UNIVERSITI PUTRA MALAYSIA

DETERMINATION OF ARSENIC CONCENTRATION IN INSTANT NOODLE AND HEALTH RISK ASSESSMENT AMONG STUDENTS IN UNIVERSITI PUTRA MALAYSIA

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BY

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ABSTRACT

DETERMINATION OF ARSENIC CONCENTRATION IN INSTANT NOODLE AND HEALTH RISK ASSESSMENT AMONG STUDENTS IN UNIVERSITI PUTRA MALAYSIA

MUHAMMAD FAHZELI BIN MOHD NAZRI

Introduction: Instant noodle is one of the favourite food especially among students that have low income and insufficient money to afford their foods. However, heavy metals can be contaminated the instant noodle whether through the process of making the instant noodle or the seasoning. One of the heavy metals that can be contaminated these foods is Arsenic. Exposure for a long time to this heavy metal from food can cause adverse effect such as cancer and skin lesions. It also can be connected to the developmental effects, cardiovascular disease, neurotoxicity and diabetes. **Objective:** This study was conducted to determine the arsenic concentration in instant noodle and compare the health risk assessments among two groups of UPM students who these two groups of students have a different socio-demographic background. **Methodology:** This cross-sectional comparative study was conducted among two groups of students which from Foundation of Agriculture Sciences and undergraduate students in UPM. The background information of the respondents was obtained by using pre-tested questionnaire. The arsenic concentration in instant noodle and seasoning were prepared by using Wet-digestion method and were analyzed by using Inductively Coupled Plasma Mass Spectrometry (ICPMS). Hazard Quotient (HQ) and Life Cancer Risk (LCR) were calculated to determine the non-carcinogenic and carcinogenic health risk of the respondents **Result:** A total of 200 respondents which 100 from foundation students and 100 from undergraduate students involved in the study and majority of the respondents were female and age between 18-27 years old. It is found that most of the respondents for both groups were consumed instant noodles once a week. The result also showed that all seven types of instant noodles and seasoning contained arsenic concentration but did not exceed the limit of Malaysia Food Regulation 1985 by 1 mg/kg. The arsenic concentration in instant noodles was higher compared to seasoning. **Conclusion:** This study showed that low level of arsenic was detected in all samples of instant noodles and 4 samples of seasoning. The arsenic concentration in instant noodles were higher than in the seasonings. Besides, the main factor for respondents' consumption of instant noodles is due to easy to prepare. Most of the respondents consumed instant noodles once in a week, therefore no health risk is likely to occur (HQ<1) and LCR is acceptable).

Keywords: Instant Noodles, Seasoning, Arsenic, Hazard Quotient, Lifetime Cancer Risk

ABSTRAK

PENENTUAN KEPEKATAN ARSENIK DALAM MI SEGERA DAN PENILAIAN RISIKO KESIHATAN DALAM KALANGAN PELAJAR DI UNIVERSITI PUTRA MALAYSIA

MUHAMMAD FAHZELI BIN MOHD NAZRI

Pengenalan: Mi segera adalah salah satu makanan kegemaran terutama di kalangan pelajar yang mempunyai pendapatan yang rendah dan wang yang tidak mencukupi untuk membiayai makanan mereka. Bagaimanapun, logam berat boleh tercemar mi segera sama ada melalui proses pembuatan mi segera atau perasa. Salah satu logam berat yang boleh mencemari makanan ini adalah arsenik. Pendedahan untuk masa yang lama oleh logam berat ini dari makanan boleh menyebabkan kesan buruk seperti kanser dan gatal kulit. Arsenik juga boleh dikaitkan kepada kesan perkembangan, penyakit kardiovaskular, neurotoksin dan diabetes. **Objektif**: Kajian ini dijalankan untuk mengenal pasti kepekatan arsenik dalam mi segera dan membandingkan penilaian risiko kesihatan di kalangan dua kumpulan pelajar UPM yang mempunyai latar belakang sosio-ekonomi yang berbeza. **Metodologi:** Kajian perbandingan keratan rentas ini dijalankan di antara dua kumpulan pelajar yang terdiri daripada pelajar Asasi Sains Pertanian dan pelajar sarjana muda di UPM. Maklumat latar belakang responden diperoleh dengan menggunakan soal selidik yang telah dipra-uji. Kepekatan arsenik dalam mi segera dan perasa telah disediakan dengan menggunakan kaedah *Wet acid digestion* dan dianalisis dengan menggunakan *Inductively Coupled Plasma Mass Spectrometry* (ICP-MS). Kuasa Berbahaya (HQ) dan Risiko Kanser Kehidupan (LCR) dikira untuk menentukan risiko kesihatan tidak karsinogenik dan karsinogenik responden **Keputusan**: Sejumlah 200 orang responden iaitu 100 orang pelajar asasi dan 100 orang pelajar sarjana muda yang terlibat dalam kajian ini dan majoriti responden adalah perempuan berumur di antara 18-27 tahun. Didapati kebanyakan responden untuk kedua-dua kumpulan itu memakan mi segera 1 kali dalam masa seminggu. Hasil kajian menunjukkan bahawa tujuh jenis mi segera dan perasa mengandungi kepekatan arsenik tetapi tidak melebihi had Peraturan Makanan Malaysia 1985 iaitu 1 mg / kg. Kepekatan arsenik dalam mi segera lebih tinggi berbanding perasa. **Kesimpulan**: Kajian ini menunjukkan arsenik paras rendah dikesan dalam semua sampel mi segera dan empat sampel perasa. Kepekatan arsenik mi segera adalah lebih tinggi daripada di dalam bahan perasa. Selain itu, faktor utama responden makan mi segera adalah kerana mudah untuk disediakan. Kebanyakan responden makan mi segera 1 kali dalam seminggu. Oleh itu, pengambilan mi segera ini tidak menyebabkan risiko kesihatan (HQ<1 dan LCR boleh diterima)

Kata kunci: Mi Segera, Perasa, Arsenik, Kuasa Berbahaya, Risiko Kanser Sepanjang Hayat

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

CHAPTER 1

INTRODUCTION

1.1 Background

First country that introduced instant noodles was Japan in 1958, 10 years after Japan's defeat in World War II. The person that responsible to the introduction of instant noodles was Momofuku Ando and the first instant noodles was "Chicken Ramen"(WINA, 2016). In this new generation, instant noodles have become worldwide and well-known in about more than 80 countries all over the world. Most all the instant noodles nowadays are made in the same ingredients that are need to make instant noodles are wheat flour, palm oil, and salt and the common used in their flavouring are salt, monosodium glutamate, seasoning and sugar. In addition, at times a little measure of phosphoric acid also found in the instant noodle. Besides, particular sorts of noodles also can be produced by using other flour such as buckwheat. In some certain area, instant noodle also can be known as ramen or maggi.

In this new technology world, instant noodles are consumed widely and its become second global consumption after bread. In Malaysia, there are variety types and brand of instant noodles. Nestle also reported that the instant noodles market in Malaysia were growth about 7.2% from 2010 to 2017 and will witness a growth of 5.5% till 2022. The instant noodles were growth amazingly fast because instant noodles have delicious taste, very convenient, it is easy to cook, low cost food and have a relatively long shelf-life. (Onyema et al, 2014)

The main problem that when consumed this kind of food is from time to time there are a lot of cases involving increasing of incidents about contamination of

heavy metals in agriculture and food industry.The toxicity of these metals is in part due to the fact that they accumulate in biological tissues, a process known as bioaccumulation. This process of bioaccumulation of metals occurs in all living organisms as a result of exposure to metals in food and the environment, including food animals such as fish and cattle as well as humans.

Heavy metal such as arsenic is one of the materials in concerning due to the relation of its toxicity in the general pollution. Naturally, arsenic can be found in the soil, water, plant and animal. Since arsenic is widely used in the industry, it also can be found in the food process because arsenic is used as one of the ingredients for food preservatives. These past years, many of the studies showed that arsenic was also found in the instant noodle. It is very hard to identify the sources of the arsenic whether it come from the noodles or from the seasoning. According to the study by Lundberg (2016), he stated that the arsenic comes during the process of making instant noodles which the substances that contaminated were flour, wheat, water and seafood. These substances are the main ingredients to make instant noodle.

Exposure for a long time to this heavy metal from food can cause adverse effect such as cancer and skin lesions. It also can be connected to the developmental effects, cardiovascular disease, neurotoxicity and diabetes (World Health Organization, 2016). Besides, exposure for prolong tie to this metals can also contribute to get cancer such as lung cancer, bladder cancer and skin cancer. When someone inhale high concentrations of arsenic, it can produces compounds that can make respiratory mucosa irritate. The effect for acute exposure to arsenic include vomiting, abdominal pain and diarrhoea then following by numbness and tingling of the extremities, muscle cramping and in extreme cases, cause death. In Malaysia, to

control the quality of the food and to ensure food is safe, Malaysia Food Regulation (1985) has been set for the exposure limit for arsenic in food which is 1 mg/kg

1.2 Problem Statement

Based on the report by Nestle, in Malaysia about 3.6 million packages of instant noodle are consumed per day and average for a year was 1.34 billion. About 1.4 million of them are more likely to eat instant noodle from brand Maggi (Ngui, 2015). Based on this statistic, the increasing of these numbers from years to years are more to be worried. All brands of instant noodle that available in Malaysia market should always be monitored constantly to ensure the contains in the ingredients are not exceed the standards that been set by Malaysian food Regulation (1985).

In the other hand, there is limited or no local research that studies about the different heavy metals contaminants in instant noodles and seasoning. The community always thought that the seasoning will give adverse health effect to the consumers. Thus, the problem for this study was to determine and compare the level of arsenic concentration in instant noodles and seasoning.

Nowadays, due to the widespread use of metals in industries, special attention should be taken to control and to give awareness to the public the consequences of heavy metals in food even with a small concentration. Several cases of human diseases due to heavy metals toxicity are also being reported such as disorder, malformation, malfunction of the organ (Joshi & Uddin, 2014).

Arsenic is the natural components of the earth's crust and is widely distributed throughout environment like in the air, water and lands. Arsenic is very highly toxic when it in the organic forms. Arsenic is one of the most problematic metals and also

being classified as carcinogenic to human health (International Agency for Research on Cancer, 2005). This is because of the characteristics of the arsenic itself. When arsenic penetrates into human body, it will accumulate at the target organ such as bladder, kidney, liver, lung, prostate and skin.

Based on the report from The Taiwan News, several brands of the instant noodle was found to have arsenic (Taiwan News, 2001). Meanwhile in China, several types of instant noodle were reported to have arsenic in the seasoning of the instant noodle (Hsiao, 2013). Even though the amount that was found was in the small quantities, it should not been found whether in the seasoning or in the instant noodle itself. Some researchers believe that the instant noodle was contaminated with the heavy metals during the process of making the instant noodle (Onyema, et al 2014). This is due to instant noodle is highly processed food, there are a lots of ingredients or flavour that be added to the seasoning or instant noodle to give a perfect taste and without consideration the sources of the ingredients that can contaminate instant noodle with heavy metals.

1.3 Research Questions

The research questions in this study:

i. What is the socio-demographic status of the study respondents?

ii. What is the frequency intake of instant noodle among study respondents?

iii. What are the associated factors to the consumption of instant noodle among study respondents?

iv. Which is contains higher concentration of Arsenic, instant noodle or the seasoning?

v. What is the health risk indicates by hazard quotient (HQ) for non carcinogenic and lifetime Cancer Risk (LCR) for carcinogenic risk of the respondents?

1.4 Research Justification

As demand of the instant noodle in Malaysia highly increase, the potential of consumer to get any related disease cause by toxicity of heavy metals should be concerned. A lot of ingredients that use to make instant noodle and its seasoning which consists different levels of metals. Although there were many quality assurance was perform such as heavy metal batch analysis using inductively coupled plasma emission analysis (ICP-AEA) and inductively coupled plasma emission mass spectrometry (ICP-MS) by Nissin Global Food Safety Institute to ensure that the safety of the instant noodle, however recently there were cases of ban on instant noodle from Nestle product that was found very highly content of heavy metal (Instant Noodle Industry in Malaysia, 2016).

Besides, the information in literature about quality assessment and detection of heavy metals toxicity in instant noodle and its seasoning in Malaysia was very little and limited.Hence the study was conducted to meet a void in research. Instant noodle are well-known as life saviour and as one of the favourite junk food among junk food lovers. Majority of them just eat the instant noodle without aware the consequences of possible health risk that they will have due to toxicity of heavy metals. It is very important to detect the amount of arsenic in instant noodle and it is also important to know whether the amount of arsenic high in the instant noodle or its seasoning. Thus the most contributed of the arsenic concentrations can be differentiated. Some

researchers believe that arsenic can be found in the high concentration in the instant noodle and some thinks that the arsenic came from the seasoning due to the use of ingredients to make the seasoning. It is very important to know the amount of arsenic in instant noodle and to know the most contributed of arsenic whether in instant noodle or the seasoning so that the possible health risk due to consumption of instant noodle can be evaluated.

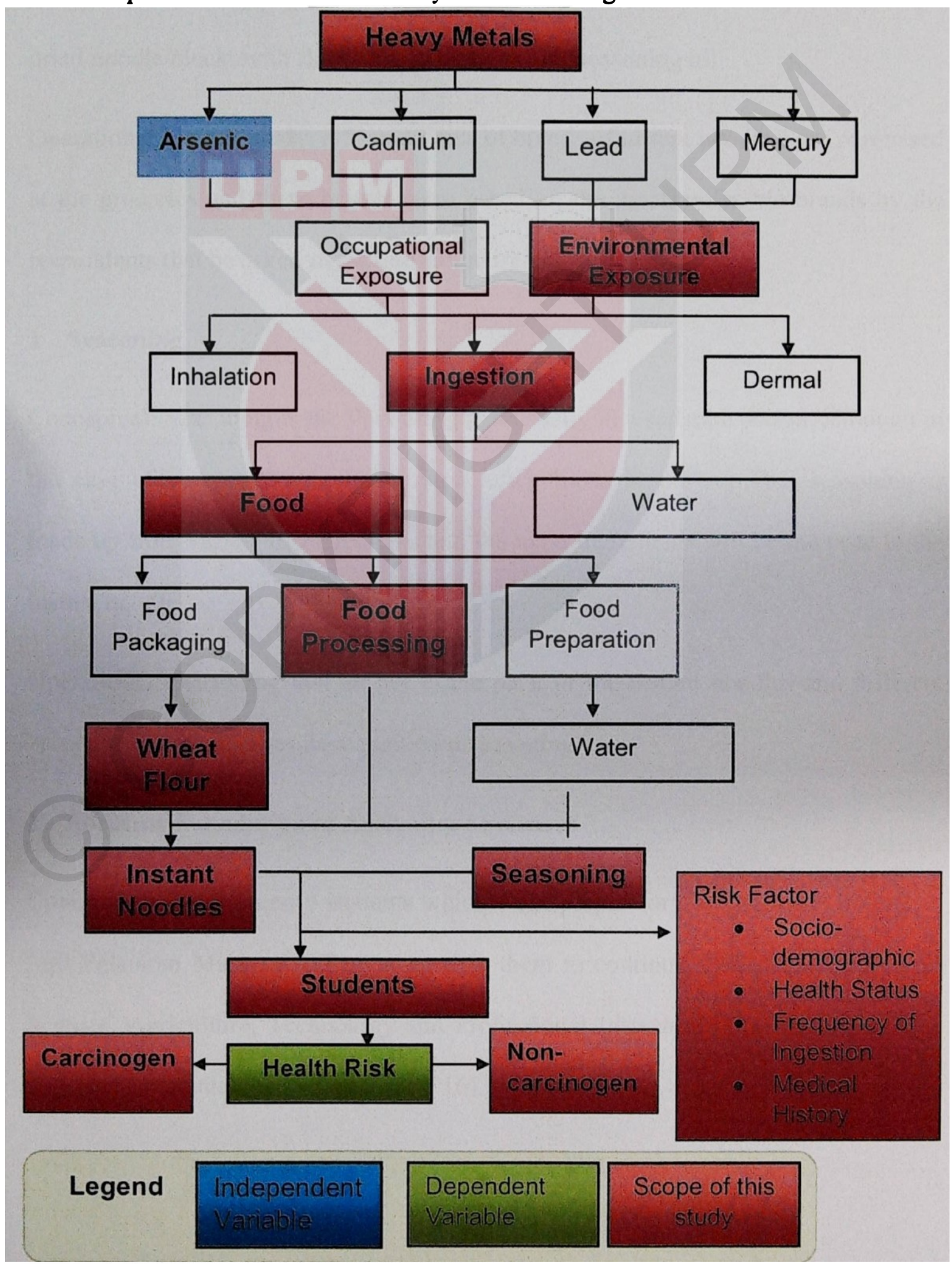
Students of UPM were chosen because based on the survey that conducted by Muslim Volunteer Malaysian Association (MVM), they found that about 44 percent of the public universities use instant noodle as their main menu because they were being so broke until they could not afford to buy food (Malley, 2016). The factors that force them to faced this situation can be cause by the delayed in allowance payment and the payment that they get are not enough to support them to survive. Therefore, they have to consume instant noodle to survive. Due to lack of data and information on food consumption especially instant noodle, thus this study was conducted among them.

Furthermore, health risk assessment indicated by Lifetime Cancer Risk (LCR) and Hazard Quotients was used to evaluate the possibility of someone getting whether carcinogenic risk or non-carcinogenic risk due to the consumption of instant noodle that was contaminated by arsenic for a long time. The result of this study may indirectly assist to improve awareness and knowledge regarding to the toxicity effect of arsenic to human health especially for those who frequently consume instant noodle. This study also aims to compare the concentration of arsenic in instant noodle and its seasoning. Thus, the information regarding amount of ingested arsenic in instant noodle will become a reference on maximum amount of instant noodle

contaminated with arsenic that can be ingested by the respondents over lifetime without risk of adverse effects due to consumption of instant noodle for a long time.

1.5 Conceptual framework

The conceptual framework of this study is shown in Figure 1.1.



1.6 Definition of Term

1) Instant Noodle

Conceptual: Instant noodle were defined as a product that prepared from wheat flour, rice flour, and other flour starches as the main ingredient, with or without the addition of other ingredients. Mostly, instant noodles were sold in a precooked and dried noodle block, with flavouring powder and/or seasoning oil.

Operational : In this study, different types of brands of instant noodle were purchased at the groceries and these brands were based on the most preferable brands by the respondents that be asked in the questionnaire.

1 Seasoning

Conceptual: Seasoning is the flavouring that usually in a separate packet, although in the case of cup noodles theflavouring is often loose in the cup.This seasoning is made up from variety of ingredients and the main ingredients will be the taste to the instant noodle.

Operational: Seasoning that be get in the pack of the instant noodles and different brands of instant noodles have their own seasoning.

2 Students Foundation of Agriculture Sciences

Conceptual: Pre-university students which enrol preparatory program and had taken Sijil Pelajaran Malaysia (SPM) to qualify them to continue their degree studies in Science, Agriculture, Technology and Professional Literature at public and private universities (Ministry of Education, 2016).

Operational: In this study, respondents were from Foundation of Agriculture Sciences that lived at College Thirteen, UPM and those who categorized between ages 18 – 20years old.

3 Undergraduate Students UPM

Conceptual: An undergraduate is a college or university student where after high school and matriculation or pre-university courses, they further their study at college or university but do not graduate yet (Ministry of Education, 2017)

Operational: In this study, respondents who are in undergraduate courses that studies in UPM.

4 Socio-demographic status

Conceptual: Socio-demographic characteristics of a population expressed statistically, such as age, sex, education level, family income, marital status, occupation, average size of family (Business Dictionary, 2014)

Operational: In this study, it was focused on socio-demographic factor such as age, gender and family income level.

5 Arsenic concentration in Instant noodle

Conceptual: Concentration of arsenic in instant noodle was the amount of arsenic detected in instant noodle. The acceptable standard level of arsenic detection in the food sample recommended by Food Regulation 1985 was 1 mg/kg (Ministry of Health Malaysia, 1985)

Operational: The level of arsenic concentration in instant noodle was analyzed by using ICP-MS and the unit of concentration was ppb.

6 Arsenic concentration in seasoning

Conceptual: Concentration of arsenic in instant noodle was the amount of arsenic detected the seasoning. The acceptable standard level of arsenic detection in the food sample recommended by Food Regulation 1985 was 1 mg/kg (Ministry of Health Malaysia, 1985)

Operational: The level of arsenic in seasoning was analyzed by using ICP-MS and the unit of concentration was ppb.

7 Health Risk Assessment

Conceptual: Human health risk assessment is the process to estimate the probability of adverse effects in humans who may exposed to any chemicals. There are four steps in health risk assessment which are hazard identification, dose-response assessment, exposure assessment and risk characterization.

Operational: Health risk assessment was measured among respondents by using questionnaire on food intake and determine the arsenic concentration in food sample. Health risk assessment was performed by calculating the HQ and LCR.

1.7 Research Objective

1.7.1 General Objective

i. To determine the arsenic concentration in instant noodle and seasoning and the health risk assessments of the respondents

1.7.2 Specific Objectives

i. To compare the socio-demographic status between the two groups of respondents.

ii. To compare the concentration of Arsenic in instant noodle and in the seasoning.

iii. To compare the frequency intake of instant noodle between the two respondents groups.

iv. To determine the associated factors of the consumption of instant noodle among the two respondents groups.

v. To associate between socio-demographic factor of respondent and frequency consumption of instant noodle among the two respondents groups.

vi. To calculate the Hazard Quotient(HQ) and the Life time Cancer risk (LCR) for instant noodle and seasoning

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1.8 Study Hypothesis

i. There is a significant different of sociodemographic status between the two groups of respondents.

ii. There is a significant different or arsenic concentration in instant noodle and in the seasoning.

iii. There is a significant different of the frequency intake of instant noodle between the two respondents groups.

iv. There is significant association between socio-demographic factor of respondent and frequency consumption of instant noodle among study and comparative respondents.

v. There is significant different of health risk assessment for the instant noodles and seasoning.

CHAPTER 2

LITERATURE REVIEW

2.1 Heavy metal

Heavy metal is metallic elements with high atomic weights for examples cadmium, arsenic and lead which can damage living things at low concentrations and tend to accumulate in the food chain (Tchounwou, Yedjou, Patlolla, & Sutton, 2012). Heavy metals are potential environmental contaminants with the capability of causing human health problems if present to excess in the food. There are two sources of heavy metals which are from nature and anthropogenic activities or man-made. Heavy metals are naturally found throughout the earth's crust also from natural phenomena such as weathering and volcanic eruptions have been reported to significantly contribute to heavy metal pollution (Yang & Stoffella, 2005). The anthropogenic activities such as mining and smelting operations, industrial production and use and domestic and agricultural use of metals and metal-containing compounds while example for industrial sources include metal processing in refineries, coal burning in power plants, petroleum combustion, nuclear power stations and high tension lines, plastics, textiles, microelectronics, wood preservation and paper processing plants (Strater, Westbeld & Klemm, 2010).

2.2 Arsenic

According to previous study by Smedkley & Kinniburgh (ascitated in Escovar, Hue & Cutler, 2006), arsenic was a metalloid that occurs naturally in soil and minerals. Therefore it may enter air, water and land from wind-blown dust and may get into water from runoff and leaching. However, it also may present in

environment resulting from agricultural and industrial. World Health organization (2016) mentioned that in industrial process, arsenic was used as an alloying agent, pigments, textiles, paper, metal adhesives and wood preservatives. Arsenic also was used in pesticides, food additives and pharmaceuticals.

Arsenic can exist in many different chemical forms. Arsenic that combined with other elements such as oxygen, chlorine and sulphur was called inorganic arsenic while arsenic combined with carbon and hydrogen was referred as organic arsenic. Mostly, the present of organic arsenic and inorganic arsenic was difficult to detect in food, water, or air. This is because they have no smell, colorless and have no special taste. Arsenic that present in environment cannor be destroyed and it only can be change its form by reacting with oxygen or other molecules present in air, water or soil. Arsenic may settle for many days and travel long distance in air. It also can dissolve in water but mostly arsenic compound ends up in the soil or sediment (Department of Health and Human Services CDC USA, 2007).

2.3 Arsenic in food

Arsenic was found routinely in most diets. Based on the US Food and Drug Administration (2017), arsenic has been found in food as long as humans have been consuming food. Arsenic may found in grains, fruits and vegetables as the arsenic was being absorbed through the soil and water. Rice has higher levels of inorganic arsenic than other grains because as rice plants grow, the plant grain absorbed arsenic more readily than other food crops. In addition, arsenic also can be found in some foods such as in fish and shellfish (American Cancer Society, 2014).

Arsenic was present in a wide array of foods, including flour, corn, wheat, poultry, rice and vegetables, as well as beer and wine, fruit juices and water (Lundberg, 2016). According to the study that conducted by Sigrist et al., (2016) most data reported for arsenic in foodstuffs refer to the content of total arsenic. Chakraborti study (as cited in Shrivastava et al., 2011) stated that arsenic may present in vegetable and agriculture product since it was cultivated arsenic-contaminated ground water

2.4 Arsenic Concentration in Instant Noodle And Seasoning

Arsenic was present in a wide array of foods including instant noodles because it was mostly from white flour which contained arsenic (Lundberg, 2016). Test of some random sample of some popular instant noodles discovered to have arsenic. Instant noodles and seasoning was produced by using different background sources and only highly-sensitive testing equipment can detect traces of heavy metals thus, making it even harder to identify the source of some elements. According to Chung, Hsueh and Huang (2013), another laboratory testing on heavy metal in instant noodle product from six companies contained residual traces of heavy metals includes arsenic. Even though the amount of arsenic detected was low, however, it still can effect human health of being consumed continuously for a long period of time. Arsenic that was found in source pack of instant noodle because it was common in environment and in other food stuff as the source were made from plant, seafood, fruit and natural oils.

2.5 Standard for Arsenic in Food by Food Regulation (1985)

Food Regulation 1985 in the Malaysia food legislation that was used as a guidance for food safety in Malaysia to ensure the public is protected from any health hazard and fraud in the preparation and use of foods. This legislation was applicable to all foods sold in this country or imported foods. Food regulation 1985, has set the standard permissible exposure limit for arsenic in food was 1mg/kg.

2.6 Health Risks Associated with Arsenic Poisoning

The International Agency for Research on Cancer (2005) has classified arsenic and arsenic compounds as Group 1 human carcinogenic. The Jakarta Post (2016) stated that overconsumption of grains can increase the risk of metabolic syndrome. The effects of exposure of toxic metals such as mercury, lead, cadmium, arsenic and aluminium may result in symptoms and disease linked to metabolic syndrome (Hogg, 2016). Arsenic was extremely toxic both acute and chronic. It can enter into human body through, inhalation or skin absorption. Contaminated water with arsenic used for drinking, food preparation and food crops poses the greatest threat to public health. World Health Organization (2016) says long-term exposure to arsenic from food can cause cancer of lung and bladder, skin lesions and kidney damage. It has also been associated with developmental effects, cardiovascular disease, neurotoxicity and diabetes. Short term exposure to arsenic may develop symptoms of acute arsenic poisoning include vomiting, abdominal pain, muscle weakness and diarrhea (American cancer Society, 2014)

2.7 Detection of Arsenic in Food Samples Using Inductively Coupled Plasma Mass Spectrometry (ICP-MS)

Arsenic concentration was detected in instant noodle by using Inductively Coupled plasma mass Spectrometry (ICP-MS) (Kapadnis et al., 2016) by using Inductively Coupled plasma mass Spectrometry (ICP-MS) was a type of plasma based technique which was capable of detecting metals and several non-metals at concentrations parts per billion (ppb) on non-interfered low-background isotopes with a single high-energy excitation source providing precise determination of arsenic in foods (Ducos et al., 2010). The ELAN DRC II uses chemical resolution in eliminate plasma-based polyatomic species before they reach the quadrupole mass spectrometer. This ion-molecule chemistry uses a gas to "chemically scrub" polyatomic or isobaric species from the ion beam before they enter the analyzer, resulting in improved detection limits for difficult elements (PerkinElmer, 2004). The important features of ICP-MS which include high linear dynamic range (LDR) allowed for the detection of ultra trace and major elements in one run to obtain comprehensive information about the sample. Analysis of trace level of heavy metals in noodles and seasoning revealed that ICP-MS offers a complete solution for the accurate determination of trace level heavy metals in instant noodle and sachets (Kapadnis et al., 2016).

2.8 Public Awareness Regarding Instant Noodles

The consumption of instant noodle was widespread everywhere in the world. Recently, healthy diets were more important however, instant noodle seems to be harmful to human health (Kichi, 2016). Many people do not realize that these cheap instant noodles that they consumed or even shared with their children were actually

dangerous to human health because it could be linked to cancer and increased risk of heart disease if consumed a few times in a week (Mills, 2015). According to Saxena (2015), most instant noodles are made from refined flour which could cause indigestion and may lead to bowel troubles and obesity. It was not surprised a few students consume instant noodle during lunch time. Based on study conducted by Brown, Mellveen & Strygned (2000), the food preference behaviour by young consumer who aware of healthy eating was not always reflect such knowledge, particularly within the school and social environments.

CHAPTER 3

METHODOLOGY

3.1 Study Design

The study that been used was a cross-sectional study which was conducted over a period of 5 months starting from September 2017 until March 2018.

3.2 Study Location

The study location was at Thirteen College and Serumpun College in UPM.

3.3 Study Sample

3.3.1 Respondents

a) Study Population

The study population were residents in Thirteen College and Serumpun College of UPM. The total population of Thirteen College is 1500 and the Serumpun College is 5000.

b) Sampling Method

Thirteen College and Serumpun College were purposively chosen due to the differences in students backgrounds who resided in both colleges. Thirteen College consist of pre-undergraduate program students while Serumpun College consists of undergraduate students from variety program in UPM. The respondents in each residential college were randomly selected to be included as study respondents. The inclusion criteria at Serumpun College, the respondents must be undergraduate

students that stay at the college. The inclusion criteria for being recruited as respondent are staying in the college and consume instant noodle. There were no exclusion criteria in this study. This technique is use because every unit in a population have equal chance to be selected (Levine, 2009).

c) Sampling Frame

Sampling frame includes all male and females students registered at the selected residential college of Universiti Putra Malaysia, Serdang to participate in the study. The numbers of respondents were based on the numbers of students which represents by races that stay at the colleges. However, only those who fulfilled the inclusion and exclusion criteria were included in this study

d) Sample Size

The sample size calculation was based on Lameshow et.al. (1990) formula for group comparison using combined (or pooled) standard deviation for the two groups as follows:

Equation 3.1

$$s = \frac{2 \text{ X } 2\,\delta^2 (Z_{1-\frac{\alpha}{2}} + Z_{1-\beta})}{(\mu 1 - \mu 2)^2}$$

Where,

$2\delta^2$ = Estimated standard deviation (assumed to be equal to each group)

$\mu 1$ = Estimated mean (larger)

$\mu 2$ = Estimated mean (smaller)

$Z_{1-\frac{\alpha}{2}}$ = Standard error associated with confident interval, 95% CI=1.96

$Z_{1-\beta}$ = Standard error associated with power, 80% of power = 0.84

Prevalence of reported number of people that have arsenic contamination among population:

$$s = \frac{4(268)^2(1.96 + 0.84)}{(280 - 180)^2}$$

= 80.44 ≈ 80 Respondents (Chakraborti, et al, 2004)

Based on formula, 80 respondents were required for both groups of students. The numbers of students were increased by 20% for the strength of the analysis of the study and to take into account on non-responsive respondents, missing data and errors. For this study, the total number of samples that were included in this study is 100 for each group of respondents.

3.3.2 Instant Noodles

The instant noodle samples were purposively sample based on the most popular brands consumed by the respondents. All of the instant noodles were purchased based on the same manufacturer year at nearby groceries.

3.4 Data Collection and Instrumentation

3.4.1 Background Information of Respondent and Instant Noodle Intake

A set of questionnaire (Appendix 2) were constructed to obtain information on socio-demographic, instant noodle frequency intake and factor influencing instant noodle consumption. The respondent were asked whether they consumed instant noodle or not and the questionnaire was only applicable to those students who currently consume instant noodle. The self administered questionnaire was modified

from National health & Nutrition Examination Survey and Methodological evaluation of method for dietary metal intake (ZukowskaBiziuk, 2008) and divide into 4 main parts, which is Part A, Part B, Part C and Part D.

Part A of the questionnaire was consists of the socio-demographic information of the respondents which include age, race, gender, parents educational level, family income level, and respondent's living expenses (food) and in the Part B of the questionnaire, the respondents were asked about the information about instant noodle includes preferred brand, the frequency intake in a week and the availability of instant noodle. Apart from that, the information of factors influence instant noodle consumption among respondents was obtained.

Part C asked the respondents about current health status and past medical history. The weights and heights of respondent were also obtained. In Part D, the questions were designed to obtain lifestyle information which includes smoking behaviour, sources of drinking water respondent consume daily and type of utensil use for preparation of instant noodle.

3.4.2 Arsenic Concentration in Instant Noodles

The arsenic concentration were determined in the instant noodle and in the seasoning separately. The preparation of the instant noodles samples were by using wet digestion method. First, to prepare the sample of instant noodle, the instant noodles were break into small pieces and immersed into 20 mL of hot water for 3 minutes. Then samples were filtered to remove the hot water. After that, 5 g of the samples were been taken by using spatula and put into the pastel and mortar. The samples were mashed properly.

About 1 g of the samples were taken and mixed with diluted 15 mL of 69% of nitric acid (HNO_3). Then, the mixture was heated at 50°C for one hour by using hot plate. About 10mL of samples from solution were transferred into one centrifuge tube and were analyzed using Inductively Couple Plasma Mass Spectrometer (ICP-MS) model Perkin Elmer Elan Dre-e. All samples were triplicate and were reported in mg/L (ppb).

For the samples of the seasoning, first the seasonings of the instants noodles were put into 20mL of hot water. After that, mixture was filtered and about 10 mL of samples from solution were transferred into one centrifuge tube and wereanalyzed using Inductively Couple Plasma Mass Spectrometer (ICP-MS) model Perkin Elmer Elan Dre-e. All samples were triplicate and were reported in mg/L (ppb).

The food standard reference material for arsenic element was analyzed to obtain the standard curve value of ±0.999 prior to the samples analysis and good recoveries were observed. The value of arsenic concentration was applied into equation below to obtain concentration of arsenic in both samples, instant noodle and seasoning.

Equation 3.2

$$\text{Arsenic Concentration} = \frac{(AXB)XC}{W}$$

Where,

A = The volume of extraction

B = Dilution factor

C = Concentration of As in extract

W = Weight of sample (1g)

3.4.3 Health Risk Assessment

The health risk assessment of the respondents was evaluated using HQ and LCR based on the concentration of arsenic detected in the samples. The details of HQ and LCR are shown below:

i. Hazard Quotient

In this study, a hazard quotient were used to measure the possibility of non-carcinogenic health effect due to chronic ingestion of instant noodle contaminate with arsenic among respondents. A HQ of less than 1 were considered as acceptable risk which means no chronic risk are likely to occur. While, HQ in which greater than 1 was indicated that the respondents might posed health effect. The HQ were calculated as below:

Equation 3.3

$$HQ = ADD/RfD$$

Where,

HQ = Hazard Quotient

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

RfD = Reference dose n(mg/kg-day)

Subsequently, the average daily dose of arsenic through ingestion of instant noodle (ADD) were calculated by using following formula.

Equation 3.4

$$ADD = \frac{C_f \times Ri \times Fi\ EF \times ED}{BW \times AT}$$

Where,

ADD = Average daily dose of arsenic through ingestion of instant noodle

C_f– Average arsenic concentration in a instant noodle (kg/meal)

Ri = Ingestion rate of instant noodle (kg/meal)

Fi = Fraction ingested from contaminated source

EF = Exposure frequency (days/years)

ED = Exposure Duration (years)

BW = Body Weight (kg)

AT = Averaging time (AT),

*70 years for LCR

* AT = ED for HQ (10 years)

b) Lifetime Cancer Risk

The lifetime cancer risk was calculated by using the formula. The acceptable value for LCR is must be greater than one in a million (10^{-6}).

Equation 3.5

$$LCR = ADD \times SF$$

Where,

Risk = Probability of carcinogenic risk

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

SF = Carcinogenic slope factor (mg/kg-day)

*SF for arsenic = 1.5 (mg/kg-day)

3.5 Data Analysis

Data that obtain from this study were analyzed by using software Statistical Package for Social Science (SPSS) version 25.The summary of the data analysis that were used in this study are in the table below.

Table 3.1: Statistical Analysis

Objectives	Variables	Type of Data	Hypothesis	Statistical Analysis
To compare the socio-demographic status of the study respondents.	- Age - Gender - Parents' education - Income - Races - Expenses for the food	Continuous Categorical	There is significant difference of socio-demographic status among two groups of respondents.	-Chi-square -T-Test/ Man-Whitney U Test
To compare the concentration of Arsenic in instant noodle and seasoning	-Arsenic concentration in instant noodle - Arsenic concentration	Continuous	There is significant difference of lead concentration in instant noodles and its	- T-test/Man-Whitney U Test

	in seasoning		seasoning.	
To determine the association of socio-demographic status and frequency intake of instant noodles	- Socioeconomic status -frequency intake of instant noodles	Categorical	There is significant difference between socioeconomic status and frequency intake of instant noodles	Chi-square
To compare the influencing factor of instant noodles consumption among two group of respondents	influencing factor of instant noodles consumption	Categorical	There is significant difference of instant noodles consumption among two group of respondents	Chi-square

3.6 Quality Control

i. Questionnaires

The pre-test was carried out among 10% from the total number of respondents with same characteristics but not from same population of the two group respondents. Based on pre-test, some minor correction had been done prior to data collection.

ii. Standard Operating Procedure

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

3.7 Ethical Approval

Ethical approval was obtained from ethic Committee for Research Involving Human Subject in Universiti Putra Malaysia (JKEUPM) (Appendix 3). Meanwhile, permission to conduct study in the selected colleges was obtained from the college management. Informed consent form (Appendix 1) was distributed to the respondents along with the questionnaires distributions and anonymous of the participants was maintained at all time

CHAPTER 4

RESULTS

4.1 Socio-demographic information

This study was conducted among Universiti Putra Malaysia's (UPM) students which consisted of two groups which namely undergraduate students and Foundation of Agriculture Sciences students. The purpose of this study was to determine the concentration of arsenic in instant noodles and in seasoning and to determine health risk assessment among students in UPM. The total number of respondents involved in this study was 200 which is 100 from undergraduate students and 100 from students of Foundation Agriculture Sciences. From Table 4.1, the respondents were mostly female, (n=78) from foundation students and (n=76) from undergraduate students. There is no significant difference (x^2 =0.113, p=0.737) for gender between two group of respondents.Table 4.1 also shows the result from Mann-Whitney U T-test for age of both respondent groups who consumed instant noodles. The minimum age for foundation students was 18 and maximum age was 19. As for undergraduate students, the minimum age was 19 and maximum was 27. There is a significant different between age among this two group of respondents (Z-statistics = -12.515, p= <0.001). For the races, the number of the respondents were represents the total numbers of residents that lived at Thirteen College and Serumpun College. For foundation group, (n=90) of them were Malays, (n=4) of them were Chinese and 6 (n=6) of them were Indians. For undergraduate group, the Malays students were highest (n= 91) compare to Chinese (n=2) and Indian (n=7). For the family income, the numbers of respondents which from middle group of family income were higher in undergraduate students (80) than in foundation students (58). The numbers of

respondents for foundation students who comes from high family income were higher (n=42) compare to undergraduate students (n=20). This different is significant (x^2=11.314, p=<0.001). For the expenses of food per month, both groups of respondents mostly spend RM50 to RM300 followed by RM300 to RM700 and then more than RM700. There is no significant different (x^2=0.735, p=0.693) between the expenses of food per month with the groups of respondents.

Table 4.1 : Socio-demographic information of respondents (N=200)

Variables	Group 1 n (%)	Group 2 n (%)	Statistical Analysis	p-value
Gender				
Male	22 (22%)	24 (24%)	χ^2 = 0.113	0.737
Female	78 (78%)	76 (76%)		
Races				
Malay	90 (90%)	91 (91%)		
Chinese	4 (4%)	2 (2%)	χ^2 = 0.749	0.688
Indian	6 (6%)	7 (7%)		
Age				
Median (IQR)	19 (0)	22 (2)	Z-stat = -12.515	**<0.001***
Min	18	19		
Max	19	27		
Family Income**				
Middle (<RM5000)	58 (58%)	80 (80%)	χ^2 = 11.314	**0.001***
High (>RM5000)	42 (42%)	20 (20%)		
Expenses for food per month				
RM50 to RM 300	60	54		
RM300 to RM700	26	30	χ^2 = 0.735	0.693
>RM700	14	16		

**Based on Central Bank of Malaysia Report 2013

*Significant p value <0.001

4.2 Frequency of Instant Noodles Consumption Among Two Groups of Respondents

Table 4.2 and figure 4.1 shows the frequency intake of different types of instant noodles consumption among respondents. From the results shown below, most of the respondents consume instants noodles less than three times per week. For foundation students 93 of them consume less than three times per week while another 7 were consuming more than three times per week. For undergraduate students, 96 consume instant noodles less than three times and another 4 consuming instant noodles frequently. From this result, foundation students consume instant noodles more frequent compare to undergraduate students. . However, the different of frequency within two groups is not significant (x^2=0.866, p=0.352).

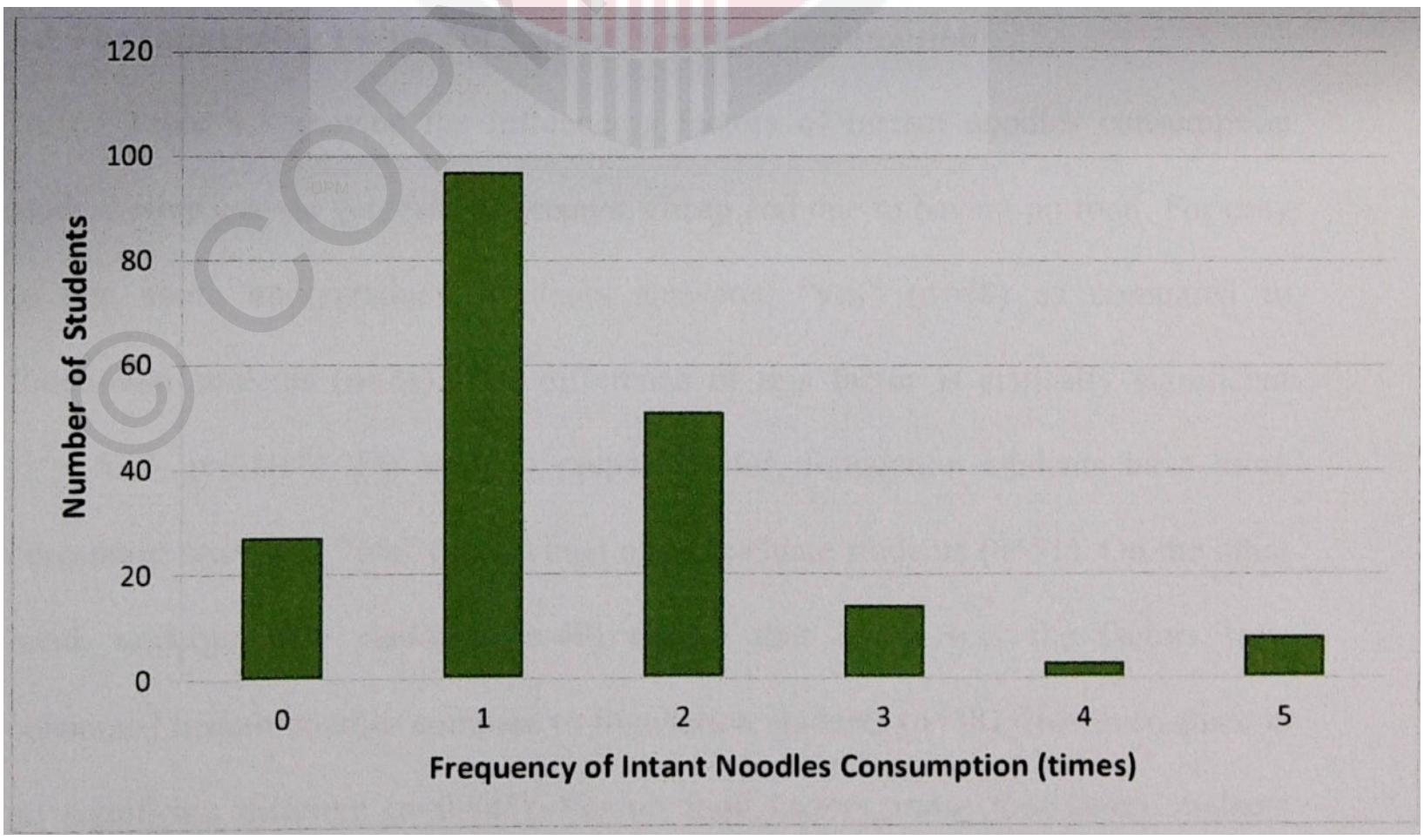

Figure 4.1: The frequency intake of instant noodles in a week

Table 4.2: Frequency of instant noodles intake (N=200)

Frequency in a week (%)	Frequency, n		Chi-Square, x	p-value
	Foundation Students	Undergraduate Students		
Less Frequent*	93 (93%)	96 (96%)	0.866	0.352
Frequent*	7 (7%)	4 (4%)		

*Less frequent = < 3 times per week } (Jahanbakhah&Mousanechez,

*Frequent = ≥ 3 times per week

*Significant p value <0.005

4.3 The Influencing Factors of Instant Noodles Consumption

Table 4.3 showed the influencing factors of instant noodles consumption studied were easy to get, easy to prepare, cheap and due to having no food. For easy to get, more undergraduate students answered "yes" (n=48) as compared to foundation students (n=21). The difference of this factor is statically significant (x^2=16.13, p=0.017). For easy to prepare factor, foundation students have more percentage answered "yes" (n=62) than undergraduate students (n=51). On the other hand, undergraduate students (n=40) agreed that cheap was the factors they consumed instant noodles compare to foundation students (n=38). However, there is no significant different (p=0.885). For no food factors, more foundation students

answered "yes" (n=45) than undergraduate students (n=30). This differences is statistically significant with p = 0.028.

Table 4.3:The influencing factors of instant noodles consumption.

Factors	Frequency, n (%)		Chi-square, x	p-value
	Group 1	Group 2		
Easy to get:				
Yes	21 (21%)	48 (48%)	16.13	**0.017***
No	79 (79%)	52 (52%)		
Easy to prepare:				
Yes	62 (62%)	51 (51%)	2.46	0.117
No	38 (38%)	49 (49%)		
Cheap				
Yes	38 (38%)	40 (40%)	0.84	0.885
No	62 (62%)	60 (60%)		
No food				
Yes	45 (45%)	30 (30%)	4.80	**0.028***
No	55 (55%)	70 (70%)		

*Significant p value <0.005

4.4 The Association of Economic Status and Frequency Consumption of Instant Noodle

Table 4.4 shows the association of economic status and the frequency intake of instant noodles among two groups of respondents. From this result, the number of respondents who consumes instant noodles frequently came from middle class family income which (n=6) for foundation students and (n=4) for undergraduate students. However the result showed the same for the respondents with less frequent intake of instant noodles were also from middle family incomes which (n=56) for foundation students and (n=76) for undergraduate students. There is no significant different found between family income and frequency intake of instant noodles for foundation students (x^2=2.373, p=0.234) and undergraduate students (x^2=0.153, p=0.695).

Table 4.4: Association of socioeconomic status and frequency intake of instant noodles (N=200)

Socioeconomic status	Group 1		Chi-square, χ^2	p-value	Group 2		Chi-square, x	p-value
	Less Frequent, n (%)	Frequent, n (%)			Less Frequent, n (%)	Frequent, n (%)		
High income >RM5000	41 (41%)	1 (1%)	2.373	0.234	20 (20%)	0 (0%)	0.153	0.695
Middle income <RM5000	52 (52%)	6 (6%)			76 (76%)	4 (4%)		

*Bank of Malaysia Report

*Significant p value < 0.05

**Less frequent = < 3 times per week

**Frequent = ≥3 times per week

4.5 Arsenic Concentration in Instant Noodles and Seasoning

Table 4.5 showed the concentration of arsenic in all instant noodles samples and Table 4.5.2 and figure 4.5 showed mean concentration of arsenic in instant noodles for all seven samples. The concentrations were calculated by using formula in Equation3.2. The results found the range concentration of arsenic in instant noodles were between 0.0010 and 0.0239 mg/kg. The sequences of arsenic concentration for instant noodles were A> B> D> C> E> G> F. The highest arsenic concentration in instant noodles was in sample A and the least was in sample F. Table 4.5 showed the concentration of arsenic in seasoning and Table 4.5.3 and figure 4.5.1showed the mean concentration of arsenic in seasoning. However only 5 sample of seasoning get the reading. Another 3 sample were below the limit of quantifications which was set at 0.002 mg/kg. The range concentration of arsenic in seasoning was 0.0020 and 0.0060 mg/kg where sample A> D> B> C. This study found that all the samples were not exceed the permitted level which is 1 mg/kg (Malaysian Food Regulation, 1985). This result found that arsenic concentration was higher in instant noodles compare to seasoning.

Table 4.5: The Calculation of Arsenic Concentration in Instant Noodles

Samples	Concentration of arsenic in extraction (mg/kg)	Dilution Factor	Volume of extract	Weight of Samples	Final Concentration (mg/kg)
A1	7.64×10^{-4}	2	10	1	0.0153
A2	9.13×10^{-4}	2	10	1	0.0183
A3	1.91×10^{-3}	2	10	1	0.0382
B1	4.33×10^{-4}	2	10	1	0.0087
B2	4.99×10^{-4}	2	10	1	0.0010
B3	1.17×10^{-3}	2	10	1	0.0234
C1	4.12×10^{-4}	2	10	1	0.0082
C2	3.80×10^{-4}	2	10	1	0.0076
C3	3.18×10^{-4}	2	10	1	0.0064
D1	1.08×10^{-3}	2	10	1	0.0216
D2	7.60×10^{-4}	2	10	1	0.0152
D3	5.39×10^{-4}	2	10	1	0.0108
E1	2.90×10^{-4}	2	10	1	0.0058
E2	2.35×10^{-4}	2	10	1	0.0047
E3	2.21×10^{-4}	2	10	1	0.0044
F1	4.00×10^{-6}	2	10	1	0.00008
F2	5.20×10^{-5}	2	10	1	0.0010
F3	1.07×10^{-4}	2	10	1	0.0021
G1	1.91×10^{-4}	2	10	1	0.0038
G2	1.95×10^{-4}	2	10	1	0.0039
G3	1.82×10^{-4}	2	10	1	0.0036

Table 4.5.1: The calculation of Arsenic Concentration in Seasoning

Samples	Concentration of arsenic in extraction (mg/kg)	Dilution Factor	Volume of extract	Weight of Samples	Final Concentration (mg/kg)
A1	7.33×10^{-3}	3.33	15	1	0.0038
A2	8.54×10^{-3}	3.33	15	1	0.0046
A3	7.89×10^{-3}	3.33	15	1	0.0096
B1	4.34×10^{-4}	3.33	15	1	0.0022
B2	1.62×10^{-4}	3.33	15	1	0.0025
B3	2.21×10^{-4}	3.33	15	1	0.0059
C1	4.12×10^{-4}	3.33	15	1	0.0021
C2	9.30×10^{-5}	3.33	15	1	0.0020
C3	7.81×10^{-3}	3.33	15	1	0.0020
D1	2.39×10^{-4}	3.33	15	1	0.0054
D2	8.90×10^{-5}	3.33	15	1	0.0038
D3	2.37×10^{-4}	3.33	15	1	0.0027
E1	< 0.002	3.33	15	1	< 0.002
E2	< 0.002	3.33	15	1	< 0.002
E3	< 0.002	3.33	15	1	< 0.002
F1	< 0.002	3.33	15	1	< 0.002
F2	< 0.002	3.33	15	1	< 0.002
F3	< 0.002	3.33	15	1	< 0.002
G1	< 0.002	3.33	15	1	< 0.002
G2	< 0.002	3.33	15	1	< 0.002
G3	< 0.002	3.33	15	1	< 0.002

Table 4.5.2: The Mean Concentration of Arsenic in Instant Noodles

Samples	Concentration (mg/kg)			Mean concentration
	Sample 1	Sample 2	Sample 3	(mg/kg)
A	0.0153	0.0183	0.0382	0.0239
B	0.0087	0.0010	0.0234	0.0175
C	0.0082	0.0076	0.0064	0.0074
D	0.0216	0.0152	0.0108	0.0159
E	0.0058	0.0047	0.0044	0.0050
F	0.00008	0.0010	0.0021	0.0010
G	0.0038	0.0039	0.0036	0.0038

Table 4.5.3: The Mean Concentration of Arsenic of Seasoning

Samples	Concentration (mg/kg)			Mean concentration
	Sample 1	Sample 2	Sample 3	(mg/kg)
A	0.0038	0.0046	0.0096	0.0060
B	0.0022	0.0025	0.0059	0.0035
C	0.0021	0.0019	0.0016	0.0020
D	0.0054	0.0038	0.0027	0.0040
E		< 0.002		*< 0.002
F		< 0.002		*< 0.002
G		< 0.002		*< 0.002

*Limit of Quantification

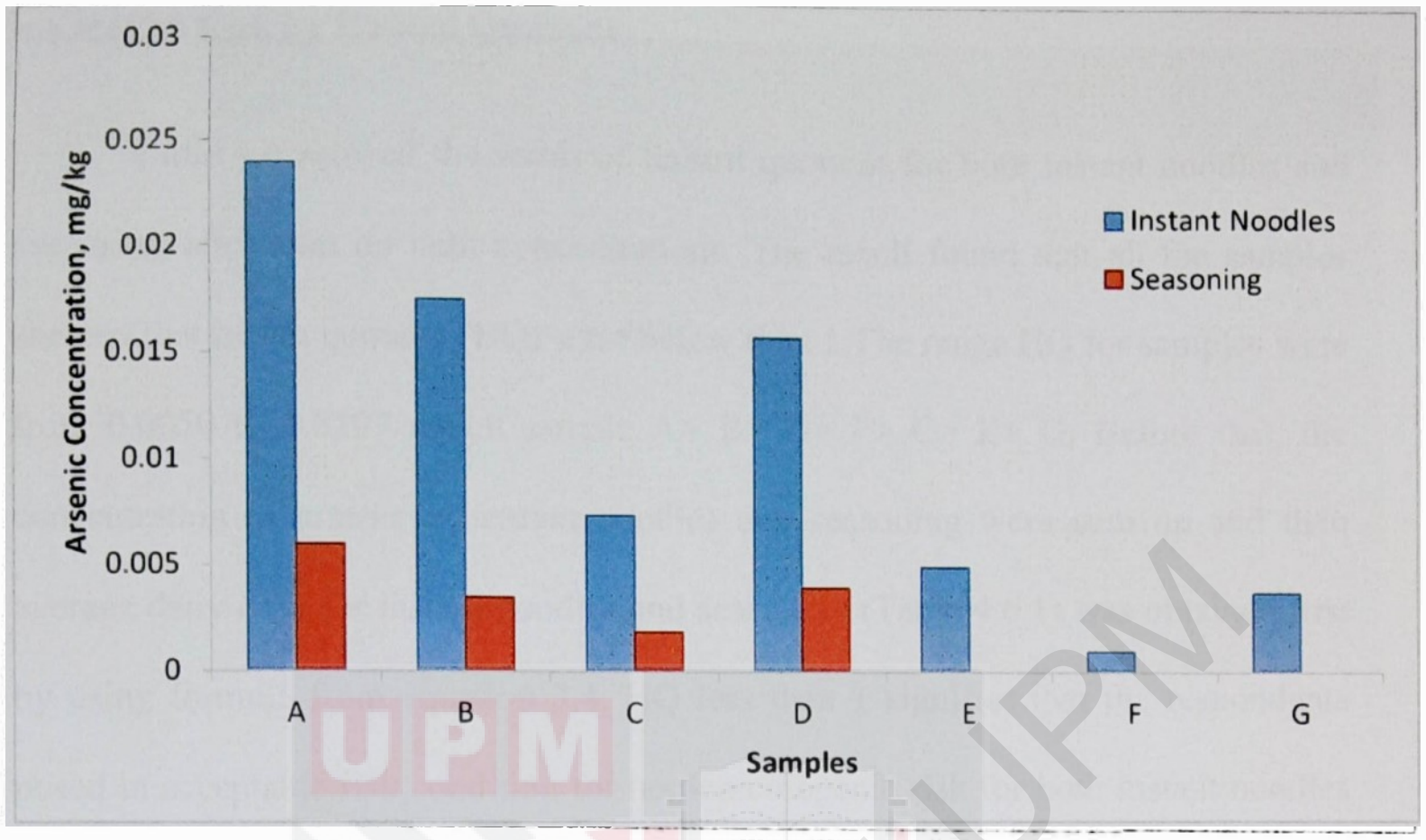

Figure 4.2: Concentration of Arsenic in Instant Noodles and Seasoning

Samples:

A: Maggi (Chicken flavour)

B: Maggi (Tom Yam flavour)

C: Maggi (Curry flavour)

D: Mamee (Curry flavour)

E: Cintan (Curry flavour)

F: MeeSedap (Asli flavour)

G: Samyang (Chicken flavour)

4.6 Health Risk by Hazard Quotient

Table 4.6 showed the result of hazard quotient for both instant noodles and seasoning after sum up both concentrations. The result found that all the samples showed that health quotient (HQ) were below than 1.The range HQ for samples were from 0.0050 to 0.0397 which sample A> B> D> F> C> E> G. Before that, the concentration of arsenic in instant noodles and seasoning were sum up and then average daily dose for instant noodles and seasoning (Table 4.6.1) was obtained first by using formula from equation 3.4. HQ less than 1 signifies that the respondents posed in acceptable risk condition for non-carcinogenic risk for both instant noodles and seasoning.

Table 4.6: Hazard Quotient for Instant Noodles and seasoning

Brands	Reference Dose (mg/kg-day)	Average Daily Dose (mg/kg-day)	Hazard Quotient	Risk
A	3.0×10^{-4}	1.19×10^{-5}	0.0397	Not significant
B	3.0×10^{-4}	8.33×10^{-6}	0.0278	Not significant
C	3.0×10^{-4}	3.69×10^{-6}	0.0123	Not significant
D	3.0×10^{-4}	7.90×10^{-6}	0.0263	Not significant
E	3.0×10^{-4}	1.98×10^{-6}	0.0066	Not significant
F	3.0×10^{-4}	3.97×10^{-7}	0.0132	Not significant
G	3.0×10^{-4}	1.51×10^{-6}	0.0050	Not significant

Table 4.6.1: The Average Daily Dose (ADD) for Arsenic in Instant Noodles and Seasoning

Brands	Arsenic Concentration (mg/kg)	IR (kg/day)	EF (day/year)	ED (years)	BW (kg)	AT (days)	ADD (mg/kg-day)
A	0.0299	0.079	104	10	56.73	3650	1.19×10^{-5}
B	0.0210	0.079	104	10	56.73	3650	8.33×10^{-6}
C	0.0093	0.079	104	10	56.73	3650	3.69×10^{-6}
D	0.0199	0.079	104	10	56.73	3650	7.90×10^{-6}
E	0.0050	0.079	104	10	56.73	3650	1.98×10^{-6}
F	0.0010	0.079	104	10	56.73	3650	3.97×10^{-7}
G	0.0038	0.079	104	10	56.73	3650	1.51×10^{-6}

4.7 Lifetime Cancer Risk

Table 4.7 shows that the Lifetime Cancer Risk for instant noodles. The range cancer risk for instant noodles and seasoning was from 5.96 $x10^{-7}$ to 1.19 $x10^{-5}$. However all 7 samples of instant noodles brands were classified as not significant because all samples were in the permissible range for carcinogenic risk 10^{-6} (one in 1 000 000) to 10^{-4} (one in 10 000) over a lifetime of 70 years (USEPA, 2011).

Table 4.7: Lifetime Cancer Risk for Instant Noodles

Brands	CSF (mg/kg-day)	Average Daily Dose (mg/kg-day)	Cancer Risk	Risk
A	1.5	$9.48 x10^{-6}$	$1.79 x10^{-5}$	Not significant
B	1.5	$6.94 x10^{-6}$	$1.25 x10^{-5}$	Not significant
C	1.5	2.94 x10-^{6}	$5.54 x10^{-6}$	Not significant
D	1.5	$6.30 x10^{-6}$	$1.19 x10^{-5}$	Not significant
E	1.5	$1.98 x10^{-6}$	$2.97 x10^{-6}$	Not significant
F	1.5	$3.97 x10^{-7}$	$5.96 x10^{-7}$	Not significant
G	1.5	$1.51 x10^{-6}$	$2.27 x10^{-6}$	Not significant

CHAPTER 5

DISCUSSION

5.1 Socio-demographic Information

The result showed that the number of respondents was mostly female because majority of UPM students are female. This finding were consistent with the study conducted by Aminah and Khairul (2014) where they found that the trend in the participation of women in education was very encouraging since the percentage of females in the different levels of education were on the increase. For family income, more undergraduate students came from middle family income category which is less than RM5000 per month. However, for high family income, more students from foundation were from this category. The differences of this family income are significantly. This result are different from studies that conduct by Park, Lee, Jang and Chung (2011), they found that the number of people that consumed instant noodles were lower than non-instant noodles consuming based on their family income. It means that when they are in the higher family income, they were not consuming instant noodles. The Mann-Whitney U test was used to differentiate the age between two groups of respondents. The result showed that the difference is significant. This is because foundation students are mostly at 18-19 years old and for undergraduate is between 19 and above.

5.2 Frequency of Instant Noodles Consumption

Based on the result, most respondents consume instant noodles once in week. This result was similar as Kim and Park (2013), they found that the most frequently chosen by the respondents was twice in a month (42.3%) followed by once a week (31.5). This study found that the frequently intake of instant noodles for both group respondents was more likely once per week. Another study which conducted by Jahanbakhsh & Mousanczhad (2015), they found that 20.3% of the respondents more likely to consume instant noodles once per week. There is no significant association found between the instant noodles frequency intake with family income in both groups of respondents. The status of family income will affect the frequency intake of instant noodles. However, the findings also showed that most of the respondents consuming instant noodles more than three times per week are from middle family income. This finding were consistent with the research done by Kim, Park, and Oh (2013), they found that the intake of instant noodles was consistently higher in the lower family income. This research found that the frequency intake of instant noodles is not depends on the respondent family income.

5.3 The Influencing Factors of Instant Noodles Consumption

In addition, there were other factors from this research that makes respondents to consume instant noodles. The result showed that there were other factors that significantly associated which is easy to get and no food. However the result also showed that the most favorite factors they consume instant noodles were easy to prepare which (n=62) for foundation and (n=51) for undergraduate. Dranak and Zakaria (2011) found that the most influencing factors for students to consume

instant noodles were easy to prepare and taste. Easy to get was significantly different between both groups because as for foundation students, groceries and supermarket were located far from their colleges. This scenario was different with undergraduate students as their college was located near to the supermarket and groceries and makes them easy to get instant noodles. Besides, due to they were different in age, transportation also be the factors that they can easily get instant noodles. This is because foundation students having difficulties to buy instant noodles due to they cannot bring vehicles to their college. However, for undergraduate students they were allowed to bring their vehicles to their colleges. Another factor which is no food, due to foundation students lives at Thirteen Colleges and they only have one food court at their colleges. They were more likely to consume instant noodles because if food court at their colleges closed or food at there were unavailable, they were more tend to consume instant noodles. From this study, the most factors for both respondents consume instant noodles due to easy to prepare, however easy to get and no food were significantly different with both group of respondents.

5.4 The Association of Economic Status And Frequency Consumption of Instant Noodles

The result showed that there is no significant association found between family income and frequency intake of instant noodles for foundation students (x^2=2.373, p=0.234) and undergraduate students (x^2=0.153, p=0.695). For the classification of the economic status was classified based on the Central Bank of Malaysia Report 2013 which classified as high for household income more than RM 5000 and classified as middle when household income less than RM 5000. Both groups of respondents that from middle category for family income were least

consumed the instant noodles. However, based on the study conducted by Mitsuo and Tanaka (2008), frequency intake of instant noodles is influenced by the family income. The higher the family income, the more frequent they purchase and consume instant noodles. Park et al. (2011) reported the results obtained showed that the middle income family consumed instant noodles less frequent than high income family. This study found that the costs of food product did not influence the purchasing of unhealthy meals like instant noodles with socioeconomic status. This is because both socio-economic, middle and higher, will purchase these instant noodles even though they know that the food were unhealthy due to other factors. This study also found that, the respondents who consumed instant noodles were younger (20-49 years), mostly in the middle and higher income family group (55%) with higher level of education.

5.5 Arsenic Concentration in Instant Noodles and Seasoning

For concentration of Arsenic that found in instant noodles and seasoning, this study showed that Arsenic concentration were higher in the instant noodles with rang 0.0010 and 0.0239 mg/kg other than in seasoning with range 0.0019 and 0.0060 mg/kg. However there was very limited or no past study on comparing arsenic concentration between instant noodles and its seasoning. This study found that all seven samples contain higher arsenic in instant noodles. Surprisingly, this result was different with community perception that they think the seasoning more likely have higher heavy metals. For three samples of seasoning which is sample E, F and G, concentration obtained were below than the limit of quantification which set at 0.002

mg/kg. However, to improve this study in the future, repeat of analysis should be done so that the concentrations of the seasoning for that seasoning can be assured.

5.6 Health Risk Assessment by Health Quotient and Lifetime Cancer Risk (LCR)

Based on the result of the health quotient, both samples of instant noodles and seasoning were not exceeding 1. This study showed that no adverse health effect that get from consume these instant noodles for certain time. In real time, the ingestion dose of heavy metal is not equal to the absorbed pollutant because a fraction of the ingested heavy metals may be excreted while the remnant can bioaccumulation in body tissues where they affect human health adversely(Zhuang et al. 2009)

For the cancer risk, all samples of instant noodles and seasoning were in permissible range for carcinogenic risk 10^{-6} (one in 1 000 000) to 10^{-4} (one in 10 000) over a lifetime of 70 years (USEPA, 2011). However, according to World Health Organization (2016), arsenic is also associated with adverse pregnancy outcomes and infant mortality, with impacts on child health and exposure in utero and in early childhood has been linked to increases in mortality in young adults due to multiple cancers, lung disease, heart attacks, and kidney failure.

Avoiding consumptions of contaminated foods is challenging because most of the foods might have been contaminated from the raw material, during processing, packaging and storing.According to the Journal of Nutritional and Environmental Science, there are several types of foods that act as detoxifier of heavy metals such as fruits and vegetables i.e. garlic and cilantro. Consumersare recommended to increase their fresh fruits and vegetables intake.

CHAPTER 6

CONCLUSION AND RECOMMENDATION

6.1 Conclusion

As a conclusion, this study found both groups of respondents from foundation students and undergraduate students consumed instant noodles once a week. Majority of the respondents that consumed instant noodles less than 3 times a week came from middle household income family. On the other hand, the main factor for respondents' consumption of instant noodles is due to easy to prepare. The factors that the significantly different between two groups of respondents are easy to get and no food. Besides, this study also found that arsenic was detected in all samples of instant noodles and 4 samples of seasoning were in low concentration. The arsenic concentrations in instant noodles were higher compare to seasonings. All samples of instant noodles and seasoning did not give any risk health to respondents as the health quotient for all samples were less than 1. Plus, for cancer risk, all the samples were in the acceptable range. Overall, the arsenic concentration in all samples were not exceeding the limit (1mg/kg) but consuming instant noodles frequently and for a long period will give harm to the consumers.

6.1 Limitations

In this study a lot of limitations have been detected. First, 3 samples from seasoning were below than limit of quantification. The reading of arsenic concentration that obtain from 3 samples were still unknown because it is below than the limit of quantification which set at 0.002 mg/kg.

Besides, the sources of wheat that used during the making and processing of instant noodles and seasoning cannot be identified. Even though the arsenic concentration for instant noodles and arsenic were not exceeding the limit, the source of arsenic that might contaminate the instant noodles could not be determined.

Other than that, only instant noodles that has been considered as the single exposure. Due to the ingestion route was taken into consideration to determine the exposure of arsenic in instant noodles, the result for risk assessment towards arsenic may be underestimated. Thus, further research should be conducted to determine other food resources such rice and cereal.

6.2 Recommendations

A few recommendations should be taken to improve this study. First, as for another 3 samples of seasoning that below than limit of quantifications, re-analysis should be done to obtain the actual concentrations. Another recommendations is in order to avoid consumer to get adverse effect due to contamination of arsenic or heavy metals in daily food, consumers should eat with balance and healthy such as eat a lot of food and vegetables which this foods are good in excretion of heavy metals in our body.

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Appendix 1
Informed Consent Form

JAWATANKUASA ETIKA UNIVERSITI UNTUK PENYELIDIKAN MELIBATKAN MANUSIA (JKEUPM)
UNIVERSITI PUTRA MALAYSIA, 43400 UPM SERDANG, SELANGOR, MALAYSIA

FORM 2.4: RESPONDENT'S INFORMATION SHEET AND INFORMED CONSENT FORM

Please read the following information carefully and do not hesitate to discuss any questions you may have with the researcher.

1.STUDY TITLE :
Arsenic Concentration in Instant Noodles and Health Risk Assessment among Students in UPM

2. INTRODUCTION:
Instant noodles are widely consumed throughout the world. There is because it is convenient and easy to cook and long shelf life. However, food contamination is a big issue since many report appear on heavy metal in foods such as Arsenic.Exposure for a long time to this heavy metal from food can cause adverse effect such as cancer and skin lesions. It also can be connected to the developmental effects, cardiovascular disease, neurotoxicity and diabetes (WHO, 2016). Besides, exposure for prolong tie to this metals can also contribute to get cancer such as lung cancer, bladder cancer and skin cancer when someone inhale high concentrations of arsenic

3. WHAT WILL YOU HAVE TO DO?
The respondents will be given a questionnaire form to obtain the information related with the research

4. WHO SHOULD NOT PARTICIPATE IN THE STUDY?
This study does not have to be participate by respondents people who does not consume instant noodles

5. WHAT WILL BE THE BENEFITS OF THE STUDY:

(a) TO YOU AS THE SUBJECT?

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

(b) TO THE INVESTIGATOR?

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

6. WHAT ARE THE POSSIBLE RISKS?

This study does not have any risk to the respondents because it is not involve human

biological sample such as blood sample

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

All the information about the respondent will kept confidential

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

If you have any additional questions, you may contact to Dr. Saliza Bt Mohd Elias, Supervisor of the research at 0162213574 or the researcher, Muhammad Fahzeli b Mohd Nazri at 0183649978.

Appendix 2
Questionnaire

ID RESPONDENT:

DATE:

DETECTION OF ARSENIC IN INSTANT NOODLES AND HEALTH RISK ASSESSMENT AMONG FOUNDATION OF AGRICULTURE SCIENCES AND UNDERGRADUATE STUDENTS

This is the study of health risk due to arsenic contamination in instant noodle that consumed by students.This study is carried out at your place. It is pleasure to say that you are lucky to be selected as respondent. Thus you are required to answer all of the questions according to the instruction given. All of information of the respondent is confidential and it is use for research purpose only.

INSTRUCTION:

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

   Part A) Socio-demographic Information

   Part B) Instant Noodle Intake

   Part C) Health Status

   Part D) Lifestyle Information

2. Please answer all of the questions.

3. This questionnaire must be return back to researcher after completing.

Part A) Socio-demographic Information

Please answer the following questions

1. Age _____

2. Gender:
   a) Male
   b) Female

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

4. Family Income : RM.....

5. Expenses for food per month:
   RM.....

6. What is your program of study?
   .....

Part B) Instant Noodle Intake

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

2.When did you start consume instant noodle? (Please sate:)
Years

3.What come first in your mind when you hear the word instant noodles?
(a) Noodles
(b) Fat food
(c) Snacks
(d) Others (please state:.....)

4. What make you consume instant noodles ? (Please tick all that apply)
(a) Easy to get
(b) Easy to prepare
(c) Cheap
(d) No food

(e) Others (please state:.....)

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

6. How frequent do you consume instant noodle in a day?
.....Times

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

8.List all brand of instant noodle product that you always consume? (Please sate:)

.....
.....

9.What size of pack do you generally purchase?
(a) Packet
(b) Cup
(c) Multi packet(5 in 1)

10. How do you prefer to eat these instant noodles?
(a) Boiled
(b) Fried
(c) Straight from packet

11. What is the sources of water do you takes to prepare instant noodles?
(a) Water cooler
(b) Mineral water
(c) Tap water
(d)Others (please state:.....)

12. Which factors are important for you while purchasing instant noodles.(Please tick all that apply)
(a) Taste
(b) Price
(c) Quality
(d) Packaging
(e) Brand
(f) Others (please state:.....)

13. Do you add any other ingredient during preparation of instant noodles? (example: eggs, vegetables, sauces,fish, meat,chicken)
(a) Yes
(b) No

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

15. Do you recommend instant noodles to other?
(a) Yes
(b) No

16. Please specify the location of purchasing instant noodle?
(a) shop nearby the college
(b) at shopping mall
(c) Others (please state:.....)

Part C) Health Status

Please state your current weight and height:

Height:.....cm
Weight:.....kg

1. Do you experience any of those symptoms after 20 minutes of consuming instant noodle? (Please tick all that apply)

Burning of mouth and throat		Memory Loss	
Abdominal Pain		Diarrhea	
Nausea		Headache	
Vomiting		Dehydration	
Constipation		Dark Urine (term black water urine)	
Numbness		Cardiac Problem	
Chest Pain		Vertigo (dizziness)	

2.If none of these, please state your current health status
(a) Good
(b) Poor
(c) Others (please state:.....)

3. **Currently**, do you have any of these disease ? (Please tick all that apply)
(a) Memory deterioration
(b) Kidney damage
(c) Reduce ability to understand
(d) High blood pressure

4. Do you have any **PAST** medical history ? (Please tick all that apply)
(a) High blood pressure
(b) Anemia
(c) Lung irritation

(d) Heart disease
(e) Kidney problem
(f) Others (Please state:.....)

PART D) Lifestyle Information

1. Do you smoke?
   (a) Yes
   (b) No

2. What is the source of your daily drinking water?
(a) Mineral Water
(b) Boiled from tap water
(c) Water dispenser

3. Do you eat canned food product? (If Yes or Sometimes; please state what type of canned food product)
   (a) Yes (Please state:.....)
   (b) Sometimes (Please state:.....)
   (c)No

4. What is the type of utensil that you use while preparing the instant noodles?
   (a) Plastic
   (b) Metal
   (c) Glas
   (d) Others (Please state:.....)

5.Do you exposed to any of these during your daily activity?
(a) Fertilizer
(b) Pesticide
(c) Paint
(d) None of these
   Please state when did you exposed to these
   :.....

THANK YOU FOR YOUR COOPERATION

Appendix 3
Ethical Clearance

ETHICS COMMITTEE FOR RESEARCH INVOLVING HUMAN SUBJECTS
(JKEUPM)
UNIVERSITI PUTRA MALAYSIA

Research title	:	**Arsenic Concentration in Instant Noodles and Health Risk Assessment Among Students in UPM**
Study Site	:	**UPM**
JKEUPM Ref No.	:	**JKEUPM-2017-200**
Researcher	:	**Muhammad Fahzeli bin Mohd Nazri**
Supervisor	:	**Dr. Saliza Mohd Elias**

Documents received and reviewed with reference to the above study:

1. Ethics Application Form. Version 1 dated 31/10/2017
2. Respondent Information Sheet & Consent (English). Version 1 dated 31/10/2017
3. Respondent Information Sheet & Consent (Malay). Version 1 dated 31/10/2017
4. Proposal (English). Version 2 dated 15/1/2018
5. Questionnaire (English). Version 1 dated 31/10/2017
6. Curriculum Vitae of:
    a. Dr. Saliza Mohd Elias

The University Research Ethics Committee, Universiti Putra Malaysia (JKEUPM) operates in accordance to the ICH-GCP Guidelines.

Decision by JKEUPM:

[X] Approved

[ ] **Permission MUST BE OBTAINED from the respective hospitals/ institutions before conducting the research**

[ ] Disapproved

Please note that the approval is VALID UNTIL 25 JANUARY 2019

Researchers should comply with the following:

I. Complete a Study Final Report upon study completion (Form 3.2).

II. Ethical approval is required in the case of amendments/ changes to the study documents/ study sites/ study team.