

# Determination of Aflatoxins in Peanut Products and Cancer Risk Estimates of Dietary Exposure in Indonesian and Thai population

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## INTRODUCTION

Peanut have been reported as one of major aflatoxin contaminated products in almost all countries. Its presence is serious public health concern worldwide, particularly in developing countries. Aflatoxin been classified into AFB<sub>1</sub>, AFB<sub>2</sub>, AFG<sub>1</sub>, and AFG<sub>2</sub> based on fluorescent and chemistry structure. AFB<sub>1</sub> known as class 1A human carcinogen (IARC, 1993). AFB<sub>1</sub> was reported to increase the risk of Hepatocellular Carcinoma (HCC) when associated with hepatitis B or C (Kirk et al. 2005, Wu et al. 2013). It was contributed 4.6%-28.2% of total annual HCC cases (Zhao et al. 2013).

The conversion of AFB<sub>1</sub> to a reactive metabolite (aflatoxin-8,9-epoxide) by cytochrome P450 can produced DNA adduct that lead to p53 tumor suppressor gene mutation in the liver. These conditions will increase the risk of chronic liver/cirrhosis and HCC for long term exposure.

WHO recommends an integrated control of aflatoxin in the human diet. Currently, Indonesian and Thailand authorities has a maximum tolerable level of 20 µg·kg<sup>-1</sup> for total aflatoxin in food products. Raw peanut and its products are frequently contaminated with aflatoxins. It has to be considered as high risk agricultural commodity. However, peanut products are staple in Indonesian and Thai population. They consumed either unprocessed or processed peanuts. The most popular peanut product is peanut sauce mixed with chili. It serves with variety of dishes. In Indonesia it serves with pecel, gado-gado, ketoprak and sate. In Thailand it served with thai pork satay: moo ping. Limited study performed the contamination all types of aflatoxin from peanuts and its product especially peanut sauce.

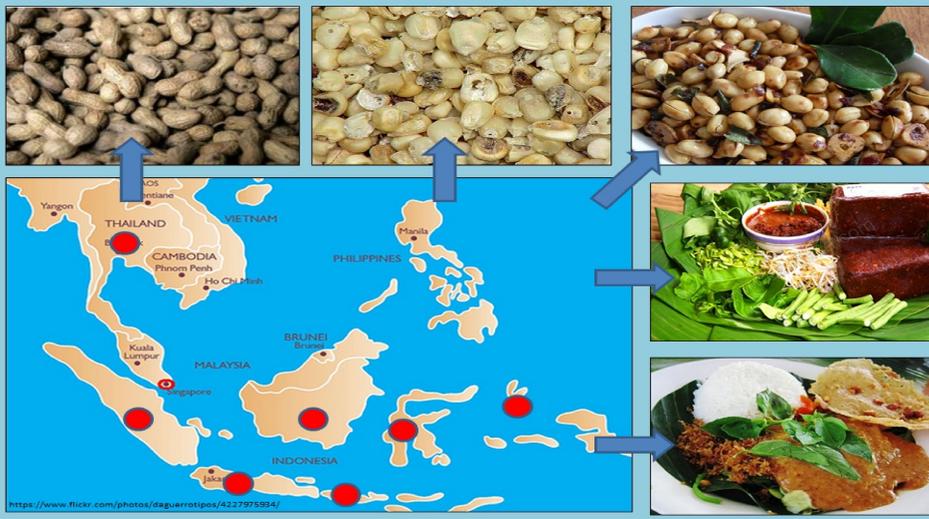
## OBJECTIVES

- To investigate the occurrence of aflatoxins from raw peanut and its product consumed by Indonesian and Thai population
- To estimate cancer risk of aflatoxin dietary exposure from raw peanut and its products

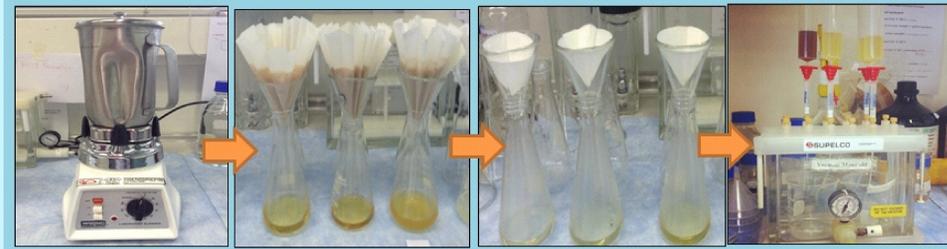
## METHODS

### 1) Sampling

A total of 99 peanuts (67 samples from Indonesia and 32 samples from Thailand) were collected between April and July 2014.



### 2) Sample extraction



### 3) Aflatoxin (B<sub>1</sub>, B<sub>2</sub>, G<sub>1</sub>, and G<sub>2</sub>) analysis

Analysis of aflatoxins was performed by LC-MS/MS system (Agilent 1100 series equipped with Micromass® Quattro micro™ MS/MS detector).



### 4) Dietary exposure and cancer risk analysis

Dietary exposure analysis of aflatoxin from peanuts for Indonesian and Thai were estimated as the sum of the intake peanuts and its products considered in this study. It is described as the mean daily intake (PDI<sub>M</sub>).

$$PDI_M = \text{Total intake} = \frac{\sum [\text{mean consumption} \times \text{concentration}]}{\text{body weight}} \quad (1)$$

(FAO/WHO, 2005)

The carcinogenic potency of aflatoxin (*P* estimated) and the cancer risk exposure to aflatoxin present in peanut diets were estimated using equation (2) and (3).

$$P_{\text{estimated}} = [\text{PHBsAg} + x \% \text{ population HBsAg} +] + [\text{PHBsAg} - x \% \text{ population HBsAg} -] \quad (2)$$

$$\text{Cancer risk} = P_{\text{estimated}} \times \text{total intake} \quad (3)$$

(JECFA, 1999)

## RESULTS AND DISCUSSION

### 1. Level of aflatoxin contaminations

- Aflatoxins level in raw peanuts and its product from both Indonesia and Thailand has same trend.

- Among three samples, peanut sauce tested has highest aflatoxins level. Peanut sauce in generally made by ground peanuts that mixed with chili, brown sugar, and other spices. Aflatoxin can easily penetrated into ground form of peanut. The processing stage such as after grinding allowed fungi to grow and produced these toxin.

Table 1. Total aflatoxins level and AFB<sub>1</sub> from peanut sources in Indonesia and Thailand

Sampling sites	Aflatoxins	Aflatoxins level (ng·g <sup>-1</sup> )		
		Raw peanuts	Peanut products	
			Cooked peanuts	Peanut sauce
Indonesia (67)	Total (B <sub>1</sub> +B <sub>2</sub> +G <sub>1</sub> +G <sub>2</sub> )	0.86±0.22 <sup>a</sup>	0.31±0.09	4.87±0.71
	AFB <sub>1</sub>	0.75±0.21	<LOQ	4.09±0.71
Thailand (32)	Total (B <sub>1</sub> +B <sub>2</sub> +G <sub>1</sub> +G <sub>2</sub> )	1.49±0.86	1.42±0.34	2.68±0.89
	AFB <sub>1</sub>	1.44±0.83	1.35±0.32	2.61±0.91

a. Value expressed as Mean±SE

b. In the parenthesis is expressed as total samples

Table 2. The probable daily intake (PDI<sub>M</sub>) of total aflatoxin and AFB<sub>1</sub> from peanuts and cancer risk estimation

Sampling sites	Aflatoxin	Mean consumption (ng·g <sup>-1</sup> ) <sup>a</sup>	PDI <sub>M</sub> (ng·kg <sup>-1</sup> b.w. day <sup>-1</sup> ) <sup>b</sup>	Cancer risk (cancers cases/100,000 person/year) <sup>c</sup>
Indonesia	Total (B <sub>1</sub> +B <sub>2</sub> +G <sub>1</sub> +G <sub>2</sub> )	2.59	0.93	-
	AFB <sub>1</sub>	2.17	0.78	0.030
Thailand	Total (B <sub>1</sub> +B <sub>2</sub> +G <sub>1</sub> +G <sub>2</sub> )	1.60	0.59	-
	AFB <sub>1</sub>	1.57	0.57	0.019

a. Value expressed based on raw peanut and its products

b. Value expressed based on dietary consumption of peanuts: 18g/person/day (GEMS/WHO, 2006)

c. Value expressed based on data from National Agency of Drug and Food Control of Indonesia (BPOM, 2010) and FDA Thailand (2006).

### 2. Probable mean daily intake (PDI<sub>M</sub>) and cancer risk estimation

- Indonesia and Thailand has higher PDI<sub>M</sub> when compared to the country that has lower incidence of total aflatoxins such as European Union (0.47 ng kg b.w. day<sup>-1</sup>) and US (0.26 ng kg b.w. day<sup>-1</sup>) (WHO, 1999).

- Based on the mean dietary exposure level to AFB<sub>1</sub>, cancer risk was estimated at 0.030 cases/100,000 person/year for Indonesian and 0.019 cases/100,000 person/year for Thai. These cancer cases both Indonesia and Thailand lower than China (0.042 cancer cases/100,000 person/year) (Zhao et al. 2013).

## CONCLUSION

Peanut sauce products has the highest aflatoxin levels compared to the raw peanuts and cooked peanuts. Its could established more than two fold higher than the raw peanuts due to processing stages. Aflatoxin levels in each group samples found in both Indonesia and Thailand has same trend. Indonesia and Thailand has higher probable mean daily intake of aflatoxins when compared to other countries that has lower incidence. It will effects in liver cancer risk in both population for long term exposure. A broad study on a number of peanut samples and other food products from this area should be carried out to provide additional information and to confirm the health risk

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