UNIVERSITI PUTRA MALAYSIA

LEAD (Pb) CONCENTRATION IN SHRIMP PASTE AND HEALTH RISKASSESSMENT AMONG ADULT RESIDENTS IN TWO VILLAGES IN MELAKA

BY
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ABSTRACT

LEAD CONCENTRATION IN SHRIMP PASTE AND HEALTH RISK ASSESSMENT AMONG ADULT RESIDENTS IN TWO VILLAGES IN MELAKA

NOR AISYAH BINTI ABD RAZAK

Introduction: Shrimp paste is a product that takes the raw salted shrimp preserved through natural fermentation and extremely popular condiment used in variety of Malaysian cooking. A cross-sectional study was carried out to determine the lead concentration in shrimp paste, assess the health risk among adult residents and to determine the relationship between the frequencies of shrimp paste intake with the signs of lead poisoning and the health risk encountered by the respondents.

Method: A set of pre-tested modified version of questionnaire from Malaysian Adult Nutrition Survey 2002-2003 were used to gather information on socio-demographic, food frequency intake and possible acute and chronic signs of lead poisoning. Five shrimp paste samples were purchased from Small Medium Industries (SMIs) and homemade shrimp paste manufacturer in the study area. Lead concentration was determined by using Inductively Coupled Plasma Mass Spectrometry (ICP-MS). The health risk assessment of the respondents were indicated by the average daily dose (ADD), weekly exposure level and hazard quotient (HQ).

Results: This study found that all 5 shrimp paste samples were contained with lead ranged between 0.0625 to 0.4367 mg/kg which not exceeding the Malaysian Food Regulation 1985. The Weekly Exposure Level was not exceeded the Provisional Tolerable Weekly Intake (PTWI). The health risk assessment showed acceptable risk for ADD and HQ. There was no significant relationship between frequencies of shrimp paste intake with the signs of lead poisoning but showed a positive significant relationship with the health risk encountered by the respondents.

Conclusion: Lead were detected in shrimp paste sample but depicted acceptable risk to respondent's health. Public should take enough nutritional intake in order to increase body resistant towards heavy metal such as Pb. Nutrient such as iron, calcium and vitamin C should be taken for reducing Pb absorption in the body.

Keywords: heavy metal, shrimp paste, average daily dose, hazard quotient

ABSTRAK

KEPEKATAN PLUMBUM DALAM BELACAN DAN PENILAIAN RISIKO KESIHATAN DI KALANGAN PENDUDUK DEWASA DI DUA KAMPUNG DI MELAKA

NOR AISYAH BINTI ABD RAZAK

Pengenalan: Belacan merupakan produk yang menggunakan udang mentah yang telah diawet menggunakan garam melalui penapaian semula jadi dan merupakan perasa yang sangat terkenal yang digunakan dalam kebanyakan masakan penduduk Malaysia. Kajian keratan rentas ini dilakukan untuk menentukan kepekatan plumbum dalam belacan, menilai risiko kesihatan di kalangan penduduk dewasa dan untuk menentukan hubungan antara kekerapan pengambilan belacan dengan tanda-tanda keracunan plumbum dan risiko kesihatan yang dihadapi oleh responden.

Kaedah: Satu set soal-selidik yang telah dipra-uji dan diubahsuai daripada Kaji-selidik Pemakanan Dewasa Malaysia 2002-2003 telah digunakan untuk mengumpul maklumat berkaitan sosio-demografi, kekerapan pengambilan makanan dan tanda-tanda keracunan plumbum yang akut dan kronik. Lima sampel belacan telah diperolehi daripada Industri Kecil-Sederhana dan pembuat belacan di rumah di kawasan kajian. Kepekatan plumbum telah ditentukan dengan menggunakan Spektrometri Jisim Pasangan Plasma Induktif (ICP-MS) dan penilaian risiko kesihatan responden ditentukan oleh dos purata harian (ADD), paras pendedahan mingguan dan *hazard quotient* (HQ).

Keputusan: Kajian ini mendapati semua 5 sampel belacan mengandungi plumbum dengan julat antara 0.0625 hingga 0.4367 mg/kg yang tidak melebihi Peraturan Makanan Malaysia 1985. Paras pendedahan mingguan adalah tidak melebihi Pengambilan Mingguan Sementara yang dibenarkan. Penilaian risiko kesihatan menunjukkan ADD dan HQ adalah boleh diterima. Tiada hubungan yang signifikan antara kekerapan pengambilan belacan dengan tanda-tanda keracunan plumbum tetapi menunjukkan hubungan positif yang signifikan dengan risiko kesihatan yang dihadapi oleh responden.

Kesimpulan: Plumbum ditemui di dalam belacan walaupun risiko kesihatan yang dihadapi oleh responden adalah boleh diterima. Pengambilan nutrisi yang mencukupi perlulah diambil untuk meningkatkan ketahanan badan terhadap logam berat seperti plumbum. Nutrisi seperti zat besi, kalsium dan vitamin C perlu diambil bagi mengurangkan penyerapan plumbum dalam badan.

Kata Kunci : logam berat, belacan, dos purata harian, *hazard quotient*

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LIST OF ACRONYMS AND ABBREVIATIONS

Pb	Lead
ATSDR	Agency for Toxic Substances and Disease Registry
EFSA	European Food Safety Authority
IARC	International Agency for Research on Cancer
ADD	Average Daily Dose
HI	Hazard Index
USEPA	United States Environmental Protection Agency
SMI	Small Medium Industry
ICP-MS	Inductively Couple Plasma Mass Spectrometry
RfD	Reference Dose
AOAC	Association of Official Analytical Chemistry
PTWI	Provisional Tolerable Weekly Intake

CHAPTER 1

INTRODUCTION

1. 1 Background

Traditional foods reflect cultural inheritance and have influenced human dietary patterns (Trichopoulou *et. al.*, 2007). Shrimp paste is one of traditional ferment food which is an extremely popular condiment used in a great variety of Malaysian cooking (Figure 1.1). It comes in the form of a pressed brick or cake and the unique thing about it is that the ingredients of shrimp paste are all raw. Traditionally, they are made with a kind of very tiny shrimps, drained and salted before being left to ferment and dry in the sun. Then, they are mashed together to form a paste and fermented again and this process is repeated.

After being caught, small shrimp are unloaded, rinsed and drained before being dried. Drying can be done on plastic mats on the ground in the sun, on metal beds on low stilts, or using other methods. After several days, the shrimp-salt mixture will darken and turn into a thick pulp.

If the shrimp used to produce the paste were small, it is ready to be served as soon as the individual shrimp have decayed beyond recognition. If the shrimp are larger, fermentation will take longer and the pulp will be ground to provide a smoother consistency. The fermentation or grinding process is usually repeated several times until the paste fully matures. The paste is then dried and cut into bricks by the villagers to be sold. Dried shrimp paste does not require refrigeration.

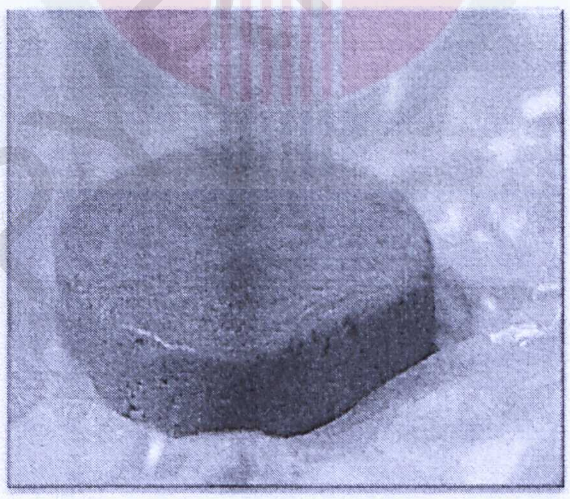

Figure 1.1 : Shrimp paste

1.2 Problem Statement

Lead (Pb) is a heavy, low melting, bluish-gray metal that occurs naturally in the earth's crust (ATSDR, 2007). Referring to European Food Safety Authority, EFSA (2010) Pb is a natural environmental contaminant, but its ubiquitous occurrence results, to a great extent, from anthropogenic activities including mining and smelting, soldering, battery manufacturing, ammunition, metal water pipes, and particularly the use in the past of Pb in paint and petrol.

International Agency for Research on Cancer (IARC) classified Pb as a possible human carcinogen based on sufficient animal data and insufficient human data in 1987 (IARC, 2006). Since then a few studies have been published, the overall evidence for Pb as a carcinogen being only weak, the most likely candidates are lung cancer, stomach cancer and gliomas (Jarup, 2003).

Human exposure to Pb can occur *via* food, water, air, soil and dust. Food is the major source of exposure to Pb (EFSA, 2010). The health risk arising from environmental contaminants depends on many factors including absorption and toxicity of the substance, its level in food, the quantity of contaminated food consumed and duration of exposure (Smirjakova *et. al.*, 2005).

Heavy metals such as Pb have long been recognized as an important pollutant due to their toxicity and ability to accumulate in marine organisms. In general, metals such as Pb is biologically non-essential, non-biodegradable, persistent type of toxic metals, and can easily accumulated in the sediments and in the aquatic flora and fauna (by bioaccumulation and biomagnification), thus causing a gross biological impact (Jatindra and Bakhta, 2010).

In this regard, due to raw ingredients of shrimp paste, which is the small tiny shrimp which will be rinsed and dried directly in the sun, contamination by some heavy metal contaminant might occur. These contaminants may come from many sources such as may easily absorb pollutants from the ambient water and from their food or pollutants from the air while drying the shrimp paste in direct sunlight and then deposit them in the body tissue of the shrimp.

In addition, shipping in the Malacca Strait might promote and contribute more Pb metal pollution from industrial wastewater. In addition, the metals Pb and other elements such as Zn and Cu are used in the manufacture of anti-rust paint and coatings to prevent attacks as algae that grow on the ship, which is also likely the cause of this contamination (Tukimat *et. al.*, 2006).

Moreover, Pb can give several health effects on human. Adverse health effects from prolonged exposure to high amounts of Pb from occupational and environmental exposure including interfere with hemoglobin biosynthesis, poor intention span, headache, kidney damage, and loss of memory and gonad dysfunction.

1.3 Study Justification

The Pb concentration determination was conducted on shrimp paste as the major ingredient is the shrimp. Several aquatic organisms such as shrimp have the ability to bio-accumulate heavy metals to a very toxic level. The impacts of these metals have not only limited the productivity and reproduction capabilities of these organisms, but ultimately affect human population due to the food chain relationship (Ololade *et. al.,* 2008).

Besides, the manufacturer usually used the old tiny shrimp to make the shrimp paste while the new shrimp will be use as the ingredients for the other popular condiment in Melaka which is the "cencaluk" or shrimp sauce. Some contamination may occur during the process of drying and storage of the tiny shrimp before further use as main ingredient in shrimp paste.

Pb was choose as the trace elements in this study as according EFSA (2010) Pb is commonly present in food and is regulated as a contaminant. Under certain environmental conditions, this heavy metals might accumulate up to a toxic concentration and cause ecological damage (Sivaperumal *et. al.,* 2007).

Normally, the tiny shrimp can be obtained directly from the fishery activities. The source of the tiny shrimp will usually obtain in the Straits of Malacca area. According to (Abdullah *et. al.*, 1999) the Straits of Malacca is subjected to a great variety of pollutants due to its strategic location as a major international shipping lane and the concentration of agriculture, industry and urbanization on the west coast of Peninsular Malaysia. Trace elements such Pb may contaminate the shrimp collected. The Straits of Malacca also is one of the busiest shipping routes in the world, resulting the level of heavy metals be potentially high besides the various industrial activities along the West Region of Peninsular Malaysia (Alina *et. al.,* 2011). In addition, Melaka is the main production area for the making of shrimp paste.

Traditional foods are usually products made of specific raw materials created from recipes which have been known for a long time (Cayot, 2007), and the processing methods have been passed down from generation to generation by word of mouth (Trichopoulou *et. al.*, 2006). Shrimp paste is an heritage from generation to generation. Due to this matter, sometimes the hygiene and the quality of the processing method is neglected and possible contamination may be occur.

Most study were conducted only on determination heavy metal in food whereas less were focus on health risk assessment in human. This health risk assessment were conducted to quantify the probability of a harmful effect of Pb to the study populations.

The aim of this study was to determine the Pb concentration in shrimp paste sample and to estimate health risk assessment indicated by Average Daily Dose (ADD) and Hazard Quotient (HQ) to the referred population group.

1.4 Conceptual Framework

Figure 1.2 shows the conceptual framework which the highlighted area indicated the study scope employ in the study. The figure shows the process of trace element Pb entering to human body from the aquatic environment. Environmental pollution can lead to contamination of Pb as it can be accumulate in the marine fauna especially shrimp.

Then, the contaminated shrimp will be used as the main ingredient in human food products. This may affect human health as it may accumulate in the target organ and can cause diseases. To determine whether Pb poses a significant risk to human health and, if so, under what circumstances, risk assessment is being conducted. Risk assessment methods can also be used to estimate the increased risk of adverse ecological effects due to toxic pollutants in the environment

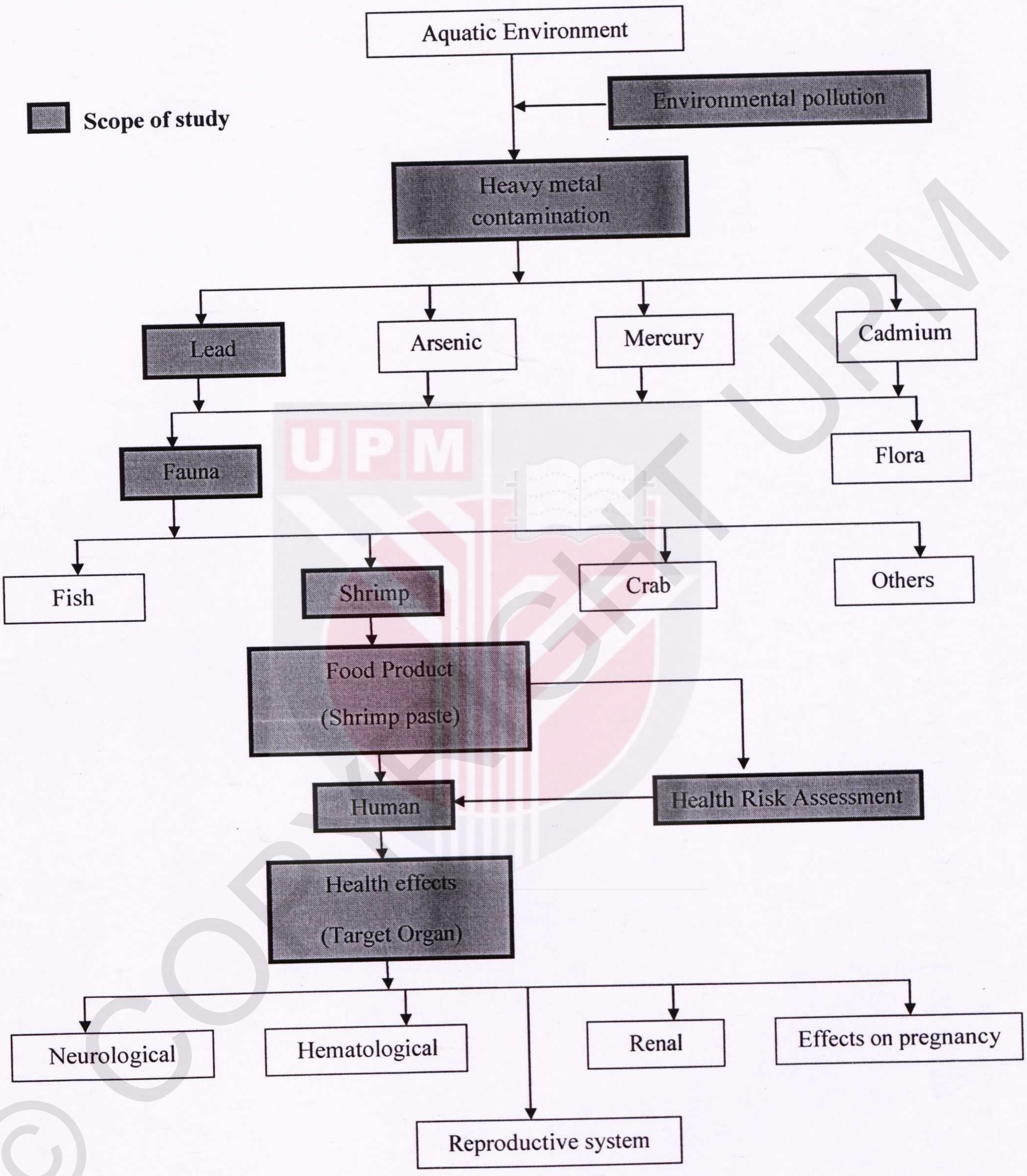

Figure 1.2 : Conceptual framework of Pb contamination from aquatic environment to human

1.5 Definition

1.5.1 Conceptual Definition

Shrimp paste

According to Leong *et. al.* (2009) shrimp paste or 'belacan' as it is called in Bahasa Malaysia is a popular food ingredient in Malaysia. It is made from fresh tiny shrimps known as 'geragau'. Traditionally, 'belacan' is used as a food enhancer in countless Malaysian dishes. In addition it could also be mixed with chilies, lime and some other ingredients as a dipping condiment known as 'sambal belacan' that is well liked by Malaysians. 'Belacan' is commonly sold in dried blocks that range in color from pink to dark brown. Generally, belacan is roasted prior to usage, either wrapped in foil and dry-roasted in a wok, toasted over a gas flame on the back of a spoon or by using a fork.

Pb concentration

Consideration of Pb intake by man must take into account other routes in addition to ingestion in food. Air contains concentrations of Pb that vary with the degree of urbanization and industrial pollution. Therefore, in the course of respiration Pb is inhaled and some of it is then absorbed into the body. Similarly, drinking water may contain concentrations of Pb which differ according to geographical location (ATSDR, 2007). Thus food, water and air contribute to the total intake of Pb, and their relative importance with respect to the resulting body burden of Pb depends on the proportion of Pb retained in the body from each source (JECFA, 1972).

Health Risk Assessment

Health risk assessment is the process of quantifying the probability of a harmful effect to individuals or populations from certain human activities. The risk assessment process is typically described as consisting of four basic steps: hazard identification, exposure assessment, dose-response assessment, and risk characterization (USEPA, 2005).

Adult

Malaysian Adult Age Act 1971 has defined adult age in Malaysia is 18 years and above. Norimah *et. al.* (2008) define adult population in Malaysia as 18 – 59 years old.

1.5.2 Operational Definition

Shrimp paste

The shrimp paste sample were purchased from Melaka which is the main production and distribution centre for shrimp paste. All shrimp paste samples were purchased through the Small Medium Industry (SMI) and homemade shrimp paste manufacturer that were available at the study population area.

Pb concentration

The Pb concentration was determine in the shrimp paste sample and conducted by Inductively Coupled Plasma Mass Spectrometer (ICP-MS) model Perkin Elmer ELAN DRC-e. The unit used for Pb concentration in shrimp paste in this study is µg/L.

Health Risk Assessment

The Health Risk Assessment was evaluated through the Hazard Quotient (HQ) to estimate the health risk of the respondents who exposed to Pb through shrimp paste intake in their daily diet. The Hazard Quotient was obtain by dividing the Average Daily Dose (ADD) with Reference Dose (RfD). The ADD and HQ calculation is shown in the Chapter 3.

Adult

Only respondents from the aged 18 to 59 years old were recruited in the assessment.

1.6 Objectives

1.6.1 General Objective

To determine the Pb concentration in shrimp paste and health risk assessment among adult residents in two villages in Melaka.

1.6.2 Specific Objectives

1. To determine the socio-demographic data of respondents.
2. To determine the frequency of shrimp paste intake of the respondents.
3. To determine the Pb concentration in shrimp paste.
4. To determine the health risk assessment of respondents indicated by average daily dose (ADD), weekly exposure level and hazard quotient (HQ)
5. To determine the relationship between frequency intake of shrimp paste and the prevalence of acute and chronic Pb poisoning signs among respondents
6. To determine the relationship between the frequency intake of shrimp paste and health risk encountered by respondents

1.7 Hypothesis

1. There is a significant relationship between frequencies intake of shrimp paste and the prevalence of acute and chronic Pb poisoning signs among respondents
2. There is a significant relationship between the frequencies intake of shrimp paste and health risk encountered by respondents.

CHAPTER 2

LITERATURE REVIEW

2.1 Lead (Pb)

Pb is a heavy, low melting, bluish-gray metal that occurs naturally in the earth's crust. However, it is rarely found naturally as a metal. It is usually found combined with two or more other elements to form Pb compounds (ATSDR, 2007).

2.1.1 Physicochemical properties of Pb

Pb exists in three oxidation states: Pb(0), the metal; Pb(II); and Pb(IV). In the environment, Pb primarily exists as Pb(II). Pb(IV) is only formed under extremely oxidizing conditions and inorganic Pb(IV) compounds are not found under ordinary environmental conditions. While organolead(II) compounds are known, organolead chemistry is dominated by the tetravalent (+4) oxidation state. Metallic lead, Pb(0) exists in nature, but its occurrence is rare (ATSDR, 2007).

Pb is a naturally occurring element that belongs to Group 4A of the periodic table and has an atomic number of 82 and atomic mass of 207.2 g/mol. It is a silver-bluish white metal that is found in small amounts in the earth's crust although it is rarely found naturally as a metal. Usually it is found combined with two or more other elements to form Pb compounds. It is highly malleable, ductile and a relatively poor conductor of electricity. Pb is very resistant to corrosion but tarnishes upon exposure to air (Korn *et. al.,* 2006).

Regardless of the form, however, Pb in the environment is not degraded and will remain available for the exposures (National Institute of Environmental Health Sciences, 2011). This may be the main reasons why Pb is well recognized as heavy metal toxic to human and hazardous to environment.

2.2 Sources of Pb Pollution In The Environment

2.2.1 Natural Sources

According to Iqbal (2006) the natural sources of Pb in environment includes weathering and erosion of Pb containing materials, resulting in Pb being incorporated into soils, leached into water, taken up by plants and windblown into the atmosphere. Other natural sources of atmosphere Pb include volcanic eruption, sea spray and emission by plants, and forest fires. Although estimation on natural sources Pb contribution may be vary, it is indicate a small amount of Pb originates from natural sources compared to anthropogenic source.

2.2.2 Anthropogenic Sources

Pb can enter the environment through releases from mining Pb and other metals, and from factories that make or use Pb, Pb alloys, or Pb compounds. Pb is released into the air during burning coal, oil, or waste. Pb was used in the manufacture of storage batteries; Pb alloys used in bearings, brass and bronze and some solders; sheets and pipe for nuclear and x-ray shielding, cable covering, noise control materials; chemical resistant linings; ammunition; and pigments and Pb compounds used in glass making, ceramic glazes, plastic stabilizers, caulk, and paints (ATSDR, 2007).

2.3 Pb Concentration In Food

2.3.1 Foreign studies

Rice samples were contaminated by lead detected in a study conducted in Northern Iran (Bakhtiarian *et. al.*, 2001) and in Taiwan (Lin *et. al.*, 2004).In Poland, vegetables, cereal products and meat products contributed most to Pb dietary exposure, representing close to 90 % of the total (Marzec and Zawadzka, 2004).

Study conducted by Chove *et. al.* (2006) found that Chinese cabbage and pumpkin leaves from Mazimbu and Towelo were contaminated by Pb. Makokha *et. al.* (2008) were also found vegetables sample contaminated with Pb. Some of the vegetables are onions, Cowpea leaves, Amaranthus, Solanum nigrum and tomatoes. Some fruits such as local guava and mango were also found contaminated with Pb.

A study conducted by Mahakarnchanakul *et. al.* (2010) on Pb investigation in ready to eat food was also that the Pb contained in the food were not fulfil the standard of Thailand Food Drug Administration. The contamination may comes from raw material, soil, water, air, plant and animal. Improper food handling and selling beside sidewalk with heavily traffic may lead to heavy metal contamination.

2.3.2 Local studies

Studies conducted in Kuala Kemaman, Terengganu found metal intake through seafood in a day is 0.003 mg / day (Tukimat *et. al.,* 2002).

Alina *et. al.* (2011) was conducted a study of Pb in selected marine fish and shellfish along the Straits of Malacca. The highest level of Pb was observed in cuttlefish at 0.33 ± 0.00 μg/ g wet weight of sample while the highest level was in Japanese threadfin bream at 0.39 ± 0.01 μg/ g wet weight of sample.

Shariff *et. al.* (2008) in previous local study on toxicological evaluation of some locally processed raw food products was found that shrimp paste were contaminated with some heavy metal. A study conducted by the Division of Human Nutrition, Institute for Medical Research, Malaysia was once completed a study of lead level in a variety of local foodstuffs. A mean of 1.93 mg/kg of lead were found in two shrimp paste sample collected (Siti *et. al.*, 1987).

2.4 Pb Contamination Outcomes

The effects of Pb are well documented and identify a wide range of possible clinical condition which often making medical diagnosis difficult (Hayes and Skubala, 2009). Pb is considered as a non-carcinogen hazard. Adverse health effects from prolonged exposure to high amounts of Pb from occupational and environmental exposure including: interfere with hemoglobin biosynthesis, poor intention span, headache, kidney damage, loss of memory and gonad dysfunction

2.4.1 Neurological

Refering to ESFA (2010), in humans, the central nervous system is the main target organ for Pb toxicity. In adults, Pb associated neurotoxicity was found to affect central information processing, especially for visuospatial organisation and short-term verbal memory, to cause psychiatric symptoms and to impair manual dexterity. There is considerable evidence demonstrating that the developing brain is more vulnerable to the neurotoxicity of lead than the mature brain. In children, an elevated blood Pb level is inversely associated with a reduced Intelligence Quotient (IQ) score and reduced cognitive functions up to at least seven years of age.

2.4.2 Renal

Pb nephrotoxicity is characterized by proximal tubular nephropathy, glomerular sclerosis and interstitial fibrosis as cited by ATDSR (2007). Acute effects of exposure to high concentration of Pb resulting in proximal tubular damage manifested by glycosuria and aminoacid uria (Karthryn *et. al.,* 2000).

Functional deficits in humans that have been associated with excessive Pb exposure include enzymuria, low- and high-molecular weight proteinuria, impaired transport of organic anions and glucose, and depressed glomerular filtration rate (ATDSR, 2007).

2.4.3 Haematological

Pb has long been known to alter the haematological system. The anaemia induced by Pb is microcytic and hypochromic and results primarily from both inhibition of heme synthesis and shortening of the erythrocyte lifespan (ATDSR, 2007). Pb certainly inhibits several enzymes particularly porphobilingen synthetase and heme synthetase. Of these two, heme synthetase is of particular interest, since it is a mitochondrial bound enzyme, suggesting the possibility that Pb inhibits this enzyme simply by altering mitochondrial function rather than by specifically altering the enzyme (Karthryn *et. al.,* 2000).

2.4.4 Reproductive system

The available evidence suggest that occupational and environmental exposure resulting in moderately high Pb might result in abortion and pre-term delivery in women, and in alterations in sperm and decreased fertility in men (ATDSR, 2007).

Investigation of reproductive effects of Pb have most recently focused on male reproductive toxicity (Karthryn *et. al.,* 2000). In addition, the study also concluded that when blood Pb concentration exceed 40µ/dL , then appear to be associate decrease in sperm count, volume, mortality and morphological alternation.

2.4.5 Effects on pregnancy

The explanation from Katharina (2003) did mention pregnancy can enhances the mobilization of Pb from maternal bone, thus exposing the fetus to increased risk of toxicity. The effects of Pb on pregnancy and the fetus are complex and understood incompletely. Maternal Pb exposure has been linked to congenital malformations, intrauterine growth restriction, preterm delivery, preeclampsia, and fetal neurotoxicity .

2.5 Adult

Malaysian Adult Age Act 1971 has defined adult age in Malaysia is 18 years and above. Norimah *et. al.* (2008) define adult population in Malaysia as 18 – 59 years old.

2.6 Health Risk Assessment

Health risk assessments are used to determine if a particular chemical poses a significant risk to human health and, if so, under what circumstances (Office of Environmental Health Hazard Assessment, 2001). Risk assessment methods can also be used to estimate increased risk of adverse ecological effects due to toxic pollutants in the environment. There are four steps to assess risk assessment which are hazard identification, dose-response assessment, exposure assessment, and risk characterization (Boguski, 2010).

2.6.1 Hazard Identification

Hazard identification is defined as a process of determining whether human exposure to an agent could cause an increase in the incidence of health condition or whether exposure by non human receptor might adversely affected. It involves characterizing the nature and strength of the evidence of causation (Paustenbach, 1989).

2.6.2 Dose-response assessment

Dose-response assessment is the process of characterizing the relationship between the dose of an agent administered or received and the incidence of an adverse health effect in exposed populations and estimating the incidence of the effect as a function of exposure to the agent. This process considers such important factors as intensity of exposure, age pattern of exposure and possibly other variables that might affect response, such as sex, lifestyle and other modifying factors (Paustenbach, 1989).

2.6.3 Exposure assessment

According to Paustenbach (1989), exposure assessment is the process of measuring or estimating intensity, frequency, and duration of human exposure to an agent currently present in the environment or of estimating hypothetical exposures that might arise from the release of new chemicals into the environment. An exposure assessment should describe the magnitude, duration, schedule and route of exposure; the size, nature and classes of the human, animal, aquatic or wildlife populations exposed; and the uncertainties in all estimates.

2.6.4 Risk characterization

It is the process of estimating the incidence of a health effect under the various conditions of human or animal exposure described in the exposure assessment. It is performed by combining the exposure and dose-response assessments. The summary effects of the uncertainties in the preceding steps should be described in this step (Paustenbach, 1989).

CHAPTER 3

METHODOLOGY

3.1 Study Location

The study was taken place in Melaka Tengah district in Melaka which involved Kampung Pinang in DUN Klebang and Kampung Pantai Rombang in DUN Pantai Kundur.

3.2 Study Design

This was a cross-sectional study which was conducted within 9 months from October 2011 until June 2012.

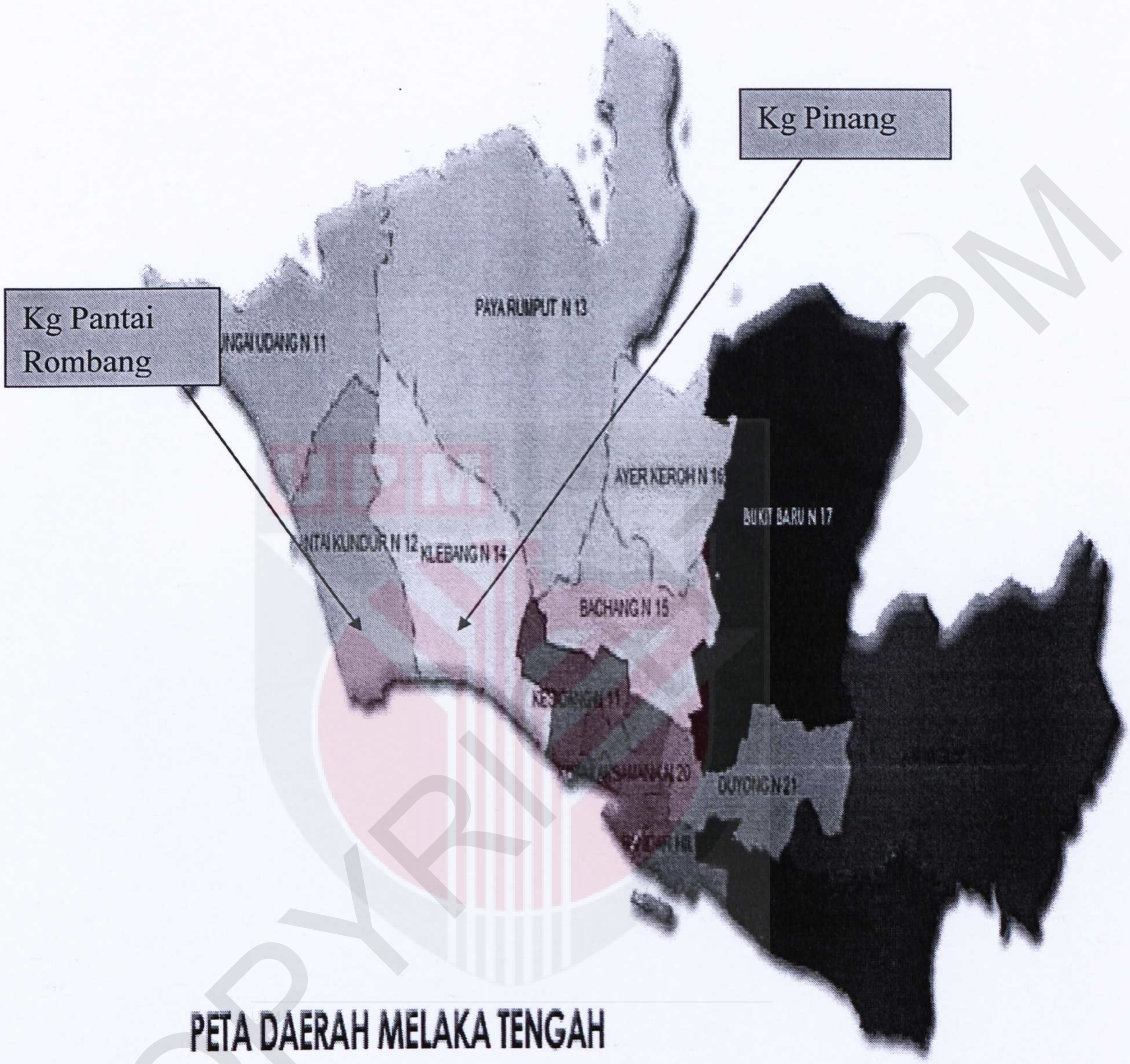

Figure 3.1 : The map of Melaka Tengah District

Source: Official website of Pejabat Daerah & Tanah Melaka Tengah (2011)

3.3 Sampling Method

Purposive sampling method was used in this study to choose the study location which take place in Melaka. Population in Melaka were chosen as they are living in the main production area of shrimp paste and assuming the population will consume shrimp paste in their daily diet. From the chosen population, respondents were pooled to form a random sample.

3.4 Study Population

3.4.1 Study Sample

The study sample were those who has fulfil the inclusive criteria and living in the selected area, which are Kg. Pinang and Kg. Pantai Rombang. The inclusive criteria includes; adult respondents which age range from 18-59 years old and were those who consume shrimp paste in their daily diet.

3.4.2 Sample Size

The sample size of this study was determined to be 10% from the total population for each village. The total population of Kg. Pinang and Kg. Pantai Rombang is 1050 and 1010 respectively.

According to Neuman (1997), 10% of the populations will be taken as the sample size if the total population was more than 1000 and less than 10 000 populations.

There for the sample size of Kg Pinang was:

$$\frac{\mathbf{10\ X\ 1050}}{\mathbf{100}} = \mathbf{105}$$

For the sample size of Kg Pantai Rombang was:

$$\frac{\mathbf{10\ X\ 1010}}{\mathbf{100}} = \mathbf{101}$$

3.5 Data Collection And Instrumentation

3.5.1 Data Collection Flow

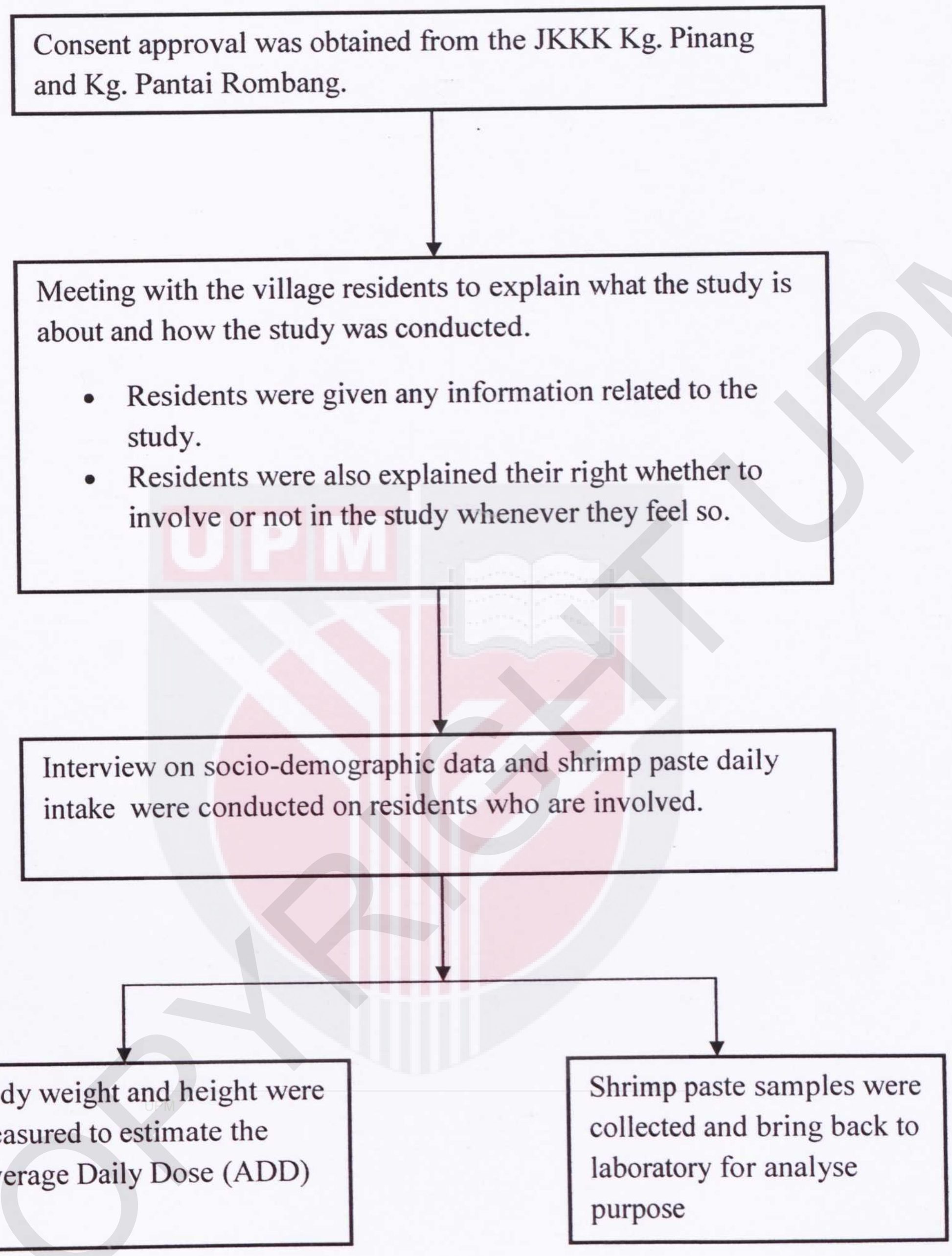

Figure 3.2 : Data collection flow of Pb concentration in shrimp paste and health risk assessment among adult residents in two villages in Melaka.

3.5.2 Potential exposure to Pb

A set of pre-tested modified version of questionnaire from Malaysian Adult Nutrition Survey 2002-2003 (Norimah *et. al.*, 2008) were used to gather information on background information potential exposure to Pb from the respondents (Appendix 3). The questionnaires consist of 5 parts which were background information, health information, anthropometric measurement, food frequency intake and sources of other exposure.

Part 1: Background Information

Socio-demographic factors was required to determine the status of the respondents including the age, sex, race and income per household.

Part 2: Health Information

Some questions on the health condition of the respondents were asked if there is possibility for the respondents to have the signs and symptoms of Pb toxicity.

Part 3: Anthropometric Measurement

The anthropometric measurement such as body weight and height were taken to estimate the Average Daily Dose (ADD) on each respondent.

Part 4: Food Frequency Intake

The frequency of food intake were asked in the questionnaire to recall what kind of food that the respondents eat. This is to estimate the frequency of other food and shrimp paste consumption in every meal. The quantity of other type of food and shrimp paste intake were also asked in the questionnaire based on the household measurement in the unit of gram(g).

Part 5: Sources of Other Exposure

The exposure to Pb from other sources was determined through questions referring to the water sources, occupational exposure and lifestyle behaviour through smoking and alcohol consumption among the respondents.

3.5.3 Pb Concentration in Shrimp Paste

Shrimp paste sample

The shrimp paste samples were purchased from Melaka which was the main production and distribution centre for shrimp paste. All shrimp paste samples were purchased through the Small Medium Industry (SMI) and homemade shrimp paste manufacturer that is available at the study population area.

Extraction of Shrimp paste sample

The extraction of shrimp paste sample was conducted by using dry ashing method modified from the AOAC Official Method 999.11 (AOAC, 2006) and the method used by Hseu (2004). One gram of sample in a crucible was placed in a preheated muffle furnace at 200-250 ºC for 30 min, and then ashed for 4 hour at 480 ºC. Then, the sample was removed from the furnace and cooled down; 2ml of 5 M HNO3 was added and evaporated to dryness on a water bath. Next, the sample was placed in a cool furnace and heated to 400 ºC for 15 min, before being removed (from the furnace, cooled and moistened with four drops of distilled water). Next, 2ml of concentrated HCl was added and the sampel was evaporated to dryness, removed, and then 5ml of 2 M HCl was added and again swirled. The solution was filtered through Whatman No.42 filter paper and <0.45 µm Milipore filter paper, and then transferred quantitatively to 125ml volumetric flask by adding distilled water. This method was using the ash from food after doing the burning process (Appendix 4).

The purpose of this method is to segregate the organic compound and the inorganic compound which is the metal. This method was using the ash from food after doing the burning process. The burning process of shrimp paste should not exceed the temperature of 650°C because at this temperature the inorganic metal will be volatilize and the ash from shrimp paste will be destroy.

Pb Concentration Determination

The concern with possible heavy metal contamination of food has created a need for analytical methodology to detect these metals in trace amounts. Several techniques, including the inductively coupled plasma (ICP) (Durali *et. al.,* 2007) have been proposed for the determination of trace element in different samples because of their sensitivity, high precision and accuracy, and also wide availability of instruments.

The Pb concentration in shrimp paste was determine using Inductively Coupled Plasma Mass Spectrometer (ICP-MS) model Perkin Elmer ELAN DRC-e in the unit of µg/L (Figure 3.3). The ICP-MS was under the following operation conditions; plasma gas flow rate was 17.0 l/min and auxiliary gas flow rate was 1.20 l/min. Argon was employed as the plasma gas. The selected isotopes was ^{208}Pb. Pb was determined by the calibration curve method with one blank and four standard solutions of 10 ppb, 30 ppb, 50 ppb and 100 ppb (Figure 3.4).

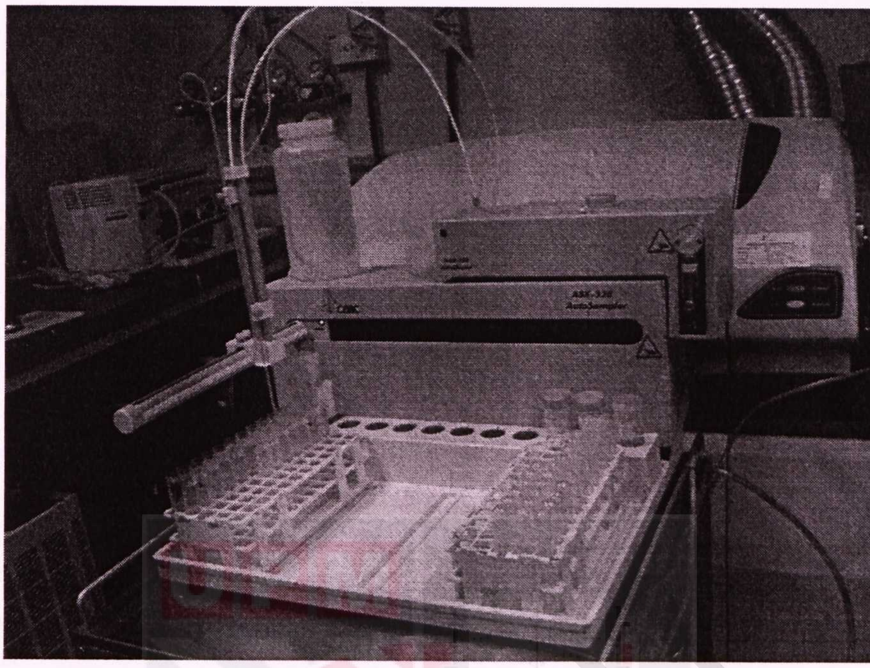

Figure 3.3 : The Inductively Coupled Plasma Mass Spectrometer (ICP-MS) model Perkin Elmer ELAN DRC-e instrument.

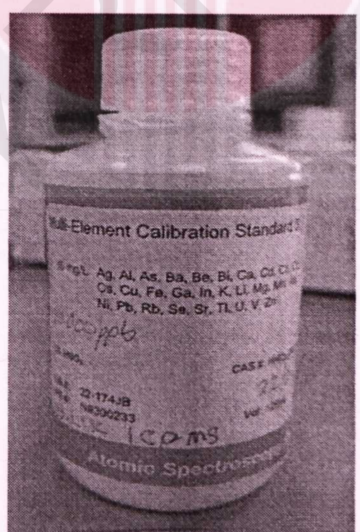

Figure 3.4 : The Multi-Element Calibration Standard Solution of ICP-MS model Perkin Elmer ELAN DRC-e.

Calculation for Pb concentration from ICP-MS

The result from ICP-MS was calculated as according the calculation stated below:

$$\textbf{Pb concentration in shrimp paste sample (mg/kg)} = (C \times B) \times \frac{A}{W}$$

Where:

C = The Pb concentration in the extract (µg/ml)

B = Dilution factor (4)

A = The volume of extract (60 ml)

W = Weight of the sample (10 g)

3.5.4 Average Daily Dose (ADD) and Hazard Quotient (HQ)

The Health Risk Assessment was evaluated through Average Daily Dose (ADD) and Hazard Quotient (HQ). According to Lushenko (2010) the calculation for ADD is as stated below:

$$\textbf{Average Daily Dose (mg/kg-day)} = \frac{\textbf{(C x IR x EF x ED)}}{\textbf{(BW x AT)}}$$

Where:

C = Total lead concentration in shrimp paste (mg/kg)

IR = Ingestion rate of shrimp paste (kg/day)

EF = Exposure frequency (days/years)

ED = Exposure duration (years)

BW = Body weight (kg)

AT = Averaging time (days)

Values of these input variables, specific to each participant, was used to estimate the subject's individual weekly exposure level. For the public health risk assessment of shrimp paste consumption, the ADD was multiplied by seven to obtain a weekly exposure level (FEHD, 2005) and was compared to the Provisional Tolerable Weekly Intake (PTWI).

The non-carcinogenic hazard quotient was also determined. The mean concentrations of Pb in all shrimp paste sample were determined and were used to calculate the non-carcinogenic hazard quotient, according to Lushenko (2010) :

$$\textbf{Hazard Quotient} = \frac{\textbf{ADD}}{\textbf{Oral RfD}}$$

Where:

Hazard Quotient	=	Non-cancer Hazard Quotient of a health effect from intake of lead.
ADD	=	Average Daily Dose
Oral RfD	=	Oral Reference dose of lead (mg/kg-day)

For non-carcinogens such as Pb, the chronic daily intake was compared to the reference dose (RfD) and if the ADD:RfD ratio is greater than 1, the exposure may pose a health risk. When the intake or dose is equal to the reference dose the HQ is one. When the intake exceeds the reference dose and thus the HQ is greater than or equal to one it is probably that non-carcinogenic adverse health effects will be observed (Lushenko, 2010). Oral reference dose (RfD) value use in this study was referred to 0.0035 mg/kg of body weight per day equivalent to PTWI of 0.025 mg of Pb per kg of body weight (World Health Organization, 2000).

3.6 Quality Control

3.6.1 Standard Operating Procedure (SOP)

The analysis of shrimp paste sample using Inductively Coupled Plasma Mass Spectrometer (ICP-MS) model Perkin Elmer ELAN DRC-e follow the standard operating procedures as given by the manufacturer and daily performance report of the ICP-MS were run. The reason of following the SOPs was to minimize analytical errors. A calibration curve approximately 1 was obtained prior to analysis of shrimp paste samples so that the absorption of Pb atom become more accurate.

3.6.2 Glassware Apparatus

All glassware used in this study were washed with detergent, soaked in nitric acid and rinsed in deionise water to minimize and prohibit external metal contamination.

3.6.3 Pre Test

Pre test of questionnaire was conducted for 10% (20 respondents) of sample size before data collection to ensure that every question ask in questionnaires was understandable and could be answer by the respondents. It was conducted based on voluntary basis on Tanjung Sedili residents in Johor.

3.7 Data Analysis

All data was analysed using the 19th version of Statistical Package for Social Science (SPSS) software. Descriptive analysis was used to describe the background information, shrimp paste frequency intake, frequency of top 10 daily consumed foods, Pb concentration in shrimp paste and the health risk assessment of the respondents.

Next, bivariat analysis was done to determine the relationship between two tested variables which were the frequency intake of shrimp paste and prevalence of acute and chronic poisoning signs among respondents. In this study, Chi-Square test was conducted to test the first hypothesis listed in the introduction

Then, Spearman Rho test was conducted to test the second hypothesis. The two tested variables were the frequency intake of shrimp paste and the health risk encountered by the respondents. A p-value of < 0.05 was considered as statistically significant.

3.8 Ethical Concern

All respondents were briefed about the study and were asked to participate in the study on a voluntary basis. Consent forms were given to be read and signed. All respondents were given a choice to continue participating in the study or to pull out at any time they choose to do so. Finally all the information about the respondents and the shrimp paste production that was involved in this research remains confidential. The study had the approval from the Medical Research Ethics Committee of Faculty of Medicine and Health Sciences, Universiti Putra Malaysia (UPM) prior to data collection.

CHAPTER 4

RESULTS

4.1 Socio-demographic data

The socio-demographic data of the respondents was shown in the table 4.1. Out of 151 total respondents, 63% which equal to 95 respondents were female while another 37% were male respondents. All of the respondents were Malays except for only one Chinese respondent.

The highest number of respondents occupied the age range between 55-59 which was a total of 40 respondents equals to 26.5% while the lowest number of respondents was in age group range from 18-19 years old with only 4 respondents. The mean of the respondents' age were 43 ± 13 years old.

A total of 71.5% respondents had total household income over RM720 and 28.5% respondents for total household income for less than RM720. The mean and standard deviation for total household income was RM 1044 ± 712 with range from RM200 to RM7000.

Most of respondents at about 47.7% equals to 72 out of 151 respondents had a normal BMI, 51 overweight, 24 obese and 4 were underweight. The mean BMI of the respondents was 25.46 ± 5.09. The range for the BMI of the respondents was from 13.45 kg to 45.28 kg.

For educational level of the respondents, the mean and standard deviation was 3.78 ± 1.69. The most respondents went for SPM for about 37.7% and the lowest number of respondents fall under Sijil/STPM/Matriculation with 7.3%.

Table 4.1: The socio demographic information of respondents (N=151)

Variable	N	%	Mean ± S.d	Range
Gender :				
Male	56	37		
Female	95	63		
Race:				
Malay	150	99		
Chinese	1	1		
Age group (years)				
18-19	4	2.6		
20-24	6	4.0		
25-29	24	15.9		
30-34	17	11.3		
35-39	10	6.6	43 ± 13	18-59
40-44	17	11.3		
45-49	12	7.9		
50-54	21	13.9		
55-59	40	26.5		
Household income:				
< 720	43	28.5	1044 ± 712	200-7000
≥ 720	108	71.5		
BMI (kg/m^2) :				
<18.5 (under weight)	4	2.6		
18.5 – 24.9 (normal)	72	47.7	25.46 ± 5.09	13.45-45.28
25-29.9 (overweight)	51	33.8		
30≥(obese)	24	15.9		
Education Level				
Never attend school	17	11.3		
UPSR	19	12.6		
PMR	21	13.9		
SPM	57	37.7	3.78 ± 1.69	
Sijil/STPM/Matriculatic	11	7.3		
Diploma	12	7.9		
Degree	14	9.3		

4.2 Shrimp paste consumption

Table 4.2 shows the shrimp paste consumption pattern among the respondents. The shrimp paste consumption were categorized into frequent (everyday and 2-6 times per week) and less frequent consumption (once a week, 2-3 times per month, once a month and seldom). Nearly 78% of the respondents were frequently consumed shrimp paste. The rest of the respondents either consumed shrimp paste once a week, 2-3 times per month, once a month and seldom. A clearer difference in frequency of shrimp paste intake was shown in Figure 4.1.

Table 4.2: The frequency of shrimp paste consumption among the respondents (N=151)

Frequency	N	%
Everyday	58	38.4
2-6 times a week	60	39.6
Once a week	8	5.3
2-3 times a month	9	6.0
Once a month	8	5.3
Seldom	8	5.3

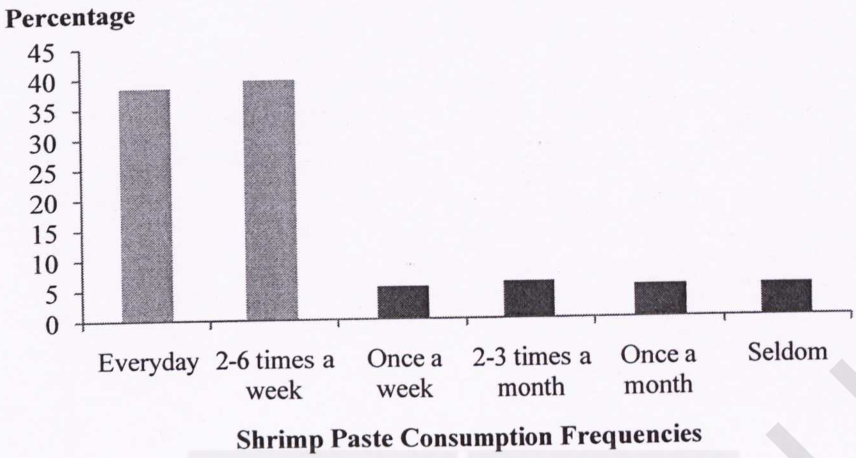

Figure 4.1 The shrimp paste frequency intake among the respondents

4.3 Other possible exposures of Pb

Table 4.3 shows the prevalence and mean frequency of the top 10 daily consumed foods by the respondents. Generally most of the respondents consumed rice as well as sugar. The other eight food items eaten daily but by a smaller portion were green leafy vegetables, fish to anchovies. All these food items were consumed at least once a day, in amounts ranging from one cup, one piece to one tablespoon.

Other possible exposures were shown in Table 4.4. Most of the respondent use tap water than using well water as domestic water sources. A total of 72.8 % respondents were not smoking, 22.5 % were smokers while 4.6 % had quit smoking.

Table 4.3: Prevalence and mean frequency of top 10 daily consumed foods

Types of foods	Prevalence who answered daily consumption (%)	Mean frequency per day	Total amount daily consumed
Rice	99.3	1.9	2 scoops
Sugar	97.4	1.6	1 teaspoon
Green Leafy vegetables	84.1	1.5	1 cup
Fish	71.6	1.2	1 piece
Cabbages	67.6	1.1	1 cup
Bitter / pumpkin / cucumber	65.6	1.1	1 cup
Legumes	60.2	1.0	1 cup
Root vegetables	58.9	1.0	1 cup
Local salads (*Ulam*)	53.6	1.0	1 cup
Anchovies	31.7	0.4	1 tablespoon

Table 4.4: The other possible exposure of Pb by the respondents (N=151)

Variables	N	%
Water Sources		
Tap Water	148	98.0
Well Water	3	2.0
Smoking Habits		
Smoking	34	22.5
Not Smoking	110	72.8
Had Quit Smoking	7	4.6

4.4 Pb concentration in shrimp paste samples

The reading of Pb concentration from ICP-MS was calculated using the equation as stated in Chapter 3. The calculation parameters for Pb concemtration from ICP-MS were shown in Table 4.5.

Table 4.5: The parameters for calculation of Pb concentration from ICP-MS

Sample	Pb concentration in the extract (μg/ml)	Dilution factor	Volume of extract (ml)	Weight of sample (g)
Sample 1	0.0625	4	60	10
Sample 2	0.4367	4	60	10
Sample 3	0.0849	4	60	10
Sample 4	0.2373	4	60	10
Sample 5	0.1113	4	60	10

The Pb concentration in each shrimp paste sample were presented in the Table 4.6. Sample 2 showed the highest abundant of Pb with the mean of 0.4367 mg/kg followed by sample 4 (0.2373 mg/kg) and sample 5 (0.1113 mg/kg). Sample 3 had a lower mean of Pb concentration which was 0.0849 mg/kg. The lowest mean of Pb concentration was in the Sample 1 which was 0.0625 mg/kg. This study found that all shrimp paste samples were contaminated with Pb. A more clearly difference of Pb concentration in Pb was shown in Figure 4.2.

Table 4.6: The Pb concentration in shrimp paste samples

Sources (Village)	Sample	Pb Concentration (mg/kg)		
		Reading 1	Reading 2	Mean
Kg Pantai Rombang	Sample 1	0.0631	0.0618	0.0625
Kg Pantai Rombang	Sample 2	0.4377	0.4357	0.4367
Kg. Pinang	Sample 3	0.0848	0.0849	0.0849
Kg. Pinang	Sample 4	0.2310	0.2436	0.2373
Kg. Pinang	Sample 5	0.1093	0.1133	0.1113

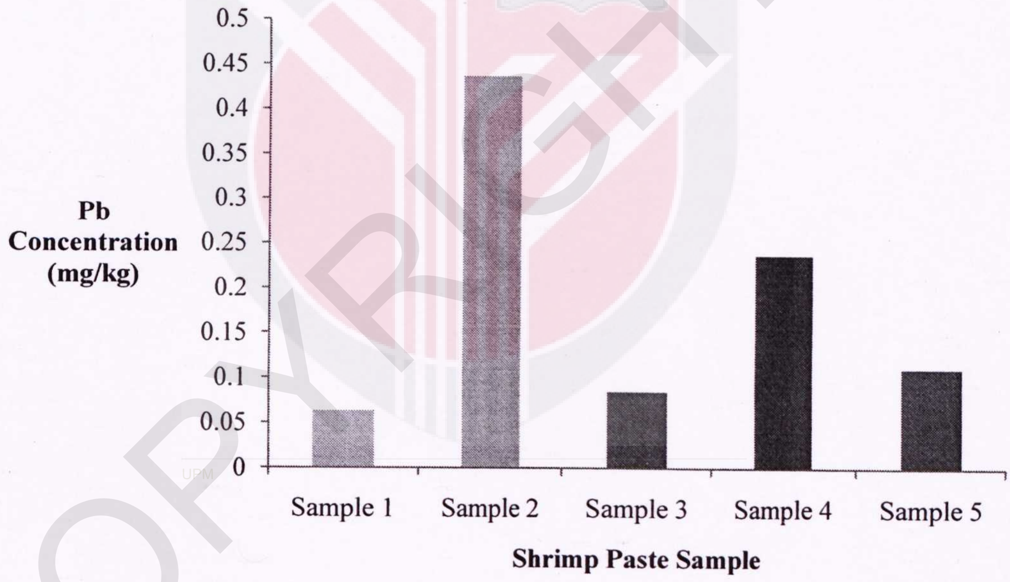

Figure 4.2 The Pb concentration in shrimp paste samples

4.5 Health risk assessment of respondents

The health risk assessment of respondents were indicated by average daily dose (ADD), weekly exposure level and hazard quotient (HQ). The calculation was based on the equation stated in the Chapter 3.

The mean for exposure frequency (EF) was 190 with standard deviation of 126 day/years. The EF had the median of 144 with the minimum EF of 1 day/years and maximum EF of 336 days/years.

The exposure duration (ED) for respondents had the mean and standard deviation of 35 ± 13 with median of 37 years. The minimum ED was 11 years while the maximum ED was 50 years.

The mean and standard deviation for respondents' body weight (BW) was 65.54 ± 13.14. The median of BW was 66.00 with minimum BW was 31.50 kg and the maximum BW was 115.00 kg.

The average daily dose (ADD) comes with the mean and standard deviation of $3.63 \times 10^{-6} \pm 2.89 \times 10^{-6}$. The median for the ADD was 3.19×10^{-6} with the minimum ADD was 2.00×10^{-8} and the maximum ADD was 1.6×10^{-5}.

Table 4.7 : The parameters for the risk assessment of the respondents indicated by the ADD

	EF (day/years)	ED (years)	BW (kg)	ADD (mg/kg)
Mean	190	35	65.54	3.63×10^{-6}
Median	144	37	66.00	3.19×10^{-6}
SD	126	13	13.14	2.89×10^{-6}
Min	1	11	31.50	0.02×10^{-6}
Max	336	50	115.00	16.0×10^{-6}

The weekly exposure level was compared to the PTWI of Pb of 0.025 mg/kg of body weight. None of the respondents were having weekly exposure level that exceeded the PTWI of Pb.

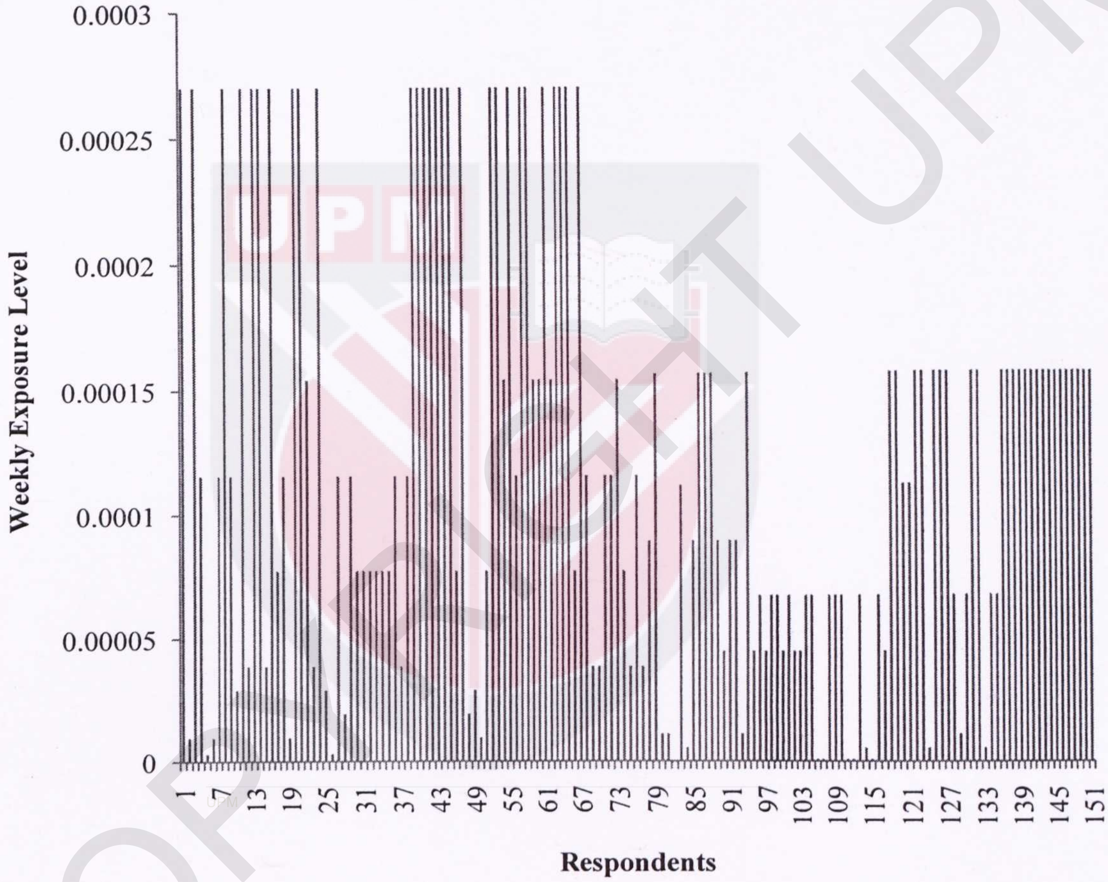

Figure 4.3 The weekly exposure level of the respondents

All of the respondents were having Hazard Quotient (HQ) that were less than 1. A HQ that is less than 1 is considered in an acceptable risk condition. Based on the weekly exposure level and the HQ, all of the respondents were in an acceptable risk condition.

Table 4.8: The risk assessment of the respondents indicated by the HQ

HI	N	%	Mean ± SD	Range
<1	151	100	$4.9 \times 10^{-3} \pm 3.6 \times 10^{-3}$	$0.0189 \times 10^{-3} \pm 11.0181 \times 10^{-3}$
≥ 1	0	0		

4.6 Relationship between frequency intake of shrimp paste and prevalence of acute and chronic lead poisoning signs.

As presented in Table 4.9, no signs and health risk showed significant association with frequency of shrimp paste intake.

Table 4.9 : The relationship between frequency intake of shrimp paste and the prevalence of acute and chronic lead poisoning signs

Symptoms		Frequency intake of shrimp paste: Frequent	Less Frequent	Total	x^2	p
Acute						
Stomach ache	Yes	11	3	14	0.002	0.968
	No	107	30	137		
Vomiting	Yes	0	2	2	0.567	0.452
	No	116	33	149		
Dizziness	Yes	37	12	49	0.295	0.587
	No	81	21	102		
Fatigue	Yes	28	9	37	0.175	0.676
	No	90	24	114		
Allergy	Yes	27	5	32	0.923	0.337
	No	91	28	119		
Hair loss	Yes	37	9	46	0.229	0.632
	No	80	24	104		
Muscle weakness	Yes	12	4	16	0.104	0.747
	No	106	29	135		
Nausea	Yes	4	0	4	1.149	0.284
	No	114	33	147		
Constipation	Yes	8	3	11	0.204	0.652
	No	110	30	140		
Chronic						
Fatigue without cause	Yes	8	1	9	0.647	0.421
	No	110	32	142		
Insomnia	Yes	21	9	30	1.455	0.228
	No	97	24	121		
Difficult to speak fluently	Yes	4	1	5	0.010	0.919
	No	114	32	146		
Poor memory	Yes	3	1	4	0.024	0.877
	No	115	32	147		
Difficult to focus	Yes	1	1	2	0.940	0.332
	No	117	32	149		

*p is significant at < 0.05

4.7 Relationship between frequency intake of shrimp paste and health risk encountered by respondents

Figure 4 shows the relationship between shrimp paste frequency intake with the health risk encountered by respondents. Spearman-Rho test revealed that there was a significant relationship with r = 0.941 ($p < 0.0001$).

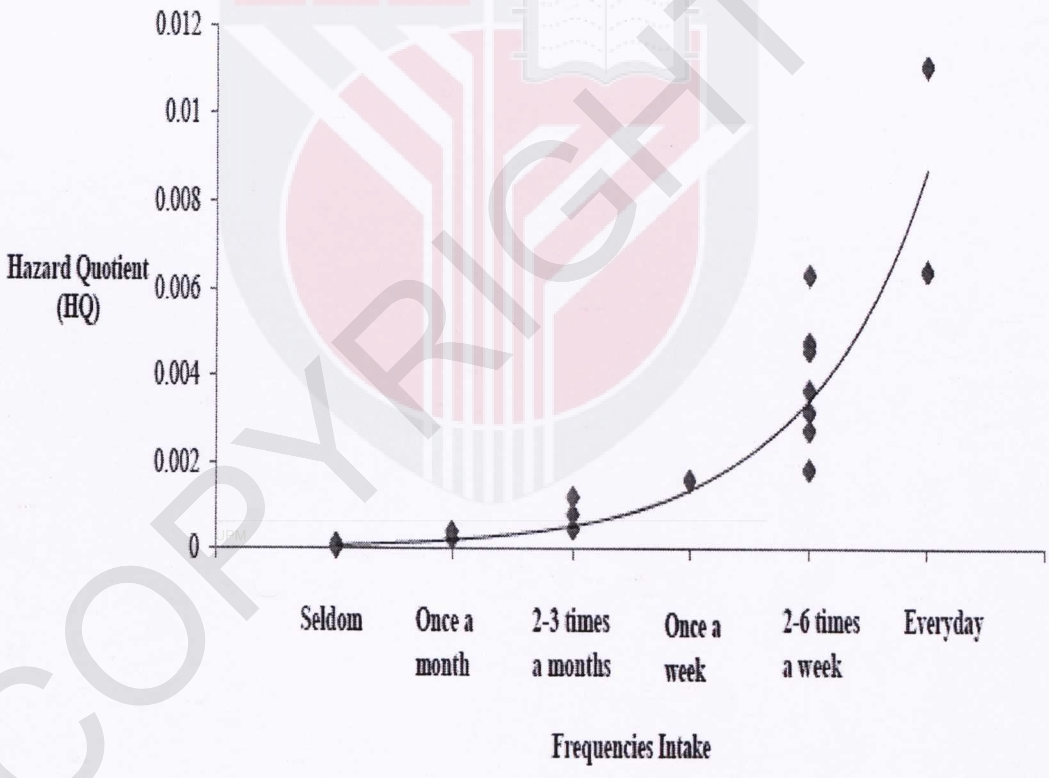

Figure 4.4 The relationship between the frequencies intake of shrimp paste and health risk encountered by respondents

CHAPTER 5

DISCUSSIONS

5.1 Socio-demographic data

A total of 206 respondents were supposed to be the sample size of the study based on the calculation. Since there were 151 respondents recruited in this study, thus, the respond rate was only 73.3 %. It was due to some of the residents of these two villages were refused to participate. Besides, some of them were not at home during the house-to-house data collection.

Out of that 63% were female respondents. The huge gap between the number of male and female respondent is due to the respondents were mostly housewives that were stayed at home during house-to-house data collection. Most of the male respondents were working outside of their home during that time

Most of respondents were in the age range from 55 to 59 that indicate older people were stayed in the village while the younger were going to work or has been moved to another place for work or school. Less respondents in the age group of 18-19 because at this age group, they were went to different area to further their studies.

Most of respondents at about 47.7% were having a normal BMI, 51 overweight, 24 obese and 4 were underweight. This indicate that most of the respondents are having the normal BMI rather than to be overweight and underweight. But still, there were 24 people which 15.9 % of the respondents were obese.

The most respondents went for SPM for about 37.7% and the lowest number of respondents fall under Sijil/STPM/Matriculation with 7.3%. Most of the respondents were late adult whose age from 55 to 59. At this age most of them went for education level until SPM only.

5.2 Shrimp paste consumption

Only respondents who ate shrimp paste were recruited in this study. The consumption level were also divided into frequent or less frequent. Frequent level categorized by consuming shrimp paste for everyday and 2-6 times a week while less frequent level was from once a week, once a month, 2-3 times a month and seldom. Most of the respondents consume shrimp paste at a frequent level.

This is not surprisingly knowing that shrimp paste is one of the most popular ingredients in numerous Malaysian dishes. This finding was supported by a study conducted by Leong *et. al.* (2009). The study found that more than 50% of the respondents of his study had very positive acceptance of shrimp paste in dishes with the mean score calculated was 3.6. It was also found that shrimp paste was relatively favourable to majority of the respondents as more than 40% of the respondents consumed dishes with shrimp paste more than 2-3 times in a week. This indicate that shrimp paste is one of the most favourable dishes for most of Malaysians.

The study also conclude that, the frequency of the respondents' consumption depended highly on the liking of each individual. Additionally, perception toward shrimp paste is a crucial factor that could influence consumers' consumption pattern.

5.3 Other possible exposures of Pb

Respondents may also posses lead exposure from food other than shrimp paste. Through this finding, almost all respondents consumed rice daily. Based on study conducted by Siti *et. al.* (1987), rice was found to be contaminated by lead. Rice samples contaminated by lead was also detected in study conducted in Northern Iran (Bakhtiarian *et. al.*, 2001) and in Taiwan (Lin *et. al.*, 2004). Rice may contaminated with lead from its origin, the paddy crops and the soil which have the ability to uptake and accumulate lead and then exert potential risk to humans (Habibah *et. al.*, 2011; Fu *et. al.*, 2008). The fact that rice are the staple food for general Malaysian populations may also one of the contributor of lead exposure through dietary intake.

Out of 10 top daily consumed food, most of them were several vegetables such as green leafy vegetables, cabbages, legumes, root vegetables and local salads. A study conducted in Korea reveals that vegetables were the most important contributor of lead exposure (Lee *et. al.*, 2006). This study found that these vegetables may be the higher contributors to total dietary lead because of their greater consumption.

Most of the respondents were used tap water as their water sources. Drinking water from tap water sources may be one of other factors that were contributing to Pb exposure. Pb may present in tap water as a result of its dissolution from natural sources, but primarily from household plumbing systems in which the pipes, solder, fittings or service connections to homes contain Pb (WHO, 2011).

General population might also be exposed to Pb in ambient air near industrial and combustion sources, in certain foods, through smoking and sometimes in drinking water (ATSDR, 2007) even though Pb exposure has been declined substantially in the last 2 decades after the ban on leaded gasoline (Pirkle *et. al.*, 1994). These factor may also one of the contributor of the lead exposure in respondents even though were not detailed out in the study.

5.4 Pb concentration in shrimp paste samples

Previous local study on toxicological evaluation of some Malaysian locally processed raw food products were found that shrimp paste were contaminated with some heavy metal (Shariff *et. al.*, 2008). A study conducted by the Division of Human Nutrition, Institute for Medical Research (IMR), Malaysia was once completed a study of lead level in a variety of local foodstuffs. A mean of 1.93 mg/kg of lead were found in two shrimp paste sample collected (Siti *et. al.*, 1987).

The finding of this study was in line with those previous studies. The Pb concentration in shrimp paste were compared with the Malaysian Food Regulation 1985. According to this regulation, a maximum of 2mg/kg of Pb concentration were permitted to be in shrimp paste. All the shrimp paste sample were found to have Pb in each sample and shows that the Pb concentration in each shrimp paste sample were not exceeding this regulation.

A lower mean of Pb concentration of 0.19 mg/kg was found in this study compare to the mean of 1.93 mg/kg of lead in the study conducted by IMR, Malaysia. The difference in lead concentration found in those shrimp paste samples might due to incrementally reducing gasoline lead concentrations in past few decades since Malaysia has banned leaded petrol in early 1990s. Although it has been banned, the legacy of using leaded petrol for years will remain for a long time in the form of dust (Shamsiah *et. al.*, 2009). This might be the main reason why lead was still be found in the shrimp paste even though in small amount.

Pb contaminant in the shrimp paste may come from many sources such as being absorbed from the ambient water of the habitat of the tiny shrimp which is the raw ingredients of shrimp paste. The contamination may also originate from the air while drying the shrimp paste in direct sunlight and then deposited in the body tissue of the shrimp. Pb is released to the environment from both natural and anthropogenic sources and exist in various organic and inorganic forms. This may affect its environmental fate, transport and bioavailability. Regardless of the form, however, Pb in the environment is not degraded and will remain available for the exposures (NIEHS, 2011). This may be the main reasons why Pb is well recognized as toxic heavy metal to human and hazardous to environment.

5.5 Health risk assessment of respondents

The ADD was calculated which expressed the average daily intake of heavy metal such as Pb over a certain period of time. The PTWI is based on a certain level of weekly intake of lead that is balanced by elimination, and therefore no accumulation within the body occurs (Lee *et. al.*, 2003). The HQ is a ratio of the intake divided by the RfD.

The health risk assessment of respondents were indicated by ADD, weekly exposure level and HQ. For the weekly exposure level calculation for each respondents, no respondents exceeds Reference Dose (RfD) which was the Provisional Tolerable Weekly Intake (PTWI) of 0.025 mg/kg body weight according to WHO (2000). All of the respondents were having PTWI that is lower than 0.025 mg/kg. The HQ for all the respondents were less than one. This finding indicate all respondents possess an acceptable risk condition.

According to Lushenko (2010), HQ $\geq$ 1 will probably cause non-carcinogenic adverse health effects. For example, a HQ of 1 or greater indicates a hazardous condition, whereby the ADD exceeds RfD. A HQ of less than 1 is categorized as an acceptable risk for a non-carcinogenic health effect (Jamal and Zailina, 2010; USEPA, 2002). For all the respondents the ADD was not exceed the RfD and the HQ was less than one which signifies that they are all poses an acceptable risk condition.

5.6 Relationship between frequency intake of shrimp paste and prevalence of acute and chronic lead poisoning signs.

This study used a list of Pb poisoning signs and health risk as an indicator of health effects of exposure to Pb. The findings shows very small percent of respondents reported to have experience the signs listed. Each signs of Pb poisoning was not associated with the frequencies of shrimp paste consumption. This may happened due to the signs itself that maybe arise from the disease they have on their own. Most of the respondents were late adult who poses diseases such as hypertension and diabetes may give arise the same signs with Pb poisoning signs. Other symptoms may also arise in respondents through their daily diet and their habit such as smoking and also through their fatigue from work.

Khalil (2009) stated that lead poisoning can be acute or chronic. Diagnosis can be difficult as symptoms and signs are non specific and present late until high blood Pb levels are reached. Patients may present with nausea, vomiting, abdominal pain and constipation. Central nervous system involvement can cause numbness and pain in the extremities, lethargy and mood disorders, muscle weakness, headache and memory loss. The same signs may shows as it may related to the person current disease. Moreover, there was no specific signs diagnosis were carried out for the respondents.

The result of this study may indicate that using the list of Pb poisoning signs and health risk was not a suitable method to measure health effects of a small dose of lead exposure. A more appropriate way suggested by Sakai (2000) and Barbosa *et. al.* (2006) is to analyse the exposure of lead was to take human biological sample such as blood. Bio monitoring for human exposure to Pb reflects an individual's current body burden, which is a function of recent and/or past exposure. Throughout the last five decades, whole blood has been the primary biological fluid and most reliable indicator used for assessment of Pb exposure.

An example of bio monitoring of human exposure to lead were discussed in a study conducted by Bjerregaard *et. al.* (2004) in Greenland. The blood samples were obtained after overnight fasting to determine the association of dietary intake with blood lead level. The blood was then separated, frozen at -20°C before analysed for lead by atomic absorption spectrometry.

5.7 Relationship between frequency intake of shrimp paste and health risk encountered by respondents

A significant positive relationship was shown between frequency of shrimp paste intake and health risk encountered by respondents. Based on the findings, most of the respondents who frequently consume shrimp paste shows the HQ which were almost to 1 which can be considered to be near to an unacceptable risk (U.S.EPA, 2001). This indicated that a frequent exposure to food contaminated with Pb will increase one's health risk.

Although consume at small amount, the fact that shrimp paste is one of most favorable condiment in cooking will make it to be consume continuously. Frequent consumption of shrimp paste that contaminated with Pb may increase Pb accumulation in the body which later can cause several health effects.

A study conducted by Lustberg *et. al.,* (2002) did mentioned an increase exposure to Pb were associated and may give rise to cardiovascular events. The observed increase in Peripheral Arterial Disease (PAD) prevalence occurred at Pb levels much lower than current safety levels used by environmental and occupational regulatory agencies were shown in a study by Navas-Acean *et. al.* (2004).

Further systematic review done by Navas-Acean *et. al.* (2007) evaluates the evidence on the association between Pb exposure and cardiovascular end points in human population. This revision revealed that Pb was positively associated with clinical cardiovascular end points in all studies.

Based on a review article by Vaziri and Gonick (2008), they were agreed with previous revision by Navas-Acean and the associates that general population syudies have revealed a positive association between Pb exposure and cardiovascular events including PAD and mortality from coronary heart disease and stroke. They also concluded that the risk of death from cardiovascular disease was significantly greater among those with the highest than those with the lowest Pb levels. Revision on lead-calcium interaction revealed that Pb can potentially compete with calcium (Ca^{2+}) for the transport by channels and pumps involved in movements of ions and can serve as a substitute for calcium in Ca^{2+}. Thus, interactions of Pb with cellular Ca^{2+} via these complex mechanisms in the vascular cells may contribute to alterations of vascular resistance.

Robert (2010) in his writing has stated that good levels of nutrients can improve well-being and resistance to toxins. For reducing Pb absorption the important nutrients appear to be vitamin C, calcium and iron. Dietary deficiencies in any of these can increase Pb absorption, though supplementation of individuals with already high levels of these nutrients in their diet may not have much impact on Pb absorption. Further, since these minerals compete with, or alter Pb absorption during digestion, taking concentrated supplements at one point of time, unless you are deficient in that particular nutrient, may not affect continuing Pb absorption, once the supplements have been processed through a particular stage of digestion.

STUDY STRENGTH AND LIMITATION

The strength of this study is that there was an evidence of lead which were still found in every shrimp paste sample collected . This study revealed to the public to be aware of what they eat. This study also may influence other researcher to keep conducting study on lead exposure from dietary intake.

This finding has the limitation by only calculated the health risk based on one food type which was the shrimp paste and other possible food which may also contaminated with Pb were not considered. Other sources of lead exposure into the body were just being asked without further analysis. This study was also not taking the biological sample as a better indicator for Pb exposure level.

CONCLUSION

This study found that lead was detected in every shrimp paste analysed. Although in a small amount but still, we should not take into granted as it may cause some accumulation of lead in the body that may manifest disease related to lead poisoning. It is true based on the HI calculation, the risk faced by the respondents were in an acceptable risk but the calculation is only considered only through one route of entry.

Other factors might also contribute to the accumulation of lead contaminant in the body. In conclusion, this study may suggest that there was lead contaminant found in the shrimp paste but the concentration of the lead contaminant will not really effects the health risk that will be encountered by the respondents. This does not mean we can take for granted as the shrimp paste still contain lead contaminant even though in a small amount.

Although the present data indicate that health risk is unlikely to be happen, a certain amount of Pb contaminant were found in all the shrimp paste samples. Continuous intake of shrimp paste may cause accumulation which later can cause adverse health effects.

RECOMMENDATION

This study suggest that there was lead contaminant found in the shrimp paste but the concentration may not really affects the health of the respondents. Due to this situation, further studies may need to be done to also take into account and study any other factors that may be contribute to Pb poisoning in humans and not focused on one type of food only. Biological monitoring should also be done for taking human biological sample such as blood that will provide an actual exposure of Pb.

Pb contamination cannot be avoided. Studies on Pb in shrimp paste should be revealed to the public so that, they can be aware of what they eat. The fact that shrimp paste is most favourable condiment in Malaysian cooking makes it a harder decision to stop eating shrimp paste. To encounter this matter, public should take enough nutritional intake in order to increase body resistant towards heavy metal such as Pb. Nutrient such as iron, calcium and vitamin C should be taken for reducing Pb absorption.

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APPENDICES

APPENDIX 1

Ethical Committee consent letter

APPENDIX 2

Approval letter from villages management

GERAKAN BELIA 4B (MALAYSIA)
Cawangan Pinang Bahagia
Kawasan Tangga Batu
Melaka
Tel. Bimbit : 6012-3653964 E-Mail : alil79_mrbk@yahoo.com

1 Belia Malaysia

Bil. Surat Kami :

Bil. Surat Tuan :

Mohd Rasul Bin Hj. Khamis
Ketua Gerakan Belia 4B (Malaysia)
Cawangan Pinang Bahagia
Kawasan Tangga Batu
Melaka

17 hb Januari 2012

Cik Aziemah Bt. Zulkifli (147318) & Cik Nor Aisyah Bt. Abd. Razak (148748)
Unit Kesihatan Persekitaran & Pekerjaan,
Jabatan Kesihatan Komuniti,
Fakulti Perubatan & Sains Kesihatan,
Universiti Putra Malaysia,
43400 Serdang Selangor.

TUAN

MEMBERIKAN KEBENARAN UNTUK TUAN MEMBUAT KAJIAN DI KAMPUNG PINANG TENTANG KEPEKATAN LOGAM BERAT ARSENIK & PLUMBUM DI DALAM BELACAN DAN PENILAIAN RISIKO KESIHATAN DI KALANGAN PENDUDUK DI MELAKA.

Adalah dengan hormatnya, perkara di atas dirujuk.

2. Sehubungan dengan itu, sukacita dimaklumkan bahawa satu kajian di atas oleh tuan akan dijalankan pada masa seperti berikut:

Tarikh	:	**20 hb hingga 22 hb Januari 2012 (Jumaat- Ahad)**
Masa	:	**9.00 Pagi hingga 5.00 Petang**
Tempat	:	**Kampung Pinang**

3. Kami dengan sukacitanya memberikan kebenaran kepada tuan untuk menjalankan kajian tersebut di kawasan Kampung Pinang ini.Kami warga belia di sini, juga amat terharu dan berbangga serta ingin mengucapkan jutaan terima kasih di atas kesudian tuan hadir dan memilih membuat kajian di kampung ini.Di harap segala kajian tuan dapat dijalankan dengan baik dan berjaya.Segala kekurangan di sini, kami memohon maaf dan diucapkan jutaan terima kasih di atas kehadiran tuan.

Sekian, terima kasih.

d/a Villa Sri Pinang, Kampung Pinang B, Batu 5 ½,
76400 Tanjong Keling, Melaka

APPENDIX 3

Questionnaire

No Siri: | | | | |

JABATAN KESIHATAN PERSEKITARAN DAN PEKERJAAN
FAKULTI PERUBATAN DAN SAINS KESIHATAN
UNIVERSITI PUTRA MALAYSIA

KEPEKATAN LOGAM BERAT PLUMBUM DI DALAM BELACAN DAN PENILAIAN RISIKO KESIHATAN DI KALANGAN PENDUDUK DEWASA DI DUA BUAH KAMPUNG DI MELAKA

Adalah dimaklumkan bahawa satu kajian tentang penilaian risiko kesihatan akibat pendedahan kepada logam plumbum sedang dijalankan di kawasan anda. Sehubungan dengan itu, sukacita dimaklumkan bahawa anda telah terpilih untuk menjadi salah seorang responden kajian ini. Oleh demikian, anda diminta menjawab semua soalan yang dikemukakan dengan mengikut arahan yang telah diberikan. Segala maklumat berkenaan responden akan dirahsiakan dan hanya akan digunakan untuk kajian ini.

ID Responden: | | | | | | | | | | |

Tarikh kajian: ....

No Kad Pengenalan: | | | | | | | | | | | | |

No Telefon: **(R)** | | | | - | | | | | | | |

(Hp) | | | | - | | | | | | | |

FAKULTI PERUBATAN DAN SAINS KESIHATAN
FACULTY OF MEDICINE AND HEALTH SCIENCES
UNIVERSITI PUTRA MALAYSIA, 43400 UPM SERDANG, SELANGOR, MALAYSIA

BORANG PERSETUJUAN RESPONDEN

TAJUK KAJIAN: KEPEKATAN LOGAM BERAT PLUMBUM DI DALAM BELACAN DAN PENILAIAN RISIKO KESIHATAN DI KALANGAN PENDUDUK DEWASA DI DUA BUAH KAMPUNG DI MELAKA.

PENYELIDIK : NOR AISYAH ABD RAZAK

Saya .... No.K/P: ....
alamat..
. ...dengan ini secara sukarela bersetuju untuk mengambil bahagian dalam penyelidikan klinikal (kajian klinikal,/kajian soal selidik/dadah percubaan) yang dinyatakan di atas. Saya telah dimaklumkan mengenai latar belakang penyelidikan ini dari segi kaedah, kemungkinan kesan buruk dan komplikasi(rujuk kepada risalah maklumat). Saya faham bahawa saya mempunyai hak untuk menarik diri dari kajian ini pada bila-bila masa tanpa memberikan apa jua sebab. Saya juga faham bahawa kajian ini adalah sulit dan semua maklumat yang diberikan mengenai identiti saya adalah sulit dan persendirian.

Saya ingin *tahu/tidak ingin mengetahui keputusan ujian yang dijalankan ke atas sampel saya.

* potong mana yang tidak berkaitan

Tandatangan .... (*Responden*)

Tandatangan.. (Saksi)

Tarikh :...

Nama :...

No. K/P :...

Saya mengesahkan bahawa saya telah menjelaskan kepada responden latar belakang dan tujuan penyelidikan di atas.

Tarikh ....

Tandatangan.. (Penyelidik)

UPM/FPSK/PADS/T7-MJKEtikaPer/F01

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UNIVERSITI PUTRA MALAYSIA, 43400 UPM SERDANG,
SELANGOR, MALAYSIA

PENERANGAN KEPADA PESERTA

TAJUK KAJIAN: KEPEKATAN LOGAM BERAT PLUMBUM DI DALAM BELACAN DAN PENILAIAN RISIKO KESIHATAN DI KALANGAN PENDUDUK DEWASA DI DUA BUAH KAMPUNG DI MELAKA.

PENYELIDIK : NOR AISYAH ABD RAZAK

Terima kasih kerana membantu kami di dalam kajian ini.

Apakah kajian ini?

Sejak kebelakangan ini, beberapa kajian telah membuktikan bahawa terdapat pencemaran logam berat seperti plumbum di dalam sumber makanan harian. Ini disebabkan oleh berlakunya pencemaran terhadap sumber-sumber semulajadi seperti sumber air. Secara tidak langsung, keadaaan ini telah menyumbang kepada pencemaran logam berat kepada hidupan laut seperti udang geragau yang menjadi bahan asas kepada pembuatan belacan. Pendedahan kepada logam berat Plumbum mungkin akan berlaku kepada masyarakat yang menjadikan belacan sebagai salah satu menu dalam pemakanan seharian mereka. Sehubungan dengan itu, kajian ini dijalankan adalah bertujuan untuk menentukan kepekatan logam berat arsenik dan plumbum yang terkandung di dalam belacan dan menjalankan penilaian risiko kesihatan terhadap pengambilan belacan di dalam menu seharian.

Apakah tujuan kajian ini?

Kajian ini dijalankan bertujuan untuk menentukan kepekatan logam berat plumbum yang terkandung di dalam belacan dan menjalankan penilaian risiko kesihatan terhadap penduduk Melaka.

Berapa ramai responden yang terpilih?

Responden akan diambil daripada kalangan penduduk kampung yang dipilih secara rawak di sekitar Melaka iaitu di Kg. Pantai Dalam dan Kg. Pinang. Seramai 101 orang responden dari Kg. Pantai Dalam dan seramai 105 orang dari Kg.Pinang akan dipilih untuk kajian ini.

Apakah jenis ujian yang akan dijalankan?

Satu set borang soal kaji selidik akan diberikan kepada setiap responden untuk diisi. Selain daripada itu, pengukuran berat badan dan ketinggian akan diambil untuk mengetahui tahap kesihatan penduduk dan akan digunakan untuk menganggar risiko kesihatan yang dihadapi oleh penduduk.

Adakah bayaran dikenakan?

Pengkaji akan menanggung segala pembiayaan ujian yang akan dijalankan dan tiada sebarang bayaran dikenakan terhadap setiap responden.

Adakah maklumat dijamin sulit?

Semua maklumat yang diberikan oleh responden di dalam borang kaji selidik adalah dijamin sulit. Tiada huraian individu akan dibuat pada mana-mana bahagian di dalam kajian atau penerbitan.

Adakah hak anda?

Kajian ini melibatkan anda secara sukarela. Oleh itu, peserta mempunyai hak untuk menarik diri dari penyertaan dalam kajian ini pada bila-bila masa sekiranya peserta merasa tidak selesa untuk memberikan maklumat kepada pengkaji.

Apakah yang harus anda lakukan?

Anda dikehendaki menandatangani borang penyertaan responden yang menyatakan minat anda untuk menyertai kajian ini. Ianya boleh dilakukan setelah anda membaca dan memahami isi kandungan penerangan ini. Borang penyertaan responden haruslah dikembalikan kepada penyelidik sebelum ujian dijalankan. Sekiranya anda mempunyai sebarang kemusykilan, penyelidik akan membantu untuk memberi maklumat yang selanjutnya.

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SELANGOR, MALAYSIA

Terima kasih atas kerjasama dan bantuan anda.

NOR AISYAH BINTI ABD RAZAK

Penyelidik

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Unit Kesihatan Persekitaran dan Pekerjaan

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UNIVERSITI PUTRA MALAYSIA, 43400 UPM SERDANG, SELANGOR, MALAYSIA

BAHAGIAN 1	KETERANGAN DIRI	RUANGAN KOD

Tandakan (√) dalam kotak berkenaan.

Nama Penuh: ....

Alamat Semasa: ....

....

1. Umur: .... Tahun

2. Jantina: ☐ Lelaki ☐ Perempuan

3. Bangsa: ☐ Melayu ☐ Cina ☐ India

   ☐ Lain-lain (Sila nyatakan): ....

4. Agama:
   - ☐ Islam
   - ☐ Kristian
   - ☐ Buddha
   - ☐ Hindu
   - ☐ Lain-lain

5. Status:
   - ☐ Bujang
   - ☐ Berkahwin
   - ☐ Bercerai/berpisah
   - ☐ Balu/Duda

6. Taraf pendidikan:
   - ☐ Tidak Bersekolah
   - ☐ UPSR
   - ☐ PMR
   - ☐ SPM
   - ☐ Sijil/STPM/Matrikulasi
   - ☐ Diploma
   - ☐ Ijazah Sarjana Muda
   - ☐ Sarjana Muda
   - ☐ Doktor Falsafah

7. Jenis pekerjaan:
   - ☐ Kerajaan
   - ☐ Swasta
   - ☐ Bekerja Sendiri
   - ☐ Pencen/Tidak Bekerja
   - ☐ Lain-lain

8. Pendapatan sebulan (RM) : _______________

9. Pendapatan isi rumah sebulan (RM) : ______________

10. Bilangan ahli isirumah : ___________ orang

BAHAGIAN 2	MAKLUMAT KESIHATAN	RUANGAN KOD

11. Adakah anda mengalami masalah kesihatan berikut?

Simtptom akut:

- [ ] Sakit perut
- [ ] Muntah
- [ ] Cirit-birit
- [ ] Pening
- [ ] Kesukaran bernafas
- [ ] Kelesuan
- [ ] Alergi
- [ ] Rambut mudah gugur
- [ ] Lemah otot
- [ ] Loya
- [ ] Sembelit

Simptom kronik:

- [ ] Kelesuan yang tidak tahu punca
- [ ] Susah tidur
- [ ] Susah untuk bertutur dengan lancar
- [ ] Lemah daya ingatan
- [ ] Kesukaran untuk fokus

11. Adakah anda telah mendapatkan rawatan untuk symptom-simptom diatas? ☐ Ya, nyatakan kali terakhir anda mendapatkan rawatan ____________________ ☐ Tidak	

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BAHAGIAN 3:	ANTHROPOMETRI	RUANGAN KOD
1. Nama peserta :	1.	
2. Berat (kg) :	2. i. ☐☐☐ . ☐ kg ii. ☐☐☐ . ☐ kg iii. ☐☐☐ . ☐ kg	
3. Tinggi (cm) :	3. i. ☐☐☐ . ☐ cm ii. ☐☐☐ . ☐ cm iii. ☐☐☐ . ☐ cm	

Pengukuran Indeks Jisim Tubuh (IJT) / *Body Mass Index (BMI)*

BMI = Berat (kg) / Tiggi x Tinggi(m2)

Klasifikasi ⇨

IJT / BMI < 18.5 = Kurang Berat Badan
IJT / BMI 18.5 - 24.9 = Normal
IJT / BMI 25.0 - 29.9 = Berlebihan berat badan
IJT / BMI ≥ 30.0 = Obes

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BAHAGIAN 4: BORANG KEKERAPAN PENGAMBILAN MAKANAN

Kod	**Jenis makanan**	**Kekerapan pengambilan**					**Ukuran sajian(pilih satu jenis ukuran sahaja)**	**Berapa banyak sajian setiap kali makan**
	(A)Bijiran dan hasil bijiran	**Berapa kali sehari**	**Berapa kali seminggu**	**Berapa kali sebulan**	**Berapa kali setahun**	**Tidak makan**		
A1	Nasi						Pinggan	
							Mangkuk cina	
							Cawan	
							senduk	
A2	Bijirin						Pinggan	
							Mangkuk cina	
							Cawan	
							senduk	

Kod	**Jenis makanan**	**Kekerapan pengambilan**					**Ukuran sajian(pilih satu jenis ukuran sahaja)**	**Berapa banyak sajian setiap kali makan**
	(B)Ikan dan makanan laut	**Berapa kali sehari**	**Berapa kali seminggu**	**Berapa kali sebulan**	**Berapa kali setahun**	**Tidak makan**		
B1	Ikan laut						Keping	
							Ekor	
B2	Ikan air tawar						Keping	
							Ekor	
B3	Ikan bilis						Sudu makan	
B4	Ikan dalam tin						Ekor	
B5	Kekerang						Sudu makan	
B6	Udang basah						Ekor sederhana	
B7	Sotong basah						Potong sederhana	
B8	Sotong kering						Keping sederhana	
							Potong sederhana	
B9	Ketam						Ekor	
B10	Ikan kering						Keping	
							Ekor	
B11	Bebola ikan/kek ikan						Bebola	
							Ketul	
B11	Kerepok lekor						Ketul	

ID PESERTA:

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Kod	**Jenis makanan**	**Kekerapan pengambilan**					**Ukuran sajian(pilih satu jenis ukuran sahaja)**	**Berapa banyak sajian setiap kali makan**
	(C)Kekacang dan hasilnya	**Berapa kali sehari**	**Berapa kali seminggu**	**Berapa kali sebulan**	**Berapa kali setahun**	**Tidak makan**		
C1	Kekacang						Sudu makan	
C2	Tauhu						Keping	
C3	Tempe						Keping	
							Sudu makan	
C4	Kacang Tanah						Sudu makan	

Kod	**Jenis makanan**	**Kekerapan pengambilan**					**Ukuran sajian (pilih satu jenis ukuran sahaja)**	**Berapa banyak sajian setiap kali makan**
	(C) Sayuran	**Berap a kali sehari**	**Berapa kali seminggu**	**Berapa kali sebulan**	**Berapa kali setahun**	**Tidak makan**		
D1	Sayuran berdaun						Cawan	
D2	Sayuran kacang						Cawan	
D3	Sayuran berubi						Cawan	
D4	Sayuran kobis						Cawan	
D5	Petola/labu /timun						Cawan	
D6	Ulam-ulaman						Cawan	
D7	Putik jagung						Sudu makan	
D8	Cendawan basah /kering						Cawan	
D9	Taugeh						Cawan	

ID PESERTA:

Kod	Jenis makanan	Kekerapan pengambilan					Ukuran sajian(pilih satu jenis ukuran sahaja)	Berapa banyak sajian setiap kali makan
	(E)Makanan perencah /perasa	Berapa kali sehari	Berapa kali seminggu	Berapa kali sebulan	Berapa kali setahun	Tidak makan		
E1	Gula						Sudu teh	
E2	Madu						Sudu teh	
E3	Cencaluk						Sudu teh	
E4	Budu						Sudu teh	
E5	Kicap pekat						Sudu teh	
E6	Kicap cair						Sudu makan	
E7	Sos cili/tomato						Sudu makan	
E9	Sos tiram						Sudu teh	
E10	Sos ikan						Sudu teh	
E11	Otak udang						Sudu teh	

Kod	Jenis makanan	Kekerapan pengambilan					Ukuran sajian(pilih satu jenis ukuran sahaja)	Berapa banyak sajian setiap kali makan
	(D)Makanan yang dikaji	Berapa kali sehari	Berapa kali seminggu	Berapa kali sebulan	Berapa kali setahun	Tidak makan		
F1	Belacan							

Sumber bekalan belacan:

☐ Buatan sendiri

☐ Perusahaan kecil (IKS)

Senaraikan 3 jenis jenama belacan yang paling kerap anda makan?

1. ____________________
2. ____________________
3. ____________________

Sudah berapa lamakah anda mengambil belacan sebagai salah satu menu harian?

Sila nyatakan : ______________________________

ID PESERTA: | | | |

BAHAGIAN 5:	FAKTOR-FAKTOR PENDEDAHAN LAIN	RUANGAN KOD

Tandakan (√) dalam kotak berkenaan.

Sumber bekalan air

1. Dari manakah anda mendapat sumber bekalan air minuman?

☐ Air paip

☐ Air perigi

☐ Lain-lain : _______________

Pendedahan pekerjaan

2. Pernahkah pekerjaan anda melibatkan penggunaan pestisid ?

☐ Ya

☐ Tidak

Jika Ya, sila ke soalan seterusnya. (3) jika Tidak, sila terus ke soalan (4)

3. Berapa lama anda terlibat dengan pekerjaan ini?

____

4. Adakah anda menggunakan racun serangga selain daripada waktu bekerja?

☐ Ya

☐ Tidak

Amalan gaya hidup

a) Merokok

5. Adakah anda merokok?

☐ Ya
☐ Tidak
☐ Sudah berhenti

Jika Ya, sila nyatakan berapa tahun anda sudah merokok dan bilangan batang rokok dihisap dalam sehari:

Bil. tahun: ___________ Bil. Batang rokok sehari _________

6. Semasa anda merokok, adakah anda menyedut asap rokok?

☐ Tidak sama sekali
☐ Sedikit
☐ Sederhana
☐ Mendalam

Jika sudah berhenti, sila jawab soalan 7

7. Pada umur berapa anda berhenti merokok sepenuhnya?

____

b) Pengambilan alkohol

8. Adakah anda pernah mengambil minuman beralkohol?

☐ Ya
☐ Tidak

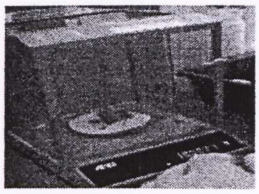
Jika ya, sila nyatakan berapa botol sehari anda minum?

_________________ botol

APPENDIX 4

Dry Ashing method

DRY ASHING METHOD

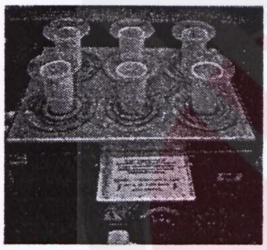


Weight one gram of shrimp paste sample. Put the sample in a crucible.

⇩

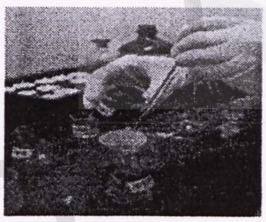
Sample in a crucible was placed in a preheated muffle furnace at 200-250 °C for 30 min, and then ashed for 4 hour at 480 °C. Then, the sample was removed from the furnace and cooled down; 2ml of 5 M HNO3 was added and evaporated to dryness on a water bath.

⇩



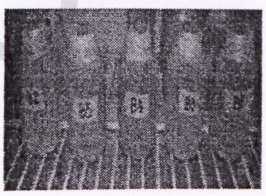
Next, the sample was placed in a cool furnace and heated to 400 °C for 15 min, before being removed (from the furnace, cooled and moistened with four drops of distilled water). Next, 2ml of concentrated HCl was added and the sampel was evaporated to dryness, removed, and then 5ml of 2 M HCl was added and again swirled.

⇩



The solution was filetered through Whatman No.42 filter paper and <0.45 µm Milipore filter paper

⇩



Then transferred quantitatively to 125ml volumetric flask by adding distilled water. Keep cool at 4 °C before metal determination.

Adapted from: Hseu Z.Y. (2004). Evaluating heavy metal contents in nine composts using for digestion methods. *Bioresource Technology* 95: 53-59

APPENDIX 5

Results of ICP-MS determination

Daily Performance Report

Sample ID: Smart Tune Solution
Sample Date/Time: Wednesday, March 28, 2012 11:32:31
Sample Description: Performance check
Method File: C:\Elandata_LC-ICPMS\Method\daily performance.mth
Dataset File: C:\Elandata_LC-ICPMS\Dataset\daily performance\Smart Tune Solution.256
Tuning File: C:\Elandata_LC-ICPMS\Tuning\default.tun
Optimization File: C:\Elandata_LC-ICPMS\Optimize\default.dac
Dual Detector Mode: Pulse

Acq. Dead Time(ns): 55
Current Dead Time (ns): 55

Summary

	Analyte	Mass	Meas. Intens. Mean	Net Intens. Mean	Net Intens. SD	Net Intens. RSD
	Mg	24.0	77734.2	77734.190	1189.049	1.5
	In	114.9	272861.7	272861.704	5849.314	2.1
	U	238.1	349530.7	349530.687	7137.074	2.0
[>	Ce	139.9	244612.1	244612.138	5946.389	2.4
[	CeO	155.9	4022.0	0.016	0.001	4.6
[>	Ba	137.9	196406.8	196406.801	3630.390	1.8
[	Ba++	69.0	4820.6	0.025	0.001	2.7
	Bkgd	220.0	7.9	7.900	0.693	8.8
	Bkgd	8.5	17.4	17.433	2.016	11.6

Current Optimization File Data

Current Value	Description
0.72	Nebulizer Gas Flow [NEB]
1.20	Auxiliary Gas Flow
17.00	Plasma Gas Flow
8.00	Lens Voltage
1100.00	ICP RF Power
-1700.00	Analog Stage Voltage
750.00	Pulse Stage Voltage
0.00	Quadrupole Rod Offset Std [QRO]
-12.00	Cell Rod Offset Std [CRO]
25.00	Discriminator Threshold
-26.00	Cell Path Voltage Std [CPV]
0.00	RPa
0.25	RPq
0.91	DRC Mode NEB
-5.50	DRC Mode QRO
-0.50	DRC Mode CRO
-16.00	DRC Mode CPV
0.00	Cell Gas A

Current Autolens Data

Analyte	Mass	Num of Pts	DAC Value	Maximum Intensity
Be	9	45	6.5	4441.1
Co	59	45	7.3	115569.0
In	115	45	8.3	241458.6

Quantitative Analysis - Summary Report

Sample ID: Blank

Sample Date/Time: Wednesday, March 28, 2012 12:04:15
Sample Description:
Solution Type: Blank
Blank File: C:\Elandata_LC-ICPMS\DataSet\Nor Aisyah (FPSK)\Blank.006
Number of Replicates: 3
Peak Processing Mode: Average
Signal Profile Processing Mode: Average
Dual Detector Mode: Dual
Dead Time (ns): 55

Sample File: C:\Elandata_LC-ICPMS\Sample\Nor Aisyah (FPSK).sam
Method File: C:\Elandata_LC-ICPMS\Method\nor aisyah (fpsk).mth
Dataset File: C:\Elandata_LC-ICPMS\DataSet\Nor Aisyah (FPSK)\Blank.006
Tuning File: C:\Elandata_LC-ICPMS\Tuning\default.tun
Optimization File: C:\Elandata_LC-ICPMS\Optimize\default.dac
Calibration File:
Calibration Type: External Calibration

Summary

Intensities

Analyte	Mass	Meas. Intens. Mean	Meas. Intens. RSD	Blank Intensity	Blank Intens. RSD
As	75	216	7.911		
Cd	111	113	14.264		
Pb	208	200	10.149		

Concentration Results

Analyte	Mass	Net Intens. Mean	Conc. Mean	Conc. SD	Conc. RSD	Sample Unit
As	75					ppb
Cd	111					ppb
Pb	208					ppb

Quantitative Analysis - Summary Report

Sample ID: Std 1 (10 ppb)

Sample Date/Time: Wednesday, March 28, 2012 12:05:58
Sample Description:
Solution Type: Standard
Blank File: C:\Elandata_LC-ICPMS\DataSet\Nor Aisyah (FPSK)\Blank.006
Number of Replicates: 3
Peak Processing Mode: Average
Signal Profile Processing Mode: Average
Dual Detector Mode: Dual
Dead Time (ns): 55

Sample File: C:\Elandata_LC-ICPMS\Sample\Nor Aisyah (FPSK).sam
Method File: C:\Elandata_LC-ICPMS\Method\nor aisyah (fpsk).mth
Dataset File: C:\Elandata_LC-ICPMS\DataSet\Nor Aisyah (FPSK)\Std 1 (10 ppb).007
Tuning File: C:\Elandata_LC-ICPMS\Tuning\default.tun
Optimization File: C:\Elandata_LC-ICPMS\Optimize\default.dac
Calibration File:
Calibration Type: External Calibration

Summary

Intensities

Analyte	Mass	Meas. Intens. Mean	Meas. Intens. RSD	Blank Intensity	Blank Intens. RSD
As	75	12348	3.975	216.003	7.911
Cd	111	16767	4.184	113.334	14.264
Pb	208	168746	5.967	200.002	10.149

Concentration Results

Analyte	Mass	Net Intens. Mean	Conc. Mean	Conc. SD	Conc. RSD	Sample Unit
As	75	12132.387	**10.000**	0.40	4.0	ppb
Cd	111	16653.465	**10.000**	0.42	4.2	ppb
Pb	208	168546.015	**10.000**	0.60	6.0	ppb

Quantitative Analysis - Summary Report

Sample ID: Std 2 (30 ppb)

Sample Date/Time: Wednesday, March 28, 2012 12:07:41
Sample Description:
Solution Type: Standard
Blank File: C:\Elandata_LC-ICPMS\DataSet\Nor Aisyah (FPSK)\Blank.006
Number of Replicates: 3
Peak Processing Mode: Average
Signal Profile Processing Mode: Average
Dual Detector Mode: Dual
Dead Time (ns): 55

Sample File: C:\Elandata_LC-ICPMS\Sample\Nor Aisyah (FPSK).sam
Method File: C:\Elandata_LC-ICPMS\Method\nor aisyah (fpsk).mth
Dataset File: C:\Elandata_LC-ICPMS\DataSet\Nor Aisyah (FPSK)\Std 2 (30 ppb).008
Tuning File: C:\Elandata_LC-ICPMS\Tuning\default.tun
Optimization File: C:\Elandata_LC-ICPMS\Optimize\default.dac
Calibration File:
Calibration Type: External Calibration

Summary

Intensities

Analyte	Mass	Meas. Intens. Mean	Meas. Intens. RSD	Blank Intensity	Blank Intens. RSD
As	75	37071	2.159	216.003	7.911
Cd	111	51849	4.230	113.334	14.264
Pb	208	525358	1.457	200.002	10.149

Concentration Results

Analyte	Mass	Net Intens. Mean	Conc. Mean	Conc. SD	Conc. RSD	Sample Unit
As	75	36855.453	**30.037**	0.65	2.2	ppb
Cd	111	51735.611	**30.103**	1.28	4.2	ppb
Pb	208	525157.706	**30.112**	0.44	1.5	ppb

Quantitative Analysis - Summary Report

Sample ID: Std 3 (50 ppb)

Sample Date/Time: Wednesday, March 28, 2012 12:09:25
Sample Description:
Solution Type: Standard
Blank File: C:\Elandata_LC-ICPMS\DataSet\Nor Aisyah (FPSK)\Blank.006
Number of Replicates: 3
Peak Processing Mode: Average
Signal Profile Processing Mode: Average
Dual Detector Mode: Dual
Dead Time (ns): 55

Sample File: C:\Elandata_LC-ICPMS\Sample\Nor Aisyah (FPSK).sam
Method File: C:\Elandata_LC-ICPMS\Method\nor aisyah (fpsk).mth
Dataset File: C:\Elandata_LC-ICPMS\DataSet\Nor Aisyah (FPSK)\Std 3 (50 ppb).009
Tuning File: C:\Elandata_LC-ICPMS\Tuning\default.tun
Optimization File: C:\Elandata_LC-ICPMS\Optimize\default.dac
Calibration File:
Calibration Type: External Calibration

Summary

Intensities

Analyte	Mass	Meas. Intens. Mean	Meas. Intens. RSD	Blank Intensity	Blank Intens. RSD
As	75	63909	0.885	216.003	7.911
Cd	111	86427	1.847	113.334	14.264
Pb	208	866919	6.218	200.002	10.149

Concentration Results

Analyte	Mass	Net Intens. Mean	Conc. Mean	Conc. SD	Conc. RSD	Sample Unit
As	75	63692.525	**50.531**	0.45	0.9	ppb
Cd	111	86313.644	**50.064**	0.93	1.8	ppb
Pb	208	866718.563	**49.913**	3.10	6.2	ppb

Quantitative Analysis - Summary Report

Sample ID: Std 4 (100 ppb)

Sample Date/Time: Wednesday, March 28, 2012 12:11:09
Sample Description:
Solution Type: Standard
Blank File: C:\Elandata_LC-ICPMS\DataSet\Nor Aisyah (FPSK)\Blank.006
Number of Replicates: 3
Peak Processing Mode: Average
Signal Profile Processing Mode: Average
Dual Detector Mode: Dual
Dead Time (ns): 55

Sample File: C:\Elandata_LC-ICPMS\Sample\Nor Aisyah (FPSK).sam
Method File: C:\Elandata_LC-ICPMS\Method\nor aisyah (fpsk).mth
Dataset File: C:\Elandata_LC-ICPMS\DataSet\Nor Aisyah (FPSK)\Std 4 (100 ppb).010
Tuning File: C:\Elandata_LC-ICPMS\Tuning\default.tun
Optimization File: C:\Elandata_LC-ICPMS\Optimize\default.dac
Calibration File:
Calibration Type: External Calibration

Summary

Intensities

Analyte	Mass	Meas. Intens. Mean	Meas. Intens. RSD	Blank Intensity	Blank Intens. RSD
As	75	132397	3.491	216.003	7.911
Cd	111	174685	1.445	113.334	14.264
Pb	208	1665278	3.038	200.002	10.149

Concentration Results

Analyte	Mass	Net Intens. Mean	Conc. Mean	Conc. SD	Conc. RSD	Sample Unit
As	75	132180.547	**101.218**	3.54	3.5	ppb
Cd	111	174571.910	**100.322**	1.45	1.4	ppb
Pb	208	1665078.028	**98.901**	3.00	3.0	ppb

Calibration Report

Analyte	Mass	Curve Type	Slope	Intercept	Corr Coeff
As	74.922	Linear Thru Zero	1305.901369	0.000	0.999754
Cd	110.904	Linear Thru Zero	1740.109343	0.000	0.999981
Pb	207.977	Linear Thru Zero	16835.846092	0.000	0.999821

Quantitative Analysis - Summary Report

Sample ID: 1

Sample Date/Time: Wednesday, March 28, 2012 12:18:23
Sample Description: Food samples
Solution Type: Sample
Blank File:
Number of Replicates: 3
Peak Processing Mode: Average
Signal Profile Processing Mode: Average
Dual Detector Mode: Dual
Dead Time (ns): 55

Sample File: C:\Elandata_LC-ICPMS\Sample\Nor Aisyah (FPSK).sam
Method File: C:\Elandata_LC-ICPMS\Method\nor aisyah (fpsk).mth
Dataset File: C:\Elandata_LC-ICPMS\DataSet\Nor Aisyah (FPSK)\1.011
Tuning File: C:\Elandata_LC-ICPMS\Tuning\default.tun
Optimization File: C:\Elandata_LC-ICPMS\Optimize\default.dac
Calibration File: C:\Elandata_LC-ICPMS\System\Nor Aisyah (FPSK).cal
Calibration Type: External Calibration

Summary

Intensities

Analyte	Mass	Meas. Intens. Mean	Meas. Intens. RSD	Blank Intensity	Blank Intens. RSD
As	75	142515	1.392	216.003	7.911
Cd	111	1647	2.731	113.334	14.264
Pb	208	44503	3.153	200.002	10.149

Concentration Results

Analyte	Mass	Net Intens. Mean	**Conc. Mean**	Conc. SD	Conc. RSD	Sample Unit
As	75	142299.199	**108.966**	1.52	1.4	ppb
Cd	111	1533.482	**0.881**	0.03	2.9	ppb
Pb	208	44302.731	**2.631**	0.08	3.2	ppb

Quantitative Analysis - Summary Report

Sample ID: 3

Sample Date/Time: Wednesday, March 28, 2012 12:21:52
Sample Description: Food samples
Solution Type: Sample
Blank File:
Number of Replicates: 3
Peak Processing Mode: Average
Signal Profile Processing Mode: Average
Dual Detector Mode: Dual
Dead Time (ns): 55

Sample File: C:\Elandata_LC-ICPMS\Sample\Nor Aisyah (FPSK).sam
Method File: C:\Elandata_LC-ICPMS\Method\nor aisyah (fpsk).mth
Dataset File: C:\Elandata_LC-ICPMS\DataSet\Nor Aisyah (FPSK)\3.013
Tuning File: C:\Elandata_LC-ICPMS\Tuning\default.tun
Optimization File: C:\Elandata_LC-ICPMS\Optimize\default.dac
Calibration File: C:\Elandata_LC-ICPMS\System\Nor Aisyah (FPSK).cal
Calibration Type: External Calibration

Summary

Intensities

Analyte	Mass	Meas. Intens. Mean	Meas. Intens. RSD	Blank Intensity	Blank Intens. RSD
As	75	212719	2.242	216.003	7.911
Cd	111	1473	6.087	113.334	14.264
Pb	208	307255	2.932	200.002	10.149

Concentration Results

Analyte	Mass	Net Intens. Mean	Conc. Mean	Conc. SD	Conc. RSD	Sample Unit
As	75	212503.415	**162.725**	3.65	2.2	ppb
Cd	111	1360.119	**0.782**	0.05	6.6	ppb
Pb	208	307054.847	**18.238**	0.54	2.9	ppb

Quantitative Analysis - Summary Report

Sample ID: 4

Sample Date/Time: Wednesday, March 28, 2012 12:23:37
Sample Description: Food samples
Solution Type: Sample
Blank File:
Number of Replicates: 3
Peak Processing Mode: Average
Signal Profile Processing Mode: Average
Dual Detector Mode: Dual
Dead Time (ns): 55

Sample File: C:\Elandata_LC-ICPMS\Sample\Nor Aisyah (FPSK).sam
Method File: C:\Elandata_LC-ICPMS\Method\nor aisyah (fpsk).mth
Dataset File: C:\Elandata_LC-ICPMS\DataSet\Nor Aisyah (FPSK)\4.014
Tuning File: C:\Elandata_LC-ICPMS\Tuning\default.tun
Optimization File: C:\Elandata_LC-ICPMS\Optimize\default.dac
Calibration File: C:\Elandata_LC-ICPMS\System\Nor Aisyah (FPSK).cal
Calibration Type: External Calibration

Summary

Intensities

Analyte	Mass	Meas. Intens. Mean	Meas. Intens. RSD	Blank Intensity	Blank Intens. RSD
As	75	234419	3.262	216.003	7.911
Cd	111	1521	4.148	113.334	14.264
Pb	208	305874	3.700	200.002	10.149

Concentration Results

Analyte	Mass	Net Intens. Mean	Conc. Mean	Conc. SD	Conc. RSD	Sample Unit
As	75	234202.620	**179.342**	5.86	3.3	ppb
Cd	111	1407.460	**0.809**	0.04	4.5	ppb
Pb	208	305673.729	**18.156**	0.67	3.7	ppb

Quantitative Analysis - Summary Report

Sample ID: 5

Sample Date/Time: Wednesday, March 28, 2012 12:25:22
Sample Description: Food samples
Solution Type: Sample
Blank File:
Number of Replicates: 3
Peak Processing Mode: Average
Signal Profile Processing Mode: Average
Dual Detector Mode: Dual
Dead Time (ns): 55

Sample File: C:\Elandata_LC-ICPMS\Sample\Nor Aisyah (FPSK).sam
Method File: C:\Elandata_LC-ICPMS\Method\nor aisyah (fpsk).mth
Dataset File: C:\Elandata_LC-ICPMS\DataSet\Nor Aisyah (FPSK)\5.015
Tuning File: C:\Elandata_LC-ICPMS\Tuning\default.tun
Optimization File: C:\Elandata_LC-ICPMS\Optimize\default.dac
Calibration File: C:\Elandata_LC-ICPMS\System\Nor Aisyah (FPSK).cal
Calibration Type: External Calibration

Summary

Intensities

Analyte	Mass	Meas. Intens. Mean	Meas. Intens. RSD	Blank Intensity	Blank Intens. RSD
As	75	239506	3.026	216.003	7.911
Cd	111	4815	2.694	113.334	14.264
Pb	208	59681	4.070	200.002	10.149

Concentration Results

Analyte	Mass	Net Intens. Mean	Conc. Mean	Conc. SD	Conc. RSD	Sample Unit
As	75	239290.481	**183.238**	5.55	3.0	ppb
Cd	111	4701.942	**2.702**	0.07	2.8	ppb
Pb	208	59481.474	**3.533**	0.14	4.1	ppb

Quantitative Analysis - Summary Report

Sample ID: 6

Sample Date/Time: Wednesday, March 28, 2012 12:27:08
Sample Description: Food samples
Solution Type: Sample
Blank File:
Number of Replicates: 3
Peak Processing Mode: Average
Signal Profile Processing Mode: Average
Dual Detector Mode: Dual
Dead Time (ns): 55

Sample File: C:\Elandata_LC-ICPMS\Sample\Nor Aisyah (FPSK).sam
Method File: C:\Elandata_LC-ICPMS\Method\nor aisyah (fpsk).mth
Dataset File: C:\Elandata_LC-ICPMS\DataSet\Nor Aisyah (FPSK)\6.016
Tuning File: C:\Elandata_LC-ICPMS\Tuning\default.tun
Optimization File: C:\Elandata_LC-ICPMS\Optimize\default.dac
Calibration File: C:\Elandata_LC-ICPMS\System\Nor Aisyah (FPSK).cal
Calibration Type: External Calibration

Summary

Intensities

Analyte	Mass	Meas. Intens. Mean	Meas. Intens. RSD	Blank Intensity	Blank Intens. RSD
As	75	241281	1.698	216.003	7.911
Cd	111	4793	2.841	113.334	14.264
Pb	208	59743	4.014	200.002	10.149

Concentration Results

Analyte	Mass	Net Intens. Mean	Conc. Mean	Conc. SD	Conc. RSD	Sample Unit
As	75	241064.552	**184.596**	3.14	1.7	ppb
Cd	111	4679.263	**2.689**	0.08	2.9	ppb
Pb	208	59542.535	**3.537**	0.14	4.0	ppb

Quantitative Analysis - Summary Report

Sample ID: 7

Sample Date/Time: Wednesday, March 28, 2012 12:28:53
Sample Description: Food samples
Solution Type: Sample
Blank File:
Number of Replicates: 3
Peak Processing Mode: Average
Signal Profile Processing Mode: Average
Dual Detector Mode: Dual
Dead Time (ns): 55

Sample File: C:\Elandata_LC-ICPMS\Sample\Nor Aisyah (FPSK).sam
Method File: C:\Elandata_LC-ICPMS\Method\nor aisyah (fpsk).mth
Dataset File: C:\Elandata_LC-ICPMS\DataSet\Nor Aisyah (FPSK)\7.017
Tuning File: C:\Elandata_LC-ICPMS\Tuning\default.tun
Optimization File: C:\Elandata_LC-ICPMS\Optimize\default.dac
Calibration File: C:\Elandata_LC-ICPMS\System\Nor Aisyah (FPSK).cal
Calibration Type: External Calibration

Summary

Intensities

Analyte	Mass	Meas. Intens. Mean	Meas. Intens. RSD	Blank Intensity	Blank Intens. RSD
As	75	180575	0.359	216.003	7.911
Cd	111	559	1.256	113.334	14.264
Pb	208	162256	3.207	200.002	10.149

Concentration Results

Analyte	Mass	Net Intens. Mean	Conc. Mean	Conc. SD	Conc. RSD	Sample Unit
As	75	180359.115	**138.111**	0.50	0.4	ppb
Cd	111	446.016	**0.256**	0.00	1.6	ppb
Pb	208	162056.145	**9.626**	0.31	3.2	ppb

Quantitative Analysis - Summary Report

Sample ID: 8

Sample Date/Time: Wednesday, March 28, 2012 12:30:38
Sample Description: Food samples
Solution Type: Sample
Blank File:
Number of Replicates: 3
Peak Processing Mode: Average
Signal Profile Processing Mode: Average
Dual Detector Mode: Dual
Dead Time (ns): 55

Sample File: C:\Elandata_LC-ICPMS\Sample\Nor Aisyah (FPSK).sam
Method File: C:\Elandata_LC-ICPMS\Method\nor aisyah (fpsk).mth
Dataset File: C:\Elandata_LC-ICPMS\DataSet\Nor Aisyah (FPSK)\8.018
Tuning File: C:\Elandata_LC-ICPMS\Tuning\default.tun
Optimization File: C:\Elandata_LC-ICPMS\Optimize\default.dac
Calibration File: C:\Elandata_LC-ICPMS\System\Nor Aisyah (FPSK).cal
Calibration Type: External Calibration

Summary

Intensities

Analyte	Mass	Meas. Intens. Mean	Meas. Intens. RSD	Blank Intensity	Blank Intens. RSD
As	75	178993	1.489	216.003	7.911
Cd	111	612	7.850	113.334	14.264
Pb	208	171096	0.671	200.002	10.149

Concentration Results

Analyte	Mass	Net Intens. Mean	**Conc. Mean**	Conc. SD	Conc. RSD	Sample Unit
As	75	178776.513	**136.899**	2.04	1.5	ppb
Cd	111	498.687	**0.287**	0.03	9.6	ppb
Pb	208	170896.438	**10.151**	0.07	0.7	ppb

Quantitative Analysis - Summary Report

Sample ID: 9

Sample Date/Time: Wednesday, March 28, 2012 12:32:20
Sample Description: Food samples
Solution Type: Sample
Blank File:
Number of Replicates: 3
Peak Processing Mode: Average
Signal Profile Processing Mode: Average
Dual Detector Mode: Dual
Dead Time (ns): 55

Sample File: C:\Elandata_LC-ICPMS\Sample\Nor Aisyah (FPSK).sam
Method File: C:\Elandata_LC-ICPMS\Method\nor aisyah (fpsk).mth
Dataset File: C:\Elandata_LC-ICPMS\DataSet\Nor Aisyah (FPSK)\9.019
Tuning File: C:\Elandata_LC-ICPMS\Tuning\default.tun
Optimization File: C:\Elandata_LC-ICPMS\Optimize\default.dac
Calibration File: C:\Elandata_LC-ICPMS\System\Nor Aisyah (FPSK).cal
Calibration Type: External Calibration

Summary

Intensities

Analyte	Mass	Meas. Intens. Mean	Meas. Intens. RSD	Blank Intensity	Blank Intens. RSD
As	75	223178	0.432	216.003	7.911
Cd	111	3403	2.503	113.334	14.264
Pb	208	76875	3.398	200.002	10.149

Concentration Results

Analyte	Mass	Net Intens. Mean	**Conc. Mean**	Conc. SD	Conc. RSD	Sample Unit
As	75	222961.598	**170.734**	0.74	0.4	ppb
Cd	111	3289.303	**1.890**	0.05	2.6	ppb
Pb	208	76674.577	**4.554**	0.16	3.4	ppb

Quantitative Analysis - Summary Report

Sample ID: 10

Sample Date/Time: Wednesday, March 28, 2012 12:34:03
Sample Description: Food samples
Solution Type: Sample
Blank File:
Number of Replicates: 3
Peak Processing Mode: Average
Signal Profile Processing Mode: Average
Dual Detector Mode: Dual
Dead Time (ns): 55

Sample File: C:\Elandata_LC-ICPMS\Sample\Nor Aisyah (FPSK).sam
Method File: C:\Elandata_LC-ICPMS\Method\nor aisyah (fpsk).mth
Dataset File: C:\Elandata_LC-ICPMS\DataSet\Nor Aisyah (FPSK)\10.020
Tuning File: C:\Elandata_LC-ICPMS\Tuning\default.tun
Optimization File: C:\Elandata_LC-ICPMS\Optimize\default.dac
Calibration File: C:\Elandata_LC-ICPMS\System\Nor Aisyah (FPSK).cal
Calibration Type: External Calibration

Summary

Intensities

Analyte	Mass	Meas. Intens. Mean	Meas. Intens. RSD	Blank Intensity	Blank Intens. RSD
As	75	225571	1.557	216.003	7.911
Cd	111	3450	3.339	113.334	14.264
Pb	208	79665	5.662	200.002	10.149

Concentration Results

Analyte	Mass	Net Intens. Mean	Conc. Mean	Conc. SD	Conc. RSD	Sample Unit
As	75	225354.656	**172.566**	2.69	1.6	ppb
Cd	111	3336.654	**1.917**	0.07	3.5	ppb
Pb	208	79464.936	**4.720**	0.27	5.7	ppb