Factors Influencing Market Participants Decision to Sort Groundnuts along the Marketing Chain in Ghana

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ABSTRACT

Peanut (*Arachis hypogaea* L.) is an important source of protein and fat in Ghana and other developing countries. However, peanut is often contaminated with aflatoxin because of poor storage conditions. One possible approach to minimizing human consumption of aflatoxin is to sort and remove contaminated nuts at various stages of marketing. Logistic regression models were used to investigate factors influencing market participants' decision to sort peanut before processing and consumption. Results show that farmers' decision to sort peanut before consumption was influenced by gender, education, age, number of dependents assisting, knowledge of health problems associated with consuming aflatoxin contaminated peanut, total revenue per hectare of peanut, and the form in which the peanut is consumed. Livestock owners' decision to sort before consumption was influenced by education and the form in which the peanut is consumed. The level of education of consumers, and the form in which the peanut is consumed influenced consumers' decision to sort peanut. Farmers' decision to sort peanut before processing into paste was influenced by the number of dependents assisting in household labor activities, the revenue from peanut and the form in which the peanut is consumed. The form in which the peanut is consumed and knowledge of the health effects of aflatoxin influenced livestock owner's, retailer's, and consumer's decision to sort peanut before processing into paste. Processors' decision to sort before conversion into paste was influenced by education, knowledge of the reasons for sorting and the form in which peanut is consumed.

Key Words: Peanut, sorting, market, participants, logistic models.

Peanut (*Arachis hypogaea* L.) is an important component of diets in developing countries, including Ghana. Peanut provides high-quality cooking oil, and is a critical source of protein for both humans and livestock. Peanut also provides foreign exchange through the export of kernels and peanut oil cake. With market demand of peanut expected to increase due to growing population and urbanization, African countries have the potential of increasing peanut output and consumption, and possibly export to neighboring countries (FAO, 2002).

A major constraint to peanut production and export is aflatoxin contamination (Otsuki *et al.*, 2001). Aflatoxins are metabolites produced mainly by *Aspergillus flavus* and *A. parasiticus* (CAST, 2003). Aflatoxin is among the most toxic mycotoxins in nature and is a major hazard to human and animal health. Aflatoxin causes hepatocellular carcinoma, one of the most common cancers in tropical countries (Enomoto and Saito, 1972; Oyelami *et al.*, 1997; Ibeh *et al.*, 1994; Waliyar, 2002). Studies in Africa (Njapu *et al*, 1998; Lötter and Kröhm, 1988; Munimbazi and Bullerman, 1996) have reported high frequencies of liver cancer compared with Western countries. Presence of aflatoxin in peanut and peanut-based products contribute to cancer and other health problems (Groopman *et al*, 1996; Wogan, 1992). High temperature and humidity common to tropical regions contribute to elevated levels of aflatoxin (Basu, 2002).

Programs have been implemented to educate producers, processors and consumers of peanuts on proper handling and storage to minimize aflatoxin contamination in peanut. Proper post-harvest and storage practices can greatly reduce aflatoxin contamination (Riley and Norred, 1999). Adequate drying of peanut after harvest to reduce moisture levels to below 12%; removing broken and discolored kernels; storage in a dry clean area, and storage on pallets to allow air to circulate through the peanut to reduce aflatoxin development and subsequent contamination, may be effective to reduce it to an acceptable level. Pre- or post-harvest prevention of fungal contamination and proliferation is the preferred strategy for minimizing aflatoxin in peanut (Riley and Norred, 1999).

A number of methods have been suggested for the reduction of aflatoxin in peanut. Among them are heat, mechanical, electronic and hand picking, chemical, density and flotation techniques, and manual sorting. Heat treatment is not a useful method for the reduction of aflatoxin because the temperature required to destroy aflatoxin is 270°C which may reduce peanut quality (AOC International, 1995; Galvez *et al.*, 2003). Chlorinating agents

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(hydrogen hypochlorite, gaseous chlorine), oxidizing agents (hydrogen peroxide, ozone, sodium bisulfite), and/or hydrochloric agents (acids, alkalis, ammonia) (Galvez *et al.*, 2003) can be used to partially destroy aflatoxin. However, these materials may not be available and are difficult to apply under on-farm conditions. Electronic color sorting and hand picking are widely used to separate aflatoxin contaminated kernels from sound kernels. Electronic color sorting is only 72% efficient while hand picking, although more selective, is impractical for large quantities of peanut (Dickens and Whitaker, 1975). Density based separation schemes are theoretically feasible, but the loss of kernels with such methods is high and the level of efficiency achieved with this method is highly variable (Gnanasekharan and Chinnan 1989; Henderson *et al.*, 1989).

A major problem in subsistence level economies, like Ghana, is that a large portion of the food produced is consumed with little or no processing outside the home. Therefore, given the nature of aflatoxin, the efficiency of the methods used to reduce it and the associated costs of the aflatoxin reduction techniques, it is recommended that individuals, producers, marketers, and consumers in the marketing chain increase their awareness of the hazards associated with the consumption of aflatoxin contaminated peanut, and use individual, hygienic and manual techniques of sorting before consumption to reduce the levels of aflatoxin-ingested peanut.

To attain a given level of sorting by consumers of peanut, it is imperative to understand the factors influencing market participants' decision to sort peanut. The main objective of this study is to determine the level of awareness of the aflatoxin problem among various stakeholders in the peanut industry in Ghana, and to determine the factors influencing market participants to sort their peanut before consumption or converting into paste.

Materials and Methods

A survey instrument with questions on peanut production systems, consumption patterns, market participants' awareness of mycotoxins and health effects of aflatoxin was administered to respondents in three broad zones in Ghana. Socioeconomic and demographic data on household characteristics were also collected.

The Northern, Upper East and Upper West Regions made up of Bawku East, Bawku West, Lawra, Savelugu-Nanton, Tamale and West Mamprusi Districts constituted the Northern Zone and considered to be the high production zone. The Middle Zone (medium production zone) comprised of Brong Ahafo and Ashanti Regions with the following districts: Techiman, Wenchi, Ejisu-Juaben, Ejura-Sekyedumase, Ahafo Ano South, Kumasi Metropolitan Area and Atwima Districts. The Eastern Region, Greater Accra Region, Central, and Volta Regions with the following districts constituted the Southern Zone: Koforidua, Kwahu South, Tema, Dangbe West, Accra Metropolitan Area, Abora Asebu, Mfantsiman, Awutu Efutu-Senya, Nkwanta, Ho, Hohoe, Kpando, Adidome, Ketu, Sogakope and Akatsi Districts. The Southern Zone was considered the low production zone.

The respondents included the various stakeholders involved in the peanut industry in Ghana and included peanut farmers, processors, feed millers, poultry farmers (live stockers), retailers, and consumers. Almost all members of the sample produce peanut, but the participants interviewed declared whether they were producers, processors, millers, or consumers. We interviewed 332 farmers, 727 consumers, 372 retailers, 400 processors, 18 millers and 135 poultry farmers between the months of March to September 2001.

The survey data were analyzed using Statistical Package for Social Scientist (SPSS) software and Statistical Analysis System Software (SAS Institute, Cary, NC). Both national and zonal analyses were conducted. The national analysis was performed on all six categories of stakeholders that are farmers, processors, feed millers, poultry farmers, retailers and consumers. In the zonal analysis, data from only farmers, processors, retailers and consumers were included. Poultry farmers and feed millers were not incorporated because they were not encountered in the northern zone.

The analysis was in two parts, (1) the overall national analysis over the various categories of stakeholders and (2) the restricted zonal analysis over the same categories of stakeholders. Analytical tools included: (a) descriptive statistics, including both qualitative and quantitative analyses and (b) logistic regression analysis.

Factors Influencing Sorting

While the parameter estimates from the maximum–likelihood analysis only indicate direction of influence on probability, the actual probabilities are provided by the magnitude of the marginal effects (Madala 1987; Armah and Kennedy 2000). Under the multinomial logit model, if there are n categories, the probability that a decision maker is in a particular category, P_j, is given by:

$$P_j = \frac{\exp(\beta_j' \chi)}{\sum_{j=1}^{n} \exp(\beta_j' \chi)} \quad j = 1 \ldots n \qquad (1)$$

Table 1. Variables used to estimate odds ratio that sorting was done before consumption.

Variables	Measurement
Farmers	
Female vs. Male	1=female vs. 2=male
Education Illiterate, Primary vs. Secondary, Tertiary	1=education illiterate, primary vs., 2=secondary, tertiary
Age > 55 vs. Age <= 55	1=age > 55 vs. 2=age <= 55
Num. of dep. assisting on farm > 2 vs. <=2	1=num. of dep. assisting on farm > 2 vs. 2=<=2
Knowledge of health problem assoc. with eating groundnut	1=knowledge of health problem assoc. with eating groundnut, 2=absence of knowledge
Total revenue of peanut per acre > 250, 000 vs. 250,000	1=total revenue of peanut per acre > 250, 000 vs.2= 250,000
Eat fresh boiled	1=eat fresh boiled, 2=other forms
Eat dry shelled boiled	1=eat dry shelled boiled, 2=other forms
Eat peanut shelled fried	1=eat peanut shelled fried, 2=other forms
Livestock	
Education Secondary, Tertiary vs. Illiterate, Primary	1=education secondary, tertiary vs., 2= illiterate, primary
Consume peanut dry-shelled boiled	1=consume peanut dry-shelled boiled, 2=other forms
Consumer	
Education Secondary, Tertiary vs. Illiterate, Primary	1=education Secondary, tertiary vs., 2= illiterate, primary
Consume peanut fresh boiled	1=consume peanut fresh boiled, 2=other form
Do you consume peanut roasted ground fried	1=consume peanut roasted ground fried, 2=other form

One of the vectors of the coefficients β is set to zero for normalization (Wynn *et al.*, 2001). If it is β_1 that is set to zero; then in the case of a binary logistic model we have:

$$\log\left(\frac{P_j}{P_i}\right) = \beta_j' \chi_j = 2 \ldots n \qquad (2)$$

The empirical logistic regression models were developed to determine whether the decision maker did or did not sort peanut along the marketing chain and to investigate the factors affecting sorting of kernels before consumption and conversion into paste. The dependent variable (Y) in this case is a dichotomous variable with a value of 1 for sorting and 2 for non-sorting. The model can be represented as follows:

$$P(Y_i = 1) = F(\beta_i X_i) \qquad (3)$$

where P is the probability of sorting the peanut, F is a cumulative density function, X_i represent a vector of the explanatory variables, and β_i (i =0,….n) are parameter coefficients. The descriptions of the explanatory variables used in the development of the models are seen Tables 1 and 2.

Results

Demographic Characteristics of producers

Eighty-two percent of the respondents were between 20–55 years of age, with 37% being between 36–55, and 18% over 55 years of age (Table 3). The male to female ratio was skewed towards males, with 83% male and only 17% female (data not shown). Most of the households had large numbers of dependents with a little less than a third having between one and five dependents with 43% having between five and ten dependents. A large percent of the respondents (61%) declared that they had no formal education. About 35% received some primary/elementary education. Only 16% of the households had some secondary/technical education, and less than 2.0% had some level of tertiary education. The northern zone was noted to have an illiteracy rate of 7 5%. While the educational gap between the North and the South narrowed, there was a difference between those claiming to have attended secondary and technical schools. Those from the South who claim to attend some form of secondary, technical or tertiary institution averaged about 34% while in the Middle Zone it was only about 11% (Table 3).

Peanut is generally stored unshelled. About 92% of the farmers stated that they stored the peanuts in the unshelled form (data not shown). The most common storage material is the sack, which is used by as many as 74.6% of the farmers (Table 4). Use of barns is not common. Only 12.1% of farmers interviewed used barns for storage.

Of 331 farmers interviewed, (44.7%) sort peanut to some extent before marketing, and (53.3%) do not sort. Most farmers (70.4%) cited reasons other than attraction of customers, receipt of higher market prices and ensuring good quality peanut before selling. Some of the other reasons are removal of chaff, stones, sand particles and rodent feces.

Table 2. Variables used to estimate of odds ratio that sorting was done before converting to paste.

Variables	Measurement
Num. of dep. assisting on farm >2 vs. <= 2	number of dependents 1=less than 2, 2=greater or equal to 2
Total revenue of peanut per acre > 250, 000 vs. 250,000	1= less than 250,0000 cedis per acre and 2=equal or greater than 250,0000
Eat raw	1= eat raw vs., 2=eat other forms
Eat roasted, ground, fried	1= eat roasted vs., 2= other forms
Live stockers	
Consume peanut shelled fried	1= consume peanut shelled fried and 2=other form
Consume peanut as tumkumsa	1= consume peanut as tumkumsa, 2=other
Know of any health problems	1= know of any health problems, 2=other
Processors	
Education Secondary, Tertiary vs. Illiterate, Primary	1= education secondary, tertiary vs.2= Illiterate, primary
Consume peanut dry shelled boiled	1= consume peanut dry shelled boiled, 2=other forms
Do you consume peanut shelled roasted	1= consume peanut shelled roasted, 2=other
Do you consume peanut shelled roasted	1= consume peanut shelled roasted, 2=other
Reason for sorting	1= know reason for sorting, 2=other
Retailers	
Do you consume peanut dry shelled boiled	1= consume peanut dry shelled boiled, 2=other
Consume peanut roasted, ground, fried eg, cubicula	1= consume peanut roasted, ground, fried, e.g. kulikuli, 2=other
Know of any health problems	1= know of any health problems, 2=other
Consumer	
Do you consume peanut dry shelled boiled	1= consume peanut dry shelled boiled, 2=other
Do you consume peanut shelled roasted	1= consume peanut shelled roasted, 2=other
Consume peanut fresh boiled	1= consume peanut fresh boiled, 2=other
Consume when mixed with flour	1= consume when mixed with flour, 2=other
Know of any health problems	1= know of any health problems, 2=other

Between 50 and 67.7% (average 57.9%) of respondents thoroughly sort the nuts before grinding them into paste. The highest response was from the farmers (67.7%) while poultry farmers had the lowest response of 43.7% (Table 5). Between 88.2% and 94.4% of the respondents across the different groups (average 91.3%) sorted their peanut before consumption. As to whether or not sorting was thorough, between 38.9% and 66.7% (average 53%) of the respondents indicated that they sort peanut thoroughly before consumption. According to the results, the main reasons for sorting the nuts is to ensure good taste (42.4% of respondents indicated this reason). Some respondents also know that bad nuts are not edible and or unsafe. Thus, various groups of people who consume peanut are aware that consumption of bad nuts could be harmful.

Regarding the fate of the bad nuts, between 38.8 and 100% (average 74.1%) of respondents who

Table 3. Education levels and age category of respondents by zones

	North		Middle		South		
	Number	%	Number	%	Number	%	Average%
Age Category							
20–35	193	29.56	169	45.19	435	61.18	45.31
36–55	423	64.78	153	40.91	31	4.36	36.68
over 55	37	5.67	52	13.90	245	34.46	17.98
Education*							
Illiterate	416	74.82	188	39.58	217	27.93	47.44
Primary/JSS	105	18.88	222	46.74	297	38.22	34.61
Sec/Tech/Tr.	28	5.04	47	9.89	259	33.33	16.09
Tertiary	7	1.26	18	3.79	4	0.51	1.85

*Sec = Secondary; Tech. = Technical; Tr. = Training College.

Table 4. Types of storage materials/structures for peanut in Ghana.

Structure	Number	Percent
None	77	6.6
Sacks	247	74.6
Floor	10	7.0
Barn	40	12.1
Others	15	3.6

answered the question indicated that the bad nuts are discarded. A high percentage of farmers (47.6%) and retailers (53.6%) apparently have some use for the bad nuts which include processing into human food/feeding to backyard poultry (Table 5).

In the northern zone, 50.5% of respondents throw away the bad nuts while the rest of respondents use the nuts to feed backyard poultry, for processing into foods and for other purposes (Table 5). This is contrasted with the middle and southern zones where as high as 84.26 and 73.48% of respondents discard the bad nuts and only a few utilize them for poultry feed, human foods and other purposes. More respondents in the northern zone find some use for the bad nuts possibly because of poverty and food scarcity common in that zone.

A very high percentage of respondents (88.9–97%; average, 94.8%) indicated that they can identify spoiled or bad nuts. The most obvious criterion used to identify bad nuts is blackening (Table 6). This criterion was used by 56.7 and 77.8% of the respondents (average 67.85%). A few of the respondents mentioned decay of kernels as the criterion used.

To reduce the contamination of aflatoxin in peanut, individuals are asked to store their nuts in sanitized, dry storage bins. Recommendation is made to sort the nuts before and after storage to remove broken and moldy peanut. However, the study revealed that only about 58% of respondents sort their nuts before processing. Most of the participants discarded the peanut only when they were already black, and about 40 and 20% of farmers and retailers, respectively, converted the spoiled nuts into other products for consumption.

Sorting before Consumption Farmers

The model for farmers (Table 7) show that females are 4.1($p = 0.0005$, CI=1.883–9.358) times more likely to sort peanut before consumption than men. The predicted odds of sorting before consumption show that those who are illiterate and those farmers who only attained a primary school education are 3 ($p=0.0446$, CI=1.027–9.358) times more likely to sort their peanut before consumption than those who have attained a secondary or tertiary education. Farmers, who are 55 years and older, are 2.5 ($p=0.0089$, CI=1.021–9.235) times more likely to sort peanut before consumption than those less than 55 years. Individual farmers with knowledge of health problems of aflatoxin are 1.7 ($p=0.0513$, CI=0.997–3.073) times more likely to sort their peanuts before consumption than those who are not aware of the health problems. Farmers

Table 5. Percentage of respondents in the three zones who improve peanut quality through sorting.

	North		Middle		South	
	Number	Frequency %	Number	Frequency %	Number	Frequency %
Thorough sorting before processing into butter						
Yes	397	78	242	84.3	467	69.0
No	112	22	45	5.7	210	31.0
Ability of identify bad nuts						
Yes	573	97.4	365	97.6	817	94.3
No	15	2.6	9	2.4	49	5.7
Sorting before consumption						
Yes	548	95.0	350	94.0	771	91.5
No	29	5.0	22	5.9	72	8.5
Sorting thoroughly before consumption						
Yes	466	85.8	251	69.3	288	36.1
No	77	4.2	111	30.7	510	63.9
Uses for bad, sorted out nuts						
Thrown away	201	50.5	289	84.3	546	73.5
Poultry feed	78	19.5	34	9.9	131	17.6
Processed/food	86	21.6	14	4.1	39	5.2
Others	33	8.3	6	1.8	27	3.6

Table 6. Percentage of stakeholders using various signs to identify poor quality kernels.

Sign used	Farmers	Livestockers	Millers	Retailers	Processors	Consumers
Rottenness	8.5	4.4	0.0	3.8	3.8	7.8
Blackening	69.5	71.9	77.8	69.1	62.0	56.7
Smell	0.3	3.7	0.0	0.3	0.5	1.9
Small size	1.8	0.0	0.0	0.5	2.3	1.5
Oiliness	2.4	0.7	0.0	1.3	4.5	2.1
Moldiness	15.1	8.1	5.6	18.8	18.8	8.0
Bitterness	1.2	3.0	5.6	0.0	0.3	16.2
Others	1.2	8.1	11.2	6.2	8.0	5.8

with income above \$26.32 are 2.06 ($p=0.0111$, CI=1.180–3.610) times more likely to sort peanut before consumption than those with income less than \$26.32. Those who eat peanut fresh boiled and shelled fried are 2.51($p=0.0412$, CI=1.037–6.101) and 1.99($p=0.0356$, CI=2.235–7.836) times, respectively, less likely to sort peanut before consumption than those who do not eat them in this form. Farmers who consume peanut shelled dry are 4.2 ($p<0.0001$, CI=2.325–7.836) times more likely to sort peanut than those who do not eat them in that form.

Poultry Farmers

Poultry farmers, who receive a secondary or tertiary education, are 3.4($p=0.0786$, CI=0.0871–12.861) times more likely to sort peanut before consumption than those who have only primary education or are illiterate. Poultry farmers who consume peanut in a dry-shelled form are 6.8($p=0.0189$, CI=1.373–33.976) times more likely to sort peanut before consumption.

Consumers

Consumers who attain secondary and tertiary education levels are 1.7 ($p=0.0581$, CI=0.982–2.89) times more likely to sort peanut before consumption than those who only have a primary education, or who are illiterate. Those consumers, who eat peanut in the form of fresh boiled, are 1.8 ($p=0.0368$, CI=1.036–3.090) times less likely to sort peanut before consumption than those who do not. Consumers who do not consume peanut fried roasted are 1.9 ($p=0.0125$, CI=1.153–3.266) times more likely to sort peanuts before consumption than those who do.

Sorting Before Processing Farmers

Farmers with household members greater than two assisting in sorting are 3.4 ($p<0.0001$, CI=1.874–6.358) times more likely to sort peanut before processing them into paste. Farmers with revenue greater than \$23.62 are 2.5 ($p=0.0031$, CI=1.1359–4.522) times more likely to sort peanut before converting them into paste. Farmers who

Table 7. Maximum likelihood estimates of odds ratio that sorting was done before consumption

Predictors	Odds Ratios (CI)	P-value	N (Yes No)
Farmers			(137, 175)
Female vs. Male	4.198 (1.883 9.358)	0.0005	
Education Illiterate, Primary vs. Secondary, Tertiary	3.080 (1.027 9.235)	0.0446	
Age > 55 vs. Age <= 55	2.519 (1.261 5.032)	0.0089	
Num. of dep. assisting on farm > 2 vs. <=2	1.736 (0.997 3.024)	0.0513	
Knowledge of health problem assoc. with gnut eating	1.738 (0.983 3.073)	0.0575	
Total revenue of peanut per acre > 250, 000 vs. 250,000	2.064 (1.180 3.610)	0.0111	
Eat fresh boiled	2.515 (1.037 6.101)*	0.0412	
Eat dry shelled boiled	4.268 (2.325 7.836)	<0.0001	
Eat groundnut shelled fried	1.992 (1.048 3.787)*	0.0356	
Livestock			(97, 11)
Education Secondary, Tertiary vs. Illiterate, Primary	3.339 (0.871 12.801)	0.0786	
Consume peanut dry-shelled boiled	6.831 (1.373 33.976)*	0.0189	
Consumer			(618, 69)
Education Secondary, Tertiary vs. Illiterate, Primary	1.686 (0.982 2.895)	0.0581	
Consume peanut fresh boiled	1.789 (1.036 3.090)*	0.0368	
Do you consume peanut roasted ground fried	1.941 (1.153 3.266)	0.0125	

*Probability that sorting was not done before consumption
The above p-value is the testing the null hypothesis that individual coefficient are equal to zero.

Table 8. Maximum likelihood estimates of odds ratio that sorting was done before converting to paste.

Predictors	Odds Ratios (CI)	P-value	P value for Model	N (Yes No)
Farmers			<0.0001	(208, 82)
Num. of dep. assisting on farm >2 vs. <= 2	3.452 (1.874–358)	<0.0001		
Total revenue of peanut per acre > 250, 000 vs. 250,000	2.487 (1.359–4.552)	0.0031		
Eat raw	3.286 (1.1299–563)*	0.0291		
Eat roasted, ground, fried	5.671 (3.131–10.271)	<0.0001		
Live stockers			0.0053	(46, 9)
Consume peanut shelled fried	16.133 (2.082 –125.026)	0.0078		
Consume peanut as tumkumsa	12.226 (0.969–154.193)	0.0529		
Know of any health problems	6.402 (0.896–45.737)	0.0642		
Processors			<0.0001	(210,64)
Education Secondary, Tertiary vs. Illiterate, Primary	2.309 (1.112–4.795)	0.0247		
Consume peanut dry shelled boiled	5.440 (2.526–11.715)	<0.0001		
Do you consume peanut shelled roasted	3.545 (1.672–7.512)*	0.0010		
Do you consume peanut mixed with flour	2.145 (0.924–4.977)*	0.0757		
Reason for sorting	1.787 (0.922–3.460)	0.0853		
Retailers			<0.0001	(216, 50)
Do you consume peanut dry shelled boiled	12.059 (.465–32.568)	<0.0001		
Consume peanut roasted, ground, fried, e.g., kulikuli	2.009 (1.013–3.987)	0.0460		
Know of any health problems	3.113 (1.545–6.273)	0.0015		
Consumer			<0.0001	(393, 73)
Do you consume peanut dry shelled boiled	1.585 (0.916–2.743)*	0.0994		
Do you consume peanut shelled roasted	2.353 (1.291–4.290)	0.0052		
Consume peanut fresh boiled	2.719 (1.505–4.914)	0.0009		
Consume when mixed with flour	2.309 (1.204–4.429)*	0.0118		
Know of any health problems	2.063 (1.203–3.540)	0.0085		

*Probability that sorting was not done before converting to paste
The above p-value is the testing the null hypothesis that individual coefficient are equal

eat peanut raw are 3.3 (p=0.0291, CI=1.129–9.563) times more likely to sort peanut before processing than those who did not eat them raw. Those farmers who eat the peanut fried roasted are 5.6 (p<0.0001, CI=3.131–10.271) times more likely to sort peanut before converting them into paste.

Poultry Farmers

Poultry farmers, who consumed peanut shelled fried, are 16.1 (p=0.0078, CI=2.082–125.026) times more likely to sort peanut before processing them into paste than those who do not. Those poultry farmers who consume peanut in the form of *tumkumsa* (fermented peanut product) are 12.2 (p=0.0529, CI=0.969–54.193) times more likely to sort peanut before processing into paste. Those who know about health problems associated with AF contamination are 6.4 (p=0.0642, CI=0.896–45.737) times more likely to sort peanut before consumption (Table 8).

Processors

The predicted odds of processors sorting before converting into paste by those with secondary and tertiary education are 2.3 (p=0.0247, CI=1.112–4.795) times that of those with only primary education and those who are illiterate. Those who consume peanut dry shelled boiled are 5.4 (p<0.0001, CI=2.526–11.715) times more likely to sort their peanut before processing into paste. Those who consume shell roasted or eat peanut mixed with flour are 3.5 (p=0.001, CI=1.672–7.512) and 2.1(p=0.0757, CI=0.924–4.977) times less likely to sort peanut before processing into paste. Those who are aware of reasons for sorting are 1.8 (p=0.0853, CI=0.0922–3.460) times more likely to sort peanut before processing into paste than those who do not know the reasons for sorting.

Retailers

Retailers who consume peanut dry shelled and ground fried are 12.1 (p<0.0001, CI=0465–32.568) and 2 (p=0.0460, CI=1.013–3.987) times more likely to sort peanut before processing them into paste. Those retailers who know about the health hazards associated with consuming AF contaminated peanut are 3.11 (p=0.005, CI=1.545–6.273) times more likely to sort peanut before processing into paste than those who are not aware.

Consumers

Those consumers who eat peanut in the form of dry shelled and mixed with flour are 1.6(p=0.0994, CI=0.916–2.743) and 2.3(p=0.0.0118, CI=1.204–4.429) times less likely to sort their peanut before conversion into paste. Those consumers who eat their peanut shelled roasted and fresh boiled are 2.3(p=0.0052, CI=1.291–4.290) and 2.7(p=0.0009, CI=1.505–4.914) times more likely to sort their peanut before conversion into paste. Those consumers who know about health problems associated with eating AF contaminated peanut are 2.1(p=0.0085, CI=1.203–3.540) times more likely to sort their nuts before conversion into paste.

Conclusion

Peanut is produced in all regions of Ghana, but is concentrated mainly in the north and central regions. Peanut competes well for land and generates net income, second only to yams. The major production constraint faced by farmers is the availability of capital for investment and the problems associated with pests and diseases.

In spite of the high daily consumption of peanut, many people are not aware that peanut that is not properly stored can be contaminated with aflatoxin produced by *Aspergillus flavus* and *A. parasiticus* which are highly toxic and may cause cancer of the liver and other health problems (Waliyar, 2002). The study showed up to 90% of farmers, processors and consumers are not aware of aflatoxin. Jolly *et al.* (2006) found that 92.3% of farmers in the Ejura district in the Ashanti region had never heard of the word ''aflatoxin'' but 76.8% said they sorted their peanut and 90% said they were able to identify unwholesome peanut and grains. The study found that most of those who know about aflatoxin (50.9%) got their information from attending workshops organized by the Ministry of Food and Agriculture.

Most participants indicate that they know how to identify poor quality peanut. The most common method used is visual and that is when the nuts are already black with fungus present which many have levels of aflatoxin higher than that recommended as safe for human or animal consumption.

There are a number of factors influencing the sorting of nuts before consumption, among those, are education, age, revenue from peanut and the form in which the peanut is consumed. Females are more likely to sort peanut before consumption than males. Gender roles influence household chores in Ghanaian society. Women are more likely to engage in food preparation and the safety aspects of food consumption (Danso *et al.*, 2004). Lin (1995) found that those most concerned with food safety tended to be women, older, more educated, full-time homemakers, or have a member of their household in an at-risk group. Baker (2003) also indicated that women had the strongest reaction to low-visibility food safety risk. Older women who remained home are usually given specific tasks and included among those is the cleaning or sorting of produce for marketing and consumption. Hence it is expected that women would be more likely involved in sorting of peanut for consumption at the household level.

Two noted outcomes are illiterate farmers or those who attended primary school only are more likely to sort peanut before consumption, while processors, retailers and consumers, who have attained secondary and tertiary levels of education, are more likely to sort their peanut. This may be so since in a labor surplus economy like that of Ghana, farmers who are educated tend to be absentee farmers and are more likely to pay those who are less educated to sort peanut before consumption. Those men who are older and less educated remain home and are more likely to be involved in post-harvest activities such as sorting of peanut that require less physical exertion. One of the roles agriculture plays in Ghana is that of a safety net (Sarpong and Asuming-Brempong, 2004). As members of the extended family grow old or are threatened by economic deprivation, disability or social isolation, they are protected in times of crisis through making claims of assistance on kin. These individuals, who are usually less educated, trade their labor services for household support on the farm and in meal preparation. Livestock owners, retailers and consumers who know about health problems related to aflatoxin ingestion are more likely to sort their peanut before processing them into paste.

Those who are aware of the negative effects of consuming aflatoxin-contaminated peanut are more likely to sort their peanut. Appropriate policy formulation requires decision makers to stress the health awareness aspects of aflatoxin-contaminated peanut and emphasize the diffusion of information on the importance of the hygienic aspects of peanut sorting to reducing aflatoxin levels and to improve peanut quality. Education on peanut sorting and food safety issues related to consuming aflatoxin contaminated peanut should be directed to the entire household since everyone should be aware of the effects of aflatoxin-contaminated peanut at all levels of the marketing chain, the diffusion of information on the health benefits of reducing aflatoxin in peanut and grains should be emphasized.

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