CONSUMER KNOWLEDGE, ATTITUDE AND CONCERN IN CONSUMING CONTAMINATED PEANUT-BASED PRODUCTS

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CONSUMER KNOWLEDGE, ATTITUDE AND CONCERN IN CONSUMING CONTAMINATED PEANUT-BASED PRODUCTS

By

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Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia, in Fulfilment of the Requirements for the Degree of Master of Science

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DEDICATION

I dedicated this thesis to my beloved country, family members, lecturers and friends.

Abstract of this thesis presented to the Senate of Universiti Putra Malaysia in fulfilment of the requirements for the degree of Master of Science

CONSUMER KNOWLEDGE, ATTITUDE AND CONCERN IN CONSUMING CONTAMINATED PEANUT-BASED PRODUCTS

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NUR ADIBAH HASSAN

November 2018

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In Malaysia, peanut has been consumed in form of snacks, or better known as peanut-based products (roasted peanut, peanut candy, confectioneries, pastry) and as main ingredients in several local dishes, most notably the satay sauce. However, peanut-based products have been associated to contamination such as Aflatoxin (AF), Salmonella and possible metal pieces. Food products contamination is a serious issue and it is most related to food safety issues. Issues of contaminated peanut-based products have been mentioned from various parties to minimize the risks of peanut-based products contamination.

The general objective was to determine the consumer knowledge, attitude and concern in consuming contaminated peanut-based products. Meanwhile, the specific objectives were to determine consumer's knowledge, attitude, and concern level in consuming contaminated peanut-based products, to determine the significant association between consumer socio-demographic profiles and consumer's knowledge, attitude and concern level in consuming contaminated peanut-based products, to examine the relationship between knowledge, attitude and concern level in consuming contaminated peanut-based products and to investigate the most influential factors that influence consumers' behaviour in consuming contaminated peanut-based products.

Purposive sampling was used as sampling method with 1,263 consumer was selected as respondents to represent Klang Valley. A structured questionnaire was used in order to gather the data. Four analyses were used to achieve the objectives of the study, namely descriptive analysis, Chi-square analysis, Pearson correlation analysis and logistic regression analysis. The result showed that about 86.3% of the consumers have inadequate knowledge level towards consuming contaminated peanut-based products. In terms of attitude level, about 74.8% of the consumers have unfavourable attitude towards consuming contaminated peanut-based products due to the lack of knowledge towards

issues discussed. However, 81.6% of the consumers have high concern towards consuming contaminated peanut-based products.

Pearson correlation analysis was conducted to examine the strength of relationship between knowledge, attitude, and concern level in consuming contaminated peanut-based products. The results showed the strength association correlation between knowledge, attitude, and concern level is moderate to low with positive relationships and significant at 1% level of significance. Chi-square analysis was carried out to determine the association between consumers' socio-demographic profiles and knowledge, attitude, and concern level. Age, gender, religion, education level, and income were significantly associated with consumers' knowledge level towards consuming contaminated peanut-based products. Age, religion, and marital status were significantly associated with consumers' attitude level towards consuming contaminated peanut-based products, while religion, income, and marital status were significantly associated with consumers' concern level towards consuming contaminated peanut-based products. Logistic regression analysis was conducted to investigate the most influential factors that influence consumers' behaviour in consuming contaminated peanut-based products. The study found that socio-demographic profiles such as religion and household number had significant relationship with frequency of consumers experience behaviour in consuming contaminated peanut-based products. The variables of knowledge, attitude, and concern also had significant relationship with frequency of consumers experience in consuming contaminated peanut-based products.

As an improvement guideline for upstream industry to control the contamination peanut-based products, government should focus on downstream, particularly the consumers by educating public knowledge on contamination symptoms of peanut-based products. Frequent press release, campaign and intervention through mass and social media could increase the public knowledge on the danger of peanut-based products contamination, as well as reducing the risk of consuming contaminated products among consumers.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk Ijazah Master Sains

PENGETAHUAN, SIKAP DAN KEBIMBANGAN PENGGUNA DALAM PENGAMBILAN PRODUK BERASASKAN KACANG TANAH TERCEMAR

Oleh

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Di Malaysia, kacang tanah diambil dalam bentuk snek yang juga dikenali sebagai produk berasaskan kacang tanah (kacang tanah panggang, gula-gula kacang tanah, manisan, pastri) dan menjadi bahan utama di dalam sebahagian masakan tempatan seperti kuah sate. Walau bagaimanapun, produk berasaskan kacang tanah telah dikaitkan dengan pencemaran seperti Aflatoksin (AF), Salmonella, dan serpihan logam. Pencemaran produk makanan merupakan isu serius yang kebiasaannya berkaitan dengan isu keselamatan makanan. Isu produk berasaskan kacang tanah tercemar telah diketengahkan oleh pelbagai pihak bagi mengurangkan risiko pencemaran produk berasaskan kacang tanah.

Objektif utama kajian ini adalah untuk menentukan pengetahuan, sikap, dan kebimbangan pengguna dalam pengambilan produk berasaskan kacang tanah tercemar. Selain itu, objektif spesifik ialah untuk memeriksa tahap pengetahuan, sikap, dan kebimbangan pengguna dalam pengambilan produk berasaskan kacang tanah tercemar, untuk menentukan perkaitan yang signifikan antara profil sosio demografi pengguna dengan tahap pengetahuan, sikap, dan kebimbangan pengguna dalam pengambilan produk berasaskan kacang tanah tercemar, untuk memeriksa hubungan antara tahap pengetahuan, sikap, dan kebimbangan pengguna dalam pengambilan produk berasaskan kacang tanah tercemar, dan untuk mengkaji faktor yang paling mempengaruhi tingkah laku pengguna dalam pengambilan produk berasaskan kacang tanah tercemar.

Persampelan bertujuan digunakan sebagai kaedah persampelan kepada 1,263 orang pengguna yang dipilih bagi mewakili kawasan Lembah Klang. Borang soal selidik berstruktur digunakan dalam merangka pengumpulan data. Empat jenis analisis telah digunakan untuk mencapai objektif kajian ini, iaitu analysis diskriptif, analisis Khi-kuasa dua, analisis korelasi Pearson, dan analisis regresi logistik. Keputusan menunjukkan kira-kira 86.3% daripada pengguna mempunyai tahap pengetahuan yang tidak mencukupi

terhadap pengambilan produk berasaskan kacang tanah tercemar. Dari segi sikap pengguna, kira-kira 74.8% pengguna mempunyai sikap yang negatif dalam pengambilan produk berasaskan kacang tanah tercemar disebabkan kurang pengetahuan terhadap isu yang dibincangkan. Walau bagaimanapun, 81.6% pengguna menunjukkan tahap kebimbangan yang tinggi dalam pengambilan produk berasaskan kacang tanah tercemar.

Analisis korelasi Pearson dijalankan untuk memeriksa kekuatan hubungan antara tahap pengetahuan, sikap dan kebimbangan pengguna dalam pengambilan produk berasaskan kacang tanah tercemar. Keputusan menunjukkan kekuatan hubungan antara tahap pengetahuan, sikap, dan kebimbangan adalah sederhana hingga lemah dengan hubungan positif dan signifikan pada tahap 1%. dengan nilai-*r* sebanyak 0.465. Sementara itu, kekuatan hubungan antara tahap pengetahuan dan kebimbangan adalah lemah dengan nilai-*r* sebanyak 0.275. Tambahan lagi, kekuatan hubungan antara tahap pengetahuan dan kebimbangan juga adalah lemah dengan nilai-*r* sebanyak 0.340. Hubungan antara tahap pengetahuan, sikap dan kebimbangan menunjukkan hubungan positif dengan tahap signifikan sebanyak 1%. Analisis Khi-kuasa dua telah dijalankan untuk menentukan perkaitan antara profil sosio demografi pengguna dengan tahap pengetahuan, sikap dan kebimbangan. Umur, jantina, agama, tahap pendidikan, dan pendapatan mempunyai perkaitan yang signifikan dengan tahap pengetahuan pengguna terhadap pengambilan produk berasaskan kacang tanah tercemar. Umur, agama, dan status perkahwinan mempunyai perkaitan yang signifikan dengan tahap sikap pengguna terhadap pengambilan produk berasaskan kacang tanah tercemar, sementara agama, pendapatan, dan status perkahwinan mempunyai perkaitan yang signifikan dengan tahap kebimbangan pengguna terhadap pengambilan produk berasaskan kacang tanah tercemar. Analisis regresi logistik telah dijalankan untuk mengkaji faktor yang paling mempengaruhi tingkah laku pengguna dalam pengambilan produk berasaskan kacang tanah tercemar. Kajian ini mendapati bahawa profil sosio demografi seperti agama dan bilangan isi rumah mempunyai hubungan yang signifikan dengan kekerapan pengalaman pengguna dalam pengambilan produk berasaskan kacang tanah tercemar. Pemboleh ubah seperti pengetahuan, sikap, dan kebimbangan juga mempunyai hubungan yang signifikan dengan kekerapan pengalaman pengguna dalam pengambilan kacang tanah tercemar.

Penambahbaikan garis panduan dalam industri huluan adalah perlu bagi mengawal pencemaran produk berasaskan kacang tanah, kerajaan juga perlu menumpukan perhatian kepada industri hiliran, terutamanya pengguna dalam memberikan maklumat kepada umum tentang simptom-simptom pencemaran produk berasaskan kacang tanah. Kekerapan dalam penyiaran akhbar, kempen, dan penglibatan melalui media massa dan media sosial dapat meningkatkan pengetahuan umum tentang bahaya pencemaran serta mengurangkan risiko dalam pengambilan produk berasaskan kacang tanah tercemar di kalangan pengguna.

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This thesis was submitted to the Senate of Universiti Putra Malaysia and has been accepted as fulfilment of the requirement for the degree of Master of Science. The members of the Supervisory Committee were as follows:

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LIST OF ABBREVIATIONS

AF	Aflatoxin
AFB_1	Aflatoxin B_1
CCPs	Critical Control Points
DOSM	Department of Statistics Malaysia
DV	Dependent Variable
FAO	Food and Agriculture Organization
FoSIM	Food Safety Information System of Malaysia
GMP	Good Manufacturing Practice
HACCP	Hazard Analysis and Critical Control Point
INC	International Nut and Dried Fruits Council Foundation
IV	Independent Variable
MOH	Ministry of Health Malaysia
myGAP	Malaysian Good Agricultural Practice
SD	Standard Deviation
SOP	Standard Operating Procedure
SPSS	Statistic Package for Social Science
TRA	Theory of Reasoned Action
TPB	Theory of Planned Behaviour
USA	United Stated of America
USDA	The United Stated Department of Agriculture

CHAPTER 1

INTRODUCTION

This chapter discusses introduction on global peanut production, consumption, and contamination issues in peanut-based products, peanut-based products contamination incidence in Malaysia, Malaysian guidelines on peanut-based products, problem statement, research questions, and objectives of the study. The problems arise on the peanut-based products and interconnected with consumers' knowledge, attitude, and concern are explained in the problem statement. The significance of the study is also presented to reveal the impact of the study to respected parties.

1.1 Global Peanut Production

Arachis hypogaea or peanut is a legume crop that can provide protein as a nutrient source required by human being (Akram, Shafiq, and Ashraf, 2018; Dharsenda, Dabhi, Jethva, and Kapopara, 2015). It is also known as groundnut and contributed the sources for oilseed production (Fletcher and Shi, 2016). Peanut is an annual legume crop and grown mainly in tropics and subtropics area. There are a few varieties of commercialized peanuts such as Virginia (*hypogaea hypogaea*), Spanish (*fastigiata vulgaris*), Valencia (*fastigiata fastigiata*) and Runner (*hybrid*) (Paik-Ro, Smith, and Knauft, 1992). Each variety can be differentiated by colour, size, flavour, nutritional, and composition (Deng and Han, 2018). Runner is the hybrid variety from Virginia (*hypogaea hypogaea*) and Spanish (*fastigiata vulgaris*) subspecies.

Peanut is one of the protein-based, highly nutritious foods consumed around the world. The world's peanut production has increased progressively throughout 2017 season with 2% up from the previous season (International Nut and Dried Fruits Council Foundation (INC), 2015; International Nut and Dried Fruits Council Foundation (INC), 2017). Figure 1.1 shows the world production of peanut trend that has increased over the years reaching 41.5 million metric tons of in-shell peanut, more than 16% increase from over the last 10 years on average (INC, 2017).

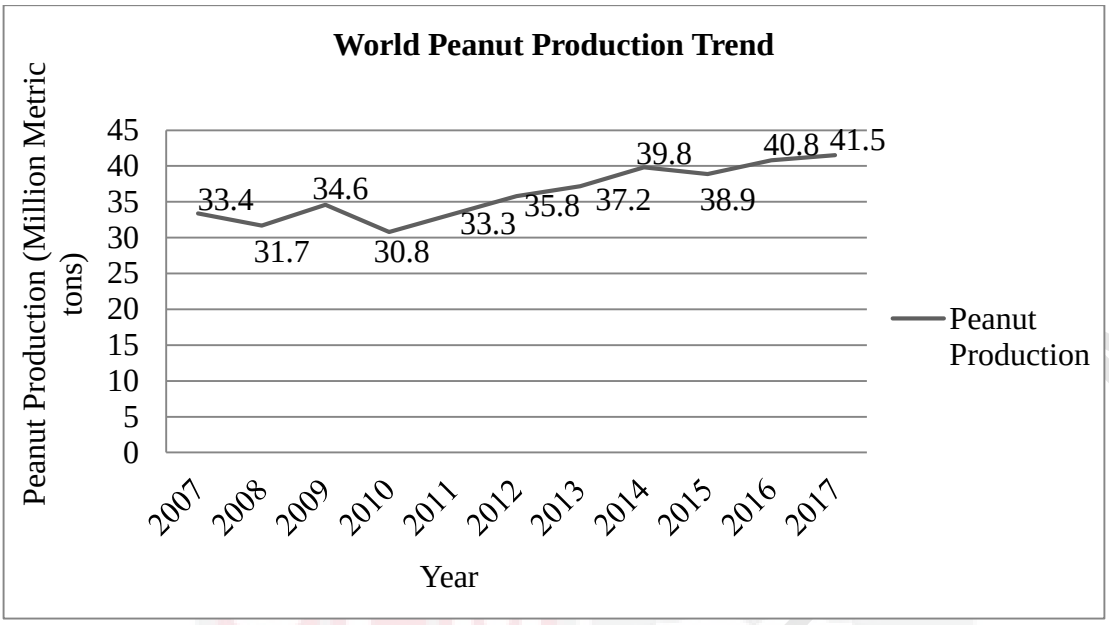

Figure 1.1: World Peanut Production Trend (Million Metric Tons)
Source: INC (2017)

Only few of the countries in the world are producing peanut in large scale for export due to their lower cost of production and good climate condition for peanut species. China, India, and Nigeria are the three largest producer countries of peanuts, contributing 62% of the total world productions. The other producer countries of peanut are the United States of America, Indonesia, Argentina, and a few other countries (INC, 2017). India is the largest exporting country in 2015, exporting about 1.6 million metric tons of shelled peanut. South Eastern Asia such as Indonesia, Malaysia, Thailand, Philippines, and Vietnam are the main importing countries of India's shelled peanut exports, accounting 77% of total Indian shelled peanut exports (INC, 2017). Peanut and the other nutty products made up a staple food in most of the countries in the world such as Africa and India. In fact, peanut is one of the sources for side protein and an essential component of protein diet that mostly consumed in the world (Dharsenda *et al.*, 2015).

1.2 Global Peanut Consumption

Table 1.1 shows the global peanut consumption from year 2012 until 2016. Twenty countries are ranked in descending order based on the world's largest peanut consumption. There were more than 6,000,000 metric tons of increased consumption from 35,990,513 metric tons in 2014 to 42,596,000 metric tons in 2016 (INC, 2015; INC, 2017). China, being the world's largest population is also the world's largest producer and consumer of peanut. Their consumption increased from 16,682,808 metric tons in 2006 to 17,371,242 metric tons in 2015. The other two producers, namely India and Nigeria accounted 4,093,543 and 3,000,000 metric tons of peanut consumption in 2015, respectively. India shows increasing trend of peanut consumption of 5,627,940 metric tons in 2016, with 1,000,000 metric tons of increase per year. Meanwhile, Nigeria recorded the same amount of peanut consumption in 2016 which is 3,000,025 metric tons (INC, 2017). Based on the

data provided in Table 1.1, Asian region such as China, India, Indonesia, Vietnam, Thailand, Malaysia, Philippines, and Japan consist of the world's top 20 peanut consumers.

Table 1.1: World Consumption of Peanut in Metric Tons

Country/ Year	Consumption in Metric Tons				
	2012	**2013**	**2014**	**2015**	**2016**
1. China	16,462,347	16,421,641	16,636,003	16,682,808	17,371,242
2. India	4,339,061	1,096,543	4,247,948	4,093,543	5,627,940
3. Nigeria	1,550,930	3,000,000	2,999,992	3,000,000	3,000,025
4. USA	2,116,879	1,992,756	2,213,881	2,614,629	2,313,684
5. Indonesia	1,272,932	1,365,917	1,367,024	1,324,925	1,310,520
6. Vietnam	743,703	667,212	648,599	574,994	669,618
7. Brazil	226,410	279,472	287,614	348,459	329,803
8. Mexico	159,546	204,399	212,601	220,761	203,355
9. South Africa	107,880	103,879	78,697	35,946	136,168
10. Canada	74,326	83,350	87,543	91,485	95,797
11. Germany	74,481	85,616	82,574	97,628	92,375
12. UK	46,782	71,103	68,396	70,334	85,099
13. Russian	47,819	66,059	70,986	64,432	77,653
14. Thailand	25,867	29,491	36,192	69,462	74,742
15. Malaysia	**74,780**	**58,020**	**72,182**	**84,985**	**71,494**
16. Philippines	58,043	57,764	70,390	62,357	61,106
17. Algeria	15,375	41,177	40,354	33,027	50,698
18. Poland	24,590	30,763	28,276	22,772	46,257
19. Japan	13,030	25,903	29,070	26,016	29,302
20. France	11,036	13,734	16,872	16,204	25,911
World Total	**35,990,518**	**35,990,513**	**39,144,000**	**41,701,000**	**42,596,000**

Source: INC (2017)

According to Arya, Salve, and Chauhan (2016), 60% of the world's peanut consumption is intended as peanut oil. It is also the world's most consumed type of oil (Fletcher and Shi, 2016). Presently, peanut consumption around the world varies, be it as ingredients in local cuisine, confectioneries, spread or even as snack (Rozalli, Chin, and Yusof, 2015). The nutritional properties of peanut such as proteins, the presence of fatty acids, fibres, and carbohydrates are essential to human nutrition and peanut has been an important food especially in developing countries (Arya *et al.*, 2016). Peanut also provides essential micronutrients such as vitamin A and E, folate, calcium, magnesium, zinc, and iron that can improve the quality of individual diet (Griel, Eissentat, Juturu, Hsieh, and Kris-Etherton, 2004).

The peanut consumption is higher in terms of percentage of consumer, but lower in terms of daily intake for each portion size (King, Blumberg, Ingwersen, Jenab, and Tucker, 2008). In Northern Europe (Denmark, Norway and Sweden), the peanut consumption is 20.3 gram per day and 29.1 gram per day in Southern Europe such as France, Greece, Italy, and Spain. The central European region such as Germany, Netherlands, and United Kingdom consumed around 44.9 gram per day (King *et al.*, 2008). Peanut can be consumed from simple roasting to grinding that can be mixed with sugar syrup, roasted, and salted,

as well as the wide variety of food and food products derived from peanut such as peanut butter (Singh and Singh, 1991).

1.3 Global Peanut-Based Products Contamination

Raw peanuts are consumed around the globe as well as processed peanut-based products (Arya *et al*., 2016). Peanut-based products are referred to processed products that utilize raw peanuts as the main ingredients. Peanuts are also processed as value added products to broaden the variety and to create unique roasted flavour (Ketney, Santini, and Oancea, 2017). There a number of peanut-based products classified based on the countries of origin, brands, and product assortment (Carver, 2013). A food-based product is the most popular products of peanut other than beverages, household products, and cosmetics. Household products (laundry soap and sweeping compound), beverages (peanut orange punch and peanut lemon punch), and cosmetics (hand and face lotion, and peanut oil shampoo) are several examples of peanut-based products produced in the global market (Carver, 2013). Roasted peanuts are the most popular product among peanut-based products that mainly consumed by consumers. Roasted peanuts are produced through the heating process depending on moisture content around 12 to 15 minutes for up to 180 °C or 40 to 60 minutes for 160 °C (Arya *et al*., 2016). This process has created the roasted flavour and crunchy texture to be consumed as snacks. Peanut biscuits, peanut butter spreads, ice cream, and pastries are other examples of food peanut-based products.

Increasing production and consumption of peanut-based products without good production processes could expose consumers to the health problems due to the contamination issues in peanut and peanut-based products. Food contamination is generally explained as foods that are spoiled or tainted by microorganisms such as bacteria, parasites, toxic or any foreign substances that make them unfit for human food and animal feed consumption. Generally, food contaminations are assessed and categorized into three groups, namely physical, biological, and chemical contaminations (Santacruz, 2016; Schweihofer, 2013).

Physical contamination can be identified by consumers simply by the existence of foreign object such as hair, nail, insects, broken glass, staples, plastics or bone that may have accidently contacted on food or food products. Biological contamination can be caused by microorganism such as bacteria, viruses, yeasts, moulds, and parasites that may have produced toxins. Third category of food contamination, namely chemical contamination varies in the aspect of production they are related to such as improper use of pesticide, chemical used on processing equipment and very high concentration of safe substances such as sweeteners, colouring agent and sodium nitrate (Hussain, 2016). Contaminants products can be caused by climate condition, hygiene issue and improper processing. These food product contaminants generally affected consumers' health and even resulted in economic losses to the producer country (Kumar, Mahato, Kamle, Mohanta, and Kang, 2017).

There are only two categories of contamination issues that have been recorded in Europe (United States), Africa, and Asia (Indonesia, Malaysia, Thailand, and India) related to

peanut and peanut-based products which are physical and biological contaminations (Channaiah, Holmgren, Michael, Sevart, Milke, Schwan, and Milliken 2016; Ban and Kang, 2014). Types of contamination in peanut and peanut-based products can be divided into three, namely Aflatoxin (AF), Salmonella, and possible metal pieces (Grasso, Grove, Halik, Arritt, and Keller, 2015; Schaffner Buchanan, Calhoun, Danyluk, Harris, Djordjevic, and Wiedmann, 2013; Ban and Kang, 2014). Aflatoxin (AF) and Salmonella are categorized as biological contamination, while possible metal pieces are categorized as physical contamination.

1.3.1 Aflatoxin

Issues in nutty products have existed from various contexts of contaminations and AF is the most concerning issues in nutty products especially peanut-based products (Ali, 2000). Aflatoxin (AF) is naturally toxic produced by specific fungi namely *Aspergillus flavus* and *Aspergillus parasiticus* (Gong, Watson, and Routledge, 2016). The presence of AF depends on various factors including region, humidity, season, and temperature (Dashti, Al-Hamli, Alomirah, Al-Zenki, Abbas, and Sawaya, 2009). The main factors for these fungi to grow in soil are high moisture contents and temperature at pre-harvest and post-harvest stage (Aycicek, Aksoy and Saygi, 2005; Dorner, Cole, Connick, Daigle, McGuire, and Shasha, 2003). Historically, contaminated peanut-based products associated with AF infected during production and processing resulting from growth of *Aspergillus flavus* and *Aspergillus paraciticus* (Abbas Wilkinson, Zablotowicz, Accinelli, Abel, Bruns, and Weaver, 2009). Mycotoxicosis is a term used to describe diseases of animals caused by toxic metabolic while aflatoxicosis is a term used to describe the infections by AF after consuming food that is highly carcinogenic (Herrman, Trigo-Stockli, and Pedersen, 2002). Aflatoxin (AF) is one of mycotoxin, also known as secondary metabolites and has been a major concern due to its carcinogenic to human foods and animal feeds (Chen, Luan, Wang, Wang, and Shao, 2017; Yu, Payne, Campbell, Guo, Cleveland, Robens, and Nierman, 2008; Akbas and Ozdemir, 2006). Various agricultural commodities, specifically cereals including peanut, corn, pistachio, sorghum, and almond have potential to be contaminated by AF (Yazdanpanah, Mohammadi, Abouhossain, and Cheraghali, 2005). However, peanut is most susceptible to AF contamination compared to other agricultural cereal commodities. This is mainly due to the direct contact between the fungi (*A. flavus* and *A. parasiticus*) commonly found in the soil with the underground peanut. Ultimately, highly toxic AF subsequently affects the peanut (Aycicek *et al.*, 2005). Although, the presence of these fungi are depend on various factors including region, humidity, season, and temperature (Dashti *et al.*, 2009). Higher moisture contents and temperature at pre-harvest and post-harvest stage are favourable for fungal growth in the soil (Aycicek *et al.*, 2005; Dorner *et al.*, 2003).

Previous studies conducted particularly in Asia, revealed AF is a common contamination that has infected peanut-based products. For example in Thailand, contamination of AF from natural fungi is most frequently found in peanut-based products compared to other cereal products such as corn, wheat, barley, and spices (Kooprasertying, Maneeboon, Hongprayoon, and Mahakarnchanakul, 2016). Sugita-Konishi, Nakajima, Tabata, Ishikuro, Tanaka, Norizuki, and Kumagai (2006) also revealed AF contamination in peanut-based products (peanut butter) was found in the Japanese local market, indicating that Japan is not free from AF.

The occurrences of AF contamination and mycotoxin contamination in major food commodities including peanut-based products are reported around Southeast Asia such as Thailand, Indonesia, and Philippines (Pitt and Hocking, 1996). As argued by Wang, Lien and Ling (2018), peanuts and peanut-based products are the commodities that mostly infected by AF (Wang *et al*., 2018). In Indonesia, the contamination levels of AF in various food products including peanut-based products are frequently reported (Razzazi-Fazeli, Noviandi, Porasuphatana, Agus, and Böhm, 2004). Peanut-chilli sauces, traditional snacks, peanut butter, flour egg coated peanut, and peanut cake are the mostly affected peanut-based products with 35% of the these products contaminated with AF and the contamination level is ranged between 5лg/kg to 870лg/kg (Razzazi-Fazeli *et al*., 2004).

In 2001, the occurrence of AF has been reported in Taiwan. Commercial peanut products sold in the local market are contaminated with AF between 0.2лg/kg to 513.4лg/kg. Peanut-butter is reported as the highest level of AF contamination, followed by peanut flour and peanut candy. The level of AF contamination has exceeded the maximum permissible limit of AF in Taiwan (15лg/kg) (Chen Liao, Lin, Chiueh, and Shih, 2013). Most of the contaminated peanut-based products throughout Asia are attributed of AF with various levels of contamination and mostly exceeded the maximum permitted limit set by each of the country regulations.

The clinical signs of aflatoxicosis are extremely varied as the infection also depends on the individual. Signs of acute of Aflatoxicosis includes depression, nervousness, abdominal pain, diarrhoea, stunted growth on children, liver cancer, and possibly even death due to weaken immune system (Herrman *et al*., 2002; Lewis, Onsongo, Njapau, Schurz-Rogers, Luber, Kieszak, and DeCock, 2005; Wild and Gong, 2010; Zain, 2011). Recent investigations have also recognized liver cancer as a cause by AF. According to Ministry of Health Malaysia, liver cancer is listed as the top ten most common cancers occurring in Malaysia (MOH, 2011; MOH, 2006). As stated by Norlia *et al*. (2018) that liver cancer is the main target of aflatoxicosis due to high consumption of AF in peanut-based products in the Malaysian market. Furthermore, Nemunaitis, Brown-Glabeman, Soares, Belmonte, Liem, Nir, and Gullapalli (2018) recently released that AF exposure increased the risk of gallbladder cancer. Koshiol, Gao, Dean, Egner, Nepal, Jones, and Ferreccio (2017) also reported that scientific research has indicated the AF effect on human body system. The risk of gallbladder cancer among consumer can be reduced by educating consumers on AF contamination (Koshiol *et al.,* 2017).

AF contamination in peanut have caused decline in terms of quantity and quality of peanut-based products (Loi, Fanelli, Liuzzi, Logrieco, and Mulè, 2017). Findings from previous studies reported that contaminated peanut as a sign from AF contamination can be identified by discolouration, mould, and rancidity of the product (N'Dede, Jolly, Vodouhe, and Jolly, 2013). Since AF cannot be eliminated using heat treatment or during processing, monitoring and prevention in upstream and downstream must be implemented to reduce the risks of AF contamination.

1.3.2 Salmonella

Salmonella is mostly infected on raw peanuts and peanut-based products during processing stage (production, harvesting, storage, processing, and packaging) and this is due to non-hygiene practices that caused Salmonellosis (Nascimento, Carminati, Silva, Silva, Bernardi, and Copetti, 2018; Ministry of Health Malaysia (MOH), 2015). Salmonellosis can be described as the illness cause by Salmonella infection (Acheson and Hohmann, 2001). According to Peng, Salaheen, Almario, Tesfaye, Buchanan, and Biswas (2016) and Delgago, Rosegrant, Steinfeld, Ehui, and Courbois (2001), Salmonellosis incidents are associated with consumption of animal products such as poultry, meat or eggs, fresh produce, and foods of low water activity included peanut butter. Current outbreak reported that Salmonellosis have shifted focus from AF as major contamination in peanut-based products due to the fact that Salmonella also contributed the infections in same type of products which is peanut-based products (CDC, 2010). In the United States, it has been reported that multistate outbreaks involving *S. Typhimurium* in peanut butter products occurred during 2008 to 2009 (CDC, 2009; CDC, 2010; CDC, 2011). These salmonellosis outbreaks have caused for illnesses in 714 people resulting in more than 150 hospitalizations and 9 recorded deaths (CDC, 2011; CDC, 2010; Shachar and Yaron, 2006).

According to Scheil, Cameron, Heaton, Kirk, Vulcanis, Holland, and Rouch, (1996), the first outbreak of salmonellosis was reported in 1996 in five mainland states of Australia and Northern Territory. South Australia alone reported 15 cases during three months, compared with 12 cases over previous five years (Scheil, Cameron, Dalton, Murray, and Wilson, 1998). Based on 44 cases reported in Victoria, children and senior citizen are most susceptible to the risk of salmonellosis infection (Lund and O'Brien, 2009). Investigation results revealed that the consumption of nine different brands of peanut butter is associated with salmonellosis incidence (Shachar and Yaron, 2006). All brands except one were produced in the same factory (Scheil *et al*., 1998). In 2015, the cases of Salmonella outbreak were reported from 10 states in USA. According to Peng *et al*. (2016), from 13 outbreak cases, seven were related with peanut butter products that have been consumed by consumers.

1.3.3 Possible Metal Pieces

Possible metal pieces can be identified as physical contamination in the product due to non-hygiene practices occurring along the supply chain processes. These types of contamination in peanut-based products are identified as "high profile" incidence of food products issue. In 2015, the first case of physical contamination in peanut-based products was reported in the United State of America (USA). Skippy Reduced Fat Creamy Peanut Butter Spread is among the product contaminated with the metal shaving on the jar of the products, also known as possible metal pieces. Jars containing small pieces of metal shavings were discovered on an in-line magnet check during routine cleaning and the size of the contamination objects were found to be greater than 7mm in length. It was reported that the product batch affected by the physical contamination is limited to 16.3 ounce per jar, "Best If Used By" batch DEC1416 with a package UPC code 37600-10500. However, this batch was not marketed in Malaysia (MOH, 2015). Possible metal pieces are categorized as physical contamination with reports being one of the contaminants in peanut

butter (Santacruz, 2016). The company has issued a statement where 153 cases of reduced fat creamy Skippy brand peanut butter may be contaminated by small pieces of metal discovered during an in-line magnet check.

1.4 Peanut-Based Products Contamination Incidence in Malaysia

In Malaysia, peanut and peanut-based products are not specified as staple food. However, this foodstuff has been used as main or as base ingredients for some local dishes (Norlia, Jinap, Nor-Khaizura, Son, and Chin, 2018). Malaysia is listed at the top 12 of the highest peanut consumption in 2015 and top 15 of the highest peanut consumption in 2016 (INC, 2015; INC, 2017). The average daily intake of peanut and peanut-based products among the Malaysian consumers is around 56.90 g per day with the purchasing pattern of nuts and their products twice per month (Arzandeh, Selamat, and Lioe, 2010; Leong, Ismail, Latiff, Nurul Izzah, Narazah, and Nurul Ain, 2011). Despite peanut not being a staple food and main protein source among Malaysian consumers, the consumption of peanut is rising in recent year due to the variety of peanut products and the high accessibility of the products in the market (Mohd Azaman, Kamarulzaman, Shamsudin, and Selamat, 2015). Malaysian consumers, particularly consumed peanut in forms of snack or ready-to-eat foodstuff (roasted peanut, unshelled peanut, and peanut candy), as well as in local cuisine such as satay sauce, desserts, pastries, buns, and cookies (Mohd Azaman, Kamarulzaman, Shamsudin, and Selamat, 2016). However, some of the peanut-based products listed in the Malaysian market have been identified to be contaminated by AF (Arzandeh *et al*., 2010). It has been widely reported by Malaysian research that AF is the major incidence of peanut-based products contamination compared to incidences associated with Salmonella and possible metal pieces globally (Sulaiman, Chye, Hamid, and Yatim, 2007; Sabran, Jamaluddin, Mutalib, Sokhini, and Ahmad, 2013; Hong *et al*., 2010; Leong, Ismail, Latif, and Ahmad, 2010). Malaysian's hot and humid climate is favourable for AF growth (Sabran *et al*., 2013). Malaysia is located at equatorial area with high humidity range and an average temperature of 28°C to 31°C with heavy rainfall throughout the years that provide favourable condition for fungal growth. Hence, the risks of mould growth an AF production in peanut-based products increased especially when stored under these conditions (Norlia *et al*., 2018; Arzandeh *et al*., 2010; Cotty and Jaime-Garcia, 2007; Kozakiewicz, Highley, and Johnson, 1996).

The first incidence of AF outbreak in Malaysia began in Perak during 1988 resulting 13 deaths among children after consuming contaminated noodles (Chao, Maxwell, and Wong, 1991; Isa *et al*., 1995). Since then, research on AF has been conducted in Malaysia (Sabran *et al*., 2013). Peanut are the main cereal commodities commonly found to have been contaminated with AF (Isa and Abidin, 1995).

Surprisingly, the level of AF contamination in peanut-based products is greater than maximum permissible limit by Malaysian 1985 (Sulaiman *et al*., 2007; Sabran *et al*., 2013). In 1981, AF was found in peanut butter in the local market of Malaysia. In Melaka, Selangor, and Negeri Sembilan have reported of AF contamination with the state of Selangor contained only 5.8% of peanut-based products safe to consume by human, whereas the rest of the peanut-based products samples contained AF contamination and

exceeded the maximum permitted limits set by Malaysian Food and Regulation 1985 (Isa and Abidin, 1995). Aflatoxin B_1 (AFB_1) was reported as the major contamination in peanut-based products among all AF class (Ali, Hashim, and Yoshizawa, 1999).

In Kuala Terengganu, the incidence of contamination in peanut-based products was reported to have exceeded the permitted limit of AF set by Malaysian standard (Hong, Mohd Yusof, and Ling, 2010). The same incidence was also reported in Penang Island where peanut-based products in the local market such as roasted ground nut in shell, roasted ground nut shelled, peanut cake, peanut butter, and bakery products were contaminated by AF. The level of contamination detected was more than 15μg/kg, which has exceeded the maximum permitted limit of AF set by Malaysian Food Act 1983 and Regulation 1985. This incidence was reported to be the highest level of AF contamination found in most of the peanut-based products in the local market (Leong *et al*., 2010).

Peanut consumption among Malaysian consumers has increased due to the availability of peanut-based products in the local market. Therefore, consumers are likely to be exposed to the health hazards of consuming contaminated peanut-based products (Mohd Azaman *et al*., 2016; Afsah-hejri, Jinap, Hajeb, Radu, and Shakibazadeh, 2013). Cereal-based foods which are peanut-based products were reported as the most susceptible to AF contamination. Abdullah, Nawawi, and Othman (1998) reported that contamination of AF in food products frequently occurred at the consumer level due to the higher percentage of contaminated peanut samples occurring at private homes compared to retail market. Policy concept under food safety frequently highlighted treatments to reduce microbiological hazards such as pasteurization, pulsed light technologies, and high-pressure treatments were not necessary to ensure complete elimination of the hazards such as Salmonella (Norhana, Poole, Deeth, and Dykes, 2010). The food safety with respect to food products contamination is of great concern worldwide. Consumers need to have knowledge towards the issues of contaminated peanut-based products by identifying the contaminated symptoms. Information on the symptoms of food products contaminations should not be withheld by scientists but must be educated to the consumers as well (Abdullah *et al*., 1998).

Thus far, there are no cases on the outbreak of contaminated peanut-based products reported by Malaysian consumers, but the incidence of AF infection in peanut-based products are frequently reported around Malaysian market by various agencies (Sulaiman *et al*., 2007; Sabran *et al*., 2013; Hong *et al*., 2010; Leong *et al*., 2010). Malaysia has lower incidence rates compared to developed countries such as France and United Kingdom. In the United Kingdom, the incidence rates was reported to be 2,600 cases per 100,000;, 1,210 cases per 100,000 in France; and 25,000 per 100,000 in both Australia and United States (Teisl and Roe, 2010). The incidence rates in Malaysia are unreported due to the complex chain that needs to be addressed before it can be reported to the authority (Soon, Singh, and Baines, 2011). Such a situation indicates that peanut-based products outbreaks cannot be identified by Malaysian consumers due to lack of knowledge especially in terms of food safety. Consumers' lack of knowledge towards products contamination will lead to unfavourable attitude. The argument that consumers have lack of public knowledge about the incidence needs to be addressed and resolved (Sabran, Jamaluddin, Abdul Mutalib, and Abdul Rahman, 2012).

1.5 Malaysian Guidelines on Peanut-Based Products

The policies adapted by different countries serve as guidelines to control activities of business firms, but also to protect consumers from any hazards include food contamination issue. Food contamination is the prevalent case occurring most of the countries in the world. Peanut-based products are one of the food products highly exposed to food contamination issues. In terms of health concern, international and local regulation such as Hazards Analysis and Critical Control Point (HACCP), Good Manufacturing Practice (GMP), Malaysian Good Agricultural Practice (myGAP), Standard Operating Procedure (SOP), Food Act 1983, Food Regulation 1985, Codex Alimentarius Commision, Regulatory Limit of Aflatoxin and government department which have role to control food safety of products before entering Malaysian markets were employed and enacted to protect the public from food products contamination issues and fraud in the preparation, sale, and the use of food (Regulatory Limits of Mycotoxins in ASEAN Countries, 2015; MOH, 2018).

Food safety can be analysed by hazard analysis or HACCP, the universal standard that are accepted globally as a guideline to control the food contaminations issues. Pillsbury Company was developed HACCP standard in 1959 and it became mandatory requirement by USDA before being accepted as the world's standard for food safety control (Schweihofer, 2013). There are seven principles in HACCP analyses to minimize the food safety hazard, namely conduct of hazard analysis, determination of the critical control points (CCPs), establishment of critical limits, monitoring procedures, corrective actions, verification procedures and record-keeping and documentation procedures (Schweihofer, 2013). Written documentation and verification are keys to a successful HACCP plan (Schweihofer, 2013).

Regulatory Limit of Mycotoxin in ASEAN is a collaboration between ASEAN countries as a guideline used to control the existence of Mycotoxin especially AF not only in nutty products, but also in other foods such as spices, cereals, herbs, and infant food. Brunei Darussalam, Indonesia, Philippines, Singapore, Thailand, Vietnam, and Malaysia are the involved countries for this regulation (Regulatory Limit of Mycotoxins in ASEAN Countries, 2015). Under this regulation, the permitted limits of AF differ between countries, foods categories, and AF groups. As mentioned before, AFB_1 is the most carcinogenic among mycotoxins and has been highlighted in the Regulatory Limit of Mycotoxin in ASEAN (Coppock, Christian, and Jacobsen, 2018; Xiong, Xiong, Zhou, Liu, and Wu, 2018). The details of permitted limit of mycotoxins for AFB_1 and total AF are listed in Table 1.2.

Based on Table 1.2, permitted limit of total AF in Malaysia for peanut-based products are divided into three products namely raw peanut, peanut for further processing, and peanut ready-to-eat. Raw peanut recorded about 35 лg/kg for total AF that has been permitted in this product. Peanut for further processing shows about 15 лg/kg and only 10 лg/kg of total AF that has been permitted in peanut ready-to-eat products.

Table 1.2: Permitted Limit of Mycotoxins in ASEAN Countries for Aflatoxins

Aflatoxins	AFB_1 (лg/kg)		Total Aflatoxins (лg/kg)	
Country	Food Category	Max Limits	Food Category	Max Limits
Indonesia	Peanuts, maize, spices	15	Peanuts, maize, spices	15
	Maize	15	Maize	15
	Spices	15	-	-
	-	-	Food	20
Malaysia	Cereal-based food for infants and children (calculated as dry matter basis)	0.1	Food	35
	-	-	Peanuts	35
	-	-	Other food	5
	-	-	Peanuts, almonds, hazelnuts and pistachios for further processing	15
	-	-	Brazil nut, shelled, for further processing	10
	-	-	Peanuts, almonds, hazelnuts and pistachios ready-to-eat	10
	-	-	Others	5
Philippines	Herbal food products ready-to-drink Food supplements	10	Processed pili nut	10
	-	-	Peanuts for further processing	15
	-	-	Ready to eat tree nuts	10
	-	-	Corn based snack foods	20
	-	-	Shelled corn (Feed greds	50
	-	-	Herbal food Products ready-to-drink Food supplements	20
	-	-	Dry base mixes for soups and bases containing peanut	10
Singapore	All foods except food for infants or young children	5	All foods except food for infants or young children	5
	Food for infants or young children	0.1	-	-
	-	-	Food	20

Thailand	-	-	Class I, II, III of corn kernel		15, 20, 50
Vietnam	1.1	Peanuts and other kinds of oil seeds used as raw materials or need to be processed before using as food or as food ingredients.	8	1.1 Peanuts and other kinds of oil seeds used as raw materials or need to be processed before using as food or as food ingredients.	15
	1.2	Almonds, pistachio, dried apricots used as raw materials or need to be processed before using as food or as food ingredients.	12	1.2 Almonds, pistachio, dried apricots used as raw materials or need to be processed before using as food or as food ingredients.	15
	1.3	Chestnuts, brazil nuts used as raw materials or need to be processed before using as food or as food ingredients.	8	1.3 Chestnuts, brazil nuts used as raw materials or need to be processed before using as food or as food ingredients.	15
	1.4	Tree nuts used as raw materials, excluding the products specified in 1.2; 1.3; or need to be processed before using as food or as food ingredients.	5	1.4 Tree nuts used as raw materials, excluding the products specified in 1.2; 1.3; or need to be processed before using as food or as food ingredients.	10
	1.5	Peanuts and other oil seeds for eating and their derived products Except for: crude vegetable oil for refinery and refined vegetable oil	2	1.5 Peanuts and other oil seeds for eating and their derived products Except for: crude vegetable oil for refinery and refined vegetable oil	4

1.6	Almonds, pistachio, dried apricots used as food or as food ingredients.	8	1.6 Almonds, pistachio, dried apricots used as food or as food ingredients.	10
1.7	Chestnuts and brazil nuts used as food or as food ingredients.	5	1.7 Chestnuts and brazil nuts used as food or as food ingredients.	10
1.8	Tree nuts used as food, excluding the products specified in 1.6, 1.7, or products used as food ingredients.	2	1.8 Tree nuts used as food, excluding the products specified in 1.6, 1.7, or products used as food ingredients.	4
2.0	Material dried fruits that need to be processed before using as food or as food ingredients.	5	2.0 Material dried fruits that need to be processed before using as food or as food ingredients.	10
2.1	Dried fruits and derived products used as food or as food ingredients.	2	2.1 Dried fruits and derived products used as food or as food ingredients.	4
2.2	Cereal and derived products including processed products (except for the products specified in 1.12; 1.15; 1.17)	2	2.2 Cereal and derived products including processed products (except for the products specified in 1.12; 1.15; 1.17)	4
2.3	Corn and rice that need to be processed before using as food or as food ingredients.	5	2.3 Corn and rice that need to be processed before using as food or as food ingredients.	10
2.4	Material milk, thermos-processed milk, milk for producing dairy	5	2.4 Material milk, thermos-processed milk, milk for producing dairy	10

2.5	Spices: - Chili: all kinds of chilies, chili sauce, chili powder, paprika, hot chilies. - Pepper, - including both black and white pepper - Nutmeg - Ginger and turmeric	0.1	2.5 Spices: - Chili: all kinds of chilies, chili sauce, chili powder, paprika, hot chilies. - Pepper, including - both black and white pepper - Nutmeg - Ginger and turmeric	10
2.6	Food derived from cereal for new born babies and small children	0.1	2.6 Food derived from cereal for new born babies and small children	Unspe-cified
2.7	Milk powder for children and milk for new born babies	Unspe-cified	2.7 Milk powder for children and milk for new born babies	Unspe-cified
2.8	Diet food especially for new born babies	0.1	2.8 Diet food especially for new born babies	Unspe-cified

Source: Regulatory Limit of Mycotoxins in ASEAN Countries (2015)

In addition, collaboration between several countries was also initiated to overcome the AF contamination in peanut-based products. Codex standards is the guideline applies to peanut and peanut-based products for human consumption. The scope highlights contaminant, hygiene, methods of analysis and sampling, packaging, labelling, essential component, and quality factors. Essential component and quality factors characterize peanut contaminants that can be identified by physical characteristics such as mouldy kernels, decayed kernels, and rancid kernels. Mouldy kernels can be referred to kernels with mould filaments visible to the naked eye, whereas decayed kernel as those showing visibly significant decomposition. Meanwhile, rancid kernels are related to the oxidation of lipids or the production of free fatty acids that result in the production of unpleasant flavours (Wallace and Walton, 2011). Codex also highlighted the maximum level for moisture content as less than 10% and 9% for peanut in-pod and peanut kernels, respectively. The limit is imposed to prevent contaminant peanut especially during transportation where climate, duration of transport, and storage are important regulators.

Food Regulations 1985 outlines the standards and particular labelling requirements for food stuffs including nut and nut products. All nut and nut products must be free from moulds and insect infestation. For peanut butter products, the product must be prepared by clean grinding, sound, and using roasted peanut kernels that have been decorticated (Malaysian Food Regulations, 1985). Under this regulation, there are also specific requirement that needed to be followed where the amount of peanut, protein, edible fat and

edible oil, water, sugar and glucose, salt, and permitted food conditioner cannot exceed or less than required.

Food Safety Information System of Malaysia (FoSIM) under the Ministry of Health Malaysia (MOH) controls the inspection of imported food products before entering the Malaysian market from any hazardous physical, chemical or biological contaminants. The news release by Food Safety Information System of Malaysia (FoSIM) on contaminated peanut butter with possible metal pieces and subsequently being recalled from the market shelves is a good medium to broadcast the current issue of food contamination (Ministry of Health Malaysia, 2015).

1.6 Problem Statement

Peanut and peanut-based products are consumed as a side component of the protein and the consumption rate in Malaysia is high although it is not the staple food of Malaysians (Afsah-Hejri *et al*., 2013). Most of the peanuts are imported from China and India to fulfil the consumers' demand on peanut and peanut-based products (INC, 2017). However, peanuts are susceptible to contamination by fungi, specifically *Aspergillus flavus* and *Aspergillus paraciticus* due to the climate condition during the transport between the exporting and importing countries. Contamination by the fungi resulted in the release of toxin called Aflatoxin (AF) that can also be found in several cereal grains, feeds, and nuts such as peanuts, cocoa beans, spices, and others nutty products.

Fungi are distributed worldwide and can be found in various food and feedstuffs. The incidences of foodborne diseases due to the AF contamination have been reported especially in developing countries like Malaysia, as well as in the developed countries (Norlia *et al*., 2018; Sulaiman *et al*., 2018). Aflatoxin (AF) contaminations have caused serious problem to consumers' health both short or long term and these problems have become a great issue and concern among consumers in Malaysia. The common effects of AF contaminations are liver cancer, vomiting, diarrhoea, and convulsion. Consumers that are exposed to high level of AF contamination could result in fatalities within a short time. As indicated by Norlia *et al*. (2018) that liver cancer is the main target of aflatoxicosis due to high consumption of AF in peanut-based products in the Malaysian market. Other than AF, Salmonella, and possible metal piece are also listed as 'high profile' food incidence in peanut-based products. Salmonella and possible metal pieces occur during processing stage due to non-hygiene practices that have negatively affect consumers' health. Possible metal piece will lead to injuries such as choking, cuts or broken teeth where a Salmonella infection can cause nausea, vomiting, abdominal cramps, diarrhoea, fever, and headache (Santacruz, 2016; Rahmianna, Purnomo, and Yusnawan, 2015).

Although there are yet major cases reported in Malaysia, there is a high possibility of the consumers inflicted by contaminated peanut-based products. The low incidence rates in Malaysia are masked by the lack of knowledge among the Malaysian consumers on peanut-based products outbreak and related issues (Soon *et al*., 2011). As consumers are not in the best position to accurately assess food risk themselves, they rely on the food industry and

government to remove the risk. However, many stakeholders are still ignoring the importance of safety certification label includes HACCP (Abdul-Mutalib, Syafinaz, Sakai, and Shirai, 2015). Consumers' knowledge, attitude, and concern on detailed information related to contamination of food products in various markets need to be addressed where they must be educated with scientific knowledge on symptoms of food products contaminations (Ziman, 2004). Otherwise, the consumers will be exposed to the danger of consuming contaminated peanuts-based products that can lead to adverse health especially over a long term period. Hence, consumers' knowledge, attitude, and concern towards various types of contamination in food products especially peanut-based products become critical.

1.7 Research Questions

In this study, four research questions were developed as follows:

1. What is the level of consumers' knowledge, attitude, and concern in consuming contaminated peanut-based products?
2. Is there any significant association between socio-demographic profiles and consumers' knowledge, attitude, and concern level in consuming contaminated peanut-based products?
3. What is the relationship between consumers' knowledge, attitude, and concern in consuming contaminated peanut-based products?
4. What are the most influential factors that influence consumers' behaviour in consuming contaminated peanut-based products?

1.8 Objectives of the Study

The general objective of this study is to examine consumer knowledge, attitude, and concern in consuming contaminated peanut-based products.

The specific objectives of this study are as follows:-

1. To determine consumers' knowledge, attitude, and concern level in consuming contaminated peanut-based products.
2. To determine the significant association between consumers' socio-demographic profiles and consumers' knowledge, attitude, and concern level in consuming contaminated peanut-based products.
3. To examine the relationship between knowledge, attitude, and concern in consuming contaminated peanut-based products.
4. To investigate the most influential factors that influence consumers' behaviour in consuming contaminated peanut-based products.

1.9 Significance of the Study

This study will benefit to the industry players such as producers, manufacturers, and marketers to have a better understanding about consumers' knowledge, attitude, and concern on safe food products for consumption. By understanding the level of consumers' knowledge, attitude, and concern in consuming contaminated peanut-based products, this study indirectly provides the government and private agencies the information towards consumers' risks in consuming contaminated peanut-based products. In addition, findings from this study will contribute important information to the policy makers as the guideline for better policy formulation in terms of reducing the risk of consuming contaminated peanut-based products.

1.10 Organization of Thesis

The thesis is organized into five chapters. The first chapter discusses the background of the study which included global peanut production, global peanut consumption, global peanut-based products contamination, peanut-based products contamination incidence in Malaysia, Malaysian guidelines on peanut-based products, the research questions and the objectives. The second chapter displays a review of some relevant literature on previous study, information and findings which are appropriate to the study. The third chapter discusses an overview of the approach employed to research methodology selection including sampling techniques, methods of data collection, description of the study areas, and tools of the data analysis for this study. The fourth chapter presents an in-depth discussion on analysis and findings of the study. The last chapter discusses briefly the summary of the findings, policy recommendations, limitation of the study, suggestion for future research, and conclusion.

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