UNIVERSITI PUTRA MALAYSIA

FACTORS INFLUENCING AFLATOXIN BIOMARKER LEVEL IN URINE AMONG ADULTS IN HULU LANGAT DISTRICT, SELANGOR, MALAYSIA

SITI HUSNA BINTI SULAIMAN

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By

SITI HUSNA BINTI SULAIMAN

Thesis submitted to the School of Graduate Studies, Universiti Putra Malaysia in fulfilment of the requirement for the Master of Science

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

FACTORS INFLUENCING AFLATOXIN BIOMARKER LEVEL IN URINE AMONG ADULTS IN HULU LANGAT DISTRICT, SELANGOR

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Chairman : Rosita binti Jamaluddin, Ph.D
Faculty : Medicine and Health Science

Previously, there were several cases related to aflatoxin occurred in Malaysia. Aflatoin is commonly found in human food resources especially in nuts, cereals, poultry and livestock, and the impact of this food-borne poisoning should be taken seriously. This study involved a total of 468 adults who resided in Hulu Langat district and aged from 18 to 60 years old. Data on socio-demography (SD) knowledge, attitude and practice (KAP) on aflatoxin and its contamination in food, dietary intake (DI), physical activity (PA) and weight status (WS) through the questionnaires and 15ml of non-fasting morning urine samples were collected to measure the aflatoxin level. The quantification of urinary aflatoxin M_1 (AFM_1) was done using ELISA kit. Statistical analysis involved descriptive analysis and inferential analysis.

Of the 468 screened respondents, 444 met the following study criteria: in good health; not taking any medications or supplements; not smoking; not following a restricted diet; not pregnant and not in postpartum period.

There were 249 females and 199 males of which majority of them aged between 18 to 24 years old with an average age of 29.21 years old. More than half of the respondents were single (n= 320) and had RM1500 or less amount of personal income (n=303). There were 238 respondents had low knowledge, 178 respondents had positive attitude while 209 respondents had positive practice towards aflatoxin. A total of 281 respondents had a normal BMI with majority of them (n=190) practised a low level of physical activity. Cereal and cereal-based products recorded the highest food consumption among respondents with an average intake of 512.54g/day. From 444 samples, 199 were positive with AFM1 with 37 of them exceeded the limit of detection (LOD) of 0.64ng/mL. The statistical analysis showed significant associations in

aflatoxin level based on age group (p<0.05), ethnicity (p<0.01) and household income (p<0.01), attitude (p<0.01) and practice (p=0.03) towards aflatoxin and its contamination in food, intake of eggs (p=0.03) and milk and dairy products (p<0.01). Besides, the binomial logistic regression showed ethnicity, household income and intake of dairy products were factors that contributed to aflatoxin occurrence in urine with ethnicity (W=25.57, p<0.01) as the main predictor. Chinese were 3.20 times more likely to exhibit aflatoxin occurrence in urine compared to non-Chinese.

When both husband and wife are working, the household income increases and encourages the eating-out activity. Eating-out exposes consumers to aflatoxin contamination, as not all food premise owners care about the presence and danger of this toxin to humans. Chinese were having the highest levels of urinary aflatoxin due to high intake of potentially aflatoxin-contaminated foods such as cereals, nuts, milk and eggs. This research was one of the first steps in increasing the awareness towards aflatoxin among adults in Hulu Langat district, Selangor. Findings from this research showed the current level of aflatoxin among Malaysians in Hulu Langat and the factors that might influence the aflatoxin presence in human based on the aflatoxin biomarker level.

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

FAKTOR YANG MEMPENGARUHI PARAS BIOMARKER AFLATOKSIN DALAM URIN DI KALANGAN ORANG DEWASA DI DAERAH HULU LANGAT, SELANGOR

Oleh

SITI HUSNA BINTI SULAIMAN

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Sebelum ini, terdapat beberapa kes yang berkaitan dengan aflatoksin berlaku di Malaysia disebabkan pengambilan makanan yang tercemar dengan aflatoksin. Aflatoksin lazimnya didapati di dalam sumber makanan manusia terutamanya dalam kekacang, bijirin, ayam dan ternakan maka kesan keracunannya perlu diberi perhatian serius. Kajian ini melibatkan 468 orang dewasa yang menetap di Hulu Langat serta berusia antara 18 hingga 60 tahun. Data berkaitan latar belakang (SD), pengetahuan, sikap dan amalan terhadap aflatoksin (KAP), pengambilan makanan (DI), aktiviti fizikal (PA) dan status berat (WS) diperoleh melalui satu soal selidik dan 15ml sampel urin tidak berpuasa dikumpul untuk mengukur tahap aflatoksin. Pengukuran aflatoksin M_1 (AFM_1) di dalam air kencing dilakukan dengan menggunakan kit ELISA. Analisis statistik melibatkan analisis deskriptif dan analisis inferensi.

Daripada 468 responden yang terlibat, 444 memenuhi kriteria berikut: mempunyai kesihatan yang baik; tidak mengambil apa-apa ubat atau makanan tambahan; tidak merokok; tidak mempunyai diet yang tertentu; tidak hamil dan bukan dalam tempoh berpantang.

Terdapat 249 wanita dan 199 lelaki terlibat dalam kajian ini di mana majoriti daripada mereka yang berusia antara 18 hingga 24 tahun dengan purata usia 29.21 tahun. Lebih separuh daripada responden berstatus bujang (n=320) dan mempunyai pendapatan peribadi berjumlah RM1500 dan kurang (n=303). Sebanyak 238 responden mempunyai pengetahuan yang rendah terhadap aflatoksin 178 orang responden mempunyai sikap yang baik terhadap aflatoksin manakala 209 orang reponden mempunyai amalan yang baik terhadap aflatoksin. Sejumlah 281 responden mempunyai BMI yang normal

dengan majoritinya (n=190) mengamalkan aktiviti fizikal bertahap rendah. Bijirin dan produk berasaskan bijirin mencatatkan pengambilan makanan yang tertinggi di kalangan responden dengan purata pengambilan sebanyak 512.54kg/hari. Daripada 44 sampel, 199 adalah positif AFM_1 dengan 37 daripadanya melebihi had pengesanan (LOD), 0.64ng/mL. Hasil analisis mendapati terdapat kaitan yang signifikan antara tahap aflatoksin dengan kategori umur (p<0.05), etnik (p<0.01), pendapatan isi rumah (p<0.01), amalan (p<0.01) dan sikap (p=0.03) terhadap aflatoksin dan pencemarannya dalam makanan, pengambilan telur (p=0.03) dan juga susu dan produk tenusu (p<0.01). Selain itu, regresi logistik binomial menunjukkan etnik, pendapatan isi rumah serta pengambilan susu dan produk tenusu merupakan faktor penyumbang kepada berlakunya aflatoksin dalam air kencing, dengan etnisiti (W=25.57, p<0.01) sebagai peramal utama di kalangan semua. Kaum Cina didapati 3.20 kali lebih cenderung mempunyai aflatoksin biomarker di dalam air kencing berbanding dengan kaum lain.

Apabila kedua suami isteri bekerja, pendapatan isi rumah meningkat dan menggalakan mereka untuk makan di luar. Pengambilan makanan luar mendedahkan pengguna kepada pencemaran aflatoksin memandangkan tidak semua pemilik premis makanan peduli dengan kehadiran dan bahayanya toksin tersebut kepada manusia. Kaum Cina didapati mempunyai paras aflatoksin yang tertinggi di dalam urin dan ini berkaitan dengan pengambilan makanan-makanan yang berpotensi terdedah dengan aflatoksin seperti bijirin, kekacang, susu dan telur. Kajian ini adalah salah satu daripada langkah-langkah pertama dalam meningkatkan kesedaran terhadap aflatoksin di kalangan orang dewasa di kawasan Hulu Langat, Selangor. Penemuan daripada kajian ini menunjukkan tahap semasa aflatoksin di kalangan rakyat Malaysia di Hulu Langat dan mengenalpasti faktor-faktor yang mungkin mempengaruhi kehadiran aflatoksin dalam manusia berdasarkan tahap biomarker aflatoksin.

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I certify that a Thesis Examination Committee has met on 23 November 2017 to conduct the final examination of Siti Husna binti Sulaiman on her thesis entitled "Factors Influencing Aflatoxin Biomarker Level in Urine among Adults in Hulu Langat District, Selangor, Malaysia" in accordance with the Universities and University Colleges Act 1971 and the Constitution of the Universiti Putra Malaysia [P.U.(A) 106] 15 March 1998. The Committee recommends that the student be awarded the Master of Science.

Members of the Thesis Examination Committee were as follows:

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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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This is to confirm that:

- The research conducted and the writing of this thesis was under our supervision;
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LIST OF ABBREVIATIONS

AFB_1	Aflatoxin B_1
AFB_2	Aflatoxin B_2
AFG_1	Aflatoxin G_1
AFG_2	Aflatoxin G_2
Aflatoxin M_1	AFM_1
Aflatoxin M_2	AFM_2
Aflatoxin P_1	AFP_1
Aflatoxin Q_1	AFQ_1
AFM_1	Aflatoxin M_1
BMI	Body mass index
CAC	Codex Alimentarius Commision
DI	Dietary intake
DNA	Deoxyribonucleic acid
ELISA	Enzyme-linked immunosorbent assay
EU	European Union
FAO	Food and Agricultural Organization
FDA	Food and Drug Administration
FFQ	Food frequency questionnaire
FTC	Food Technology Center
GC	Gas chromatography
GP-IPS	Geran Putra-Inisiatif Putra Siswazah
HBV	Hepatitis B virus
HCC	Hepatocellular carcinoma
HCV	Hepatitis C virus
HPLC	High pressure liquid chromatography
IARC	International Agency for Research on Cancer
IMR	Institute of Medical Research
IPAQ	International Physical Activity Questionnaire
KAP	Knowledge, attitude, practice
LOD	Level of detection
MARDI	Malaysian Agricultural Research & Development Institute
MOH	Ministry of Health
MPKJ	Majlis Perbandaran Kajang
PA	Physical activity
RMC	Research Management Centre
SCF	Scientific Committee on Food
SD	Socio-demography
TLC	Thin layer chromatography
UPM	Universiti Putra Malaysia
WHO	World Health Organization
WS	Weight status

CHAPTER 1

INTRODUCTION

1.1 Background

Responsibility concerning food safety is necessary among people to overcome food-borne illnesses and poisonings. However, the level of awareness among people around the world is still below satisfactory level as cases related to food-borne illnesses and poisonings are still reported all over the world (Diane *et al*., 2010). As the food is exposed to hazardous agents biologically, physically or chemically, the contaminated food may lead to adverse health consequences towards human and animals. These hazardous agents may be introduced into food and feed via harvesting, formulation and processing, packaging and labelling, storage, preparation, transportation and serving. There are a variety of chemical hazards involved in the food industry, but the most notable ones are mycotoxins, natural and marine toxins, food additives, agricultural products and veterinary drug residues. The most emphasized chemical hazard that will be discussed here is mycotoxin.

Mycotoxins are natural toxicants of moulds and fungi. These fungal secondary metabolites are found everywhere and unavoidable within the natural world. The growth of moulds and fungi is normally promoted by certain temperature with the presence of moisture. They are produced by filamentous molds especially from the family of *Fusarium*, *Penicillium* and *Aspergillus sp*. (Pitt *et al*, 2000). Even though all mycotoxins originated from fungi, but, not all toxic compounds produced by fungi are termed as mycotoxins. The role of metabolite and its function to living things are the conditions that shoud be seen in terming the fungi-toxic compounds (Bennet and Klich, 2003). When the toxic compounds are fatal to bacteria, the toxin is called antibiotics, otherwise when the toxic compounds are fatal to plants, the plant pathologists termed them as phytotoxins. The one that is toxic to human and animals is called as mycotoxins. The most recognized mycotoxins presence in food and feeds are aflatoxins, fumonisins, ochratoxins, trichothecenes, zearalenone and patulin (Marin*et al*, 2013).

Mycotoxicosis is a disease that leads to chemical contamination via food and feed which is associated with the exposures to mycotoxins produced by fungi (Robert *et al*., 2010). Poor storage and production process of grain and feed for poultry attribute the growth of toxin-producing fungi which results in the production of mycotoxin (Mohamed, 2011). There are a lot of mycotoxicosis cases which happened globally due to fungal infections and some of them were initially reported to occur widely in the European countries in 1960s (Asao *et al*., 1963). The infection of fungi in diets caused the outbreak of disease known as St. Anthony‘s or Holy Fire in many European countries due to the contamination of rye by ergot alkaloid, produced by *Clavicepspurpurea*

(Paterson and Lima, 2010). Since then, many cases have been reported and the discovery of “Turkey X” disease in London, England caused by aflatoxin in 1950s and early 1960s had opened new prospectus on the scientific research related to the aetiology of mycotoxicosis and preventive strategies that exists in foods, animals and human (Kensler *et al*., 2011). Kensler *et al*. (2011) described the epidemic disease as the major cause of death of numerous poultry animals due to the consumption of feeds containing nuts and cereals, contaminated by *Aspergillus flavus*, a pathogenic fungus. It was found that extracts from the culture of the fungus isolated from the meal were found to have the capability to induce “Turkey X” syndromes (Kensler *et al*., 2011).

The same situation is faced by Malaysians as evident by recent publications and reports on the occurrences of contaminants and toxicants in the diets and their impacts on human and animals (Leong *et al*., 2010; Arzandeh *et al*., 2010; Sulaiman *et al*., 2007). There was a report in Malaysia about mycotoxicosis, a food-borne poisoning, namely aflatoxicosis. Back in 1988, this case has led to thirteen deaths of children in Perak (Lye *et al*., 1995). This aflatoxicosis case appeared due to the presence of aflatoxin, a mycotoxin by fungi which is commonly found in human food resources especially in nuts and cereals and poultry and the impact of this food-borne poisoning should be taken seriously. The tropical climate prevailing in Malaysia accompanied with poor storage and production process enhance the growth of *Aspergillus* species of fungi and subsequently the production of aflatoxin in the foodstuffs, in which can lead to the occurrence of aflatoxicosis.

There are a large number of mycotoxins found in human and animal’s diet. Aflatoxins, trichothecenes, ochratoxins, fumonisins and zearalenone are the most important mycotoxins in food and feed industries with aflatoxins as the most studied mycotoxin among all. Aflatoxins are classified into several types according to their fluorescent properties under ultraviolet light. Of many aflatoxin types, aflatoxin B_1 (AFB_1) is classified by the International Agency for Research on Cancer (IARC) as group 1 carcinogen. In fact, AFB_1 owing to its mutagenic and carcinogenic properties has been classified as a major risk factor, alongside the hepatitis B virus (HBV) and the hepatitis C virus (HCV) (Kensler *et al*., 2011) for the development of liver cancer.

1.2 Problem Statement

Aflatoxin is classified as hepatotoxic, mutagenic, carcinogenic difuran-containing, polyketide-derived *Aspergillus* toxin and aflatoxin B_1 (AFB_1) has been classified by International Agency for Research on Cancer (IARC) as the most carcinogenic aflatoxin. Liver is the main organ for metabolizing aflatoxin in human and animals (Monosson, 2012) but aflatoxin metabolizing process may occur directly during absorption, in the blood or in several hepatic organs. Hence, aflatoxin exposure can cause liver cancer and its chronic exposure disturbs the immune system (Jiang *et al.*, 2005; Meissonier *et al*., 2006) in human andinterferes protein synthesis in animals (Applegate *et al.*, 2009).

Many people do not recognize the exposure until the critical and chronic symptoms and signs appear. To overcome this problem, early stage of prevention must be conducted. Before the preventive measures are taken, the detection of aflatoxin in the biological samples needs to be made as these biomarkers are feasible, reliable and reflect the exposure to aflatoxin through the diet. The prevalence and level of human exposure to aflatoxin together with its contributing factors are limitedly discovered and thus, more studies on aflatoxin exposure should be carried out to discover those possible factors. Even though there are almost similar studies conducted (Leong *et al.*, 2012; Mohd Redzwan *et al.*, 2012), these data cannot be used to represent the general aflatoxin exposure in Malaysia. As the main route of aflatoxin exposure is through the diet, it is possible that different populations are exposed to different aflatoxin exposure. This has been proven by a previous study conducted in Penang by Leong and colleagues (2012). They discovered a high level of aflatoxin among Chinese respondents with 3.05 times higher than Malay respondents. In fact, the use of aflatoxin biomarkers to assess human exposure to aflatoxin in Malaysia is still in its infancy stage (Mohd Redzwan *et al.*, 2013). Thus, this study is carried out to provide additional information towards the extent of human exposure to aflatoxin in different population; that is in Hulu Langat and to find the underlying factors for the detection of aflatoxin biomarker.

1.3 Research Questions

By taking into account the stated problems above, this study was conducted to discover the possible factors that contributed to the presence of aflatoxin AFM_1 biomarker in urine among healthy adults in Hulu Langat district, Selangor. Hence, this study was conducted to answer:

a. What is the level of aflatoxin among adults in Hulu Langat?
b. Is there any association in aflatoxin AFM_1 biomarker level among adults in Hulu Langat district based on socio-demographic (SD) variables (genders, age, marital status, ethnicity, educational level, personal and household income)?
c. Are there any associations between knowledge, attitude and practice (KAP) towards aflatoxin, physical activity (PA) level, dietary intake (DI), and weight status (WS) towards aflatoxin AFM_1 biomarker level among adults in Hulu Langat district?
d. What are the factors influencing the presence of aflatoxin AFM_1 biomarker among adults in Hulu Langat district?

1.4 Objectives

This study is conducted to determine the prevalence and factors influencing aflatoxin presence in urine (AFM_1) among healthy adults in Hulu Langat district, Selangor.

1.4.1 Specific Objectives

1. To measure aflatoxin level among healthy adults in Hulu Langat district based on aflatoxin AFM_1 biomarker in urine samples.
2. To determine the associations between socio-demograhic (SD) characteristics and aflatoxin AFM_1 biomarkerlevel in urine.
3. To determine the associations between knowledge, attitude and practice scores, physical activity level, dietary intake and weight status of participants with detectable aflatoxin AFM_1 biomarkerlevel in urine.
4. To evaluate the predictors to the presence of aflatoxin biomarker, AFM_1 in urine samples among adults in Hulu Langat district.

1.5 Hypothesis

There are four null hypotheses to be tested in this study:

$H_0$1: There are no association between socio-demographic characteristics with aflatoxin AFM_1 biomarker level.

$H_0$2: There is no association between knowledge, attitude and practice with AFM_1 biomarker level.

$H_0$3: There is no association between dietary intakes, physical activity and weight status with AFM_1 biomarker level.

$H_0$4: The chosen factors like socio-demography variables (gender, age, marital status, ethnicity, educational level, personal income and household income), knowledge, attitude and practice, dietary intake, physical activity level and weight status are not the predictors in aflatoxin AFM_1 biomarker presence.

1.6 Significance of Study

Aflatoxin is an acute cancer-causing chemical which is commonly found in staple commodities such as cereals and cereal-based products which are stored improperly. Once contaminated, the aflatoxin will remain in the food even after being processed. This harms both animals (pet and agricultural animals) and human. In animals, the ingested aflatoxin will be transformed into its by-products and are found in eggs, milk products and meat (Fratamico *et. al.*, 2008). This has been proven by a study in Pakistan which showed detectable aflatoxin biomarkers in chicken meats and eggs after the chickens were fed on the aflatoxin-contaminated feeds (Shahzad *et al.*, 2014).

Even though aflatoxicosis cases rarely reported in Malaysia and majority of Malaysians were not concerned on the possible adverse effect of it, they still need to be alert on the consequences of the long-term exposure of this toxin. Aflatoxins, especially the B_1 type affects the liver as it is the main biochemical synthesizer and detoxifying organ of many toxicants. Excessive dietary aflatoxins exposure is one of the causes to hepatic diseases such as cirrhosis and carcinoma in liver as reported in Asia and Africa (Cristina *et al.*, 2014). There is no specific antidote discovered yet to overcome aflatoxicosis. Thus,

people need to take the first step in creating the awareness towards aflatoxin and control its exposure from entering their body.

Therefore, this research was one of the first steps in creating the awareness towards aflatoxin among adults in selected areas in Hulu Langat, Selangor. Findings from this research will be able to show the current level of aflatoxin among Malaysians in Hulu Langat and the factors that might influence the aflatoxin presence in human based on the aflatoxin biomarker level. Then, these findings may alert Malaysians by giving information and guideline in reducing the risk for aflatoxin exposure among Malaysians, due to their varieties of lifestyles and multi-ethnicity population.

1.7 Conceptual Framework

Conceptual framework in **Figure 1.2** illustrates the connection of independent and dependent variables. The chosen factors such as socio-demography characteristics, level of knowledge, attitude and practice towards aflatoxin, dietary intake of possible aflatoxin-contaminated food, physical acticity level and weight status were measured in this study to determine the association between them onto AFM_1 biomarker level among adults in selected area in Hulu Langat district, Selangor.

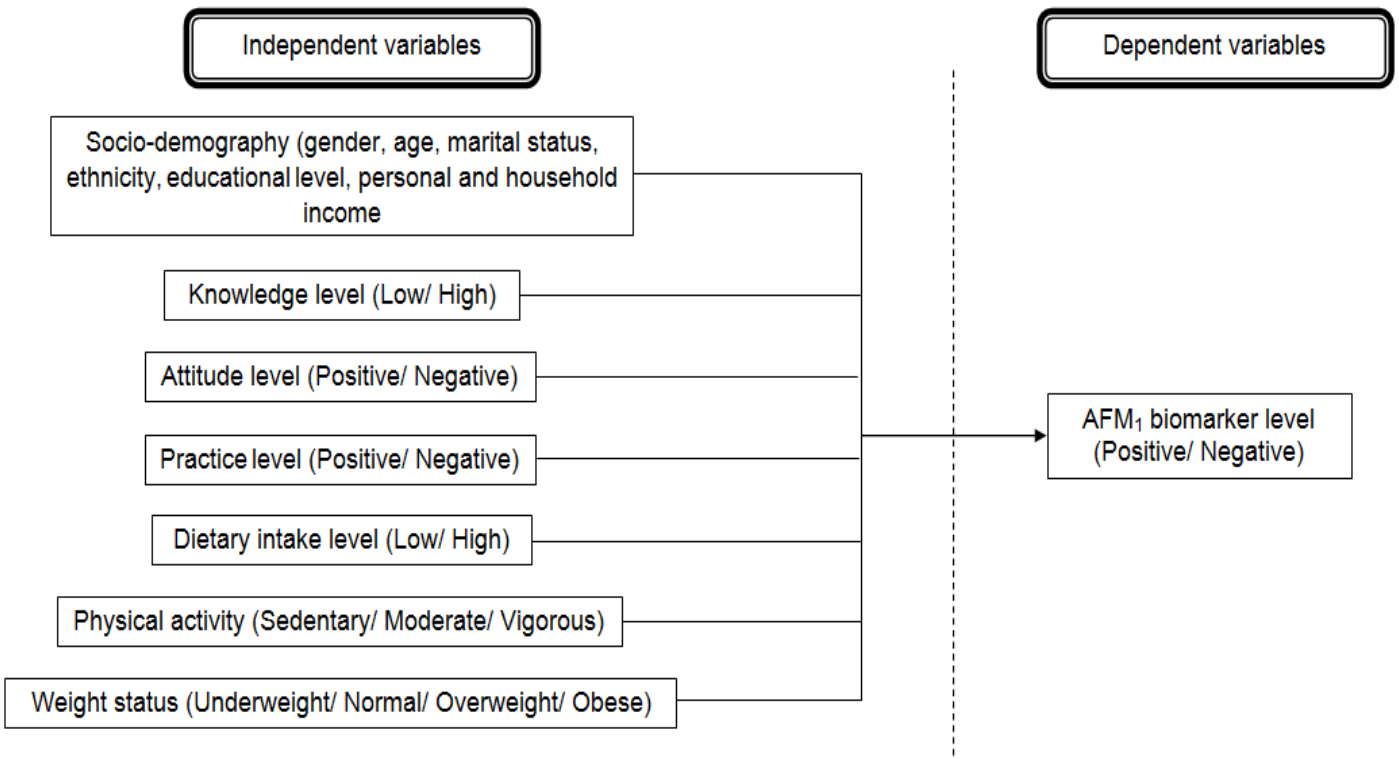

Figure 1.1: Conceptual framework

REFERENCES

Abdullah, N., Nawawi, A. and Othman, I. (1998). Survey of fungal counts and natural occurance of aflatoxins in Malaysian starch-based foods. *Mycopathologia*. 143(1), 53-58.

Adekunle, A. A., Hayes, J. R., and Campbell, T. C. (1977). Interrelationships of dietary protein level, aflatoxin B_1 metabolism, and hepatic microsomal epoxide hydrase activity. *Life Sciences*, *21*(12), 1785-1792.

Alejandro E.C., Luis M.C.M., Rafael F.M.H., Jesús R.M.A., Ramón G.G.G. and Irineo T.P. (2011). *Methods for Detection and Quantification of Aflatoxins, Aflatoxins - Detection, Measurement and Control*, Dr Irineo Torres-Pacheco (Ed.), ISBN: 978-953-307-711-6, InTech, Available from: http://www.intechopen.com/books/aflatoxinsdetection-measurement-and-control/methods-for-detection-and-quantification-of-aflatoxins

Alex, P.W., Deborah, W., Peter, C.V. and Joseph F.H. (2014). Methods for detection of aflatoxins in agricultural food crops. *Journal of Applied Chemistry*.Volume 2014, ID 706291.15 pages.

Ali, N., Hossain, K., Blaszkewicz, M., Rahman, M., Mohanto, N.C., Alim, A. and Degen, G.H.(2016). Occurance of aflatoxin M_1 in urines from rural and urban adult cohorts in Bangladesh. *Archives of Toxicology*. 90(7),1749-1755.

Alpsoy, L. (2010). Inhibitory effect of essential oil on aflatoxin activities. *African Journal of Biotechnology.* 9(17), 2474–2481. Anonymous (2013). Mycotoxin Hotspots On The Farm. *KnowMycotoxins*. Retrieved from www.knowmycotoxins.com on 2nd July 2015.

Annika Launiala. (2009). How much can a KAP survey tell us about people's knowledge, attitudes and practices? Some observations from medical anthropology research on malaria in pregnancy in Malawi. *Anthropology Matters Journal*, 7(1), 1-13. Retrieved from http://www.anthropologymatters.com/ on 29th May 2016.

Ashiq, S. (2015), Natural Occurrence of Mycotoxins in Food and Feed: Pakistan Perspective. *Comprehensive Reviews in Food Science and Food Safety*, 14 (2), 159–175.

Asao, T., Büchi, G., Abdel-Kader, M.M., Chang, S.B., Wick, E.L. and Wogan, G.N. (1963).Aflatoxins B and G. *Journal of The American Chemical Society*, 85 (11),1706–1707.

Balshem, M. (1993). Cancer in the community: Class and medical authority. Washington, DC: Smithson Inst. Press.

Bennet, J.W. and Klich, M. (2003). Mycotoxins. *Clinical Microbiology Reviews*. 16 (1), 497-516.

Bezerra da Rocha, M.E., Francisco da Chagas, O.F., Feltosa Maia, F.E., Florindo Guedes, M.I. and Rondina, D. (2014). Mycotoxins and their effects on human and animal health. *Food Control* 36 (1), 159-165.

Black, A.E., Goldberg, G.R., Jebb, S.A., Livingstone, M.B.E., Cole, T.J. and Prentice, A.M. (1991). Critical evaluation of energy intake data using fundamental principles of energy physiology: 2. Evaluating the

results of published surveys. *European Journal of Clinical Nutrition*, 45 (12), 583- 599. ISSN: 0954-3007

Bland, J.M. and Altman, D.G. (1997) Statistics Notes: Cronbach's Alpha. *The BMJ*, 314 (7080), 572.

Boermans, H.J. and Leung, M.C. (2007). Mycotoxins and the pet food industry: toxicological evidence and risk assessment. *International Journal of Food Microbiology,*119 (1-2), 95–102.

Bouchard, G., Carrillo, M.C., Tuchweber, B., Perea, A., Ledoux, M., Poulin, D. and Yousef, I.M. (1994). Moderate long-term physical activity improves the age-related decline in bile formation and bile salt secretion in rats. *Proceedings of the Society for Experimental Biology Medicine*, 206(4), 409-415.

Bressac, B., Puisieux, A., Kew, M., Volkmann, M., Bozcall, S., Mura, J.B., Suzzanne de la Monte, Carlson, R., Blum, H., Wands, J., Takahashi, H., Fritz von Weizsacker, Galun, E., Kar, S. et al. (1991). p53 mutation in hepatocellular carcinoma after aflatoxin exposure. *The Lancet* Volume 338 (8779), 1356-1359.

CAC (Codex Alimentarius Commission). (2013). General standard for contaminants and toxins in food and feed (CODEX STAN 193–1995). Retrieved from : http://www.codexalimentarius.org/standards/list-of standards/. on 1st June 2016.

Calle, E.E, Rodriguez, C., Walker-Thurmond, K., Thun, M.J. (2003). Overweight, obesity, and mortality from cancer in a prospectively studied cohort of U.S. adults. *The New England Journal of Medicine*. 348 (17), 1625-1638.

Centers for Disease Control and Prevention (CDC) (3rd September 2004). Outbreak of aflatoxin poisoning-Eastern and Central provinces, Kenya, January-July 2004.*Morbidity and Mortality Weekly Report (MMWR)*,3;53 (34), 790-792. Retrieved from https://www.cdc.gov/nceh/hsb/chemicals/pdfs/mmwr5334p790.pdf on 27th March 2017.

Chong, L.F. and Norimah, A.K. (2002). Development and calibration of food frequency questionnaire for Malaysian Chinese adults. Book of Abstracts. 17th Scientific Conference, Nutrition Society of Malaysia, p 19.

Clark, L. A. and Watson, D. (1995). Constructing validity: Basic issues in objective scale development. *Psychlogical Assessment. American Psychological Association*, 7(3), 309-319.

Cohen, J. (1988). Statistical power and analysis for the behavioral sciences (2nd ed.), Hillsdale, N.J., Lawrence Erlbaum Associates, Inc. Cole, R.J. and Cox, R.H. (1981). Handbook of toxic fungal metabolites. *Academic Press*, New York, USA. Pp 937.

Cristina, B., Federica, T. and Carlo La Vecchia (2014). Hepatocellular carcinoma epidemiology. *Best Practice & Research Clinical Gastroenterology*. 28 (5), 753-770.

David, L. E. and John, D. G. (2013). The toxicology of aflatoxins: Human health, veterinary and agriculture significance. p418-420. Retrieved from https://books.google.com.my/books on 5th April 2017.

Dennis, G. H., Vincent, E. B., Freederick, T. G. and David, C. S. (2009).

Mycotoxin detection in human samples from patients exposed to environmental molds. *International Journal of Molecular Science,* 10(4), 1465-1475.

Department of Statistics Malaysia (2015). Household income and Basic Amenities Survey (HISB & BA). Report of Household Income and Basic Amenities Survey 2014. Retrieved on 25th January 2017 from https://www.dosm.gov.my/v1/index.php?r=column/cthemeByCat&cat=120&bul_id=aHhtTHVWNVYzTFBua2dSUlBRL1Rjdz09&menu_id=amVoWU54UTl0a21NWmdhMjFMMWcyZz09

Delmulle, B. S., de Saeger, S. M. D. G., Sibanda, L., Barna-Vetro, I. and van Peteghem C. H. (2005). Development of an immunoassay-based lateral flow dipstick for the rapid detection of aflatoxin B_1in pig feed. *Journal of Agricultural and Food Chemistry*. 53 (9), 3364-3368.

Diane, G. N., Marion, K., Linda, V., Erwin, D., Aidara-Kane, A., Hein, S., Marieke, O., Marel, L., John, T., Flemming, S., Joke van der Giessen and Hilde, K. (2010). Food-borne diseases — The challenges of 20 years ago still persist while new ones continue to emerge. *International Journal of Food Microbiolgy* 139, S3-S15.

Dillman, D.A. (2000). *Mail and internet surveys: The tailored design method* (Vol.2). New York: Wiley

Dohnal, V., Wu, Q. and Kuča, K. (2014). Metabolism of aflatoxins: key enzymes and interindividual as well as interspecies differences. *Archives of Toxicology,* 88(9), 1635-1644.

Douglas L. Schmucker (2005). Age-related changes in liver structure and function: Implications for disease?.*Experimental Gerontology*. 40(8-9), 650-659.

E Anyanwu, J Ehiri, I kanu (2006). High cholesterol levels and chronic exposure to toxigenic molds in damp buildings: A high risk for cardiovascular diseases and stroke. *The Internet Journal of Toxicology*. Volume 3, no. 2. Retrieved from http://ispub.com/ on 15th January 2016.

El-Nezami, H., Mykkänen, H., Kankaanpaa, P., Suomalainen, T., Salminen, S., Ahokas J (2000b). Ability of a mixture of lactobacillus and propionibacterium to influence the faecal aflatoxin content in healthy Egyptian volunteers: a pilot clinical study. *Bioscience Microflora*. 19(1), 41-45.

Ellen, E. Y., Johnni, H. D., Lauren, S. L., Michael, E. R., Ekaterina, M. P., Andrea, A. K., Joel, M. M., Rebecca, B., Mamo U. A., Willis, A., Robert, F. B. and Shahnaaz, K. S. (2013). Human aflatoxin exposure in Kenya, 2007: a cross sectional study. *Journal Food Additives & Contaminants*: Part A. 30(7), 1322-1331.

EP. (2002). The European Commission. Directive 2002/32/EC of the European Parliament and of the Council of 7 May 2002 on undesirable substances in animal feed. *Official Journal of European Union* L32*:*1–21. *Re*trieved from*:* http://www.fediol.eu/data/Dir_2002_32_undesirable_substances_in_feed_CONS_2006--10.pdf on 1st June 2016

Elizabeth, S. (2003). Food safety and foodborne disease in 21st century homes. *The Canadian Journal of Infectious Diseases*, 14 (5) (2003), 277-280.

EU. (2006a). European Commission Regulation (EC) No. 1881/2006 of 19

December 2006 setting maximum levels for certain contaminants in foodstuffs, 2006. *Official Journal of European Union.* 364:5–24. Retrieved from: http://www.fsai.ie/uploadedFiles/Regulation-EC-1881--2006.pdf on 1st June 2016

EU. (2007). European Commission Regulation (EC) No. 1126/2007 of 28 September 2007 amending Regulation (EC) No 1881/2006 setting maximum levels for certain contaminants in foodstuffs as regards Fusarium toxins in maize and maize products. *Official Journal of European Union,* L255:14–7. Retrieved from: http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32007R1126&rid=1 on 1st June 2016

EU. (2010). European Union Commission Regulation (EU) No. 165/2010 of 26 February 2010 amending Regulation (EC) No 1881/2006 setting maximum levels for certain contaminants in foodstuffs as regards aflatoxins. *Official Journal of European Union L* 50:8–12. Retrieved from:http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri = CELEX:32010R0165&rid = 1 on 1st June 2016

EU. (2012). European Union Commission Regulation (EU) No 594/2012 of July 2012 amending Regulation (EC) 1881/2006 as regards the maximum levels of the contaminants ochratoxin A, non dioxin-like PCBs and melamine in foodstuffs. *Official Journal of European UnionL* 176 :43–5. Retrieved from: https://www.fsai.ie/uploadedFiles/Reg594_2012.pdfon 1st June 2016.

Farah, N. A., Rosita, J., Norhaizan, M.E., Mohd-Redzwan, S. (2017).Screening of aflatoxin M_1 o4ccurrence in selected milk and dairy products in Terengganu, Malaysia. *Food Control.* 73B, 209-214.

Farmer, P.E. (1997). Social scientists and new tuberculosis. *Social Science and Medicine*. 44(3), 347-358.

FDA, Food and Drug Administration (1979). Conference on mycotoxins in animal feeds and grains related to animal health. Rockville, Maryland

FDA, Food and Drug Administration (2016). Hazard analysis and risk-based preventive controls for human food: Draft guidance for industry. Food Safety and Applied Nutrition, U.S. Food and Drug Administration. Retreived from www.fda.gov/downloads/food/guidanceregulation/fsma/ucm517396.pdf on 21st July 2017.

Forrester, L.M., Neal, G.E., Judah, D.J., Glancey, M.J. and Wolf, C.R. (1990). Evidence for involvement of multiple forms of cytocrome P-450 in aflatoxin B_1 metabolism in human liver. *Proceedings of the National Academy of Sciences of the United States of America*. 87 (21), 8306-8310.

Fratamico, P.M., Bhunia, A.K., Smith, J.L. eds. (2008). *Foodborne Pathogens: Microbiology and Molecular Biology*. Wyndmoor, USA: Horizon Scientific Press. ISBN 978-1-898486-52-7

Frenkl, R., Gyore, A. and Szeberenyi, S. (1980). The effect of muscular exercise on the microsomal enzyme system of the rat liver. *European Journal of Applied Physiology and Occupational Physiology*. 44 (2), 135-140.

Garner, R.C., Miller, E.C., Miller, J.A. (1972). Liver Microsomal Metabolism of Aflatoxin B_1 to a reactive derivative toxic to Salmonella typhimurium TA 1530. *American Association for Cancer Research*. 32 (10), 2058-2066.

George, D. and Mallery, P. (2003). *SPSS for Windows step-by-step: A simple guide and reference*. 11.0 update (4th ed.) Boston: Allyn & Bacon.

Graham, A.C., Carolyn, C.C. and Lindsay Frazier. (1997). Physical activity and reduced risk of colon cancer: Implications for prevention. *Cancer Causes & Control.* 8 (4), 649-667.

Green, C. E. (2001). Can qualitative research produce reliable quantitative findings? *Field Methods* 13(3), 3-19.

Groopman, J.D., Donahue, P.R., Zhu, J.Q., Chen, J.S., Wogan, G.N., Montesano, R. and Wild, C.P. Molecular dosimetry of aflatoxin-N7-guanine in human urine obtained in The Gambia, West Africa. *Cancer Epidemiology Biomarkers Prev*ention, 1(3), 221-227.

Guengerich, F.P., Johnson, W. W., Shimada, T., Ueng, Y.F., Yamazaki, H., and Langouet, S. (1998). Activation and detoxification of aflatoxin B_1. *Mutation Research/ Fundamental and Molecular Mechanisms of Mutagenesis*. 402 (1-2), 121-128.

Hamid, A. B. (1997). Present status and future prospects of research on the groundnuts aflatoxin problem in Malaysia. In Mehan, V. K. & Growda, C. L. L. (Eds). Aflatoxin contamination problems in groundnut in Asia: Proceeding of the First Asia Working Group Meeting. (pp 32-35). India: International Crops Research Institute for the Semi-Arid Tropics.

Hausmann-Muela, S., Ribera, J.M. and Nyamongo, I. (2003). Health-seeking behaviour and the health system response. *DCPP Working Paper* no. 14. London: London School of Hygiene and Tropical Medicine.

Herzallah, S.M. (2009). Determination of aflatoxins in eggs, milk, meat and meat products using HPLC fluorescent and UV detectors. *Food Chemistry,* 114, 1141–1146.

Ho, J. A. and Wauchope, R. D. (2002). A strip liposome immunoassay for aflatoxin B_1. *Anaytical Journal*. 74 (7), 1493–1496. Retrieved from http://pubs.acs.org/doi/abs/10.1021/ac010903q on 10th April 2017.

Howes, M., McEwen, S., Griffiths M. and Harris, L. (1996). Food handler certification by home study: measuring changes in knowledge and behaviour. *Dairy, Food and Environment Sanitation*, 16 (11), 737-744.

Hussein, H.S. and Brasel, J.M. (2001). Toxicity, metabolism and impact of mycotoxins on humans and animals. *Toxicology*. 167(2), 101-134.

IARC- International Agency fro Research on Cancer (2002). Aflatoxin in: Some traditional herbal medicines, some mycotoxin, naphthalene and styrene. IARC Monograph on the Evaluation of Carcinogenic Risk to Humans, Vol 82 (1-599). Lyoon: IARC.

IPAQ Questionnaire, Downloadable. Retrieve from https://sites.google.com/site/theipaq/home on 30th October 2015.

IPAQ Research Committee (2004). Guidelines for data processing and analysis of the international physical activity questionnaire (IPAQ)-short form. Version 2.0. April 2004. Retrieve from

http://www.institutferran.org/documentos/scoring_short_ipaq_april04.pdf on 2nd November 2015.

Irfan, A.R.; Wee, Y. K.; Woon, K.P. and Jeongheui, L. (2017). The sources of chemical contaminants in food and their health implications. *Frontiers in Pharmacology*. 8 (830), 1-8.

James, B., Adda, C., Cardwell, K., Annang, D., Hell, K., Korie, S., Edorh, M., Gbeassor, F., Nagatey, K. and Houenou, G. (2007). Public information campaign on aflatoxin contamination of maize grains in market stores in Benin, Ghana and Togo. *Food additives and Contaminants*, 24 (11), 1283-1291.

Jolly, P., Jiang, Y., Ellis, W., Awuah, R., Nnedu, O., Phillips, T., et al. (2006). Determinants of aflatoxin levels in Ghanaians: sociodemographic factors, knowledge of aflatoxin and food handling and consumption practices. *International Journal Hygiene Environmental Health*, 209 (4), 345-358.

Julious, S.A. (2009). Sample Sizes for Clinical Trials. Chapman and Hall/CRC. Kensler, T. W., Roebuck, B. D., Wogan, G. N., & Groopman, J. D. (2011). Aflatoxin: A 50 year odyssey of mechanistic and translation toxicology. *Toxicological Sciences*, 120 (S1), S28-S48.

Kiama, T.N., Lindahl, J.F., Sirma, A.J., Senerwa, D.M., Waithanji, E.M., Ochungo, P.A., Poole, E.J., Kang'ethe, E.K. and Grace, D. (2016). Kenya dairy farmer perception of moulds and mycotoxins and implications for exposure to aflatoxins: a gendered analysis. *African Journal of Food, Agriculture, Nutrition and Development*. 16(3). Retrieved on 24th January 2017 from http://www.ajol.info/index.php/ajfand/article/view/141933/131675

Krishnamachari, K. A. V. R., Nagarajan, V., Ramesh, V.B. and Tilak,T. M. G. (1975). Hepatitis due to aflatoxicosis. An outbreak in Western India. *TheLancet*,305 (7915), 1061-1063.

Launiala, A. and Honkasalo, M-L. (2007). Ethnographic study of factors influencing compliance to intermittent preventive treatment of malaria during pregnancy among Yao women in rural Malawi. *Transactions of the Royal Society of Tropical Medicine and Hygiene,* 101(10), 980-989.

Leong, Y-H., Ismail, N., Latiff, A.A., & Ahmad, R. (2010). Aflatoxin occurance in nuts and commercial nutty products in Malaysia. *Food Control*, 21, 334-338.

Leong, Y-H., Rosma, A., Latiff, A. A., & Ahmad, N. I. (2011). Exposure assessment and risk characterization of aflatoxin B_1 in Malaysia. *Mycotoxin Research*, 27(3), 207-214.

Leong, Y-H., Rosma, A., Latiff, A. A., and Nurul Izzah, A. (2012). Associations of serum aflatoxin B_1-lysine adduct level with socio-demographic factors and aflatoxin intake from nuts and related nuts products in Malaysia. *International Journal of Hygiene and Environmental Health*, 215, 368-372.

Lim, H. K. and Yeap, G. S. (1966). The occurrence of aflatoxin in Malayan imported oil cakes and groundnut kernels. *Malaysian Agricultural of Journal*, 45, 232-244.

Liu, Y.and Wu, F. (2010). Global burden of aflatoxin-induced hepatocellular carcinoma: A risk assessment. *Environmental Health Perspectives*, 118(6), 818-824.

Lye, M. S., Ghazali, A. A. , Mohan, J., Alwin, N., and Nair, R. C. (1995). An outbreak of acute hepatic encephalopathy due to severe aflatoxicosis in Malaysia. *The American Journal of Tropical Medicine and Hygiene*, 53, 68-72.

Machida M and Gomi K, eds. (2010). *Aspergillus: Molecular Biology and Genomics.* Caister Academic Press. ISBN 978-1-904455-53-0. Majlis Perbandaran Kajang (MPKJ), Jalan Semenyih, 43000 Kajang, Selangor. Referred on 22nd December 2015.

Malaysian Economic Planning Unit. (n.d.) Mean Monthly Gross Household Income of Top 20%, Middle 40% and Bottom 40% of Households by Ethnicity and Strata, Malaysia, 1970-2009. Retrieved from http://www.epu.gov.my/c/document_library/get_file?uuid=5b461e12-9843-47d4-b54f-4c50e258c540&groupId=10124.

Manderson, L. and P. Aaby (1992). An epidemic in the field? Rapid assessment procedures and health research. *Social Science and Medicine.* 35(7), 839-850.

Manique R., Pena A., Lino C.M., Molto J.C. and Manes J (2008). Ochratoxin A in the morning and afternoon potions of urine from Coimbra and Valencian populations. *Toxicon*, 51, 1281-1287.

Marin S., Ramos, A.J., Cano-Sancho, G. and Sanchis, V. (2013). Mycotoxins: occurrence, toxicology and exposure assessment. *Food Chemical Toxicology* 60: 218-237.

Mason S., Hajimohammadi B., Ehrampoush M.H., Khabiri F. & Soltani M. (2015). A survey on relationship between diet and urinary excretion of aflatoxin M_1: a screening pilot study on Iranian population. *Journal of Food Quality and Hazards Control*. 2, 66-70. Retrieved on 24th January 2017 from http://oaji.net/articles/2015/1169-1426484760.pdf

Ministry of Health (MOH) (1985).Malaysian Food Regulations 1985. Food Safety Information System of Malaysia. MOH, Putrajaya.

Ministry of Health, Malaysia (MOH) (2011). Album Saiz Sajian Makanan Malaysia. Kajian Pengambilan Makanan Malaysia. MOH, Putrajaya. MOH, Ministry of Health. (2014). National Health and Morbidity Survey 2014:

Malaysia Adults Nutrition Survey. Vol. III, Food Consumption Statistics of Malaysia. Putrajaya: Ministry of Health, Malaysia.

Mohamed E. Z. (2011). Impact of Mycotoxins on Humans and Animals. *Journal of Saudi Chemical Society*. 15 (2),129-144.

Mohd Redzwan S., Rosita J., Mohd Sokhini A.M. and Nurul Aqilah A.R. (2012). Association between aflatoxin m1 excreted in human urine samples with the consumption of milk and dairy products. *Bulletinof Environmental Contamination Toxicology*, 89(6), 1115-1119.

Mohd Redzwan S., Rosita J., Mohd Sokhini A. M. and Nurul Aqilah A. R. (2012a). Socio-demographic and socio-economic determinants of adults knowledge on fungal and aflatoxin contamination in the diets. *Asian Pacific Journal Tropical Biomedicine,* 2(3), S1835–S1841.

Mohd Redzwan S., Rosita J., Mohd Sokhini A. (2012b). Screening of aflatoxin M_1, a metabolite of aflatoxin B_1 in human urine samples in Malaysia: A preliminary study. *Food Control.* 28(1), 55-58. Retrieved from http://dx.doi.org/10.1016/j.foodcont.2012.04.048 on 25th January 2017.

Monosson, E. (2012) Biotransformation. National Library of Medicine (NLM): *The Encyclopeadia of Earth*. http://www.eoearth.org/view/article/150674/

Murphy, K.R. and Myors, B. (1998). Statistical power analysis-A simple and general model for tradiotional and modern hypothesis tests. Mahwah, N.J., Lawrence Erlbaum Associates, Inc.

National Centre for Farmer Health (2014, March 20). Aspergillosis. Retrieved from http://www.farmerhealth.org.au/page/health-centre/aspergillosis on 7th December 2017

Noor Azia, A.R. (2002). Kajian rekabentuk dan kalibrasi soal selidik kekerapan makanan untuk dewasa Melayu. *Latihan ilmiah. Universiti Kebangsaan Malaysia*.

Noraziah, A. and Mohd Azlan, A. (2012). The food consumption and eating behaviour of Malaysian urbanites: Issues and concerns. *Malaysia Journal of Society and Space*. 8(6), 157-165.

Nunnally, J. and Bernstein, I. (1994) *Psychometric Theory* New York: McGraw Hill, 3rd ed.(required: available at SBX)

Nurul-Fadhilah, A., Teo, P.S. and Foo, L.H.(2016). Ethnic differences in the food intake patternsand its associated factors of adolescents in Kelantan, Malaysia. *Nutrients*. 8(9), 551.

Patterson, D.S.; Galaney, E.M. and Roberts, B.A.(1978). The estimation of AFM1 in milk using 2-dimensional TLC. *Food andCosmetics Toxicology*, 16(1), 49-50

Patterson, R. R. M. and Lima, N. (2010a) *Toxicology of mycotoxins*. In Luch, A. (Ed). Molecular, Clinical and Environmental Toxicology. Volume 2: Clinical Toxicology (pp31-63). Switzerland, Birkhauser Verlag.

Pelto, J. P., and G. H. Pelto. (1997). Studying knowledge, culture, and behavior in applied medical anthropology. *Medical Anthropology Quarterly* 11(2), 147- 163.

Peng T., Li L.Q., Peng M.H., Liu Z.M., Liu T.W., Guo Y., Xiao K.Y., Qin Z., Ye X.P., Mo X.S., Yan L.N., Lee B.L., Shen H.M., Tamae K., Wang L.W., Wang Q., Khan K.M., Wang K.B., Liang R.X., Wei Z.L., Kasai H., Ong C.N. and Santella R.M. (2007). Evaluation of oxidative stress in a group of adolescents exposed to a high level of aflatoxin B1- a multi-center and multibiomarker study. *Carcinogenesis,* 28(11), 2347-2354.

Peters, H.P., De Vries, W.R., Vanberge-Henegouwen, G.P. and Akkermans, L.M. (2001). Potential benefits and hazards of physical activity and exercise on the gastrointestinal tract. *Gut*, 48(3), 435-439. Retrieved from http://doi.org/10.1136/gut.48.3.435 on 15th January 2016.

Petty, R. E., and J. P. Cacioppo (1981). *Attitudes and persuasion—classic and contemporary approaches*. Dubuque, IA: W. C. Brown Co. Publishers.

Pitt, J.I., Basilico, J.C., Abarca, M.L. and Lopez, C. (2000). Mycotoxins and toxigenic fungi. *Medical Mycology,* 38 (1), 41-46.

Polychronaki, N., Wild, C. P., Mykkanen, H., Amra, H., Abdel-Wahhab, M., Sylla, and Turner, P. C. (2008). Urinary biomarkers of aflatoxin exposure in young children from Egypt and Guinea. *Food and Chemical Toxicology*, 46(2), 519-526.

Preston, R. S., Hayes, J. R. and Campbell, T. C. (1976). The effect of protein deficiency on the in vivo binding of aflatoxin B_1 to rat liver macromolecules. *Life Sciences*, 19(8), 1191-1198.

Qian, G.S., Ross, R.K., Yu, M.C., Yuan, J.M., Gao, Y.T., Henderson, B.E., Wogan, G.N., Groopman, J.D.. A follow-up study of urinary markers of alfatoxin exposure and liver cancer risk in Shanghai, People's Republic of China. *Cancer Epidemiology Biomarkers and Prev*ention, 3(1), 3-10.

Raiola, A. and Ritieni, A. (2014). *Good Food and Feed Processing Techniques.* In: Leslie JF, Logrieco AF (eds). Mycotoxins Reduction in Grain Chains: A Practical Guide. John Wiley and Sons, Iowa, USA, pp. 271-279.

Rand, D. Conger, K.J., Conger, M.J. and Martin (2011). Socioeconomic status, family processes, and individual develoement. *Journal Marriage Family*. 72(3):685-704. Retrieved from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2910915/ on 25th January 2017.

Reddy, KR.N., Reddy, C.S., Muralidharan, K.K. (2009). Detection of Aspergillus spp. and aflatoxin B_1 in rice in India. *Food Microbial*. 26(1), 27-31.

Reddy, K. R. N., Farhana, N. I., & Salleh, B. (2011). Occurance of *Aspergillus spp*. and aflatoxin B_1 in Malaysian food used for human consumption. *Journal of Food Science*, 76(4), T99-T104.

Reddy, K.R.N. and Salleh B. (2010). A preliminary study on the occurrence of Aspergillus spp. and aflatoxin B1 in imported wheat and barley in Penang, Malaysia. *Mycotoxin Research*. 26 (4), 267-271.

Robert K., Matthias K., David S., Stefan M., Ronald M., and Irene N. (2010). Determination of Mycotoxins in Foods: Current State of Analytical Methods and Limitations. *Applied Microbiology and Biotechnology*. 86(6), 1595-1612.

Ronald P. de Vries, Isabelle B. G. and Mikael R.A. (2016). *Aspergillus and Penicillium in the Post-genomic Era*. Caister Academic Press. ISBN: 978-1-910190-40-1. Retrieved from http://www.highveld.com/microbiology/aspergillus.html on 23rd July 2017.

Roux, A., Lison, D., Junot, C., and Heilier, J. (2010). Applications of liquid chromatography coupled to mass spectrometry-based metabolomics in clinical chemistry and toxicology: A review. *Clinical Biochemistry*. 44 (1), 119-135. Retrieved from http://www.sciencedirect.com/science/article/pii/S0009912010003759 on 10th April 2017.

Salant, P. and Dillman, D.A. (1994). *How to conduct your survey* (pp.54-55). New York : Wiley.

Scott P. M. (1995). Mycotoxin methodology. *Food Additives and Contaminants*. 12 (3), 395-403. Retrieved from http://dx.doi.org/10.1080/02652039509374321 on 10th April 2017.

Segal, B. H. (2009). Aspergillosis. *New England Journal of Medicine,* 360(18), 1870-1884.

Selestin N., Bendantukuka T., Dismas M. and Martin K. (2017). Awareness

of aflatoxin health risks among parents with children aged between 6-23 months in Central Tanzania. *International Journal of Nutrition and Food Sciences*. (5)6, 429-436.

Shahzad Z.I., Sonia N., Muhammad Rafique A. and S. Jinap (2014). Natural incidence of aflatoxins, ochratoxins A and zearalenone in chicken meat and eggs. *Food Control*, 43, 98-103.

Shephard, G.S., Berthiller, F., Burdaspal, P.A., Crews, C., Jonker, M.A., Krska, R., MacDonald, S., Malone, R.J., Maragos, C., Sabino, M., Solfrizzo, M., Van Egmond, H.P. and Whitaker, T.B. (2011). Developments in mycotoxin analysis: an update for 2009-2010. *World Mycotoxin* Journal 4(1), 3-28

Soleimany, F., Jinap, S., and Abas, F. (2012a). Determination of mycotoxins in cereals by liquid chromatography tandem mass spectrometry. *Food Chemistry,* 130(4), 1055–1060.

Srisit, K. (1989). Mycotoxin prevention and control in foodgrains: Introduction to mycotoxins analysis. FAO Corporate Document Repository, Agriculture and Consumer Protection. Retrieved from http://www.fao.org/docrep/X5036E/x5036E0j.htm on 3rd April 2017.

Sulaiman, M. R., Yee, C. F., Hamid, A. and Yatim, A. M. (2007). The occurance of aflatoxins in raw shelled peanut samples from three districts of Perak, Malaysia. *Electronic Journal of Environmental, Agricultural and Food Chemistry*, 6(5), 2045-2052.

Sun, Z., Lu, P., Gail, M.H., Pee, D., Zhang, Q. Ming, L., Wang, J., Wu, Y., Liu, G., Wu, Y. and Zhu, Y. (1999). Increased risk of hepatocellular carcinoma in male hepatitis B surface antigen carriers with chronic hepatitis who have detectable urinary aflatoxin metabolite M_1. *Hepatology*. 30(2), 379-383.

Suzana, S., Aini, M.Y., Shanita, S., Rafidah, G., and Roslina, A. (2009). In E. Kedua (Ed.), *Atlas Makanan: Saiz Pertukaran & Porsi: Atlas of Food Exchanges & Portion Sizes* (2nd edition). Malaysia. KL. MDC.

Tang L., Tang M., Xu L., Luo M., Huang T., Yu J., Zhang L., Gao W., Cox S.B., Wang J.S. (2008). Modulation of aflatoxin biomarkers in human blood and urine by green tea polyphenois intervention. *Carcinogenesis*, 29(2), 411-417.

Tuckman, B. W. (1999). *Conducting Educational Research*. Belmont, CA: Wadsworth Group. ISBN: 9781442209657

Turner P.C., Sylla A., Diallo M.S., Castegnaro J-Jacques, Hall A.J. and Wild C.P. (2002). The role of alfaflatoxins and hepatitis viruses in the etiopathogenesis of hepatocellular carcinoma: A basis for primary prevention in Guinea-Conakry, West Africa. *Journal of Gastroenterology and Hepatology*. 17(s4): S441-S448.

Turner P.C., Rothwell J.C., White K.L.M, Gong Y.Y., Cade J., Wild C.P. (2008). Urinary deoxynivalenol is correlated with cereal intake in individuals from the United Kingdom. *Environmental Health Perspectives*, 116 (1), 21-25.

Toh P.S. and Birchenough A. (2000). Food safety knowledge and attitudes: culture and environment impact on hawkers in Malaysia: knowledge and attitudes are key attributes of concern in hawker foodhandling practices and outbreaks of food poisoning and their prevention. *Food Control*. 11 (6), 447–452

Tzee-Cheng Chao, Sheila M. Maxwell and Su-Yong Wong (1991). An outbreak of aflatoxicosis and boric acid poisoning in Malaysia: A clinicopathological study. *The Journal of Pathology,* 164 (3), 225-233.

van Egmond, H.P. (1991). Worldwide regulations for ochratoxin *International Agency for Reasearch on Cancer Scientific Publications,* 115, 331–336.

van Egmond, H.P. (2013). Mycotoxins: risks, regulations and European cooperation. *Matica Srps Journal for Natural Sciences,* 125, 7–20.

WHO (2002) Guidelines for the evaluation of probiotics in foods. Food and Agriculture Organization of the United Nations and World Health Organization Expert Consultation Report. Food and Agricultural Organization of the United Nations and World Health Organization Working Group Report (online).

WHO (2008). Advocacy, communication and social mobilization for TB control: A guide to developing knowledge, attitude and practice surveys. *WHO Library Cataloguing-in-Publication Data*. ISBN 9789241596176. Retrieved from http://apps.who.int/iris/bitstream/10665/43790/1/9789241596176_eng.pdf on 1st June 2016.

Wild, C. P. & Turner, P. C. (2002). The toxicology of aflatoxins as basis for public health decisions. *Mutagenesis*, 17(6), 471-481.

Wouters, A.T., Casagrande R.A., Wouters, F., Watanabe, T.T., Boabaid, F.M., Cruz, C.E. and Driemeier, D. (2013). An outbreak of aflatoxin poisoning in dogs associated with aflatoxin B_1-contaminated maize products. *Journal of Veterinary Diagnostic Investigation*. 25 (2), 282 – 287.

Yao, H., Hruska, Z. and Diana, D.M. (2015). Developments in detection and determination of aflatoxins. *World Mycotoxin Journal*, 8(2), 181-191.

Yvette, F. M. and Peter G. (2014). Guidelines for assessing nutrition-related Knowledge, Attitudes and Practices. KAP Manual. Food and Agriculture Organization of the United Nations (FOA). E-ISBN: 978-92-5-107768-9 (PDF). Retrieved from http://www.fao.org/docrep/019/i3545e/i3545e00.htm on 1st June 2016.

Yiannikouris, A. and Jouany J.P. (2002). Mycotoxins in feeds and their fate in animals: a review. Animal Research.51 (2), p81-99. DOI:10.1051/animres:2002012

Zain-ul-Abidin, Khatoon, A., Qureshi, M.A. and Butt T.M. (2013). Determination of aflatoxin B_1 in finished poultry feed samples collected from different poultry farms and markets of Lahore, Pakistan. *International Journal of Veterinary Science*. 2(1), 28-31. ISSN: 2304-3075