of instant noodles for human consumption is still in doubt. **Objectives:** The study was conducted to determine lead concentration in instant noodles and health risk assessment among private university students. **Methodology:** Cross-sectional study was conducted among 121 of private university students at Universiti Tenaga Nasional. A set of questionnaire was used to obtain the socio-demographic information, instant noodles frequency intake and the influencing factor of the instant noodle consumption. Seven different brands of instant noodles were purposely chosen. The samples were prepared by dry ashing method and lead concentration was analysed by using Inductively Coupled Plasma Mass Spectrophotometer (ICP-MS). Hazard Quotient (HQ) for respondents were calculated to determine the non-carcinogenic health risk. **Result:** Two out of seven samples contained lead that exceeded the limit of Malaysia Food Regulation 1985 by 2 mg/kg. Most of the respondents were less frequently consumed the instant noodles. All of the Hazard Quotient of the respondents were under the acceptable risk and possibly no adverse health effect. **Conclusion:** HQ level for lead in all samples of instant noodles were less than 1. Thus, it can be concluded that although there were high level of lead were detected in instant noodles samples, no adverse health effects were found due to small quantity of contaminated instant noodles consumed by the respondents at one time.

Keywords: Instant Noodle, Lead, Provisional Tolerable Weekly Intake, Hazard Quotient, ICP-MS

ABSTRAK

KEPEKATAN PLUMBUM DALAM MI SEGERA DAN PENILAIAN RISIKO KESIHATAN DI KALANGAN PELAJAR UNIVERSITI SWASTA

NUR SABRINA BINTI SHAMSANI

Pengenalan: Keselamatan makanan telah muncul sebagai isu global dengan peningkatan perdagangan antarabangsa termasuk keselamatan makanan yang tercemar dengan plumbum. Malaysia berada di kedudukan ke-13 bagi permintaan global mi segera. Mi segera mungkin tercemar dengan plumbum yang hadir dalam tanah, udara dan air. Walau bagaimanapun, keselamatan mi segera untuk kegunaan manusia masih lagi diragui. **Objektif:** Kajian ini telah dijalankan untuk menentukan kepekatan plumbum dalam mi segera dan penilaian risiko kesihatan di kalangan pelajar universiti swasta. **Metodologi:** Kajian vinivers rentas telah dijalankan dalam kаланagan pelajar viniversity swasta di Universiti Tenaga Nasional. Satu set soal selidik telah digunakan untuk mendapatkan maklumat sosiodemografi, frekuensi pengambilan mi segera dan faktor yang mempengaruhi pemakanan mi segera. Tujuh jenama mi segera telah dipilih. Sampel telah disediakan dengan kaedah pengabuan kering dan kepekatan plumbum dianalisis dengan menggunakan Induktif Bersama Plasma Mass Spectrophotometer (ICP-MS) untuk mengesan kepekatan plumbum. Bahaya hasil bahagi (HQ) untuk responden telah dikira untuk menentukan risiko kesihatan bukan karsinogenik. **Keputusan:** Dua daripada tujuh sampel dikesan mengandungi kepekatan plumbum yang melebihi had Peraturan Makanan Malaysia 1985. Semua bahaya hasil bahagi daripada responden adalah di bawah risiko yang boleh diterima dan mungkin tiada kesan kesihatan yang buruk. **Kesimpulan:** Tahap bahaya hasil bahagi dalam semua sampel mi segera kurang daripada 1. Oleh itu, dapat disimpulkan bahawa walaupun terdapat plumbum yang tinggi dikesan di dalam sampel mi segera, tiada kesan kesihatan yang buruk ditemui disebabkan oleh responden mengambil mi segera yang telah tercemar dalam kuantiti kecil pada satu masa.

Kata kunci: Mi Segera, Plumbum, Peruntukan Pengambilan Mingguan yang Dibenarkan, Bahaya Hasil Bahagi, ICP-MS

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LIST OF ABBREVIATIONS

| | |
|---------------|--|
| Pb | Lead |
| ADD | Average Daily Dose |
| ATSDR | Agency Toxic for Substance and Disease Registry |
| PTWI | Provisional Tolerable Weekly Intake |
| FAO | Food and Agriculture Organization |
| HRA | Health Risk Assessment |
| HQ | Hazard Quotient |
| RfD | Reference Dose |
| ICP-MS | Inductively Coupled Plasma Mass Spectrophotometer |
| JECFA | Joint FAO/WHO Expert Committee on Food Additives |
| USEPA | United States Environmental Protection Agency |
| MOH | Ministry of Health |
| mg/kg | Milligram per kilogram |
| Ppm | Part per million |
| C | Concentration of lead |
| IR | Ingestion Rate |
| EF | Exposure Frequency |
| ED | Exposure Duration |
| BW | Body Weight |
| AT | Average Time |

ADD

Average Daily Dose



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CHAPTER 1

INTRODUCTION

1.1 Background

Food safety has emerged as a global issue with the growing of international trade (Jothi and Uddin, 2014). There are some food that has high risk of heavy metal contamination such as vegetables, seafood product and cereal (Alam et al., 2003). However there might be some food that contain heavy metal but still in a low investigation such as instant noodles. One of the most important foods in Asian is noodles. Instant noodles were first invented by Momofuku Ando on 1958 in Japan (World Instant Noodles Association, 2016). According to Jothi and Uddin (2003), approximately 40% of total wheat flour is consumed as noodles. It is also made of simple ingredients such as water and salt and also carbohydrate, protein and small amount of fatty acids. Instant noodles was spread to Asia and then to America and Europe. That was why in 2012, instant noodles demand was exceeded 100 billion serving. Instant noodles is consumed in more than 80 countries around the world and become internationally recognized food. Figure 1.1 shows there are 95.4 million serving

of instant noodles annually to consumers throughout the world and the demand keep rising (World Instant Noodles Association, 2016).

In Malaysia, instant noodles were become staple food. According to World Instant Noodles Association (2016), Malaysia was ranked at the 13th place of consuming instant noodles. Instant noodles are consumed by many people especially job holders because they do not have to spend a lot of time to prepare it (Habib, Dardak and Zakaria, 2011). They further stated that instant noodles is a ready to eat food as it only takes two minutes by adding boiling water.

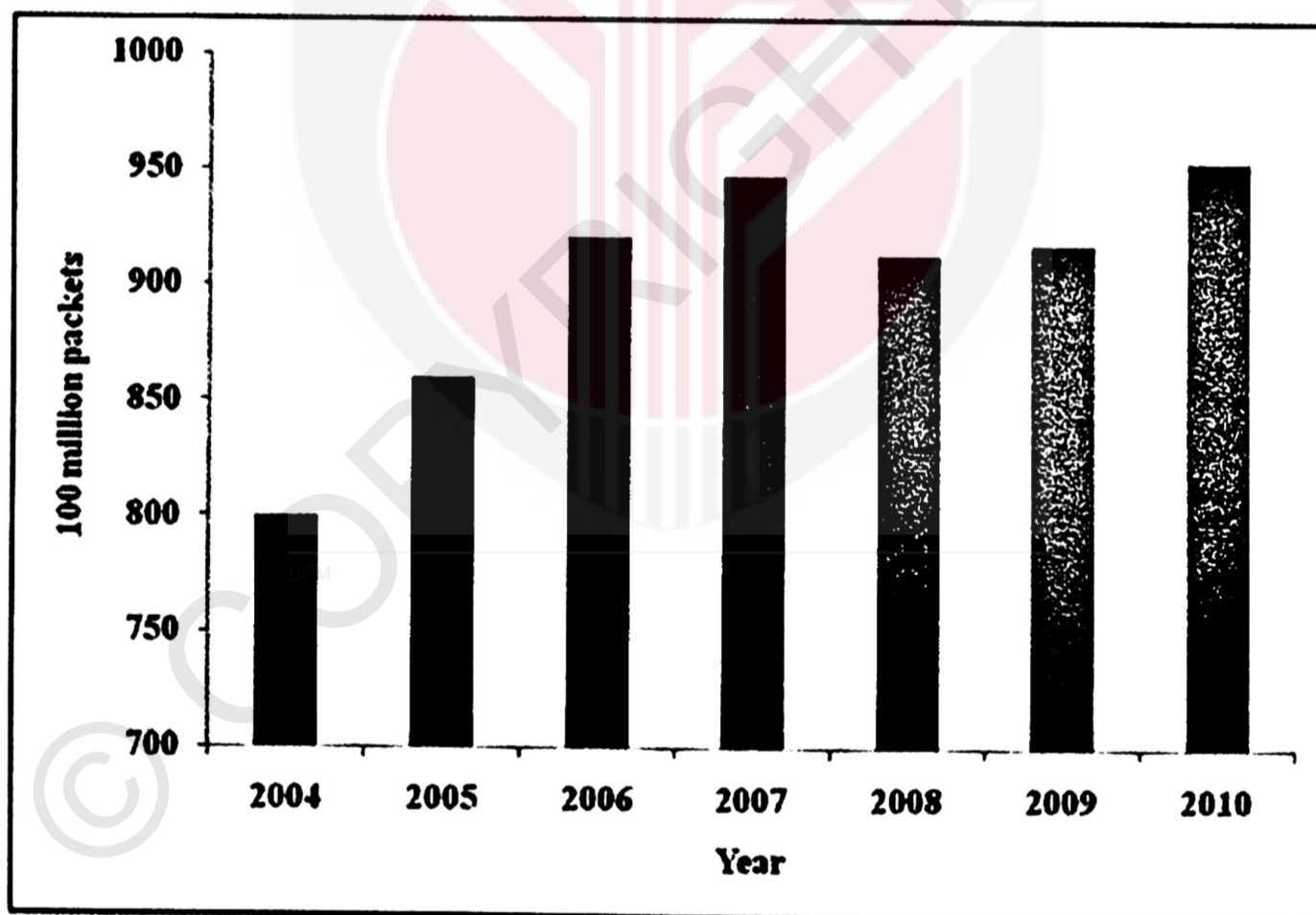


Figure 1.1: Consumption of instant noodles for the recent years in the world (WINA, 2016).

1.2 Problem Statement

Muslim Volunteer Malaysia Association (2016) stated that 41% of undergraduate students in Malaysia consume instant noodles. Most of students consume instant noodle because instant noodles are affordable. According to World Instant Noodles Association (2016), the global demand for instant noodles for Malaysia was 1360 number of serving for the year 2016. However the safety of instant noodles for human consumption is still in doubt. The greatest concern is we cannot identify whether the contamination of instant noodles happens during the plantation of wheat, processing or the way of packaging and preparing. Some claimed instant noodles contain heavy metal such as lead and some are not.

According to Jothi and Uddin (2003), there was lead contamination found in the instant noodle that has been sampled. A study was conducted by Onyema et al. (2014) on heavy metals analysis of five instant noodles in Nigeria. From the study, there were some heavy metals like cadmium, chromium, manganese, nickel and lead were slightly higher than minimum tolerable limit of World Health Organization. In 2015, it was reported that there were presence of high level of lead in some packets of instant noodles which is produced by Nestle (Food Safety and Standard Authority of India, 2015).

A previous study conducted by Alam et al. (2002) disclosed that food might be contaminated with heavy metal. The heavy metal in instant noodles may not give a significant effect for this time being. However, the heavy metals can accumulate in the body and lead to health problems (Onyema et al., 2014). Thus, caution must be taken to

avoid health issue related with disease due to accumulation of this heavy metal. Therefore due to the increasing concern about intake of contaminants in food, this study was conducted to determine the lead concentration in instant noodles and to estimate the health risk.

1.3 Study Justification

There is a need to conduct continuous quality assessment for food products in order to ensure and enhance the food safety and security. As stated earlier, this study was conducted to determine the lead concentration in instant noodles and health risk assessment among private university students. This study was also carried out to identify whether instant noodles are safe for human consumption and whether it is comply with the standard. Studies conducted on heavy metals in instant noodles can help researchers to identify whether they are safe for consumption and also improve the food safety of a country. A yearly monitoring program for heavy metals in commercial brands of instant noodles is necessary although heavy metals in instant noodles do not pose immediate risk to human health yet (Jothi and Uddin, 2003).

According to Codex Committee for Food Additives and Contaminants (2007), dietary intake of lead needs to be assessed in a regular basis together with the public concern and rapidly update to determine the recent dietary intake in a developing country (Lee et al., 2005). Therefore, it is important to detect and determine the amount of heavy metals concentration in instant noodles (Jothi and Uddin, 2003).

Heavy metals can be classified as a toxic to living organisms because they have the tendency to accumulate in selected tissues. Environmental chemicals that are exposed to the human can come from a lot of sources (Zukowska and Biziuk, 2008). According to UNL Environmental Health and Safety (2002), there are four routes of exposure for the substances to enter the body such as inhalation, ingestion, dermal and injection. Zukowska and Biziuk (2008) stated that one of the exposure routes is through ingestion of hazardous chemicals through contaminated food and water. Heavy metals are commonly defined as metals that having a specific density of more than 5 g/cm^3 (Jarup, 2003). He further stated that the exposure to lead, arsenic, cadmium and mercury can bring adverse health effects to human. Lead is a highly toxic metal which has caused extensive environmental contamination and health problems. According to Jothi and Uddin (2003), there was presence of lead in the instant noodles. Lead can affect several organs such as kidney, central nervous system, liver, hematopoietic system, endocrine system and reproductive system (ATSDR, 2007).

Thus, based on the high consumption of instant noodles but still less research regarding this issue, it is necessary to assess the safety of instant noodles. Heavy metals exposure via consumption among consumer must be identified. The human health risk also must be identified and evaluated. In Malaysia, there are a lot of studies conducted on heavy metals. However, there are only a few studies that had been carried out on heavy metals in instant noodles.

1.4 Research Questions

The research questions for this study were:

- i. What are the socio-demographic information of the respondents?
- ii. What is the instant noodles frequency intake of the respondents?
- iii. What are the influencing factors of instant noodles consumption among respondents?
- iv. What is the concentration of lead in the instant noodles?
- v. What is the association of socioeconomic status and frequency intake of instant noodles?
- vi. What is the Provisional Tolerable Weekly Intake (PTWI) of lead among respondents?
- vii. What is the health risk indicated by Hazard Quotient (HQ)?

1.5 Research Objectives

General objective:

To determine the lead concentration in instant noodles and health risk assessment among a private university students.

Specific objectives:

- i. To determine the socio-demographic information of respondents.
- ii. To determine the instant noodles frequency intake of respondents.

- iii. To determine the influencing factor of instant noodles consumption among respondents.
- iv. To determine the lead concentration in instant noodles.
- v. To determine the association of socioeconomic status and frequency intake of instant noodles.
- vi. To determine and compare Provisional Tolerable Weekly Intake (PTWI) of lead of respondents with Food and Agriculture Organization/World Health Organization (FAO/WHO) Joint Expert Committee on Food Additive (JECFA) standard.
- vii. To assess the health risk by Hazard Quotient (HQ).

1.6 Research Hypothesis

- i. The lead concentration in instant noodle is exceeding the Food and Agriculture Organization/World Health Organization (FAO/WHO) Joint Expert Committee on Food Additive (JECFA). The Provisional Tolerable Weekly Intake (PTWI) of lead is 0.025 mg/kg body weight for adult (WHO, 2011).
- ii. There is significant association between socioeconomic status with frequency intake of instant noodles.
- iii. The Provisional Tolerable Weekly Intake (PTWI) lead of respondent is exceeding the standard by Food and Agriculture Organization/World Health Organization (FAO/WHO) Joint Expert Committee on Food Additive (JECFA).

1.7 Definition of Terms

1.7.1 Conceptual Definition

Lead: Lead is a bright silvery metal and slightly bluish in a dry atmosphere (WHO, 2010).

Instant noodles: Instant noodles are product that made of wheat flour, rice flour or other flour and starch as the main ingredient, with or without addition of other ingredients. The instant noodles can be packed with seasonings (World Instant Noodles Association, 2016).

Health risk assessment: Health risk assessment is a process of estimating the nature and probability of health effects in human who may exposed to chemicals that have been contaminated, now or future (USEPA, 2015).

Students: According to Cambridge Dictionary (2017), student is a person who is learning at a college or university.

Provisional Tolerable Weekly intake (PTWI): Maximum amount of contaminant the person can be exposed per week over a lifetime without an unacceptable risk of health (Bhupander and Mukherjee, 2011).

1.7.2 Operational Definition

Lead: The lead concentration in instant noodles is measured by using ICP-MS. The unit of lead concentration is ppb.

Instant noodles: Instant noodles that were chosen for this study is the seven most preferred instant noodles brands.

Health risk assessment: Health risk assessment for this study is non-carcinogenic risk which is determined by Hazard Quotient.

Students: The students from a private university, Universiti Tenaga Nasional were become the respondents in this study.

Provisional Tolerable Weekly intake (PTWI): Maximum amount of lead that the students can be exposed per week over a lifetime without an unacceptable risk of health. The PTWI was calculated based on the amount of lead in instant noodles and frequency intake of instant noodles.

1.8 Variables

The independent and dependent variables in this study are:

1.8.1 Independent variable: Lead concentration in instant noodles.

1.8.2 Dependent variable: Health risk assessment among a private university students.

1.9 Conceptual Framework

The possible contamination sources of lead in instant noodle can be schematically represented as in Figure 1.2. There are several of heavy metals such as lead, arsenic, cadmium and mercury that can be exposed to human by occupational exposure and environmental exposure. Lead contamination in instant noodles can give health effect to the people through ingestion. Lead contamination can be found in water and wheat flour. Students that constantly consumed instant noodles are high risk to the acute and chronic effect of lead contamination.

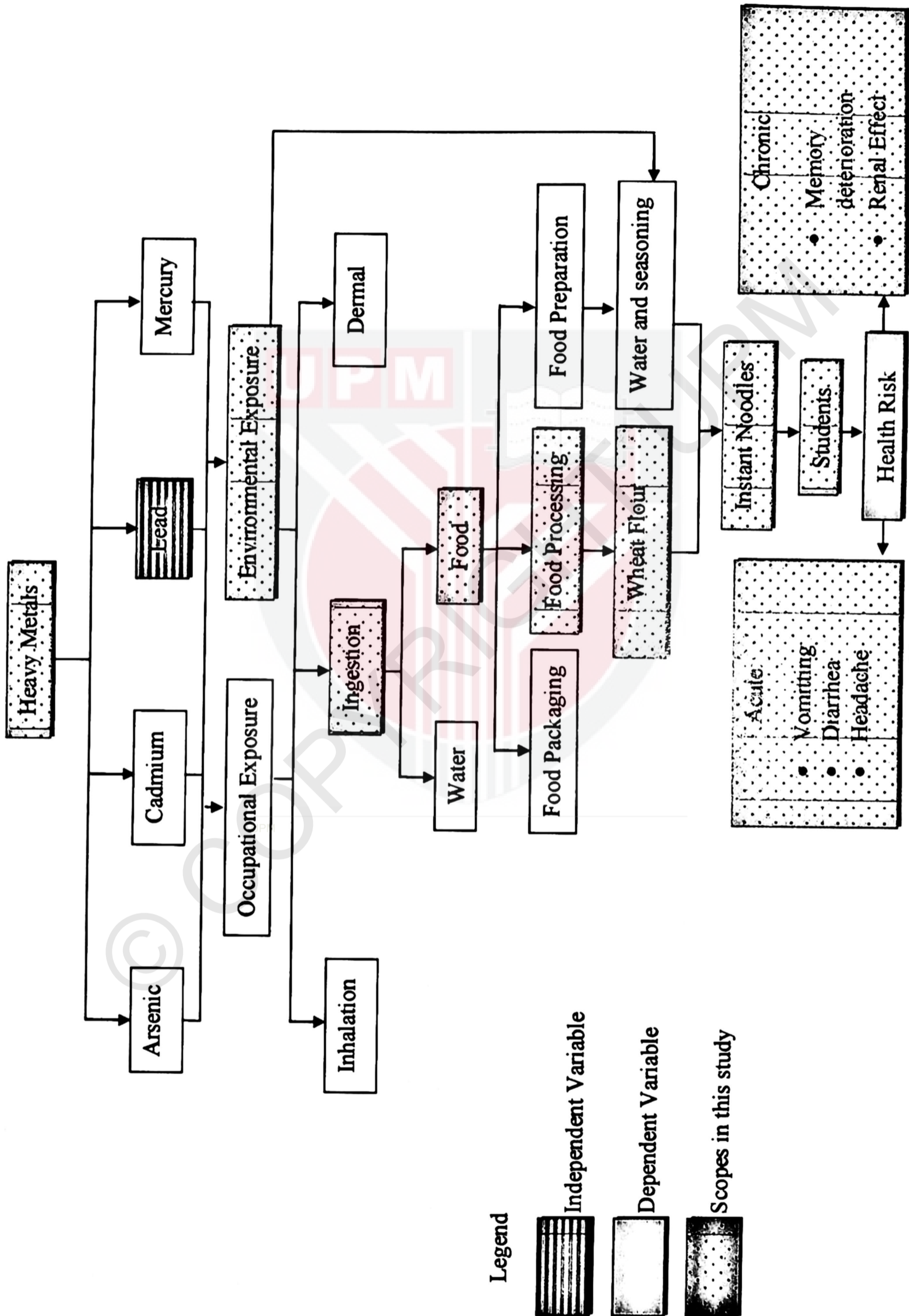


Figure 1.2: Conceptual Framework

CHAPTER 2

LITERATURE REVIEW

2.1 Heavy Metal

Heavy metals are commonly defined as those that having a specific density of more than 5g/cm^3 (Jarup, 2003). Heavy metals have a relatively high density when compared to water (Tchounwou et al., 2012). Examples of heavy metals are lead, cadmium, arsenic and mercury. According to Jaishankar (2014), toxicity of heavy metals have been proved to be a major threat and associate with health effects. Tchounwou et al. (2012) stated that the toxicity of them are depends on various factors such as dose, route of exposure, genetics and nutritional status. Jothi and Uddin (2014) stated that study on heavy metals is important because it is necessary to determine the accumulation of heavy metals especially for heavy metal that pose a serious health hazards to human. The heavy metals are toxic as they can accumulate in biological tissues or process known as bioaccumulation. As the result of exposure to the metals, bioaccumulation of metals can occurs in food, animal and human.

2.2 Lead

Lead is a highly toxic metal which it uses has caused extensive environmental contamination and health problems. Lead is a bright silvery metal and slightly bluish in a dry atmosphere (WHO, 2010). Lead has been widely used in industrial process, food, smoking, drinking water and domestic sources (WHO, 2010). Lead and cadmium are among the most heavy metal and particularly toxic (Radwan and Salama, 2006). Fewtrell et al., (2003) and IPCS (1995) defined lead as a toxic metal that can cause environmental contamination and health problems. Lead is a cumulative toxicant that can cause multiple body system problems (WHO, 2010). The daily intake of lead is come from ingestion of food, dirt and dust. The half life of lead can be one month in blood, one to two months in soft tissue and 20 to 30 years in bone. But, ingestion of food contaminated with lead show symptoms after 20 minutes.

2.3 Lead Route of Exposure

Lead can enter the human body mainly through inhalation and ingestion routes. Absorption through skin and dermal are another route of exposure. However exposure of lead by dermal is when people having a contact with the metals such as during activities of agriculture, manufacturing and pharmaceutical (Njagi, 2009). Ingestion of contaminated food may be significant to some population (ATSDR, 2007). Inhalation is the second major pathway of lead. Inhalation can contribute to lead body burden and significant to workers that work in lead-related occupations.

2.4 Health Effect Related to Lead Exposure

Lead is a toxicant that can affect several organs such as kidney, central nervous system, liver, hematopoietic system, endocrine system and reproductive system (ATSDR, 2007). Exposure to heavy metal such as lead can cause chronic effect and acute effect. Lead can accumulate in the organ for a long time and eliminate through urine (Jarup, 2003). The half life of the accumulated lead in the skeleton is about 20 to 30 years while its half life in the blood is about one month. People that are exposed to lead for a long duration may suffer memory deterioration, prolonged time of reaction and reduce the ability to understand (Jarup, 2003). Acute exposure to high level of lead can cause vomiting, diarrhea, convulsion, coma and death. People exposed to high level of lead in a short duration can also get brain damage, anemia, paralysis and gastrointestinal symptoms. The symptoms of acute lead exposure are headache, irritability, abdominal pain and other symptoms that related to the nervous system (Jarup, 2003). While, long term exposure to lead can cause damage to kidneys, reproductive, immune and nervous system. However, infants and young children are more vulnerable to the toxic effects of lead compared to adults.

2.5 Heavy Metal Contamination in Food

Heavy metals such as lead can be naturally present in food or can enter food as a result of human activities such as industrial and agriculture processes. There are several steps to trace the heavy metal such as sample digestion and detection method. There are four main methods digestion of sample which are dry ashing method, microwave

digestion, acid digestion and dissolve sample directly into the acid. The Food and Drug Administration has carried out various determination of heavy metal in food. The Food and Drug Administration has a program that monitor content of lead, cadmium, mercury and arsenic in foods (Mahaffey et al., 1975). Some food like salted fish contains heavy metal (Elias et al., 2014). There were several studies that indicate fish and seafood are contaminated with pollutants via contamination of the fish natural habitat. Heavy metal contamination in fish and seafood is because of the metallic elements do not disintegrate rapidly in the marine environment. All those metals which contaminated in the fish can be taken up from water, food, sedimentation and suspended particulate materials (Agusa et al., 2005).

Other foods that contaminated with heavy metal is vegetable. This is due to irrigation with contaminated water, fertilizers and metal-based pesticides. Plants are take up metals by absorbing them from contaminated soil as well as from deposits on parts of the plants exposed to the air from polluted environments (Radwan and Salama, 2006). High level of heavy metals in environment had created fear in the public as to the presence of heavy metals in daily food. It is necessary to analyse food to ensure the level of the contaminants are comply with the international requirements.

2.6 Lead in Instant Noodles

According to Food Safety and Standards Authority of India (2015), there is a presence of lead that excess the maximum permissible level in 10 out of 13 samples of instant noodles tested. According to Onyema et al. (2014), instant noodles are widely

consumed throughout the world until it falls second after bread. This is because it is convenient and easy to cook. Moreover, it has a long shelf life. However, many food products that contaminated with heavy metals and it is unavoidable. Harmful elements like arsenic, cadmium and lead can be found in instant noodles. Heavy metals arise from rapid growth of chemical use for agricultural purposes and anthropogenic activities. The health of the population will be affected by the ingestion of contaminated food products.

Jothi and Uddin (2014) stated that it is important to detect the amount of heavy metals in instant noodles in order to determine the possible health risk. They conducted a study to determine the amount of heavy metals such as lead, cadmium, arsenic and tin in commercial brand of noodles that available in Bangladesh. After comparing the result of the heavy metals with the standards, the amount of lead was higher in one of the instant noodles samples. The possible sources of lead are from the ingredient that has been used in the noodles which is wheat flour. Maleki and Zarasvand (2008) claimed that the conventional agriculture was contaminated by lead. The other possible sources of lead are irrigation with contaminated water, use of fertilizer, metal based pesticides and also the method of harvesting and storage.

2.7 Process of Making of Instant Noodles

According to Gulia et al., (2014) instant noodles are made of wheat flour, starch, water and also salt. There are also other ingredients that were added to enhance the taste and texture of the instant noodles. Pasta and noodles seems similar but different and depends on the country of origin, raw materials, formula ingredients, manufacturing

procedure and pattern of consumption (Hou, 2001). Instant noodles is prepared using wheat flour either hard or soft wheat (*Triticum aestivum*) together with the water, salt and alkaline salt which is kansui. Instant noodles manufacturing also involves sheeting and cutting of dough which resulted in lower water addition.

Alcohol is added in the instant noodles to increase the life and inhibit growth of microorganism. To ensure the long life of the instant noodles, it will be soaked in dilute organic acid before packaging. In order to increase the life of instant noodles, the effective way is to dry it. The moisture of the noodles can be removed by air-drying, deep-frying or vacuum-drying. This contention is supported by Fu (2007) that the moisture of instant noodles is removed by using the deep-frying method.

2.8 Lead in Wheat Flour

Lead presents in air, soil, dust and earth crust. It can also be absorbed by plants. Lead that has been absorbed by plant cannot be removed by washing or other food processing steps. Thus, food products may contain minute amount of lead in the range of part per billion (Buchi, 2016). According to Doe et al. (2013), lead was detected at varying concentration in two brands of the wheat flour in their study heavy metals in wheat flour on the Ghanaian market. One brand of the wheat flour is made in Ghana and another one is made in Turkey. The lead concentration was determined by atomic absorption spectrometry.

Koki and Hammed (2016) revealed that the concentration of lead in the eight brands of processed wheat flour exceeded the permissible exposure limit of national and international regulations on food quality by the range of 0.25 to 0.10 mg/kg. This study was to determine the lead and cadmium concentration in some selected processed wheat flour. According to Koki (2015), the high concentration of lead in grain is due to the absorption through air pollution from the highway traffics which may affect the irrigation water or farm soil of the plants. Atmospheric deposition resulted in 90% of the lead in plant material.

2.9 Dietary Pattern of Malaysian Students

According to ODPHP (2010), dietary pattern is quantities, proportions, variety or combination of different kind of food, drinks, nutrients in diet including the frequency with which they are habitually consumed. Basically dietary pattern reflect the whole food or combinations of consumption, temporal distribution of intake and habitual pattern. Dietary pattern is important for individuals and population in the prevention of diseases.

Instant noodles consumption was particularly high among Asian populations. A research was conducted among South Koreans who have the highest per-capita instant noodles consumers in the world which associate with rapid increases in heart disease and obesity. According to the study on Instant Noodles Intake and Dietary Patterns Associated with Distinct Cardio metabolic Risk Factors in Korea (Shin et al., 2014) the consumption of instant noodles of more than 2 times in a week was associated with a

higher prevalence of metabolic syndrome. The prevalence of metabolic syndrome in the adult population was increased up to 31% in 2014 in South Korea. This research was significant since many people are consuming instant noodles without knowing possible health risks. Moon (2014) had investigated the association between heavy metals including lead, mercury, and cadmium and arsenic with metabolic syndrome (MS) in the Korean population. The results from this study showed that the sum of heavy metals exposed to the population in Korea has significant relationship with the component of metabolic syndrome.

2.10 Nutritional Value and Hazard of the Instant Noodles

Instant noodles are highly processed since it is made to bear a longer shelf life. It contains low nutrition, high on fat, calories and sodium. Common ingredients of the flavoring powder are salt, monosodium glutamate, seasoning, and sugar (World Instant Noodles Association, 2016). In addition, it also laced with artificial colours, preservatives, additives and flavourings (Saxena, 2015). Despite the instant noodles, the monosodium glutamate (MSG) or the seasoning also can cause health effects. MSG is a chemical preservative that derived from the petroleum industry and used as taste enhancing and preserving properties. Regular intake of these elements can lead to health effects even the dietary intake is within the limit. MSG is an excitotoxin, which means it can overexcites the nerve cells to the point of damage or death, causing brain dysfunction and potentially even triggering or worsening learning disabilities, Alzheimer's disease, Parkinson's disease, and Lou Gehrig's disease (Liu & He, 2008).

According to Saxena (2015), there is increased risk for metabolic syndrome in high sodium, unhealthy and saturated fats. Instant noodles are processed food that contains saturated fatty acid or trans-fat. Saturated fats in instant noodles can cause increase level of cholesterol in blood if continuously and excessively consumes (Saxena, 2015). She further stated the increase level of cholesterol can cause heart disease and type 2 diabetes.

Besides that, a cancer-causing substance known as Benzopyrene was found in six different brands of noodles produced by Nongshim, South Korea's largest instant noodles company at Korea (Kichi, 2016). In addition, some instant noodles brands in Spain contain the toxic preservative tertiary-butyl hydroquinone (TBHQ). TBHQ is a byproduct of the petroleum industry, it is a synthetic chemical with antioxidant and the function is to prevent oxidation of fats and oils, also extending the shelf life of processed food. Apart from that, according to A Consumer's Dictionary of Food Additives, as exposure to five grams of TBHQ can be lethal and exposure to just one gram of TBHQ can cause nausea, vomiting, ringing in the ears (tinnitus), sense of suffocation and collapse (Mercola, 2014).

Eating a packet of instant noodles occasionally may not kill the consumers, but when the convenience food is substituted to real food, health problems will likely develop due to the consumption of unhealthy ingredients in the meal.

2.11 Permitted Level and Provisional Tolerable Weekly Intake (PTWI) of Lead

Based on Malaysian Food Regulation 1985, the permitted level for the lead concentration in food is 2 mg/kg in order to ensure food safety and quality (Malaysian Food Act 1983).

The Provisional Tolerable Weekly Intake (PTWI) is used to determine the amount of heavy metal in food. PTWI is a maximum amount of contaminant the person can be exposed per week over a lifetime without an unacceptable risk of health (Bhupander and Mukherjee, 2011). PTWI was used instead of Acceptable Daily Intake (ADI) because PTWI is established and used for substances with extremely long elimination half-life. The PTWI of heavy metal are set by the Food and Agriculture Organization/World Health Organization (FAO/WHO) Joint Expert Committee on Food Additive (JECFA). The PTWI of lead is 0.025 mg/kg body weight for adult (WHO, 2011).

2.12 Health Risk Assessment

According to USEPA (2015), there are four steps in health risk assessment. The steps are (i) Hazard Identification, (ii) Dose Response Assessment, (iii) Exposure Assessment and (iv) Risk Characterization. Figure 2.1 shows the four main steps in risk assessment.

2.12.1 Hazard Identification

Hazard identification is a step to determine the potential hazard that can cause harm to human. In this study, the hazard that will be identified is the lead in instant noodles. Other than that is to determine whether the instant noodles will produce the adverse health effect to human.

2.12.2 Dose Response Assessment

Dose response assessment is to assess the relationship between exposure and effects quantitatively or qualitatively. The measured effects will be increases as the dose increases. There may be no effect at the low exposure. However, the exposure and effects can be variable between different individuals, pollutants, exposure routes and others. In this study, the instant noodles will be analysed to determine the lead concentration and the health risk.

2.12.3 Exposure Assessment

Exposure assessment is a process to assess and measure the frequency, duration and level of contact with the hazard or exposure. Exposure assessment can also include some factors such as size, nature and types of human populations that expose to the hazard. In this study, the frequency intake and amount of the instant noodles will be obtained by using a questionnaire.

2.12.4 Risk Characterization

Risk characterization is a last step to examine health effect after the exposure. The risk will be identified by using a Hazard Quotient for non carcinogenic risk and Life Cancer Risk for carcinogenic risk. The first step in risk characterization is to compute the total intake of a contaminant in human body, which reflects the body burden of contaminants. The total contaminants intake can be termed as the average daily dose (ADD) for non carcinogenic risk. There ADD need to take into account:

- i. **Nature of the contaminants.** If the toxicant inhaled in the state of gas, vapour or mist, it may be ingested if in the state of solid and liquid and will be absorbed through skin if in the state of vapour, mist and liquid.
- ii. **Magnitude of intake:** The rate of intake of the contaminants into human body is in terms of mg/kg. This also means the concentration of the contaminants in the contaminated media such as air, water and food. At the point of contact with the exposed person and also the intake rate of the contaminated media per day.
- iii. **Frequency of intake:** Frequency of intake is a frequency with which intake of the contaminant into the human body take place.
- iv. **Duration of exposure:** The magnitude of intake will determine the dose of exposure. The frequency of intake and duration of exposure will produce the total duration of exposure.

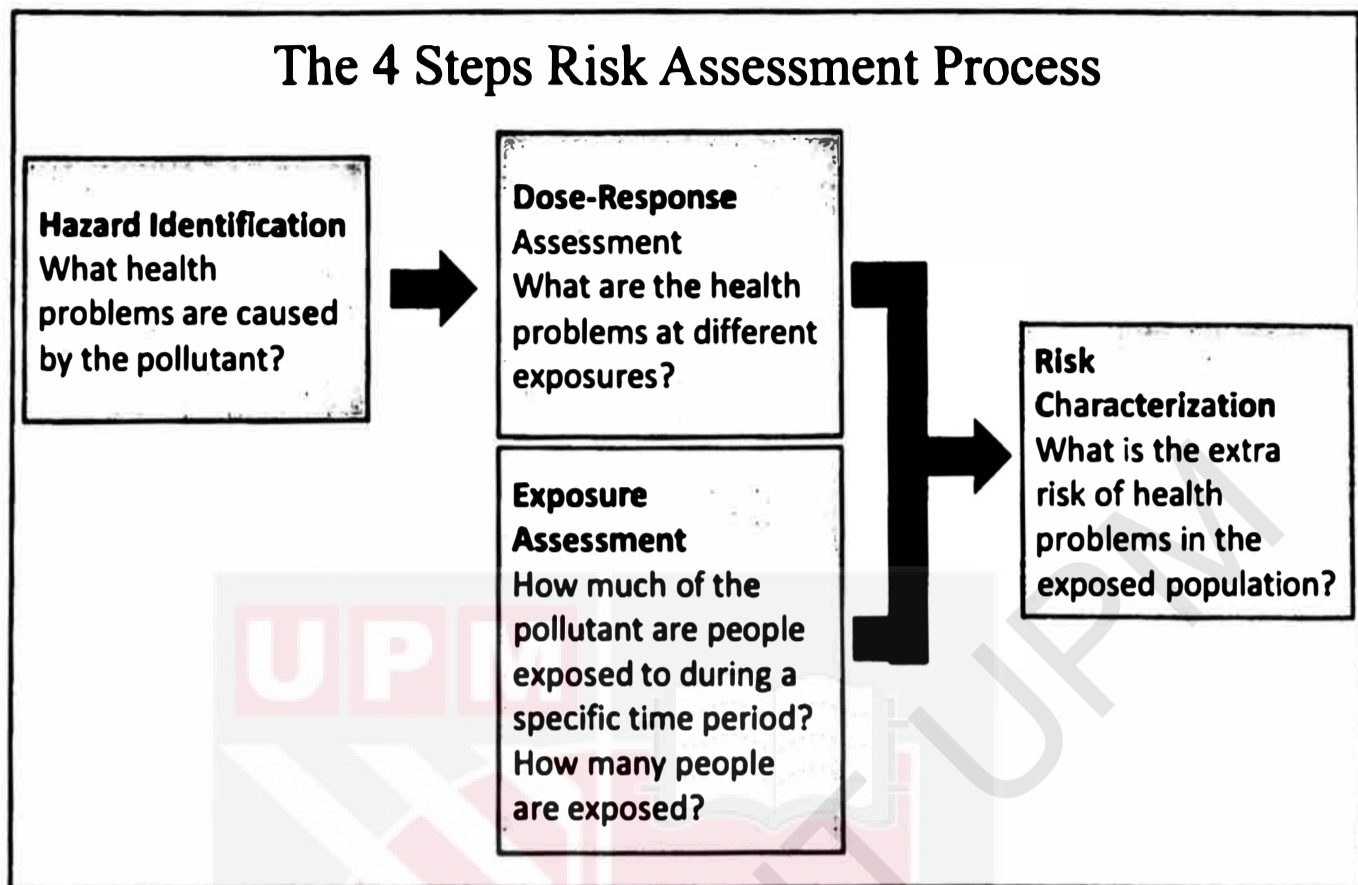


Figure 2.1: Steps in Risk Assessment

Source: USEPA, 2015

CHAPTER 3

METHODOLOGY

3.1 Study Design

A cross sectional study was conducted to determine the lead concentration in instant noodles and health risk assessment among a private university students. This study was conducted from January to May 2017.

3.2 Study Location

The study was conducted at Universiti Tenaga Nasional which involved the students. Figure 3.1 shows the location of this study. This location had been chosen because it is assumed that there is a lot of student who consume instant noodles. According to Tan et al., (2016), instant noodle is the most popular food among university students. It is believed, instant food product will help them to save money and time. Instant noodles are easily to get with affordable price.

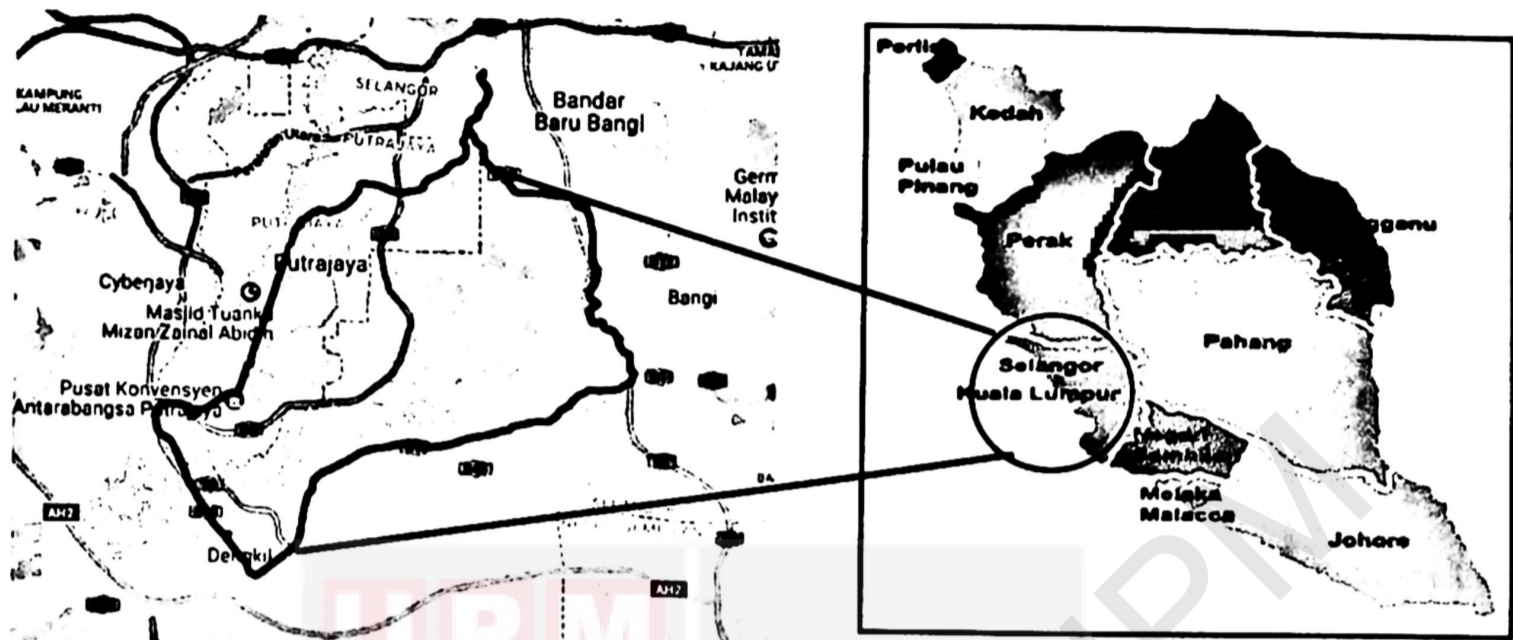


Figure 3.1: Location of Universiti Tenaga Nasional

3.3 Study Sample

3.3.1 Respondents

a) Study Population

The study populations for this study were private university students which is Universiti Tenaga Nasional (UNITEN) students. This university is located near the Kajang, Selangor and has an area of 214 hectares. The courses that held at this campus are engineering, information technology and other technology courses. Students population had been choose because it is believed that students are the one who always consume instant noodles. The inclusion criterion is students who are consume instant noodles.

b) Sampling Method

The respondents were chosen by simple random sampling. This technique was the most preferred technique of data collection as every unit in population has the same chance of being selected as every other sample of the same size (Levine et al., 2009). The respondents were selected based on the same characteristic of the population which is the students who consume instant noodles.

c) Sample Size

The sample size was calculated based on the formula by Krejcie and Morgan (1970) to estimate the required sample size for a cross sectional study design for one group of known population. The formula is shown below:

$$S = \frac{X^2NP(1 - P)}{d^2 (N - 1) + X^2P (1 - P)} \quad \text{Eq. 3.1}$$

Where,

S= Required sample size

N= The given population size

P= prevalence

D= The degree of accuracy

X²= 3.841 for the 95% confidence interval

Thus,

P= 0.41

N= 8000

$$S = \frac{(3.841)(8000)(0.41)(1-0.41)}{(0.1)^2(8000-1) + (3.841)(0.41)(1-0.41)} \quad \text{Eq. 3.2}$$

S= 93

=20% from 93

=112

However, after taking into consideration, additional 20% respondents were added for the rejected samples, the estimated sample size taken was 112 respondents among UNITEN students.

3.3.2 Instant Noodle Sample

a) Sampling Method

The instant noodles were purposively sampled based on seven most preferred brands of instant noodles by the students. All the instant noodles were purchased based on the same manufacturing date at the shop in the Universiti Tenaga Nasional. Each brand of instant noodles was analysed in triplicate. The noodles mixed with the seasoning and were analysed by using Inductively Coupled Plasma Mass Spectrophotometer (ICP-MS).

3.3.3 Sampling Frame

The total number of Universiti Tenaga Nasional students was obtained. The total numbers of the students are 8000.

3.3.4 Sampling Unit

The sampling unit is a student from Universiti Tenaga Nasional. From the 8000 students, 121 of students were chosen to be the respondents.

3.4 Data Collection and Instrumentation

The data obtained are as below:

3.4.1 Socio-Demographic Information, Food Frequency Intake and Influencing Factor Of Instant Noodles Consumption

A set of questionnaire in Appendix 4 was constructed to obtain the socio-demographic information, instant noodles frequency intake and the influencing factor of the instant noodle consumption. The questionnaire was only applicable to those students who currently consume instant noodle. The self administered questionnaire was modified from National Health & Nutrition Examination Survey and Methodological Evaluation of Method for Dietary Heavy Metal Intake and divided into four main parts.

Part A of the questionnaire was provided the socio-demographic information of the respondent which include age, gender, educational level, family income level, living expenses (food) and race. The data on respondent's family income was divided into two categories based on Central Bank of Malaysia Report 2013 , which were middle family income group (< RM5000) and high family income group (> RM5000).

While Part B of the questionnaire were given information about instant noodle dietary intake. In this part, question asked includes brand of instant noodle respondents usually consumed and frequency intake of instant noodle in a week. The information regarding instant noodle frequency intake were divided into two which were less frequent (≤ 3 times per week) and frequent (> 3 times per week). Apart from that, the information of factors influence instant noodle consumption among respondents also was obtained . A few factors were listed include easy to get, easy to prepare, cheap and no food.

Then in Part C the respondents were asked about information on current health status and past medical history. The respondents were asked to fill in their weight in the questionnaire based on the Seca Body Weight results. In Part D, the question were designed to obtain lifestyle information which includes smoking behavior, sources of drinking water respondent consume daily and type of utensil use for preparation of instant noodle.

3.4.2 Lead in instant noodle

The instant noodles were extracted by using dry ashing method (Akinyele and Shokunbi, 2014). The method can be referred in Appendix 1. The noodles were analysed together with the seasoning. Firstly, the samples of instant noodles were clean with distilled water. Then, the sample was prepared by 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 to determine the lead concentration. 10mL of standard solution were prepared and diluted to 5 ppb, 10 ppb, 20 ppb, 50 ppb, 100 ppb and 300 ppb by using a formula, $M_1V_1=M_2V_2$. Lastly, the standard solution and a blank were analyses with ICP-MS to obtain the standard curve value of ± 0.999 prior to the sample analysis (Elias et al., 2014).

The heavy metal in instant noodle was determined by taking samples of instant noodles and analyses by using ICPMS model Perkin Elmer Elan Dre-e. in order to detect the lead concentration. ICP-MS is a multi-element technique that use inductive couple plasma source to dissociate the sample into constituent atoms or ions. The food standard reference material, SRM 1640a for lead element were analysed to obtain the standard curve value of ± 0.999 prior to the samples analysis and good recoveries were observed. The value of lead concentration was applied into following equation to obtain the actual concentration of lead present in the samples. Figure 3.2 shows the Perkin Elmer Inductively Coupled Plasma Mass Spectrophotometer that was used.

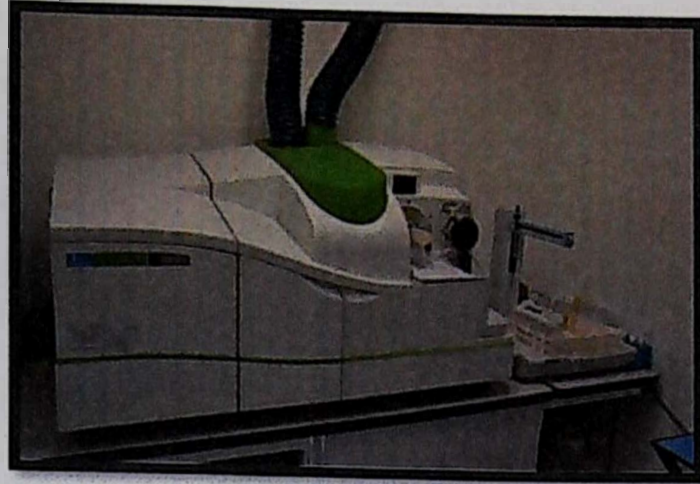


Figure 3.2: Perkin Elmer Inductively Coupled Plasma Mass Spectrophotometer

Source: perkinelmer.com, 2017

After analysed using the ICP-MS, the concentrations of the lead in instant noodles were obtained. Then, the concentrations were calculated using the formula below:

$$\text{Lead concentration in instant noodle, mg/kg} = \frac{[(A \times B)] \times C}{W} \quad \text{Eq. 3.3}$$

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 ($\mu\text{g/ml}$)

W= Weigh of sample (g)

3.4.3 Provisional Tolerable Weekly Intake (PTWI) of the Respondents

The lead intake was calculated by using the formula below. PTWI is the maximum amount of a contaminant to which a person can be exposed per week over a lifetime without an unacceptable risk of health effects.

Provisional Tolerable Weekly Intake (mg/kg bw) =

$$\frac{\text{amount of instant noodles ingested per week (kg/week)} \times \text{lead concentration in instant noodles (mg/kg)}}{\text{Body weight (kg)}}$$

Eq. 3.4

PTWI are set by Food and Agriculture Organization/ World Health Organization (FAO/WHO) Joint Expert Committee on Food Additives (JECFA). The PTWI for lead is 0.025 mg/kg.

3.4.4 Health risk Assessment

The health effects of the lead contamination were determined by using a health risk assessment. The non carcinogenic risk was identified. Non cancer risk is identified by comparing the exposure to the reference level via a ratio that known Hazard Quotient (HQ). If the value of hazard quotient is less than 1, it indicates the exposure is not likely to be associated with adverse health effects. While if the hazard quotient value is more than 1, it indicates that the exposure is likely associated adverse effects (USEPA, 2015).

Table 3.1 shows the risk acceptability for non-carcinogenic risk. The calculation below was compared to identify risk acceptability for non-carcinogenic risk.

$$\text{Average Daily Dose (ingestion)} = \frac{C \times IR \times EF \times ED}{BW \times AT}, \text{ mg/kg-day} \quad \text{Eq. 3.5}$$

(USEPA, 1992)

Where,

ADD = Average daily dose of pollutant through ingestion of food (mg/kg.day)

C = Pollutant concentration in a food item (mg/kg)

IR = Food item ingestion rate

EF = Exposure frequency

ED = Exposure duration

BW = Body weight

AT = Averaging time (days)

$$\text{Hazard Quotient} = \frac{\text{ADD}}{\text{Oral RfD}}, \text{ mg/kg/day} \quad \text{Eq. 3.6}$$

(USEPA, 1992)

Where,

HQ = Hazard quotient

ADD = Average daily dose (mg/kg-day)

RfD = Reference dose (mg/kg-day)

The reference dose of the lead is 4×10^{-3} mg/kg-day.

Table 3.1: The risk acceptability for non-carcinogenic risk

| Hazard Quotient (HQ) | Acceptability for non-carcinogenic risk |
|-----------------------------|--|
| <1 | Acceptable |
| >1 | Unacceptable |

3.5 Data Analysis

The statistical analysis that was performed is SPSS Statistics 22 which is significant at $p < 0.05$. Based on the objectives, the descriptive analysis was used to (i) measure the lead concentration in instant noodles, (ii) determine the socio-demographic information of respondents, (iii) determine the instant noodles frequency intake of respondents, (iv) determine the influencing factor of instant noodles consumption among respondents and (v) assess the health risk by Hazard Quotient (HQ). The data of the descriptive analysis are frequency and percentage in order to summarize the data in the questionnaire.

The chi square test was used to determine the association of socioeconomic status and frequency intake of instant noodles. Lastly the one sample sign test was used to determine and compare Provisional Tolerable Weekly Intake (PTWI) lead of respondents with Food and Agriculture Organization/World Health Organization

(FAO/WHO) Joint Expert Committee on Food Additive (JECFA) standard. The tables and graph were used to present the results.

3.6 Quality Control

i. Questionnaires

The pre-test was carried out among 10% from the total number of respondents with same characteristics but not from the same population. It was performed before the questionnaire was given to the respondents. This is to ensure the reliability and validity of questionnaires. It was conducted among Seventeen College students prior to the data collection to ensure appropriateness of the questions. Based on the pre-test, some minor correction was done regarding the questionnaire.

ii. Standard Operating Procedure (SOP)

Analysis of ICP-MS by follow the Standard Operating Procedure (SOP) to prevent any analytical error while analysing the concentration of lead in instant noodle. All of the preparation and procedure was conducted according to the guidance book for ICP-MS that was provided by the manufacturer. All glassware used were soaked overnight in solution of 20% nitric acid and rinsed with deionized water before used to remove organic material from glassware.

3.7 Ethical Consideration

The information about the respondents was confidential. Written consent was obtained from the respondents prior to the data collection.



CHAPTER 4

RESULTS AND DISCUSSION

4.1 Overview of the Respondents

This study was conducted among private university students at Universiti Tenaga Nasional (UNITEN). The purpose of this study was to determine the concentration of lead in instant noodles and health risk assessment among private university students. In order to complete this study, a total of 130 respondents aged 19 to 26 years old who fulfilled the inclusion criteria were approached and the questionnaire, consent forms and information sheet were randomly distributed during the study period. However, only 121 completed questionnaires with sign consent were returned to the researcher. Thus, the response rate for this study is 93% and nine of them were excluded from this study. However this number also exceeds the minimum number of respondents required for this study based on the sample size calculation which indicates that high response rate had been achieved. Therefore, less chance of bias compared to when the response rate is low.

4.2 Socio-demographic information

This study was conducted among 121 students at Universiti Tenaga Nasional (UNITEN). Table 4.1 shows the socio-demographic information of the respondents in this study. The socio-demographic information including gender, age, races, family income, expenses for food per month and weight. The respondents consist of 38 (31%) males and 83 (69%) females. The number of female respondents was higher than males because majority of the UNITEN students are females. The median age of the respondents was 22 (± 2) years old which was ranged from 19 to 26 years old. The respondents that answered the questionnaire were diplomas and degree students. There were 74.4% Malay, 3.3% Chinese, 17.4% Indian. The other 5% of the respondents were Palestinians and Iranians. UNITEN is an international university that also has foreigner students. Most of the respondents were in middle family income which is 75 (62%) followed by high income 46 (38%). According to Central Bank of Malaysia Report (2013), if the family income is more than RM5000 it will be categorized as high income where as the income for the middle family is less than RM5000. In this study most of the respondents spent RM350 to RM600 (52.2%) monthly for food followed by RM50 to RM300 (27.2%) and RM700 to RM1200 (20.6%). The weight of the respondents that involved in this study was ranged from 36 kg to 110 kg while the median of the respondents' weight was 55 (± 15.25).

Table 4.1: Socio demographic information of respondents (N=121)

| Variables | Frequency | Percent (%) | Median (inter quartile range) | Range |
|------------------------------------|------------------|--------------------|--------------------------------------|--------------|
| Gender | | | | |
| Male | 38 | 31.4 | | |
| Female | 83 | 68.6 | | |
| Age (years old) | | | 22 (2) | 19 to 26 |
| Races | | | | |
| Malay | 90 | 74.4 | | |
| Chinese | 4 | 3.3 | | |
| Indian | 21 | 17.4 | | |
| Others | 6 | 5.0 | | |
| Family income | | | | |
| Middle (<RM5000)* | 75 | 62.0 | | |
| High (>RM5000)* | 46 | 38.0 | | |
| Expenses for food per month | | | | |
| RM50 to RM300 | 28 | 27.2 | | |
| RM350 to RM600 | 87 | 52.2 | | |
| RM700 to RM1200 | 6 | 20.6 | | |
| Weight (kg) | | | 55 (15.25) | 36 to 110 |

*Based on Central Bank of Malaysia Report 2013

4.3 Frequency of instant noodles consumption

Table 4.2 and Figure 4.1 shows the frequency intake of seven different brands of instant noodles consumption among respondents. From the results shown below, there were 106 (87.6%) of respondents who ate the instant noodles once or twice per week and classified as less frequent. The other 15 (12.4%) of the respondents were frequently ate instant noodle which is more than three times per week. The classification of the

frequency intake was based on the study conducted by Jahanbakhsh & Mousanezhad (2015) in their survey of fast food consumption status.

According to Habib, Dardak and Zakaria (2011) in their study which is consumer preference and consumption towards fast food had resulted in 84.5% of the respondents purchased and consumed fast food such as instant noodles. This study also reported that the consumption of fast food among Malaysian students was higher than United Kingdom students. From the result, it was found that the majority of the students consumed instant noodles twice per month. Park et al., (2016) also revealed that the instant noodles intakes among 19 to 29 years old are more than four times per month. According to Jahanbakhsh & Mousanezhad (2015), there was 20.3% of the respondents consumed instant noodles once to twice per week. While 7.5% of the respondents consumed instant noodles three to five times per week.

Frequent consumption of instant noodles that contaminated with lead can increase the lead accumulation in the body because some of the samples that contain lead concentration exceeded the limit. Based on the previous study, lead can accumulate in blood for one month, one to two months in soft tissue and 20 to 30 years in bone (WHO, 2010).

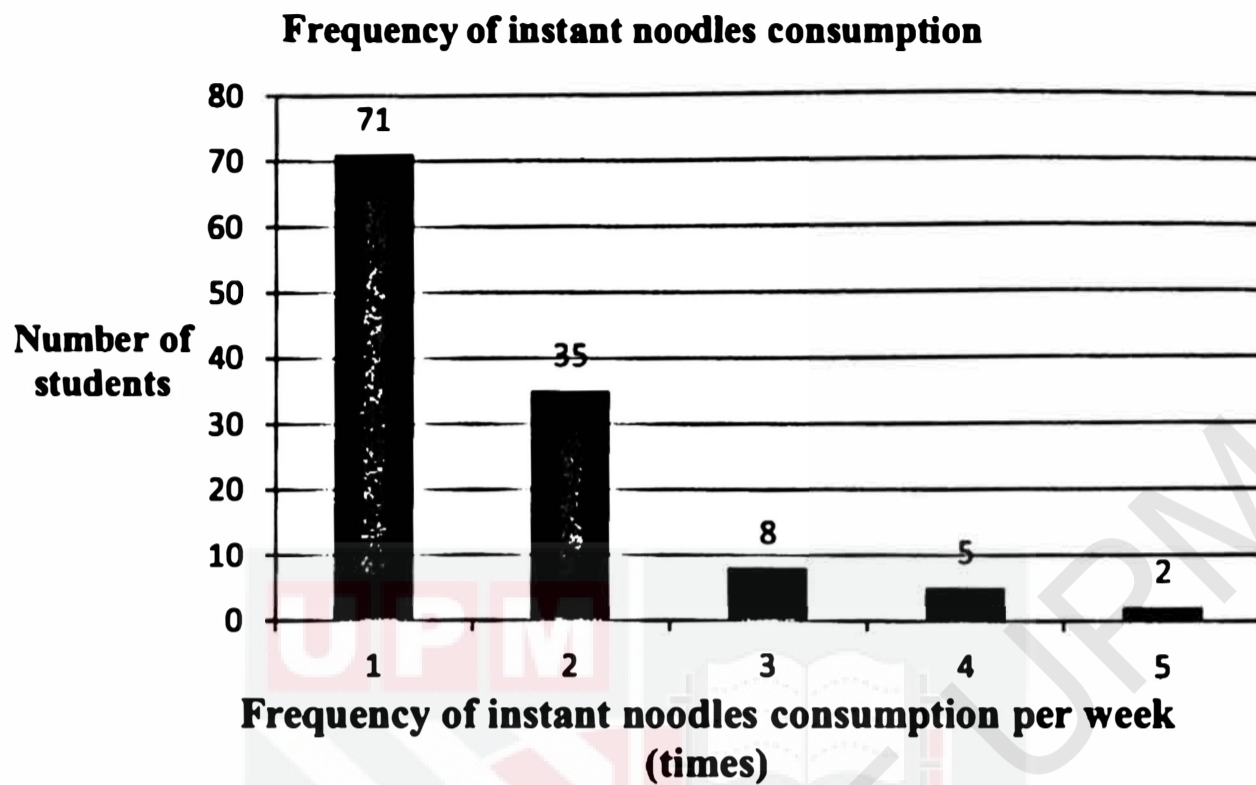


Figure 4.1: Frequency of instant noodles consumption

Table 4.2: Frequency of instant noodles consumption in a week (N=121)

| Frequency in a week | Frequency | Percent (%) |
|---------------------|-----------|-------------|
| Less frequent | 106 | 87.6 |
| Frequent | 15 | 12.4 |

* Less frequent = ≤ 3 times per week

Frequent = >3 times per week

4.4 The influencing factors of instant noodles consumption

Table 4.3 shows most of the respondents consumed instant noodles due to cheap (35.5%), then followed by easy to prepare (27.3%), no food (16.5%), easy to get (13.3%) and other factors (7.4%). The other factors were hungry and craving. Cheap is the highest factor that encourages students to consume instant noodles.

Instant noodles have become very popular because of they are cheap and everybody can afford it. Other than that, instant noodles also convenient and easy to be prepared. It does not take a very long time to enjoy the meal. Muslim Volunteer Malaysia (2016) stated that there are 41% of university students in Malaysia consumed instant noodles because of their financial problem and they chose instant noodles as it is cheap. According to Tan et al. (2016), consumers consumed instant noodles because it is convenience. This is because university students usually lack of skills, time and finance that lead them to choose instant noodles as their meal. Another study by Hakim, Muniandy & Danish, (2012) revealed that people can afford the price and it can be quickly prepared.

A study conducted by Natadjaja (2003), revealed that packaging design is the main factor that make people chose instant noodles. They chose based on the packaging because it is attractive. There were also other factors such as the taste. Atkins and Bowler (2001) stated that university students who have a busy lifestyle tend to consume instant noodles as it is not take too much time to prepare. In addition, instant noodles are easy, fast and cheap to be prepared.

Table 4.3: The influencing factors of instant noodles consumption among respondents (N=121)

| Factors | Frequency | Percent (%) |
|-----------------|------------------|--------------------|
| Easy to get | 16 | 13.3 |
| Easy to prepare | 33 | 27.3 |
| Cheap | 43 | 35.5 |
| No food | 20 | 16.5 |
| Others | 9 | 7.4 |

4.5 Association of economic status and frequency intake of instant noodles

Table 4.4 shows the association of economic status and frequency intake of instant noodles. There is no significant association between economic status and frequency intake of instant noodles ($\chi^2 = 4.326$, $p = 0.364$) of the respondents. It shows that the middle economic status family were the least consumed the instant noodles. The economic status was classified as high for household income more than RM5000 and middle for less than RM5000. This was classified based on the Central Bank of Malaysia Report 2013. Thus, it can be concluded that economic status does not associated with the frequency intake of instant noodles. However, based on the study conducted by Matsuo and Tanaka (2008), frequency intake of instant noodles is influenced by the family income. The higher the family income, the more frequent they purchase and consume instant noodles.

However Park et al. (2011) reported the results obtained showed that the middle income family consumed instant noodle less frequent than high income family. This

study found that the costs of food product did not influence the purchasing of unhealthy meals such as instant noodles among low, middle or high socioeconomic status. This is because, both socioeconomics still purchase and consume instant noodle even though they know that the food is a fast food which is not healthy due to many factors. Similarly from this study the participants who consumed instant noodles in this study were younger (20-49 years), mostly in the middle or high income group, and with a level of education greater than high school (Park et al., 2011).

Table 4.4: Association of economic status and frequency intake of instant noodles (N=121)

| *Economic status | Frequency intake | | | x ² | p value |
|------------------|------------------|----------|-------|----------------|---------|
| | Less frequent | Frequent | Total | | |
| High (>RM5000) | 43 | 3 | 46 | 4.326 | 0.364 |
| Middle (<RM5000) | 63 | 12 | 75 | | |
| Total | 106 | 15 | 121 | | |

*Bank of Malaysia Report 2013

*Significant p value < 0.05

4.6 Lead concentration in instant noodles

Table 4.5, 4.6 and Figure 4.2 shows the calculation of the lead concentration, the final concentration and the lead concentration in instant noodles respectively. The lead concentrations in instant noodles were detected in two out of seven samples. This study

revealed that the range of lead concentration detected in instant noodles were between 0.27 mg/kg to 2.94 mg/kg. The permitted level of lead concentration in instant noodle is 2 mg/kg (Malaysia Food Regulation, 1985). The highest concentration of lead was in sample A and the lowest concentration of lead was sample D. In this study, sample A(2.94 mg/kg) and C(2.52 mg/kg) exceeded the permitted level of 2 mg/kg for lead.. The concentration of lead detected in this study was lower compared to Food Safety and Standard Authority of India (2015) finding. However, in this study, there were several instant noodles that contain lead concentrations and exceed the limit.

Based on the previous studies, there were some studies revealed that the concentration of lead in instant noodles exceeded the permitted limit. Jothi and Uddin (2003) revealed that the lead concentration in four commercial brands of noodles and one of the non-branded were in the range of 1.17 mg/kg to 1.67 mg/kg. The lead concentration exceeded the limit might be due to the sources of lead which is from the raw ingredients used in instant noodles. Wheat flour is the main raw materials in making and processing of noodles. According to Maleki and Zarasvand (2008), the environment for conventional agriculture was contaminated by lead. The possible sources that can contaminate the lead are water, fertilizer, pesticide and also storage. Thus, it can be concluded that some of the instant noodles contain lead that exceeded the permitted limit.

Onyema et al., (2014) revealed that lead was found in the seven instant noodles that exceeded the limit in Nigeria. From the study, there are some heavy metals like

cadmium, chromium, manganese, nickel and lead were slightly higher than minimum tolerable limit of World Health Organization.

Food Safety and Standard Authority of India (2015) reported that there were presence of lead that exceed the maximum permissible level of 2.5 ppm. In this case, 10 out of 13 samples of instant noodles were tested. The presence of lead was at 17.2 ppm. There are other sources such as water that may contaminated with heavy metals (Ho, 2015). This is because, during the preparation of the instant noodles, water was added.

Table 4.5: The calculation of lead concentration in instant noodles.

| Samples | Concentration of lead in extraction (mg/kg) | Dilution Factor | Volume of Extract (ml) | Weight of sample (g) | Final Concentration(mg/kg) |
|----------------|--|------------------------|-------------------------------|-----------------------------|-----------------------------------|
| A1 | 6.97×10^{-3} | 25 | 25 | 1.0 | 4.36 |
| A2 | 3.96×10^{-3} | 25 | 25 | 1.0 | 2.48 |
| A3 | 3.191×10^{-3} | 25 | 25 | 1.0 | 1.99 |
| B1 | 2.19×10^{-4} | 25 | 25 | 1.0 | 0.14 |
| B2 | 3.74×10^{-4} | 25 | 25 | 1.0 | 0.23 |
| B3 | 6.73×10^{-3} | 25 | 25 | 1.0 | 4.21 |
| C1 | 4.334×10^{-3} | 25 | 25 | 1.0 | 2.71 |
| C2 | 3.913×10^{-3} | 25 | 25 | 1.0 | 2.45 |
| C3 | 3.83×10^{-3} | 25 | 25 | 1.0 | 2.39 |
| D1 | 3.47×10^{-4} | 25 | 25 | 1.0 | 0.22 |
| D2 | 5.94×10^{-4} | 25 | 25 | 1.0 | 0.37 |
| D3 | 3.41×10^{-4} | 25 | 25 | 1.0 | 0.21 |
| E1 | 5.47×10^{-4} | 25 | 25 | 1.0 | 0.34 |
| E2 | 1.229×10^{-3} | 25 | 25 | 1.0 | 0.77 |
| E3 | 4.95×10^{-4} | 25 | 25 | 1.0 | 0.31 |
| F1 | 9.72×10^{-4} | 25 | 25 | 1.0 | 0.61 |
| F2 | 1.756×10^{-3} | 25 | 25 | 1.0 | 1.10 |
| F3 | 1.978×10^{-3} | 25 | 25 | 1.0 | 1.24 |
| G1 | 9.86×10^{-4} | 25 | 25 | 1.0 | 0.62 |
| G2 | 7.79×10^{-4} | 25 | 25 | 1.0 | 0.49 |
| G3 | 1.02×10^{-3} | 25 | 25 | 1.0 | 0.64 |

Table 4.6: The mean final concentration of lead in instant noodles.

| Samples | Concentration (mg/kg) | | | Mean final concentration (mg/kg) (N=3) |
|----------|-----------------------|----------|----------|--|
| | Sample 1 | Sample 2 | Sample 3 | |
| A | 4.36 | 2.48 | 1.99 | 2.94 |
| B | 0.14 | 0.23 | 4.21 | 1.53 |
| C | 2.71 | 2.45 | 2.39 | 2.52 |
| D | 0.22 | 0.37 | 0.21 | 0.27 |
| E | 0.34 | 0.77 | 0.31 | 0.47 |
| F | 0.61 | 1.10 | 1.24 | 0.98 |
| G | 0.62 | 0.49 | 0.64 | 0.58 |

Lead Concentration in Instant Noodles

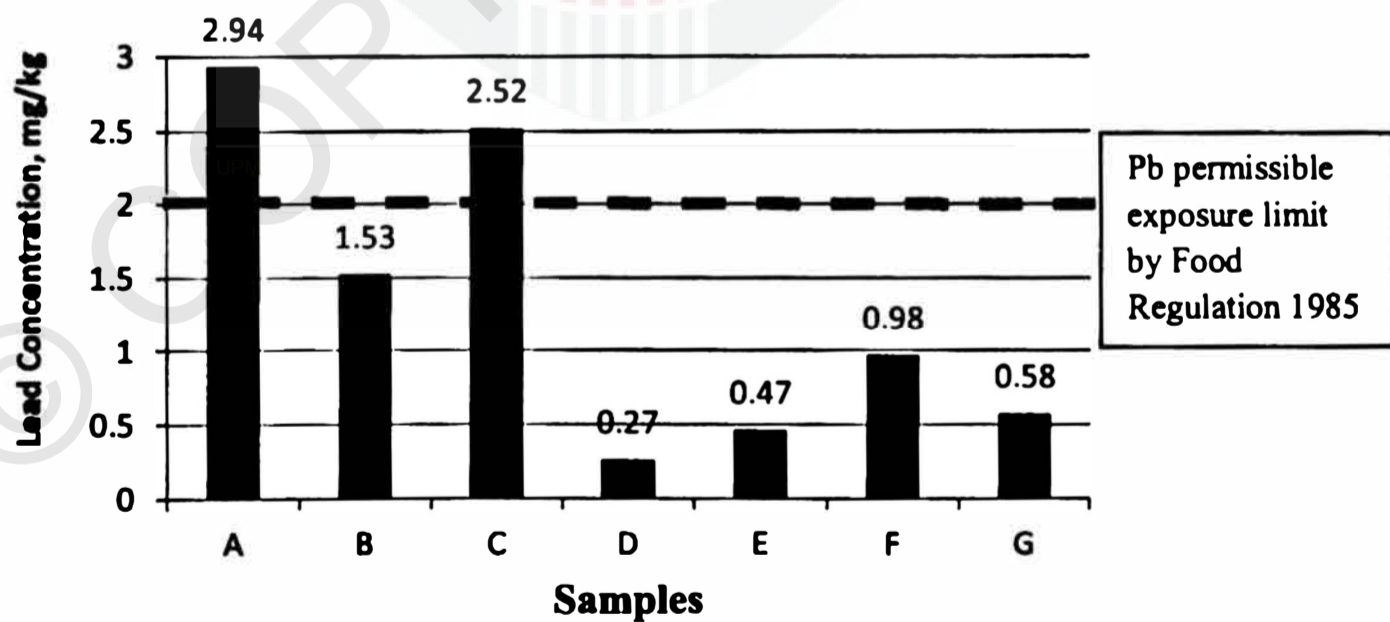


Figure 4.2: Concentration of lead in instant noodles

Samples:

A: Maggi (curry flavor)

B: Mamee (Tom Yam Flavour)

C: Mi Sedap(Asli flavor)

D: Ruski(Tom Yam Flavour)

E: Samyang (Chicken flavor)

F: Cintan (Seafood asli)

G: Indomie (Chicken curry)

4.7 Provisional Tolerable Weekly Intake (PTWI) of lead

Table 4.7 shows the summaries of calculation of Provisional Tolerable Weekly Intake (PTWI) of the respondent. The values of PTWI were calculated accordingly based on the formula in the Chapter 3. The PTWI that has been set by Food and Agriculture Organization/World Health Organization (FAO/WHO) Joint Expert Committee on Food Additive (JECFA) standard is 0.025 mg/kg. 0.025 mg/kg is the maximum amount of lead that the person can be exposed per week over a lifetime without an unacceptable risk of health. Figure 4.3 shows the comparison of PTWI of lead with the Food and Agriculture Organization/World Health Organization (FAO/WHO) Joint Expert Committee on Food Additive (JECFA) standard. All the PTWI of the respondents were below the limit of 0.025 mg/kg. The PTWI of the sample of instant noodles are A (3.98×10^{-3}), B (1.81×10^{-3}), C (3.55×10^{-3}), D (3.72×10^{-4}), E (8.12×10^{-4}), F (1.28×10^{-3}) and G (7.79×10^{-4}). The highest PTWI of respondents was sample A which is 3.98×10^{-3}

³ and the lowest PTWI is in samples D which is 3.72×10^{-4} . Table 4.7 shows the Provisional Tolerable Weekly Intake (PTWI) lead of respondents with Food and Agriculture Organization/World Health Organization (FAO/WHO) Joint Expert Committee on Food Additive (JECFA) standard and the result of one sample sign test analysis. The p value is less than 0.001 so that the PTWI of the respondents were different from the JECFA standard. Figure 4.3 shows the comparison of Provisional Tolerable Weekly Intake (PTWI) lead of respondents with Food and Agriculture Organization/World Health Organization (FAO/WHO) Joint Expert Committee on Food Additive (JECFA) standard.

Low level PTWI is due to the low frequency intake and small amount of instant noodles consumption. The PTWI were below the standard due to the small portion of intake and the frequency intake of the instant noodles. The serving size of the instant noodles was all below than 1 kg per week. According to Jahanbakhsh & Mousanezhad (2015), 20.3% of the respondents consumed instant noodles once to twice per week. Another 7.5% were for those consumed instant noodles three to five times a week. A study by Park et al. (2016) revealed that 27.9% of the respondents were consumed instant noodles more than four times per month and 14.9% of the respondents consumed instant noodle one to three times per month. Food and Environmental Hygiene Department (2013) stated that the dietary exposure of secondary school students to the lead were 1.98×10^{-3} mg/kg and 5.09×10^{-3} mg/kg and below the standard of 0.025 mg/kg. The average dietary exposure to lead among adult population were 2.1×10^{-4} mg/kg and 3.8×10^{-4} mg/kg for the consumers who were continuously consume food contaminated with lead such as snacks likes instant noodles.

Table 4.7: The PTWI of lead by the respondents.

| Brands | Concentration of lead (mg/kg) (N=3) | Ingestion rate (kg/week) | Body weight (kg) | Provisional tolerable Weekly Intake (mg/kg) | p value* | z value |
|-----------------------|--|-------------------------------------|-------------------------|--|-----------------|----------------|
| A (curry flavor) | 2.94 | 0.079 | 58.416 | 3.98×10^{-3} | <0.001 | |
| B (Tom Yam flavor) | 1.53 | 0.060 | 50.588 | 1.81×10^{-3} | <0.001 | |
| C (Asli flavor) | 2.52 | 0.091 | 64.588 | 3.55×10^{-3} | <0.001 | |
| D (Tom yam flavor) | 0.27 | 0.080 | 58.100 | 3.72×10^{-4} | <0.001 | -8.427 |
| E (chicken flavor) | 0.47 | 0.105 | 60.800 | 8.12×10^{-4} | >0.005 | |
| F (seafood asli) | 0.98 | 0.075 | 57.588 | 1.28×10^{-3} | <0.001 | |
| G (chicken curry) | 0.58 | 0.074 | 55.100 | 7.79×10^{-4} | <0.001 | |

*Significant at $p < 0.001$

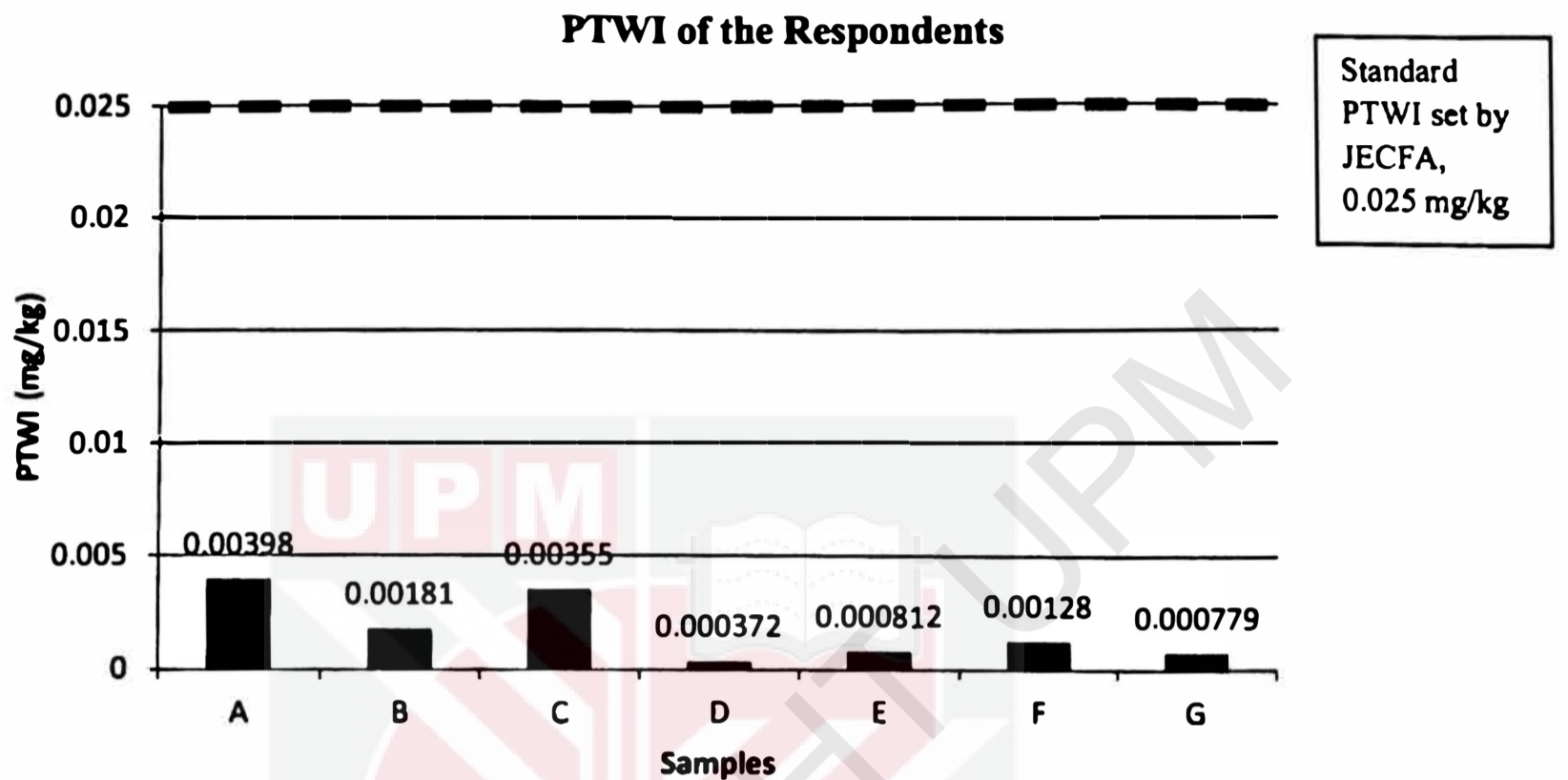


Figure 4.3: The comparison of Provisional Tolerable Weekly Intake (PTWI) of lead with the Food and Agriculture Organization/World Health Organization (FAO/WHO) Joint Expert Committee on Food Additive (JECFA) standard.

4.8 Health risk by Hazard Quotient (HQ)

As mentioned in the table below, all the HQ of seven samples of instant noodles were below 1. The range of HQ were from 0.013 to 0.28. HQ less than 1 signifies that the respondents were all poses an acceptable risk condition for non-carcinogenic risk. The information of the Average Daily Dose was obtained first to get the hazard quotient. Table 4.8 shows the summaries of calculation of lead concentration in instant noodles. The values of Average Daily Dose (ADD) were calculated accordingly based on the

formula in Chapter 3. If the Hazard Quotient (HQ) is more than 1, it means adverse health effects are possible while if the HQ is less than 1, then there is no adverse health effect are expected as a results of exposure. The acceptable risk is less than 1 (USEPA, 2015).

Exposure at or below the Hazard Quotient 1 is not likely to be associated with the adverse health effects. The acute effect of the lead can cause vomiting, diarrhea, anaemia, convulsion, coma and death. This is for those who are exposed to the high level of lead in a short duration (Jarup, 2003). While, long term exposure to lead can cause damage to kidneys, reproductive and immune systems and nervous system. However, infants and young children are more vulnerable to the toxic effects of lead compared to adults. According to Food and Environmental Hygiene Department (2013), lead is a classical chronic or cumulative poison that generally the health effect is not observed after a single exposure. JECFA (2010) concluded that concentration of lead in blood is associated with the impaired neurodevelopment, specifically reduction of intelligent quotient (IQ). ATSDR (2007) stated that lead can affect almost every system and organ in the body. One of the main targets of lead is nervous system.

According to USEPA (2015), adult that exposed to lead can suffer cardiovascular effect, increased blood pressure and hypertension, decreased kidney function and reproductive problems. Exposure to the high level of lead can cause severely damage to the brain and kidney. Men who are exposed to the high level of lead can damage the organs responsible for sperm production. Chronic exposure to lead can decrease the performance of nervous system.

IARC (2006) was classified lead compound as Group 3A which is not classifiable as to its carcinogenicity to humans. However, there is no proof that lead can cause cancer in human (ATSDR, 2007).



Table 4.8: The Average Daily Dose (ADD) for lead.

| Brands | Conc.(mg/kg) | IR (kg/day) | EF (day/year) | ED(years) | BW (kg) | AT^a(days) | ADD (mg/kg-day) |
|---------------------|---------------------|--------------------|----------------------|------------------|----------------|-----------------------------|------------------------|
| A (curry flavor) | 2.94 | 0.079 | 104 | 8 | 58.416 | 2920 | 1.13×10^{-3} |
| B (Tom Yam flavor) | 1.53 | 0.06 | 52 | 10 | 50.588 | 3650 | 2.59×10^{-4} |
| C (Asli flavor) | 2.52 | 0.091 | 104 | 10 | 64.588 | 3650 | 1.01×10^{-3} |
| D (Tom yam flavor) | 0.27 | 0.08 | 52 | 11 | 58.100 | 4015 | 5.3×10^{-5} |
| E (chicken flavour) | 0.47 | 0.105 | 52 | 9 | 60.800 | 3285 | 1.16×10^{-4} |
| F (seafood asli) | 0.98 | 0.075 | 52 | 8 | 57.588 | 2920 | 1.82×10^{-4} |
| G (chicken curry) | 0.58 | 0.074 | 104 | 10 | 55.100 | 3650 | 2.22×10^{-4} |

AT^a = Exposure Duration × 365

Table 4.9 shows the Hazard Quotient (HQ) which is the indicator for the health risk of non-carcinogenic health effect for the respondents in Universiti Tenaga Nasional. The HQ values that less than 1 in the population indicate that the exposure to lead via ingestion of the instant noodles is not associated with the non-carcinogenic risk.

Table 4.9: Health Risk for Hazard Quotient (HQ) for lead.

| Brands | Average Daily Dose (mg/kg-day) (N=3) | Reference Dose (mg/kg-day) | Hazard Quotient | Risk |
|---------------------|---|-----------------------------------|------------------------|-----------------|
| A (curry flavor) | 1.13×10^{-3} | 4×10^{-3} | 0.28 | Not significant |
| B (Tom Yam flavor) | 2.59×10^{-4} | 4×10^{-3} | 0.07 | Not significant |
| C (Asli flavor) | 1.01×10^{-3} | 4×10^{-3} | 0.25 | Not significant |
| D (Tom yam flavor) | 5.3×10^{-5} | 4×10^{-3} | 0.01 | Not significant |
| E (chicken flavour) | 1.16×10^{-4} | 4×10^{-3} | 0.03 | Not significant |
| F (seafood asli) | 1.82×10^{-4} | 4×10^{-3} | 0.05 | Not significant |
| G (chicken curry) | 2.22×10^{-4} | 4×10^{-3} | 0.06 | Not significant |

4.9 Strength

For the strength, the results of this study can be the baseline data and can be referred for lead concentration of instant noodles in Malaysia. There are limited number of studies on lead in instant noodles and health risk assessment on consumption of instant noodles.

Other than that, this study can give the students awareness and knowledge about the safety of instant noodles. This is due to many students consume instant noodles as it is cheap and easy to prepare.

4.10 Limitation

In this study, there were some limitations that occurred. Firstly, the sources of wheat during the making and processing of the instant noodles cannot be identified. Hence, the sources of lead that might contaminate the instant noodles could not be determined.

Other than that, only instant noodles that has been considered as the single dietary exposure. In this study, the ingestion route was taken into consideration to determine the exposure of lead in instant noodles. Risk assessment towards lead may be underestimated. Thus, further research needs to be done in order to determine the other food resources such as meat, rice, vegetable, fruit and cereal.

Lastly, recall bias might be happened due to the inability of the respondents to remember the frequent and consumption rate of instant noodles intake.



CHAPTER 5

CONCLUSION AND RECOMMENDATION

5.1 Conclusion

As a conclusion, most of the respondents consumed instant noodles once to three times per week. The influencing factor that makes the respondents to consume instant noodles was because they are cheap. There is no significant association between economic status and the frequency of instant noodles consumption. In this study, two out of seven samples of instant noodles exceeded the Malaysian Food Regulation 1985. Low level of PTWI suggested the ingestion of contaminant over lifetime without unacceptable risk of health. HQ for lead in all of the samples of instant noodles is less than 1. Thus, it indicates the consumption of lead in instant noodles is still safe due to the low consumption of instant noodles.

5.2 Recommendations

For the recommendation, the study on health risk assessment of instant noodles should be conducted. Ministry of Health or other bodies should conduct health risk assessment on consumption of instant noodles to identify the potential health effects. Monitoring during the instant noodles processing and making should be done to identify and control the sources of lead.

Other than that, analyse the noodles and the seasoning separately. This will produce more accurate results of heavy metals. The heavy metals can be determined whether they come from noodles or the seasoning.

Lastly, include the biological monitoring during the study. Biological monitoring is more accurate and reliable. This enables the evaluation of uptake amount of a substance taken up into blood, organ or cell. Biological monitoring makes it possible to determine the concentration of contaminant in the body.

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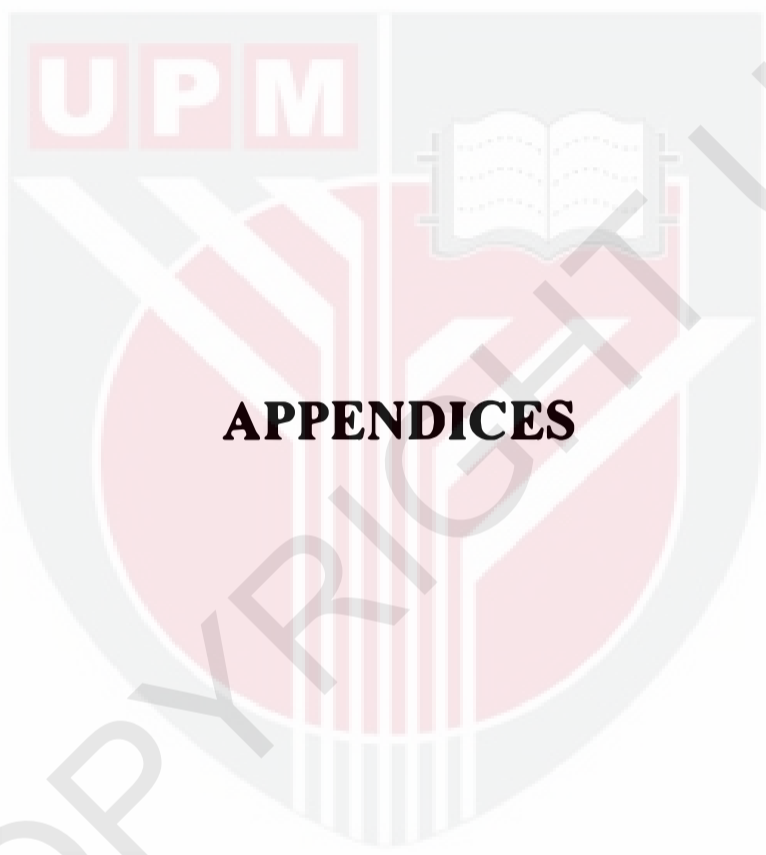
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APPENDICES

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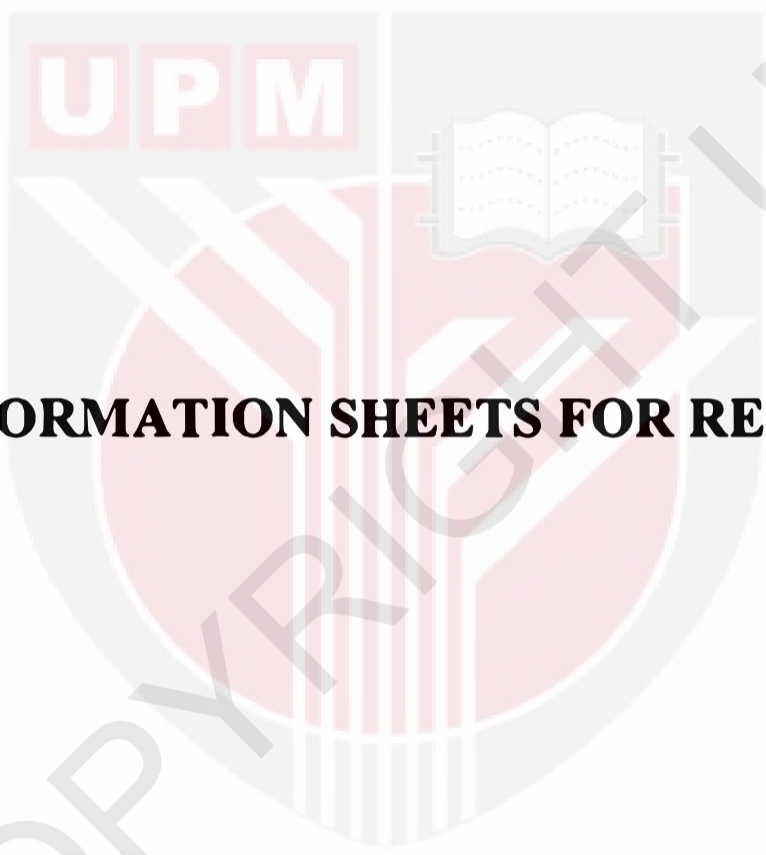


APPENDIX 1: FLOW CHART OF INSTANT NOODLE ANALYSIS



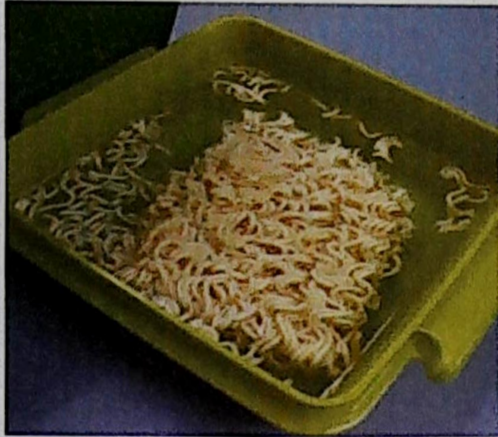
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APPENDIX 2: INFORMATION SHEETS FOR RESPONDENTS

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1. The sample of instant noodles was cleaned by using distilled water.



2. The sample was prepared by water mixed with seasoning oil and flavoring powder.



3. After that, the sample was homogenized by using food blender.

4. Then, one gram of the sample was weighted on analytical balance and placed in the crucible.



5. After that, the sample was put in the furnace. The furnace temperature was slowly increased from room temperature to 450 °C for one hour. Next, the samples were ashes in 480 °C for about four hours until a white or gray ash residue was obtained.



6. The samples were left to cool for one night in the furnace.



7. Five mL of 0.24M nitric acid (HNO_3) was added into the residue and heated slowly to dissolve the residue by using a hot plate.



8. Next, the residue was dissolved in 25ml distilled water.

9. The solution was filtered by using 0.45 μm Whatmann filter paper and transferred to a 25mL volumetric flask.



10. The final solution for the samples.

11. The lead in instant noodle samples was analyzed by using ICPMS model Perkin Elmer Elan Dre-e.



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PENYELIDIKAN MELIBATKAN MANUSIA (JKEUPM)
UNIVERSITI PUTRA MALAYSIA, 43400 UPM SERDANG,
SELANGOR, MALAYSIA**

FORM B1: RESPONDENT'S INFORMATION SHEET AND CONSENT

TITLE:

Lead Concentration in Instant Noodles and Health Risk Assessment among a Private University Students.

INTRODUCTION:

Instant noodles are widely consumed throughout the world. This is because it is convenient and easy to cook besides it easy to cook and long shelf life. However, many food products that contaminated with lead and it is unavoidable. Harmful elements like arsenic, cadmium and lead can present in instant noodles. The health of the population will be affected by the ingestion of contaminated food products by harmful elements. Excessive intake of food associated with lead can lead to cardiovascular, renal and gastrointestinal diseases.

WHAT WILL YOU HAVE TO DO?:

The respondents will be given a questionnaire form to obtain the information related with the research.

WHO SHOULD NOT PARTICIPATE IN THE STUDY?

This study does not have to be participate by respondents people who does not consume instant noodle.

WHAT WILL BE THE BENEFITS OF THE STUDY:

(a) TO YOU AS THE SUBJECT?

It will help the respondents to be aware about health effect due to acute or chronic lead poisoning and taking several measures in order to prevent from consuming food that contain high tendency of lead contamination.

(b) TO THE INVESTIGATOR

It will help the investigator to identify the risk factor associate with the lead poisoning among students and to suggest some measure which would help the students to prevent from consumption of food that contaminated by lead.

WHAT ARE THE POSSIBLE RISKS?

This study does not have any risk to the respondents because it is not involved human biological sample such as blood samples.

WILL THE INFORMATION THAT YOU PROVIDE AND YOUR IDENTITY REMAIN CONFIDENTIAL?

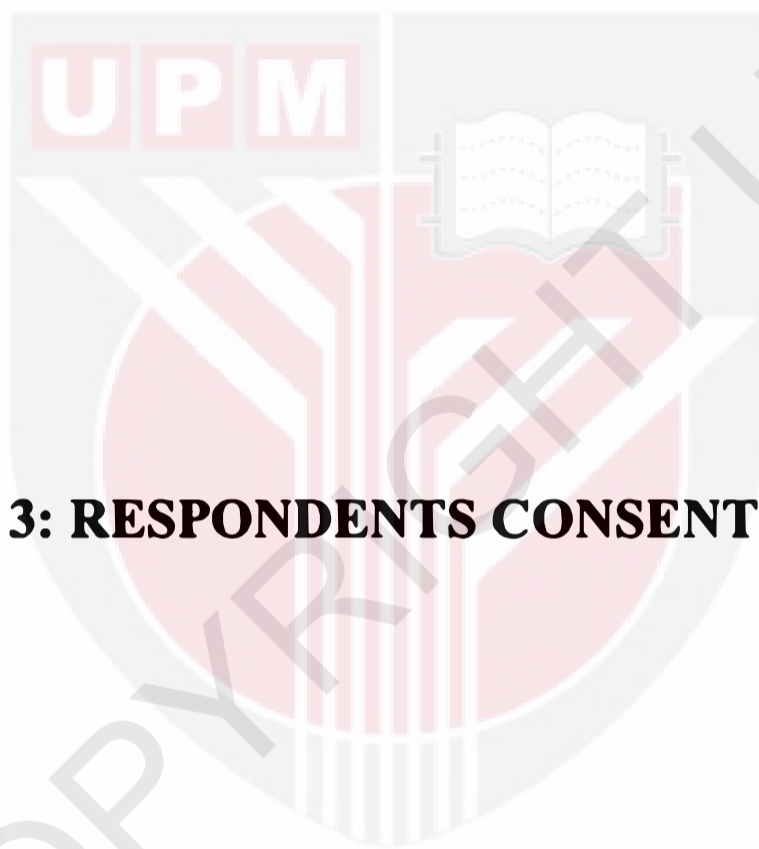
All the information about the respondent will kept confidential.

WHO SHOULD YOU CONTACT IF YOU HAVE ADDITIONAL QUESTIONS DURING THE COURSE OF THE RESEARCH?

If you have any additional questions, you may contact to Dr Saliza Bt Mohd Elias, Supervisor of the research at 0162213574 or Nur Sabrina binti Shamsani, the researcher at 0145056820.

Please initial here if you have read and understood the contents of this page _____

APPENDIX 3: RESPONDENTS CONSENT FORM



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CONSENT FORM

I Identity Card No.
address.....
.....hereby voluntarily agree to take
part in the research stated above *(clinical /drug trial/video recording/ focus group/interview-
based/ questionnaire-based).

I have been informed about the nature of the research in terms of methodology, possible adverse effects and complications (as written in the Respondent’s Information Sheet). I understand that I have the right to withdraw from this research at any time without giving any reason whatsoever. I also understand that this study is confidential and all information provided with regard to my identity will remain private and confidential.

I* wish / do not wish to know the results related to my participation in the research

I agree/do not agree that the images/photos/video recordings/voice recordings related to me be used in any form of publication or presentation (if applicable)

* delete where necessary

Signature Signature
(Respondent) (Witness)

Date : Name :

I/C No. :

I confirm that I have explained to the respondent the nature and purpose of the above-mentioned research.

Date Signature
(Researcher)



APPENDIX 4: QUESTIONNAIRES

Respondents ID

| | | |
|--|--|--|
| | | |
|--|--|--|



UPM
UNIVERSITI PUTRA MALAYSIA
BERILMU BERBAKTI

LEAD CONCENTRATION IN INSTANT NOODLES AND HEALTH RISK ASSESSMENT AMONG A PRIVATE UNIVERSITY STUDENTS.

This is the study of adversely health effect of lead contamination in instant noodle to students that is carried out at your place. It is pleasure to say that you are lucky to be selected as a respondent. Thus you are required to answer all of the question according to the instruction given. All the informations of the respondent are confidential and it is use for research purpose only.

INSTRUCTION:

1. This questionnaires contain of four (4) parts:

Part A) Socio-demographic Information

Part B) Instant Noodle Intake

Part C) Health Status

Part D) Lifestyle Information

2. Please **answer all of the questions.**
3. This questionnaire must be return back to researcher after completing.

DEPARTMENT OF ENVIRONMENTAL AND OCCUPATIONAL HEALTH

FACULTY OF MEDICINE AND HEALTH SCIENCES

UNIVERSITI PUTRA MALAYSIA

I Identity Card No.
address.....
.....hereby voluntarily agree to take
part in the research stated above ~~*(clinical /drug trial/video recording/ focus group/interview-~~
~~based/ questionnaire-based).~~

I have been informed about the nature of the research in terms of methodology, possible adverse effects and complications (as written in the Respondent's Information Sheet). I understand that I have the right to withdraw from this research at any time without giving any reason whatsoever. I also understand that this study is confidential and all information provided with regard to my identity will remain private and confidential.

I* wish / do not wish to know the results related to my participation in the research

I *agree/do not agree that the images/photos/video recordings/voice recordings related to me be used in any form of publication or presentation (if applicable)

* delete where necessary

Signature Signature
(Respondent) (Witness)

Date :..... Name :.....

I/C No. :.....

I confirm that I have explained to the respondent the nature and purpose of the above-mentioned research.

Date Signature
(Researcher)

Part A) Socio-demographic Information

1. Age : _____ years old

2. Gender:
 - (a) Male
 - (b) Female

3. Races:
 - (a) Malay
 - (b) Chinese
 - (c) Indian
 - (d) Others (Please state:.....)

4. Family income: (Please state :)
RM.....

5. Expenses for food per month: (Please state :)
RM.....

6. What is your program of study? (Please state:)
.....

Part B) Instant Noodle Intake

1. Have you ever eaten instant noodles?
 - (a) Yes
 - (b) No

2. When did you start consume instant noodles? (Please state :)
..... years old.

3. What comes first in your mind when you hear the word instant noodles?
 - (a) Noodles
 - (b) Fast food
 - (c) Snacks

(d) None of these

4. What makes you consume instant noodles? (Please tick all that apply)

- (a) Easy to get
- (b) Easy to prepare
- (c) Cheap
- (d) No food
- (e) Others (Please state:.....)

5. How frequent do you consume instant noodles in a week?

..... Times

6. What brand of instant noodles product do you consume? (Please state :)

.....

7. What size of pack do you generally purchase?

- (a) Cup
- (b) Small Packet
- (c) Family/multi packet

8. How do you prefer to eat these instant noodles?

- (a) Boiled
- (b) Fried
- (c) Straight from packet

9. Where is the source of water do you takes to prepare instant noodles?

- (a) Water cooler
- (b) Mineral water
- (c) Tap water
- (d) Others (Please state:.....)

10. Which factors are important for you while purchasing instant noodles (Please tick all that apply)

- (a) Taste
- (b) Price
- (c) Quality
- (d) Packaging
- (e) Brand
- (f) Others (Please state:.....)

11. Do you add any other ingredients during preparation of instant noodles? (examples: egg, vegetables, sauces, fish, meat, chicken)
 - (a) Yes
 - (b) No

12. Do you perceive instant noodles as a healthy product?
 - (a) Yes
 - (b) No

13. Do you recommend instant noodles to others?
 - (a) Yes
 - (b) No

14. How many packet or cup of instant noodles do you consume per meal/per intake?

..... (cup)

.....(packet)

Part C) Health Status

Please state your current weight and height:

Height: _____ cm Weight: _____ kg

1. Do you experience those symptoms (please refer symptoms below (2)) after you are consume instant noodle?
 - (a) Yes
 - (b) No

2. What are the symptoms after 20 minutes consume instant noodle? (Please tick all that apply)

| | | | |
|---------------------------------|--|-------------|--|
| Burning of the mouth and throat | | Numbness | |
| Abdominal Pain | | Chest pain | |
| Nausea | | Memory loss | |
| Vomiting | | Diarrhea | |
| Constipation | | Headache | |

If none of these, please state your current health status

- (a) Good
- (b) Poor
- (c) Others (Please state

Currently, do you have any of these diseases? (Please tick all that apply)

- (a) Memory deterioration
- (b) Kidney damage
- (c) Reduce ability to understand
- (d) High blood pressure

Do you have any PAST medical history? (Please tick all that apply)

- (a) High blood pressure
- (b) Anemia
- (c) Lung irritation
- (d) Heart disease
- (e) Kidney problem
- (f) Others (Please state:.....)

Part D) Lifestyle Information

1. Do you smoke?

- (a) Yes
- (b) No

2. What is source of your daily drinking water?

- (a) Mineral Water
- (b) Boiled from tap water
- (c) Water dispenser

3. Do you eat canned food product? (If Yes or Sometimes; please state what types of canned food product)

(a) Yes (Please state :.....)

(b) Sometimes (Please state :.....)

(c) No

4. What is the type of utensil that you use while preparing the instant noodles?

(a) Plastic

(b) Metal

(c) Glass

(d) Others (Please state:.....)

5. Do you exposed to any of these during your daily activity?

(a) Fertiliser

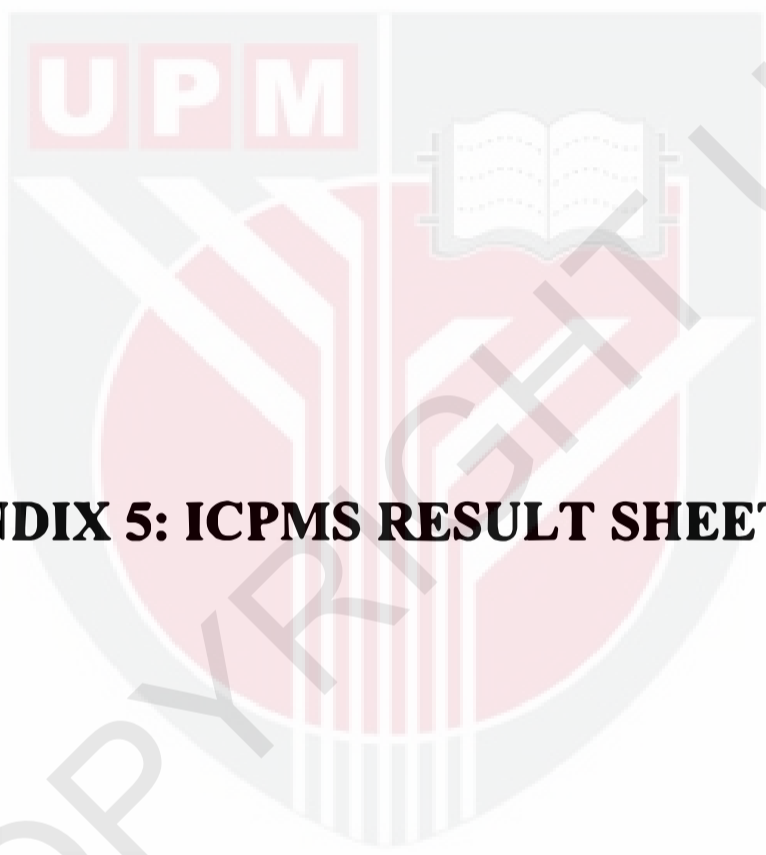
(b) Pesticide

(c) Paint

(d) None of these

Please state when did you exposed to these:.....

THANK YOU FOR YOUR COOPERATION



APPENDIX 5: ICPMS RESULT SHEETS

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ICPMS Instrumentation

The ions will be detected rather than the light that they emit. ICP-MS is an analytical technique that is used for elemental determinations. ICP-MS produces the best detection limit which is range from 1 ppt to 10 ppt. some of the advantages of ICP-MS are better or low detection limit, higher throughput, able to handle both simple and complex matrices due to high temperature and able to obtain isotopic information.



Standard Deviations

Quantitative Analysis - Summary Report

Sample ID: A

Sample Date/Time: Tuesday, February 07, 2017 10:58:33

Sample Description:

Blank File: C:\Elandata\DataSet\170207\Blank.001

Number of Replicates: 3

Sample File:

Method File: C:\Elandata\Method\Normal Analisis\2017\170207\170207 HASANAH.mth

Dataset File: C:\Elandata\DataSet\170207\A.008

Tuning File: C:\Elandata\Tuning\Default.tun

Optimization File: C:\Elandata\Optimize\Default.dac

Calibration File:

Summary

Concentration Results

| Analyte | Mass | Net Intens. | Mean | Conc. Mean | Sample Unit |
|---------|------|-------------|-----------|------------|-------------|
| As | 75 | | 250.837 | 1.919 | ppb |
| Cd | 114 | | 207.280 | 0.583 | ppb |
| Pb | 208 | | 10813.945 | 6.970 | ppb |

Replicates

Standard Deviations

Quantitative Analysis - Summary Report

Sample ID: Maggi 1 B

Sample Date/Time: Thursday, March 23, 2017 10:46:53

Sample Description:

Blank File:

Number of Replicates: 3

Sample File:

Method File: C:\Elandata\Method\Normal Analisis\2017\170228\170228 hasanah.mth

Dataset File: C:\Elandata\DataSet\170228\Maggi 1 B.028

Tuning File: C:\Elandata\Tuning\Default.tun

Optimization File: C:\Elandata\Optimize\Default.dac

Calibration File: C:\Elandata\System\2017\170228\170228.cal

Summary

Concentration Results

| Analyte | Mass | Net Intens. | Mean |
|---------|------|-------------|------|
| As | 75 | 5392.536 | |
| Cd | 114 | 7804.378 | |
| Pb | 208 | 91389.201 | |

| Conc. Mean | Sample Unit |
|------------|-------------|
| 1.036 | ppb |
| 0.747 | ppb |
| 3.960 | ppb |

Replicates



Standard Deviations

Quantitative Analysis - Summary Report

Sample ID: 2 MAGGIE C

Sample Date/Time: Thursday, March 23, 2017 10:35:52

Sample Description:

Blank File:

Number of Replicates: 3

Sample File:

Method File: C:\Elandata\Method\Normal Analisis\2017\170228\170228 hasanah.mth

Dataset File: C:\Elandata\DataSet\170228\2 MAGGIE C.023

Tuning File: C:\Elandata\Tuning\Default.tun

Optimization File: C:\Elandata\Optimize\Default.dac

Calibration File: C:\Elandata\System\2017\170228\170228.cal

Summary

Concentration Results

| Analyte | Mass | Net Intens. | Mean | Conc. Mean | Sample Unit |
|---------|------|-------------|------|------------|-------------|
| As | 75 | 4973.123 | | 0.955 | ppb |
| Cd | 114 | 5361.523 | | 0.513 | ppb |
| Pb | 208 | 73642.452 | | 3.191 | ppb |

Replicates

Standard Deviations

Quantitative Analysis - Summary Report

Sample ID: Mi Sedap 1 D

Sample Date/Time: Thursday, March 23, 2017 10:32:19

Sample Description:

Blank File:

Number of Replicates: 3

Sample File:

Method File: C:\Elandata\Method\Normal Analisis\2017\170228\170228 hasanah.mth

Dataset File: C:\Elandata\DataSet\170228\Mi Sedap 1 D.021

Tuning File: C:\Elandata\Tuning\Default.tun

Optimization File: C:\Elandata\Optimize\Default.dac

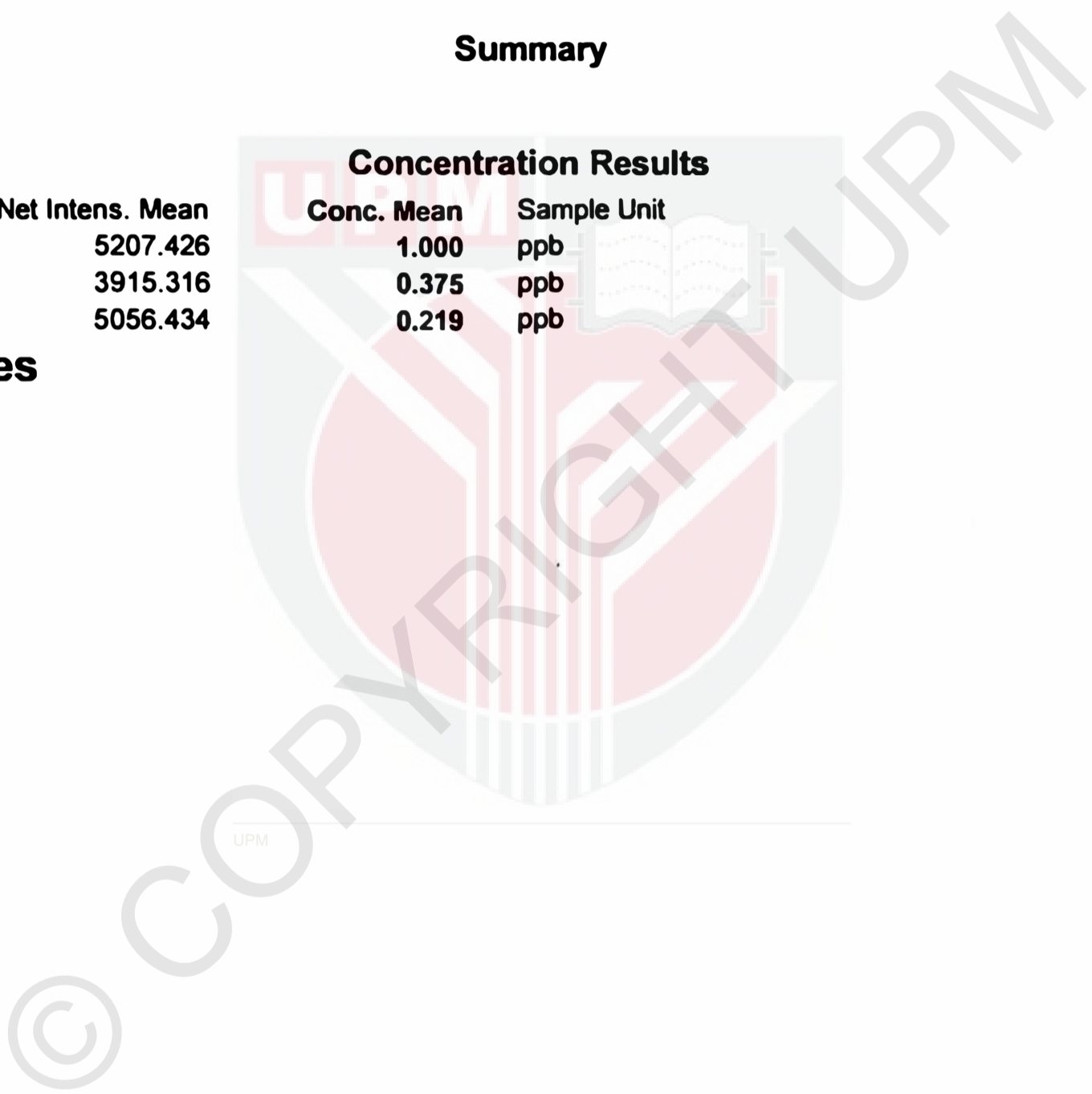
Calibration File: C:\Elandata\System\2017\170228\170228.cal

Summary

Concentration Results

| Analyte | Mass | Net Intens. | Mean | Conc. Mean | Sample Unit |
|---------|------|-------------|------|------------|-------------|
| As | 75 | 5207.426 | | 1.000 | ppb |
| Cd | 114 | 3915.316 | | 0.375 | ppb |
| Pb | 208 | 5056.434 | | 0.219 | ppb |

Replicates



Standard Deviations

Quantitative Analysis - Summary Report

Sample ID: MI SEDAP 2 E

Sample Date/Time: Thursday, March 23, 2017 10:44:13

Sample Description:

Blank File:

Number of Replicates: 3

Sample File:

Method File: C:\Elandata\Method\Normal Analisis\2017\170228\170228 hasanah.mth

Dataset File: C:\Elandata\DataSet\170228\MI SEDAP 2 E.027

Tuning File: C:\Elandata\Tuning\Default.tun

Optimization File: C:\Elandata\Optimize\Default.dac

Calibration File: C:\Elandata\System\2017\170228\170228.cal

Summary

| | | | Concentration Results | |
|---------|------|------------------|-----------------------|-------------|
| Analyte | Mass | Net Intens. Mean | Conc. Mean | Sample Unit |
| As | 75 | 3555.765 | 0.683 | ppb |
| Cd | 114 | 4378.322 | 0.419 | ppb |
| Pb | 208 | 8636.688 | 0.374 | ppb |

Replicates

Standard Deviations

Quantitative Analysis - Summary Report

Sample ID: Mi Sedap F

Sample Date/Time: Tuesday, February 28, 2017 12:33:41

Sample Description:

Blank File:

Number of Replicates: 3

Sample File:

Method File: C:\Elandata\Method\Normal Analisis\2017\170228\170228 hasanah.mth

Dataset File: C:\Elandata\DataSet\170228\Mi Sedap F.011

Tuning File: C:\Elandata\Tuning\Default.tun

Optimization File: C:\Elandata\Optimize\Default.dac

Calibration File: C:\Elandata\System\2017\170228\170228.cal

Summary

Concentration Results

| Analyte | Mass | Net Intens. | Mean | Conc. Mean | Sample Unit |
|---------|------|-------------|------|------------|-------------|
| As | 75 | 6165.543 | | 1.184 | ppb |
| Cd | 114 | 4675.933 | | 0.448 | ppb |
| Pb | 208 | 155320.984 | | 6.730 | ppb |

Replicates

Standard Deviations

Quantitative Analysis - Summary Report

Sample ID: Mamme 1 G

Sample Date/Time: Tuesday, February 28, 2017 12:29:52

Sample Description:

Blank File:

Number of Replicates: 3

Sample File:

Method File: C:\Elandata\Method\Normal Analisis\2017\170228\170228 hasanah.mth

Dataset File: C:\Elandata\DataSet\170228\Mamme 1 G.009

Tuning File: C:\Elandata\Tuning\Default.tun

Optimization File: C:\Elandata\Optimize\Default.dac

Calibration File: C:\Elandata\System\2017\170228\170228.cal

Summary

Concentration Results

| Analyte | Mass | Net Intens. | Mean |
|---------|------|-------------|------|
| As | 75 | 9186.483 | |
| Cd | 114 | 3104.256 | |
| Pb | 208 | 100032.333 | |

| Conc. Mean | Sample Unit |
|------------|-------------|
| 1.765 | ppb |
| 0.297 | ppb |
| 4.334 | ppb |

Replicates

Standard Deviations

Quantitative Analysis - Summary Report

Sample ID: Mami 2 H

Sample Date/Time: Tuesday, February 28, 2017 12:35:23

Sample Description:

Blank File:

Number of Replicates: 3

Sample File:

Method File: C:\Elandata\Method\Normal Analisis\2017\170228\170228 hasanah.mth

Dataset File: C:\Elandata\DataSet\170228\Mami 2 H.012

Tuning File: C:\Elandata\Tuning\Default.tun

Optimization File: C:\Elandata\Optimize\Default.dac

Calibration File: C:\Elandata\System\2017\170228\170228.cal

Summary

Concentration Results

| Analyte | Mass | Net Intens. | Mean |
|---------|------|-------------|------|
| As | 75 | 5603.502 | |
| Cd | 114 | 2392.856 | |
| Pb | 208 | 90296.951 | |

| Conc. Mean | Sample Unit |
|------------|-------------|
| 1.076 | ppb |
| 0.229 | ppb |
| 3.913 | ppb |

Replicates

Standard Deviations

Quantitative Analysis - Summary Report

Sample ID: Mamme 3 1

Sample Date/Time: Tuesday, February 28, 2017 12:31:35

Sample Description:

Blank File:

Number of Replicates: 3

Sample File:

Method File: C:\Elandata\Method\Normal Analisis\2017\170228\170228 hasanah.mth

Dataset File: C:\Elandata\DataSet\170228\Mamme 3 1.010

Tuning File: C:\Elandata\Tuning\Default.tun

Optimization File: C:\Elandata\Optimize\Default.dac

Calibration File: C:\Elandata\System\2017\170228\170228.cal

Summary

Concentration Results

| Analyte | Mass | Net Intens. | Mean |
|---------|------|-------------|------|
| As | 75 | 6394.871 | |
| Cd | 114 | 2584.148 | |
| Pb | 208 | 88397.445 | |

| Conc. Mean | Sample Unit |
|------------|-------------|
| 1.228 | ppb |
| 0.247 | ppb |
| 3.830 | ppb |

Replicates

Standard Deviations

Quantitative Analysis - Summary Report

Sample ID: Ruski 1 J

Sample Date/Time: Tuesday, February 28, 2017 12:42:33

Sample Description:

Blank File:

Number of Replicates: 3

Sample File:

Method File: C:\Elandata\Method\Normal Analisis\2017\170228\170228 hasanah.mth

Dataset File: C:\Elandata\DataSet\170228\Ruski 1 J.016

Tuning File: C:\Elandata\Tuning\Default.tun

Optimization File: C:\Elandata\Optimize\Default.dac

Calibration File: C:\Elandata\System\2017\170228\170228.cal

Summary

Concentration Results

| Analyte | Mass | Net Intens. | Mean | Conc. Mean | Sample Unit |
|---------|------|-------------|----------|------------|-------------|
| As | 75 | | 5519.281 | 1.060 | ppb |
| Cd | 114 | | 2177.411 | 0.208 | ppb |
| Pb | 208 | | 8006.063 | 0.347 | ppb |

Replicates

Standard Deviations

Quantitative Analysis - Summary Report

Sample ID: Ruski 2 K

Sample Date/Time: Tuesday, February 28, 2017 12:39:07

Sample Description:

Blank File:

Number of Replicates: 3

Sample File:

Method File: C:\Elandata\Method\Normal Analisis\2017\170228\170228 hasanah.mth

Dataset File: C:\Elandata\DataSet\170228\Ruski 2 K.014

Tuning File: C:\Elandata\Tuning\Default.tun

Optimization File: C:\Elandata\Optimize\Default.dac

Calibration File: C:\Elandata\System\2017\170228\170228.cal

Summary

Concentration Results

| Analyte | Mass | Net Intens. | Mean | Conc. Mean | Sample Unit |
|---------|------|-------------|------|------------|-------------|
| As | 75 | 5556.805 | | 1.067 | ppb |
| Cd | 114 | 1493.406 | | 0.143 | ppb |
| Pb | 208 | 13706.229 | | 0.594 | ppb |

Replicates

Standard Deviations

Quantitative Analysis - Summary Report

Sample ID: Ruski 3 L

Sample Date/Time: Tuesday, February 28, 2017 12:44:15

Sample Description:

Blank File:

Number of Replicates: 3

Sample File:

Method File: C:\Elandata\Method\Normal Analisis\2017\170228\170228 hasanah.mth

Dataset File: C:\Elandata\DataSet\170228\Ruski 3 L.017

Tuning File: C:\Elandata\Tuning\Default.tun

Optimization File: C:\Elandata\Optimize\Default.dac

Calibration File: C:\Elandata\System\2017\170228\170228.cal

Summary

Concentration Results

| Analyte | Mass | Net Intens. | Mean | Conc. Mean | Sample Unit |
|---------|------|-------------|------|------------|-------------|
| As | 75 | 6342.335 | | 1.218 | ppb |
| Cd | 114 | 1335.072 | | 0.128 | ppb |
| Pb | 208 | 7865.938 | | 0.341 | ppb |

Replicates

Standard Deviations

Quantitative Analysis - Summary Report

Sample ID: Ramen 1 M

Sample Date/Time: Tuesday, February 28, 2017 12:37:25

Sample Description:

Blank File:

Number of Replicates: 3

Sample File:

Method File: C:\Elandata\Method\Normal Analisis\2017\170228\170228 hasanah.mth

Dataset File: C:\Elandata\DataSet\170228\Ramen 1 M.013

Tuning File: C:\Elandata\Tuning\Default.tun

Optimization File: C:\Elandata\Optimize\Default.dac

Calibration File: C:\Elandata\System\2017\170228\170228.cal

Summary

Concentration Results

| Analyte | Mass | Net Intens. | Mean | Conc. Mean | Sample Unit |
|---------|------|-------------|------|------------|-------------|
| As | 75 | 6288.962 | | 1.208 | ppb |
| Cd | 114 | 2333.862 | | 0.223 | ppb |
| Pb | 208 | 12621.322 | | 0.547 | ppb |

Replicates

Standard Deviations

Quantitative Analysis - Summary Report

Sample ID: Ramen 2 N

Sample Date/Time: Tuesday, February 28, 2017 12:40:50

Sample Description:

Blank File:

Number of Replicates: 3

Sample File:

Method File: C:\Elandata\Method\Normal Analisis\2017\170228\170228 hasanah.mth

Dataset File: C:\Elandata\DataSet\170228\Ramen 2 N.015

Tuning File: C:\Elandata\Tuning\Default.tun

Optimization File: C:\Elandata\Optimize\Default.dac

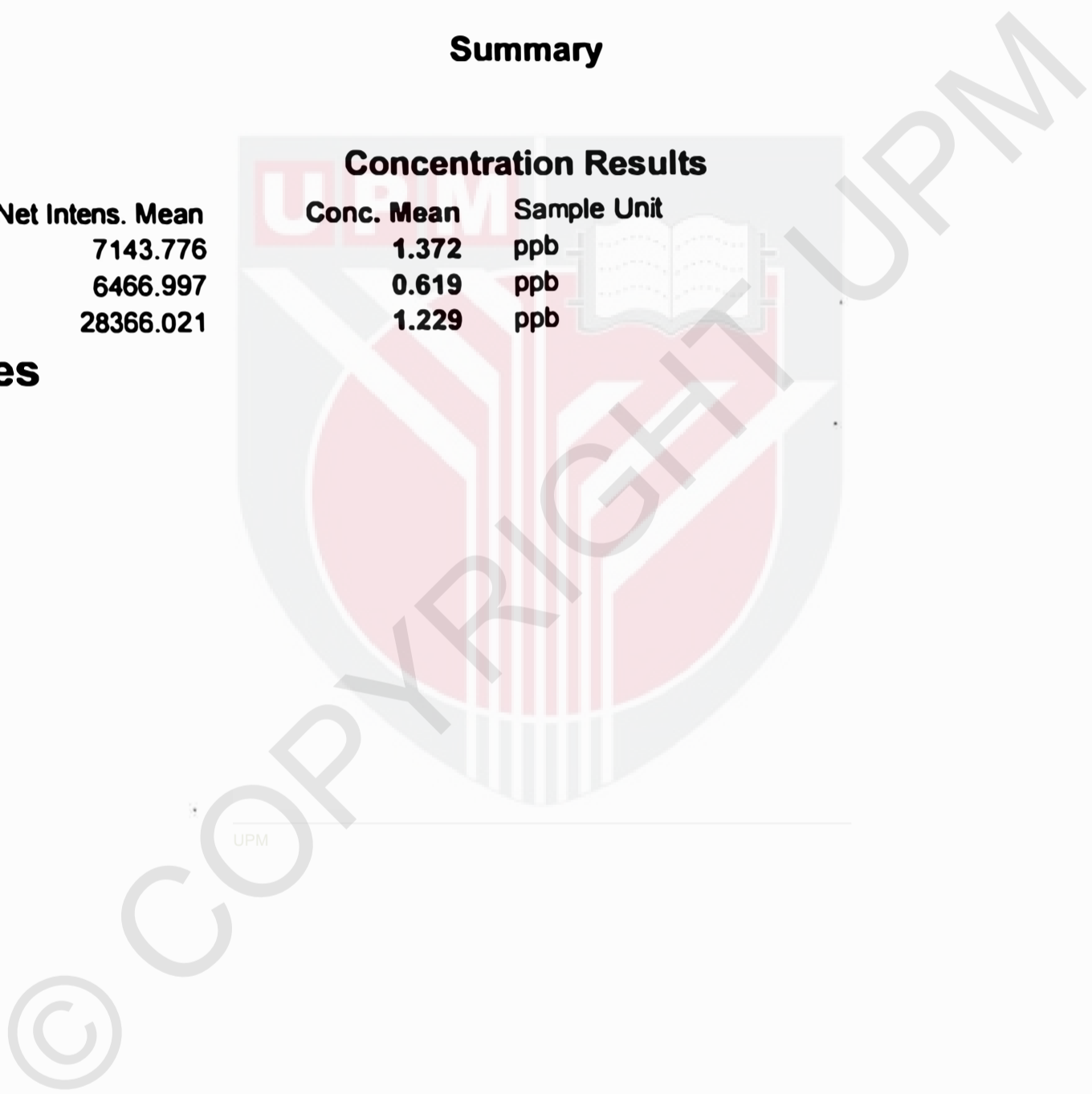
Calibration File: C:\Elandata\System\2017\170228\170228.cal

Summary

Concentration Results

| Analyte | Mass | Net Intens. | Mean | Conc. Mean | Sample Unit |
|---------|------|-------------|------|------------|-------------|
| As | 75 | 7143.776 | | 1.372 | ppb |
| Cd | 114 | 6466.997 | | 0.619 | ppb |
| Pb | 208 | 28366.021 | | 1.229 | ppb |

Replicates



Standard Deviations

Quantitative Analysis - Summary Report

Sample ID: Ramen 3 O

Sample Date/Time: Tuesday, February 28, 2017 12:45:58

Sample Description:

Blank File:

Number of Replicates: 3

Sample File:

Method File: C:\Elandata\Method\Normal Analysis\2017\170228\170228 hasanah.mth

Dataset File: C:\Elandata\DataSet\170228\Ramen 3 O.018

Tuning File: C:\Elandata\Tuning\Default.tun

Optimization File: C:\Elandata\Optimize\Default.dac

Calibration File: C:\Elandata\System\2017\170228\170228.cal

Summary

Concentration Results

| Analyte | Mass | Net Intens. | Mean | Conc. Mean | Sample Unit |
|---------|------|-------------|-----------|------------|-------------|
| As | 75 | | 6234.758 | 1.198 | ppb |
| Cd | 114 | | 2158.843 | 0.207 | ppb |
| Pb | 208 | | 11414.720 | 0.495 | ppb |

Replicates

Standard Deviations

Quantitative Analysis - Summary Report

Sample ID: CINTAN 1 P

Sample Date/Time: Thursday, March 23, 2017 10:34:02

Sample Description:

Blank File:

Number of Replicates: 3

Sample File:

Method File: C:\Elandata\Method\Normal Analisis\2017\170228\170228 hasanah.mth

Dataset File: C:\Elandata\DataSet\170228\CINTAN 1 P.022

Tuning File: C:\Elandata\Tuning\Default.tun

Optimization File: C:\Elandata\Optimize\Default.dac

Calibration File: C:\Elandata\System\2017\170228\170228.cal

Summary

Concentration Results

| Analyte | Mass | Net Intens. | Mean |
|---------|------|-------------|------|
| As | 75 | 4572.904 | |
| Cd | 114 | 1146.392 | |
| Pb | 208 | 22435.342 | |

| Conc. Mean | Sample Unit |
|------------|-------------|
| 0.878 | ppb |
| 0.110 | ppb |
| 0.972 | ppb |

Replicates

UPM

ID: CINTAN 1 P

Date/Time: Thursday, March 23, 2017 10:52:55

Standard Deviations

Quantitative Analysis - Summary Report

Sample ID: Q CINTAN 2

Sample Date/Time: Thursday, March 23, 2017 10:37:35

Sample Description:

Blank File:

Number of Replicates: 3

Sample File:

Method File: C:\Elandata\Method\Normal Analisis\2017\170228\170228 hasanah.mth

Dataset File: C:\Elandata\DataSet\170228\Q CINTAN 2.024

Tuning File: C:\Elandata\Tuning\Default.tun

Optimization File: C:\Elandata\Optimize\Default.dac

Calibration File: C:\Elandata\System\2017\170228\170228.cal

Summary

Concentration Results

| Analyte | Mass | Net Intens. | Mean |
|---------|------|-------------|-----------|
| | 75 | | 2928.862 |
| Cd | 114 | | 2210.783 |
| Pb | 208 | | 40528.794 |

| Conc. Mean | Sample Unit |
|------------|-------------|
| 0.563 | ppb |
| 0.212 | ppb |
| 1.756 | ppb |

Replicates

Sample ID: Q CINTAN 2

Report Date/Time: Thursday, March 23, 2017 10:52:58

Standard Deviations

Quantitative Analysis - Summary Report

Sample ID: R CINTAN 3

Sample Date/Time: Thursday, March 23, 2017 10:51:42

Sample Description:

Blank File:

Number of Replicates: 3

Sample File:

Method File: C:\Elandata\Method\Normal Analisis\2017\170228\170228 hasanah.mth

Dataset File: C:\Elandata\DataSet\170228\R CINTAN 3.030

Tuning File: C:\Elandata\Tuning\Default.tun

Optimization File: C:\Elandata\Optimize\Default.dac

Calibration File: C:\Elandata\System\2017\170228\170228.cal

Summary

Concentration Results

| Analyte | Mass | Net Intens. | Mean | Conc. Mean | Sample Unit |
|---------|------|-------------|------|------------|-------------|
| As | 75 | 2827.161 | | 0.543 | ppb |
| Cd | 114 | 1592.863 | | 0.153 | ppb |
| Pb | 208 | 45639.490 | | 1.978 | ppb |

Replicates

Standard Deviations

Quantitative Analysis - Summary Report

Sample ID: S INDO 1

Sample Date/Time: Thursday, March 23, 2017 10:41:50

Sample Description:

Blank File:

Number of Replicates: 3

Sample File:

Method File: C:\Elandata\Method\Normal Analisis\2017\170228\170228 hasanah.mth

Dataset File: C:\Elandata\DataSet\170228\S INDO 1.026

Tuning File: C:\Elandata\Tuning\Default.tun

Optimization File: C:\Elandata\Optimize\Default.dac

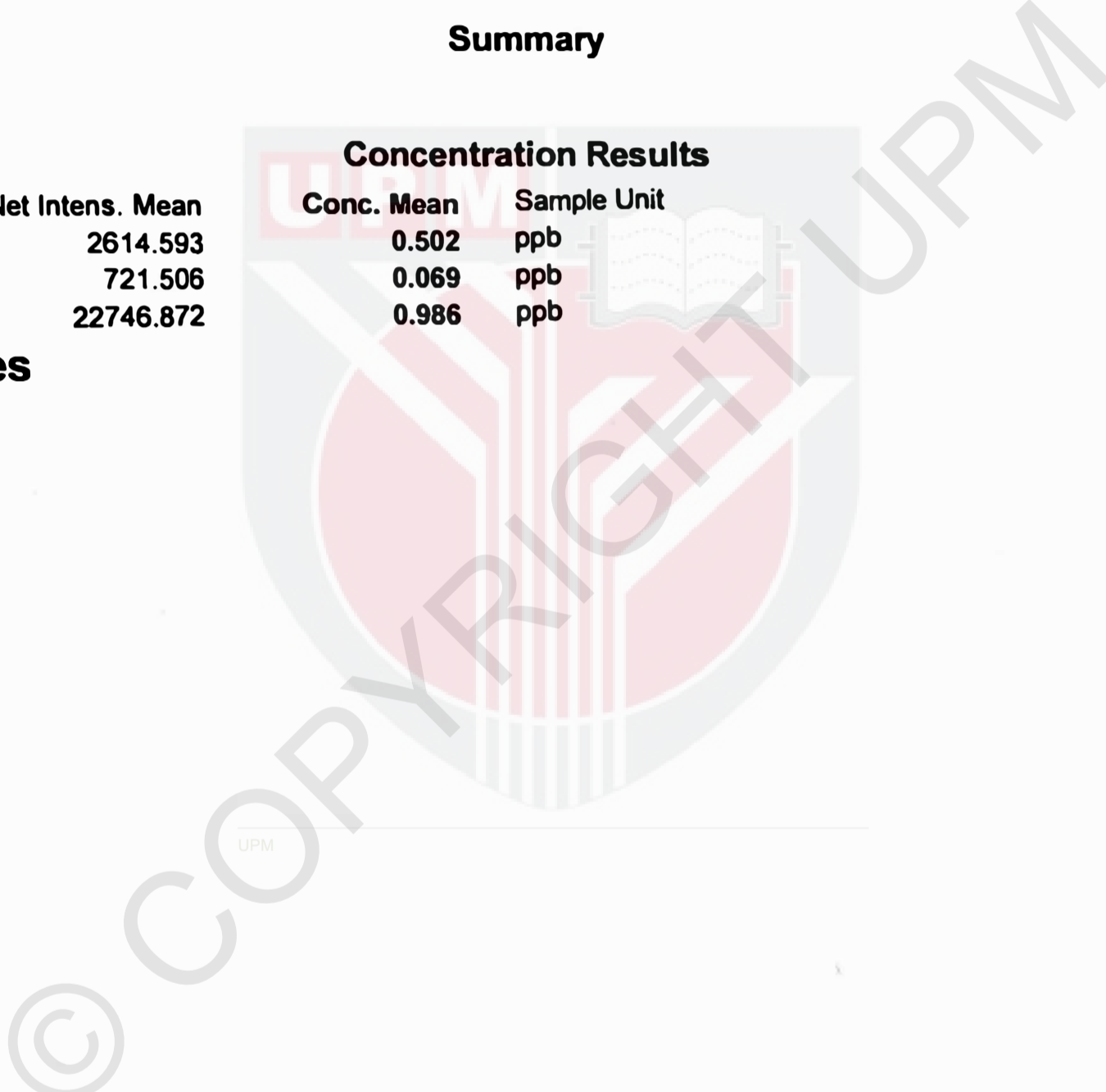
Calibration File: C:\Elandata\System\2017\170228\170228.cal

Summary

Concentration Results

| Analyte | Mass | Net Intens. | Mean | Conc. Mean | Sample Unit |
|---------|------|-------------|------|------------|-------------|
| As | 75 | 2614.593 | | 0.502 | ppb |
| Cd | 114 | 721.506 | | 0.069 | ppb |
| Pb | 208 | 22746.872 | | 0.986 | ppb |

Replicates



Standard Deviations

Quantitative Analysis - Summary Report

Sample ID: 7 INDO 2

Sample Date/Time: Thursday, March 23, 2017 10:39:18

Sample Description:

Blank File:

Number of Replicates: 3

Sample File:

Method File: C:\Elandata\Method\Normal Analisis\2017\170228\170228 hasanah.mth

Dataset File: C:\Elandata\DataSet\170228\7 INDO 2.025

Tuning File: C:\Elandata\Tuning\Default.tun

Optimization File: C:\Elandata\Optimize\Default.dac

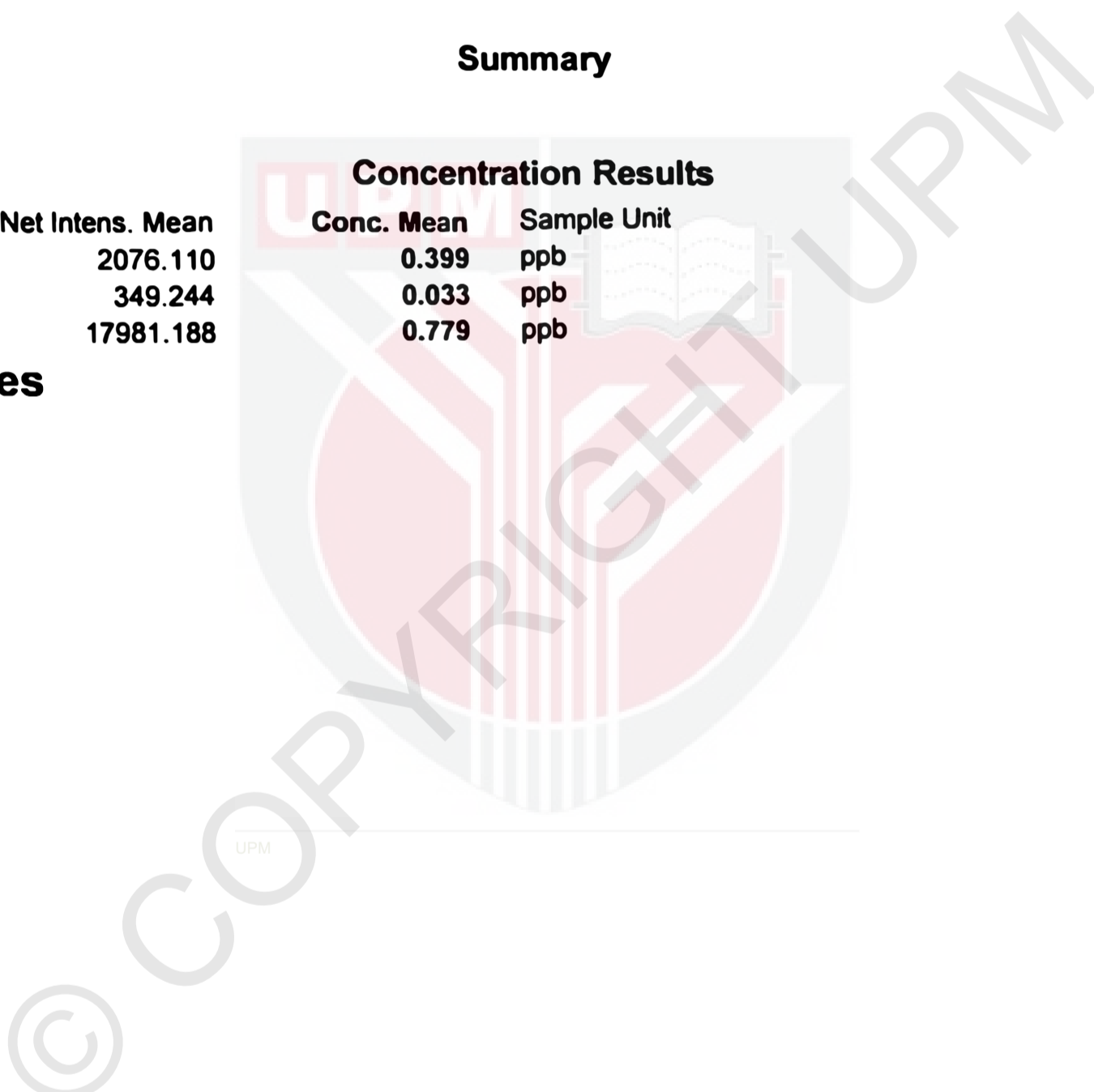
Calibration File: C:\Elandata\System\2017\170228\170228.cal

Summary

Concentration Results

| Analyte | Mass | Net Intens. | Mean | Conc. Mean | Sample Unit |
|---------|------|-------------|------|------------|-------------|
| As | 75 | 2076.110 | | 0.399 | ppb |
| Cd | 114 | 349.244 | | 0.033 | ppb |
| Pb | 208 | 17981.188 | | 0.779 | ppb |

Replicates



Standard Deviations

Quantitative Analysis - Summary Report

Sample ID: U INDOMIE 3

Sample Date/Time: Thursday, March 23, 2017 10:49:30

Sample Description:

Blank File:

Number of Replicates: 3

Sample File:

Method File: C:\Elandata\Method\Normal Analisis\2017\170228\170228 hasanah.mth

Dataset File: C:\Elandata\DataSet\170228\U INDOMIE 3.029

Tuning File: C:\Elandata\Tuning\Default.tun

Optimization File: C:\Elandata\Optimize\Default.dac

Calibration File: C:\Elandata\System\2017\170228\170228.cal

Summary

Concentration Results

| Analyte | Mass | Net Intens. | Mean | Conc. Mean | Sample Unit |
|---------|------|-------------|------|------------|-------------|
| As | 75 | 1991.090 | | 0.382 | ppb |
| Cd | 114 | 433.961 | | 0.042 | ppb |
| Pb | 208 | 23545.592 | | 1.020 | ppb |

Replicates

Standard Deviations

Quantitative Analysis - Summary Report

Sample ID: CRM

Sample Date/Time: Tuesday, February 28 2017 12:26:05

Sample Description:

Blank File:

Number of Replicates: 3

Sample File:

Method File: C:\Elandata\Method\Normal Analysis\2017\170228\170228 hasanah.mth

Dataset File: C:\Elandata\DataSet\170228\CRM.008

Tuning File: C:\Elandata\Tuning\Default.tun

Optimization File: C:\Elandata\Optimize\Default.dac

Calibration File: C:\Elandata\System\2017\170228\170228.cal

Summary

Concentration Results

| Analyte | Mass | Net Intens. Mean | Conc. Mean | Sample Unit |
|---------|------|------------------|------------|-------------|
| As | 75 | 44955.941 | 8.636 | ppb |
| Cd | 114 | 44790.542 | 4.289 | ppb |
| Pb | 208 | 361512.001 | 15.664 | ppb |

Replicates

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Calibration Report

| Analyte | Mass | Curve Type | Slope | Intercept | Corr Coeff |
|---------|---------|------------------|--------------|-----------|------------|
| As | 74.922 | Linear Thru Zero | 5205.942368 | 0.000 | 0.999756 |
| Cd | 113.904 | Linear Thru Zero | 10444.199666 | 0.000 | 0.999274 |
| Pb | 207.977 | Linear Thru Zero | 23078.544944 | 0.000 | 0.999537 |



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