Hygiene Practices in Minimizing Aflatoxins Contamination in Peanut-Based Products: Manufacturers'Perspective

Nur Nazurah Mohd Azaman[*1], Nitty Hirawaty Kamarulzaman[*2], Mad Nasir Shamsudin[*3] S. Jinap[#4]

[*]*Department of Agribusiness and Information Systems, Faculty of Agriculture*
[#]*Food Safety Research Centre (FOSREC), Faculty of Food Science and Technology*
Universiti Putra Malaysia 43400, UPM Serdang, Selangor, MALAYSIA
[1]zura_azaman@yahoo.com
[2]Corresponding author: nitty@upm.edu.my
[3]mns@upm.edu.my
[4]jinap@upm.edu.my

***Abstract*— Aflatoxins are naturally mycotoxins occurring found in human foods and animal feeds and found to be highly carcinogenic in many experimental studies. Aflatoxins contamination can cause by improper storage condition or pest infestation that favorable to growth of *Aspergillus* fungi. With certain preventive practices along the length of groundnut or peanut-based products chain can help to reduce the risks of aflatoxins contamination. Thus, this study aimed to determine the food safety and hygiene practices in minimizing aflatoxins among peanut-based products manufacturers. Face-to-face interviews were carried out using a semi-structured questionnaire with 44 respondents representing by peanut-based products manufacturers in the Peninsular Malaysia. The results from logistic regression analysis revealed that knowledge (p=0.081), attitude (p=0.055), and employee training (p=0.099) have a significant positive relationship between high level of hygiene practices and food safety among manufacturers. This study showed that most of food industry managers have higher knowledge about aflatoxins contamination. It is recommended that the managers provide relevant training and health education programs for their food handlers or workers to improve their knowledge, attitude, and practices towards aflatoxins in peanut-based products. The outcomes of this study are important to those who need further information on the extent to which stakeholders have implemented food safety activities in their organizations as well as their efforts in improving food production in Malaysia.**

***Keywords*—** *Food hygiene, food safety, practices, aflatoxins, peanut-based products, manufacturers*

1. Introduction

Currently, mycotoxins represented a major food safety issue. There are five broad groups of mycotoxins namely aflatoxins, fumonisin, ochratoxin A, vomitoxin, and zearalenone. These groups are known and suspected to have effects on human and animal health as well [1], [2] and subject to sanitary and phytosanitary (SPS) or other regulatory measures in many countries. Consuming grains or other food contaminated with certain mycotoxins can be fatal if the toxins are existent at very high levels. Long-term exposure to mycotoxins can increase cancer risk and suppress the immune system among other health problems. Mycotoxins are produced by certain fungi (*Aspergillus* ssp., *Penicillum* ssp., and *Fusarium* ssp.) that commonly grow on human food and animal feed ingredients such as corn, sorghum, peanuts, wheat, barley, and other legumes and oilseeds, which is suspected to have some effects on human health. It is widely recognized that over 300 fungal secondary metabolites are known to exist. These mycotoxins are commonly found in human food and animal feed. Besides, mycotoxins are a teratogen and a potent mutagen, which has presented health risks to both human and animal populations, and consequent to the national economic implications [3].

Among the major group of mycotoxins, aflatoxins are most widely recognized risk [2] (Jarvis & Miller, 2005) and represent the main threat worldwide due to their occurrence and toxicity. Aflatoxins are the most potent carcinogenic and mutagenic substances in human and animal population [4], [5]. Aflatoxins also known as an immunotoxic potential in many species including laboratory and domestic animals as well as interfere with the human immune system [6]. Aflatoxins are produced by the common fungi namely *Aspergillus flavus* and *Aspergillus paraciticus* [7], [8] and have been classified as

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Group 1 carcinogen by the International Agency of Research on Cancer [9]. In addition, these fungi are usually present in soil and plant material, cause decay of stored grain and food. Aflatoxins are associated with the Hepatocelullar carcinoma (HCC) or called as liver cancer, which is the third leading cause of cancer deaths that commonly significance in Africa, Philippines, and China. The first incidence came into the public spotlight and were formally identified in the early 1960s following the deaths of more than 100,000 young turkeys on a poultry farm in England, which called as a Turkey X disease, where the high level of peanut meal imported from Brazil as a feed ingredient [10], [11]. Other than that, aflatoxins may increase level of stress susceptibility and compromise growth efficiency. The clinical signs of aflatoxicosis include depression, nervousness, abdominal pain, diarrhea, and death [12]. According to [13], 40% of the productivity lost due to disease by aflatoxins in developing countries. Unfortunately, many of people in the region are not aware regarding to the danger of consuming mouldy peanuts. These happened due to the poor education levels and other socio-economics factors. Even though relevant steps are taken to make food products safe, the consumers will be unwilling to pay the extra costs and that they will still prefer to buy commodities at low prices. Furthermore, [14] suggested that studies relating to aflatoxins exposure remain important aspects of food safety that needs to be addressed. In the light of the above scenario, this study was carried out to determine the food hygiene practices and food safety towards aflatoxins contamination among peanut-based products manufacturers in Malaysia.

The incidence of food-borne disease is increasing globally, including both developed and developing countries [15], [16]. The number of food poisoning outbreaks increased and food related scares have led for better quality and hygiene practices. [17] indicated that the food-borne illness commonly related to improper storage or reheating (50%), food stored inappropriately (45%), and cross contamination (39%). These factors are caused by lack of food hygiene awareness or implementation. The UK Audit Commission found a strong relationship between premises with poor practices and low levels of training [18]. Furthermore, the significance of different food contaminant to human health varies depending on whether acute or chronic effects. Microbiological contamination and consequent food poisoning rank as the primary concerns in all societies. Based on risk assessment consideration, [19] revealed that for acute hazards, mycotoxins might be ranked below phycotoxins (toxins produced by algae), but above food additives and pesticide residues.

2. Literature Review

2.1 Aflatoxins Contamination in Food-based Products

Aflatoxins occur naturally in most agricultural commodities such as corn, peanut, and soybean, which are consumed by human and animal. Aflatoxins B_1 that occur naturally are significant contaminants of a wide variety of foods and feeds. Spores of *Aspergillus flavus* are common in air and water and also in hot and humid conditions that favorable for aflatoxins production if environmental conditions and the constitution of the food are suitable. Besides, the two major factors that cause the occurrence of mycotoxins at pre-harvest and post-harvest stages that are high temperature and moisture content [7]. There have study from [20] found aflatoxins B_1 and B_2 have been detected at level ranging from 0.2 to 101.8 ppb in 5 over 9 of their peanuts samples and 5 out of 9 corn based products. This proved that, the permitted level of aflatoxins have been exceeded maximum tolerable limits set by the Malaysian Standard. Furthermore, Malaysia has established an action level for total aflatoxins since toxins have been considered as unavoidable contaminants in food chain. Under Food Regulations 1985 [21] and Health Science Authority [22], Malaysia also has established the maximum permitted level of total aflatoxins in groundnuts and other foods, which are at 15 parts per billion (ppb) and 5ppb respectively.

2.2 Food Hygiene Practices and Food Safety

Food is an important necessity and essential for sustaining standard of living. In the recent decade, consumers are increasingly concerned with food quality and food safety that they consumed. Nurturing and maintaining consumers trust in food quality and safety necessitate the role of a quality assurance department in the food sector. By adopting food hygiene practices by producers to consumers, most of the food-borne illnesses can be prevented. Food handlers play an important role in ensuring food safety throughout food chain starting from the production, processing, storage, and preparation for consumption [23]. About 10% to 20% of food-borne disease outbreaks are due to contamination from food handlers. The mishandling from food handlers enables pathogens or fungi to come and contaminate the food [24]. Therefore, food handlers should ensure that production, processing, and distribution of food still under their control comply with hygiene practices and Good Hygiene Practices (GHP) regulations in order to minimize the level of pathogens or toxins in food. [25] explained that hygiene practices are related to the requirements of the Food Act 1983 and Food Regulations 2009. Food handlers or food operators need to take into consideration in terms of

prevention measures such as the application of Good Manufacturing Practices (GMP) and Good Hygiene Practices (GHP), Hazard Analysis Critical Control Point (HACCP), the International Organization for Standardization (ISO) method 9001, and Total Quality Management (TQM) [26]. Moreover, the key factors in the transmission of food-borne diseases are the personal hygiene and environmental sanitation. The investigations from [27] and [28] of food-borne disease outbreaks revealed an upward trend that are caused by the failure to observe satisfactory standards in the preparation, processing, cooking, storing or retailing of the food. Research suggested that highlighting preventative food safety can contribute to significant impact towards the outbreaks [29]. Thus, the managers should recognize that food handlers need formal and effective ongoing training to ensure greater consistency in food handlings and producing high quality of peanuts products [30].

3. Methodology

Stratified random sampling was used to obtain responses from a total of 44 manufacturers located in Peninsular Malaysia. The details of manufacturers were obtained from the Ministry of Health Malaysia (MOH) database. Face-to-face interviews were carried out with the manufacturers using a structured questionnaire. The questionnaire consisted of two parts, wherein the questions in the first part were established to obtain information on company's profiles. In the second part, the statements related to knowledge, attitude, and hygiene practices and food safety of aflatoxins contamination were established. Data were analyzed using descriptive analysis in order to get better understanding of demographic characteristics among the peanut-based manufacturers. The mean ranking analysis on 3-point Likert Scale statements was carried out to identify the knowledge, attitude, and hygiene practices and food safety towards aflatoxins contamination in peanut-based products. Meanwhile, the logistic regression analysis was used to estimate the outcome of the categorical dependent variable (usually dichotomous) from the independent variables. It was used to analyze the logit model for manufacturers' level of hygiene practices. The equation for prediction of outcome Eq. (1) was established as follows: -

$$\text{Log}\left(\frac{\pi}{1-\pi}\right) = \alpha + \beta_1 x_{knowledge} + \beta_2 x_{attitude} + \beta_3 x_{quality\ assurance} + \beta_4 x_{sop\ guideline} + \beta_5 x_{employee\ training} + \varepsilon_i \quad (1)$$

Table 1. Coding for Variables to Measure Level of Manufacturers' Hygiene Practices of Aflatoxins Contamination in Peanut-Based Products

Variables		Coding System
Dependent Variable	Hygiene practices	0 = low practice, 1 = high practice
Independent Variable	Knowledge	0 = inadequate, 1 = adequate
	Attitude	0 = less favorable, 1 = favorable
	Quality assurance	0 = no, 1 = yes
	SOP guideline	0 = not apply, 1 = apply
	Employee training	0 = not attend, 1= attend

Table 1 shows the coding used for variables to measure the level of manufacturers' hygiene practices towards aflatoxins contamination in peanut-based products using logistic regression analysis. The dependent variable was level of hygiene practices, which it had two categories namely '1 = high practice' which was coded as one (1) and otherwise, which was coded as zero (0). The independent variables comprised five (5) variables namely quality assurance certification, SOP guideline, employee training, knowledge, and attitude

4. Result and Discussion

4.1 Profiles of Company

Table 2 shows the profiles of 44 manufacturers who had participated in this study that located in the four regions in the Peninsular Malaysia. About 16 companies located in the Northern region (36.4%), followed by 10 companies in the Central region (22.7%), 16 companies in the Southern region (36.4%), and the East coast region had two (2) companies that accounted for 4.5%. In terms of the establishment of peanut-based company, the result revealed that six (6) companies had established their business less than 10 years (13.6%), followed by 30 companies had established their business for 11 to 30 years (68.2%), and eight (8) companies had established their business for more than 40 years which accounted for 18.2%. Most of the companies had number of workers less than 20 peoples, with 24 companies (54.5%), followed by 16 companies (36.4%) that had number of workers within 21 to 100 peoples, and four (4) companies accounted for 9.1% that had more than 100 workers at their company. Furthermore, the result showed that 26 companies had marketed their products in both markets, local and international markets. The results also showed that most of the managers interviewed were held a position of

quality control manager (5), which accounted for 25%. About 29 companies (65.9%) had quality assurance certificate for their company such as HALAL and HACCP, whereas the remaining 34.1% manufacturers did not have any certification of quality assurance. Majority of the companies (23) had Standard of Procedure (SOP) qualification that accounted for 52.3%. About 81.8% of the companies (36) had managed suitable and proper training for their employee particularly about food hygiene and personal sanitation. aflatoxins contamination in groundnut.

Table 2. Profiles of company

Variables		Frequency (n)	Percentage (%)
Region	Northern region	16	36.4
	Central region	10	22.7
	Southern region	16	36.4
	East coast region	2	4.5
Year of establishment (year)	≤ 10	6	13.6
	11 – 20	12	27.3
	21 – 30	12	27.3
	31 – 40	6	13.6
	> 40	8	18.2
Number of workers	≤ 20	24	54.5
	21 – 40	8	18.2
	41 – 60	2	4.5
	61 – 80	4	9.1
	81 – 100	2	4.5
	>100	4	9.1
Product's market	Local	16	36.4
	International	2	4.5
	Both	26	59.1
Position	General manager	6	13.6
	Production manager	8	18.2
	Executive	8	18.2
	Quality assurance manager	4	9.09
	Quality control manager	10	22.7
	Supervisor	8	18.2
Quality assurance certification	Yes	29	65.9
	No	15	34.1
SOP qualification guideline	Yes	23	52.3
	No	21	47.7
Employee training	Yes	36	81.8
	No	8	18.2

Note: n = 44

4.2 Food Safety Knowledge, Attitude and Hygiene Practices towards Aflatoxins Contamination in Peanut-based Products

The results in Table 3 revealed mean scores of the seven statements related to the food safety knowledge of aflatoxins contamination. Majority of the manufacturers (81.8%) had general knowledge about aflatoxins contamination in which the statement on "*do you know that intake of groundnuts with aflatoxins have adverse health implications?*" revealed the highest mean score of 2.80. About 79.5% of the respondents responded to the statement on "*the storage of processed peanuts should be cleaned, dried, weatherproof, free from infestation, and sealed to prevent water, rodents or insects from reaching peanuts*", in which the mean score accounted for 2.77. Meanwhile, the lowest mean score (2.45) of the knowledge of aflatoxins contamination indicated that about 56.8% of the respondents responded to the statement on "*do you know that groundnut with mould has been contaminated with aflatoxins?*". The overall mean score of 2.695 as revealed in Table 3 showed that most of the manufacturers had general knowledge about food safety towards aflatoxins contamination in peanut-based products. Another study from [31] found that about 67.8% of farmers in Gujarat, India were in medium category towards knowledge of aflatoxins management practices in

groundnut. While, [32] found that 80.6% among health workers in Ibadan, Nigeria had good knowledge regarding aflatoxins contamination in groundnut.

Table 3. Food Safety Knowledge towards Aflatoxins Contamination

Statement	Responses % (n)			Mean	SD
	1*	2*	3*		
1. Do you know that intake of groundnuts with aflatoxins have adverse health implications?	2.3 (1)	15.9 (7)	81.8 (36)	2.80	0.462
2. The storage of processed peanuts should be cleaned, dried, weatherproof, free from infestation, and sealed to prevent water, rodents or insects from reaching peanuts.	2.3 (1)	18.2 (8)	79.5 (35)	2.77	0.476
3. The warehouse should be checked frequently for leaks or infestation before and after filling the peanuts for storage.	4.5 (2)	13.6 (6)	81.8 (36)	2.77	0.522
4. Have you heard about aflatoxins?	6.8 (3)	13.6 (6)	79.5 (35)	2.73	0.585
5. Poor storage conditions will promote the presence of aflatoxins in foods.	6.8 (3)	18.2 (8)	75.0 (33)	2.68	0.601
6. Do you know that peanuts should be free from abnormal flavours, odours, living insects, and mites?	9.1 (4)	15.9 (7)	75.0 (33)	2.66	0.645
7. Do you know that groundnut with mould has been contaminated with aflatoxins?	11.4 (5)	31.8 (14)	56.8 (25)	2.45	0.697
Overall Mean Score (n=44)				**2.695**	**0.408**

*Note: *1= do not know, 2=not sure, and 3=know*

Table 4 shows the results of the five statements related to the food safety attitude of aflatoxins contamination. Majority of the manufacturers (50.0%) strongly agreed to the statement on "*I believe peanuts that have been processed should be stored in clean, dry, weatherproof, free from infestation, and sealed to prevent water, rodents or insects*" which contributed to the highest mean score of 4.41. The second highest response responded by 45.5% of the manufacturers to the statement on "*I believe that peanuts that have been processed should be transported in a proper manner to protect from damage or dampness*", where the mean score was 4.36. While the lowest mean score on food safety attitude towards aflatoxins contamination was 4.05, in which about 40.9% of the manufacturers agreed to the statement on "*I believe testing by appropriate methods of sampling and examination can prevent a hazard to health*". Hence, from the survey conducted, the results revealed that attitude of the manufacturers were favorable with the overall mean score was 4.254. Based on past studies from [33] found that knowledge and attitude were influenced and associated the behavioural actions. If people perceive the problems, there will become more aware of that particular risk. After that, they will seek the related knowledge and information to develop an attitude that will foster proper action to minimize the effects of aflatoxins contamination.

Table 4. Food Safety Attitude towards Aflatoxins Contamination

Statement	Responses % (n)					Mean	SD
	1*	2*	3*	4*	5*		
1. I believe peanuts that have been processed should be stored in clean, dry, weatherproof, free from infestation, and sealed to prevent water, rodents or insects.	0.0 (0)	0.0 (0)	9.1 (4)	40.9 (18)	50.0 (22)	4.41	0.658
2. I believe that peanuts that have been processed should be transported in a proper manner to protect from damage or dampness.	0.0 (0)	0.0 (0)	9.1 (4)	45.5 (20)	45.5 (20)	4.36	0.650
3. I believe that labeling is important to inform the consumers of the properties of prepackaged food.	0.0 (0)	0.0 (0)	13.6 (6)	43.2 (19)	43.2 (19)	4.30	0.701
4. I think that defective kernels should be bagged separately and tagged as unsuitable for human consumption.	0.0 (0)	4.5 (2)	13.6 (6)	43.2 (19)	38.6 (17)	4.16	0.834
5. I believe that testing by appropriate methods of sampling and examination can prevent a hazard to health.	4.5 (2)	0.0 (0)	18.2 (8)	40.9 (18)	36.4 (16)	4.05	0.987
Overall Mean Score (n=44)						**4.254**	**0.671**

*Note: *1= strongly disagree, 2=disagree, 3=neutral, 4=agree, and 5=strongly agree*

Table 5 shows the twelve statements related to the food safety and hygiene practices of aflatoxins contamination. Majority of the manufacturers (95.5%) indicated that it is compulsory for the workers to cover their hair when

working in the operation unit to avoid contamination particularly aflatoxins in which contributed to the highest mean score of 2.95. About 90.9% of the manufacturers ensured their workers to wash hands with soap and water before and after working and majority of them (95.5%) cleaned utensils and equipment after working, in which accounted for mean scores of 2.91 respectively. While the lowest mean score was 2.30 with 27.3% of the manufacturers responded that they never followed the Good Hygiene Practices (GHP) to minimize the spread of aflatoxins contamination in their premises. As a result, the overall mean score from this study was 2.744, indicating that most of the manufacturers followed food safety and hygiene practices towards aflatoxins contamination in peanut-based products. According to the [34], adoption through good agriculture practices, good sanitation practices, good hygiene practices, and safe food handling practices particularly when handling, processing, preparing, storing, and transporting the products. Besides, there have another study from [35] indicated that aflatoxins levels were significantly correlated ($p<0.01$) with the processing practices, storage facilities, and storage duration. Thus, knowledge related food safety and all good practices can guide and help food handlers to emphasize the hygiene and sanitation in every stage involved is important to avoid from aflatoxins contamination into the products.

Table 5. Food Safety Knowledge and Hygiene Practices towards Aflatoxins Contamination

Statement	Responses % (n)			Mean	SD
	1*	2*	3*		
1. Hair covered.	0.0 (0)	4.5 (2)	95.5 (42)	2.95	0.211
2. Wash hands with soap and water.	0.0 (0)	9.1 (4)	90.9 (40)	2.91	0.291
3. Clean utensils and equipment after working.	0.0 (0)	4.5 (2)	95.5 (42)	2.91	0.421
4. Implement personal hygiene and sanitation to avoid aflatoxins contamination.	4.5 (2)	4.5 (2)	90.9 (40)	2.86	0.462
5. Check quality before receiving.	4.5 (2)	4.5 (2)	90.9 (40)	2.86	0.462
6. Select quality peanuts for processing.	4.5 (2)	9.1 (4)	86.4 (38)	2.82	0.495
7. Had aprons.	9.1 (4)	0.0 (0)	90.9 (40)	2.82	0.582
8. Follow the process controls in every stage of operation unit.	9.1 (4)	4.5 (2)	86.4 (38)	2.77	0.605
9. Avoid entering the working place when not working.	9.1 (4)	9.1 (4)	81.8 (36)	2.73	0.624
10. Regularly disinfect the premises.	13.6 (6)	9.1 (4)	77.3 (34)	2.64	0.718
11. Check the storage temperature.	27.3 (12)	9.1 (4)	63.6 (28)	2.36	0.892
12. Follow the Good Hygiene Practices (GHP) to minimize the spread of aflatoxins contamination.	22.7 (10)	25.0 (11)	52.3 (23)	2.30	0.823
Overall Mean Score (n=44)				**2.744**	**0.288**

*Note: *1= never, 2=seldom, and 3=always*

4.3 Logit Model for Level of Hygiene Practices and Food Safety towards Aflatoxins Contamination

The logistic regression analysis was used to predict the extent to which manufacturers' level of hygiene practices and food safety towards aflatoxins contamination. This analysis was used to identify the most influential factors that influenced the level of hygiene practices and food safety towards aflatoxins contamination.

Table 6. Level of Hygiene Practices and Food Safety towards Aflatoxins Contamination in Peanut-Based Products

Variables	Estimated Coefficients	Standard Error	Wald	Significance	Exponential (B)
Knowledge	1.910	1.093	3.053	0.081*	6.752
Attitude	1.377	0.717	3.684	0.055*	3.961
Quality assurance	1.643	1.038	2.503	0.114	5.170
SOP guideline	0.408	0.943	0.187	0.666	1.503
Employee training	1.787	1.084	2.715	0.099*	5.970
Constant	-12.449	4.912	6.422	0.011	0.000
-2 Log Likelihood	38.589		Nagelkerke R^2		0.437
Cox and Snell R^2	0.312		*Hosmer* and *Lemeshow* goodness of fit test		0.200

*Note: * significant at 10% level of significance*

From Table 6, the estimate equation model Eq. (2) was given as follows: -

$$\text{Level of hygiene practices} = -12.449 + 1.910 \times (\text{knowledge}) + 1.377 \times (\text{attitude}) + 1.643 \times (\text{quality assurance}) + 0.401 \times (\text{SOP guideline}) + 1.787 \times (\text{employee training}) \quad (2)$$

Based on Table 6, there were five variables that influenced the level of hygiene practices and food safety towards aflatoxins contamination namely knowledge, attitude, quality assurance, SOP guideline, and employee training. The Hosmer and Lemeshow Test indicate the goodness of fit of a model. The Hosmer and Lemeshow test value should be insignificant, which it indicates a good fit. In this study, insignificant at 0.050 implied a good matchup predicted and observed probabilities. Table 6 also shows -2 Log Likehood statistics value and this test was carried out to measure how poorly the model predicts the decision. The smaller the statistics value showed the better model [36]. Thus, the final model of -2 Log Likehood value was 38.589. Table 6 also indicates the Cox & Snell R^2 and the Nagelkerke R^2 values. These two tests value were 0.312 and 0.437 respectively and showed that between 31.2% and 43.7% of the variability was explained by this set of variables. Three variables namely knowledge, attitude, and employee training were found significant at 10% level of significance. The exponential (B) value is an equation to calculate the probability of a case falling into a specific category that showed in the last column [37]. The direction of relationship within factors that increase or decrease the likelihood of answer 'yes' could be inferred from the positive or negative sign of values at second column of Table 6.

The positive relationship of estimated coefficient was *knowledge*. The high level of hygiene practices and food safety of manufacturers who had adequate knowledge was 6.752 times more than those who had inadequate knowledge. *Attitude* variable also revealed a positive relationship with hygiene practices and food safety, indicating that manufacturers who had favorable attitudes towards hygiene practices and food safety were 3.961 times greater than those who had less favorable attitudes. The findings supported that knowledge and attitude were crucial factors that influenced the food safety and hygiene practices, and consequently decrease the occurrence of foodborne diseases. [33] indicated that knowledge and attitude were associated and influenced by behavioral action. The food hygiene practices help food handlers to gain knowledge by certified food hygiene training programs that are designed using Knowledge, Attitude and Practice (KAP) model [38], [39]. On the other hand, the observation by [40] indicated that good knowledge on hygiene and food safety does not necessarily lead to be good in handling practices.

Meanwhile, the estimated coefficient for *training* showed a positive relationship. It indicated that the level of hygiene practices and food safety of manufacturers who carried out staff training for their employee was 5.970 times greater than those manufacturers who were not. [41] stated that the development of food safety education and training were the key components in the process of ensuring the food handlers are proficient and knowledgeable regarding food safety and personal sanitation. The proper training allowed the food handlers or employees to develop relevant knowledge so that they can make informed decisions about food safety [42] and at the same time the implementation of relevant precautions to prevent contamination of food is also necessary [43].

There are findings from relevant studies showed that food handlers lacked of knowledge about sanitation and hygiene practices due to the main reason that they did not attend food hygiene training programs [44]. As further discussed by [45] that the FOODSAFE trained food handlers in British Columbia, Canada were better in hand washing practices and attitudes compared with the untrained food handlers group. Furthermore, [46] found that 50% of food handlers had attended formal food hygiene training, but only 36% of them had mechanism for updating their hygiene knowledge. It is possible that the lack of continuous training contributed to the lack of food hygiene knowledge particularly about aspects on safe food production. According to the [43] the major cause of foodborne diseases and cross-contamination because of improper in food handling and poor in personal sanitation, which are important risk factors in the occurrence of aflatoxins contamination.

5. Conclusion

This study is carried out with the purpose to understand manufacturers' knowledge, attitude, food safety, and hygiene practices towards aflatoxins contamination. Based on the findings, the elements such as knowledge level, training, and attitude of managers are found important in implementing good hygiene practices and food safety in the organization. These elements should be highly considered by the manufacturers in improving and reducing aflatoxins contamination along peanuts-based products supply chains. Furthermore, it is important to note that food industry managers and food handlers need to increase their knowledge level and have a favorable attitude prior to the food safety and hygiene practices. This is to ensure an improvement of business operations can be continuously carried out and more importantly, the competitive advantage and survival rate of the food-based companies could also be increased. Thus, in achieving those goals, a proper food safety and personal hygiene training is deemed necessary to food handlers, and this

could not be achieved without a strong support from the management.

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