

DATA ARTICLE

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Stakeholders' perception about aflatoxin contamination in groundnut (*arachis hypogaea* L.) along the value chain actors in eastern Ethiopia

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Abstract

Background: Groundnut is an important cash crop for domestic markets as well as for foreign trade in several developing and developed countries. It is also one of the most valuable cash crops in eastern Ethiopia. However, its production is constrained by *Aspergillus* species, which cause quantitative losses and produce highly toxic and carcinogenic chemical substances known as aflatoxins. The research was conducted with the objective to determine the stakeholders' perceptions about groundnut qualities with respect to aflatoxin contamination and pre- and post-harvest practices affecting development of aflatoxigenic fungi and aflatoxin contamination. The study was conducted in groundnut growing areas in eastern Ethiopia. Primary data were collected using a semi-structured self-administered questionnaire administered to 165 randomly selected stakeholders.

Results: We found that from 165 respondents, 98.7 % farmers and 93.3 % traders disagreed on the indices of groundnut quality assumed of promoting aflatoxin contamination.

Conclusions: It is necessary to make concerted campaigns to create and raise perception among farmers, traders and consumers about pre- and post-harvest practices affecting groundnut quality and aflatoxin contamination and high quality maintenance in the groundnut value chain.

Keywords: Aflatoxin; Ethiopia; Groundnut; Perception; Value chain actors

Background

Groundnut (*Arachis hypogaea* L.), which is also known as peanut, earthnut, monkeynut and goobers, is an annual leguminous oil crop. It is one of the world's most important oilseed crops (Upadhyaya *et al.*, 2010), ranked as the 4th most important oilseed crop and the 13th most important food crop (Surendranatha *et al.*, 2011). It is currently grown on 25.2 million hectares worldwide with a total production of 35.9 million metric tons, with developing countries in Asia (66 %) and Africa (25 %) as the major producers. Groundnut kernel contains 40–50 % fat, 20–50 % protein and 10–20 % carbohydrate and is rich in vitamins and minerals (USDA, 2010).

Groundnut is relatively new to Ethiopia. It was introduced in the early 1920s (Daniel 2009). Its production is expanding and has a huge potential as a cash and food crop to improve livelihoods of farmers and traders in Ethiopia.

However, its yield and quality is constrained by both abiotic and biotic factors. In addition to yield and quality loss due to fungal diseases, infection of groundnut seed by *Aspergillus flavus* Link ex Fries and *Aspergillus parasiticus* Speare result in contamination of the seed with aflatoxins (AFs), which are toxic fungal metabolites (mycotoxins). Aflatoxin contamination of agricultural crops, such as groundnut and cereals, causes annual losses of more than US\$750 million in Africa and more than US\$100 million per year in USA (Kamika and Takoy, 2011).

Developing countries account for approximately 95 % of the world groundnut production, but are unable to sell large quantities of groundnut on the international market because of aflatoxin contamination (FAOSTAT 2010). In Ethiopia, Groundnut market is declining and export of the crop has come to a standstill to date. This is because of aflatoxin contamination of the crop and the difficulty of meeting tolerance limits demanded by importers and food processors, leading to rejection of the crop and reduction in the local and world markets.

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For instance, a food processing company in Ethiopia imported groundnuts from India, while groundnut producers in Eastern Ethiopia could not find market to sell their crop (Amare Ayalew, personal communication).

Aflatoxins are widely known mycotoxin contaminants that are most commonly associated with groundnuts (Dohlman 2003). Aflatoxin contamination of agricultural commodities poses considerable risk to human and livestock health and has a significant economic implication for the agricultural industry worldwide Richard and Payne (2003). Aflatoxins are acutely toxic, immunosuppressive, mutagenic, teratogenic and carcinogenic compounds targeting mainly the liver for toxicity and carcinogenicity (Woloshuk et al. 2009).

The level of aflatoxin awareness in many developing countries is extremely low or non-existent altogether. Poor knowledge of the aflatoxin and its health risks causes consumers to be exposed to acute and chronic toxicity through consumption of poor quality or moulded groundnuts (James *et al.*, 2010). Outbreaks of acute aflatoxicosis from contaminated groundnut in humans have been documented in Kenya, India, Malaysia and Thailand (CAST, 2003). One of the first major documented reports of aflatoxins in humans occurred in 150 villages of western India in 1974 where 397 persons were affected and 108 died (Krishnamachari *et al.*, 1975).

Aflatoxin contamination of groundnut could occur before harvest while the crop is at maturing stage in the field, particularly favored by drought stress and high soil temperature, in storage and during marketing (CAST, 2003; Mutegi *et al.*, 2009; Abdi and Alemayehu 2014). It can occur on pods and seeds in the soil near harvest, during harvest, and post-harvest in storage. It could occur during all stages along the groundnut value chain. Therefore, studies that address the entire groundnut value chain covering major nodes from production through storage to consumption (markets) are necessary, since they could support decision making targeting major points of aflatoxin contamination and averting its negative consequences.

Information on aflatoxin contamination of groundnut and the associated fungi and health risks in Ethiopia is scant, confined to limited market samples, and does not particularly address the situation at harvest. There is a need for identification of the gaps in producers'/traders' and consumers' perception about the aflatoxin generation and/or contamination problem and its causal/contributing factors. The objective of the present study was to determine the stakeholders' perceptions about groundnut qualities with respect to aflatoxin contamination and pre-and post-harvest practices affecting development of aflatoxigenic fungi and aflatoxin contamination.

Materials and Methods

Description of the study area

The study was conducted in three major groundnut growing areas, namely Babile, Gursum and Fedis Districts of East Hararghe Zone, Oromia Regional State of Ethiopia in 2014 crop season. The areas were selected purposively as they represented the bulk of groundnut production in Ethiopia. These areas have high potentials for rain fed groundnut production nationally. Descriptions of the study area are described in Ephrem *et al.* (2014).

Study methodology

The groundnut value chain in eastern Ethiopia comprises farmers, traders (wholesalers and retailers); rural, urban and semi-urban markets, and consumers. Descriptions of the groundnut value chain are described in Ephrem *et al.* (2014).

A key informant interview was used to gather primary data on stakeholders' perceptions using questionnaires. Apt questionnaires for different stakeholders were developed, pre-tested and used in the data collection. Where applicable, the questionnaire survey was conducted at the time of the postharvest groundnut sample collection and stakeholders who provided groundnut samples served as key informants in the interview. The questionnaire was developed after pre-tested through conducting a focused group discussion and interview involving farmers, traders, supporters, village elders, some community leaders and provincial administration staff. The results of the discussion were used to formulate the survey questions and respondents who perceived the situations were selected purposively. These were the criteria that I was used in inclusion and exclusion of respondents. Items defining perceptions of Aflatoxin in groundnuts were measured on a 5-point Likert scale. The questions were designed in a way that each element of the question represented a statement the respondents would have made if asked a question. This was done to minimize respondent bias (Ajzen 1991).

Data collection procedure

Four field assistants were selected by the researcher to aid in data collection. They were trained by the researcher to understand the objectives of the study and the purpose and procedure of the interview process; to have a common understanding of the questions in the interview schedule; and to ask the questions to the understanding of the respondents. The field assistants were selected based on their knowledge of the local language, previous research experience and ability to understand and write in the local dialect and English. The instruments were explained to the respondents in their local dialects which include Amharic and Oromifa. Responses

were then recorded in English by the field assistants for easy use by the researcher.

Data analysis

Data collected from the questionnaires including socio-demographic characteristics of respondents, perceptions on indices of groundnut quality, pre- and post-harvest practices of groundnut and associated factors were summarized and analyzed using Statistical Package for Social Sciences (SPSS). Descriptive statistics in the form of frequencies and means were used to analyze the data obtained.

Results

The socio-demographic characteristics of the groundnut value chain actors in the study areas have been depicted in Table 1. It was observed that farmers in the study areas had the highest number (53, 70.7 %) of male headed households, while the traders had the lowest number (7, 23.3 %). Also, the majority of the value chain actors were between the ages of 35 and 50 years old, particularly farmers (61.3 %) and traders (53.3 %). A significant number of farmers (30.7 %) tended to be somewhat younger with nearly below 35 years of age. Most of the value chain actors were married, particularly farmers (54.7 %). However, almost a third of farmers (37.3 %)

were single or unmarried and 15 (50.0 %) supporters and consumers were single and unmarried.

A large number of respondents along the value chain had no formal education (i.e. they were illiterate), especially 68.0 % of the farmers with variable household incomes. In contrast, 32.0 % of farmers, 56.7 % of traders and more than 33.3 % of consumers had at least attended primary education. However, all 30 (100 %) of supporters had tertiary education. With regard to household incomes, 46 (61.3 %) farmers earned between ETB 3000 to 10,000 per month. Traders and consumers had the lowest income with 4 (13.3 %) and 5 (16.7 %) earning less than ETB 3000 per month, respectively. With regard to years of experiences, 64 (85.3 %) of farmers had farming for more than 10 years, whereas most supporters (16, 53.3 %) had between 5 to 10 years of farm experience.

Perception of groundnut quality among actors of the groundnut value chain has been summarized and tabulated (Table 2). The tabulated indices are conditions necessary for aflatoxin contamination in groundnut and reduction in the quality of groundnut due to contamination by aflatoxin, making them unattractive to buyers and unhealthy for human consumption. The absence of these variables in groundnuts obviously reduces aflatoxin contamination.

Table 1 Socio-demographic characteristics of interviewed respondents (n = 165, %) in eastern Ethiopia in 2014

Variables		Farmers		Traders		Supporters ^a		Consumers	
		N	%	N	%	N	%	N	%
Sex group	Male	53	70.7	7	23.3	18	60.0	13	43.3
	Female	22	29.3	23	76.7	12	40.0	17	56.7
Age group	<35 years old	23	30.7	11	36.7	9	30.0	11	36.7
	35–50 years old	46	61.3	11	36.7	16	53.3	11	36.7
	>50 years old	6	8.0	8	26.7	5	16.7	8	26.7
Marital status	Single	28	37.3	11	36.7	15	50.0	15	50.0
	Married	41	54.7	12	40.0	15	50.0	15	50.0
	Divorced	6	8.0	6	20.0	0	0.0	0	0.0
	Widowed	0	0.0	1	3.3	0	0.0	0	0.0
Educational level	No formal education	51	68.0	9	30.0	0	0.0	6	20.0
	Primary education	24	32.0	17	56.7	0	0.0	10	33.3
	Secondary education	0	0.0	4	13.3	0	0.0	8	26.7
	Tertiary education	0	0.0	0	0.0	30	100.0	6	20.0
Household income per month (ETB)	<3000	22	29.3	4	13.3	11	36.7	5	16.7
	3000–10,000	46	61.3	11	36.7	10	33.3	15	50.0
	>10,000	7	9.3	15	50.0	9	30.0	10	33.3
Years of experience	<5 years	1	1.3	8	26.7	10	33.3	11	36.7
	5–10 years	10	13.3	11	36.7	16	53.3	11	36.7
	>10 years	64	85.3	11	36.7	4	13.3	8	26.7

^aHaramaya University, School of Plant Sciences, students and instructors

Table 2 Perception of value chain actors (n = 165, %) on the quality of groundnut in eastern Ethiopia in 2014

Indices of groundnut quality	Farmers		Traders		Supporters		Consumers	
	Disagree	Agree	Disagree	Agree	Disagree	Agree	Disagree	Agree
1. Groundnuts which have a change in taste promote AF	74(98.7)	1(1.3)	29(96.7)	1(3.3)	5(16.7)	25(83.3)	15(50.0)	15(50.0)
2. Groundnuts which have a change in colour promote AF	74(98.7)	1(1.3)	28(93.3)	2(6.7)	5(16.7)	25(83.3)	21(70.0)	9(30.0)
3. Mouldy groundnuts promote AF	75(100)	0(0.0)	29(96.7)	1(3.3)	5(16.7)	25(83.3)	14(46.7)	16(53.3)
4. Broken and bruised groundnuts promote AF	73(97.3)	2(2.7)	27(90.0)	3(10.0)	5(16.7)	25(83.3)	13(43.3)	17(56.7)
5. Insect-attacked groundnuts promote AF	74(98.7)	1(1.3)	28(93.3)	2(6.7)	5(16.7)	25(83.3)	10(33.3)	20(66.7)
6. Shriveled groundnuts promote AF	73(97.3)	2(2.7)	27(90.0)	3(10.0)	5(16.7)	25(83.3)	12(40.0)	18(60.0)
7. Groundnuts stored damp promote AF	74(98.7)	1(1.3)	29(96.7)	1(3.3)	5(16.7)	25(83.3)	15(50.0)	15(50.0)
8. Groundnuts which contain foreign materials promote AF	74(98.7)	1(1.3)	27(90.0)	3(10.0)	5(16.7)	25(83.3)	13(43.3)	17(56.7)

From 165 respondents, almost all farmers (98.7 %) and majority of traders (93.3 %) disagreed on consequences of the eight indices of the groundnut quality, including groundnut with a change in taste (organoleptic), a change in colour, mouldy growth, broken and bruised nuts, insect-attacked beans, shriveled kernels, stored damp and contained foreign materials (twigs, leaves, dead insects, sand, etc.) as they do promote aflatoxin contamination. It may be concluded that the majority of farmers and traders are at a great risk of aflatoxin contamination, whereas 83.3 % of supporters agreed that all of the eight indices of the groundnut quality, such as groundnuts with a change in taste, a change in colour, mouldy growth, broken and bruised nuts, insect-attacked beans, shriveled kernels, stored damp and contained foreign materials as they do promote aflatoxin contamination. This group would obviously reject groundnuts which contain one or two of the variables which project the possible presence of aflatoxin in groundnuts. Their perception of groundnut quality would influence their consumption habits and hence would reduce the risk of aflatoxicosis. This group, however, consists of only 83.3 % and this shows that the habits of groundnut consumers in the region would largely expose the majority of the respondents to aflatoxin contamination.

The perception of farmers and traders on pre-and post-harvest practices that affect aflatoxin contamination has been tabulated (Table 3). About 92 % of the respondent farmers and 83.3 % of the interviewed traders dried their groundnut seeds in the open sun. About 86.7 % of the farmers and 76.7 % of the traders spread the groundnut seeds on the bare ground during drying. As many as 13.3 % of farmers spread groundnuts on a raised platform above the ground. All the farmers and traders were involved in the storage of groundnuts. About 93.3 % of the farmers and 66.7 % of the traders stored groundnut in mixture with other crop(s) in previously used structures. According to the respondents, maize was reported to be the number one crop stored

with groundnut. All the respondents stored groundnut in rooms dedicated to crop storage. The most commonly used storage material was the polythene sack, which was used by as many as 96.0 % of the farmers and 70.0 % of the traders. About 73.3 % of farmers and 90.0 % of traders told that they sorted their groundnut to attract customers or the market. Both farmers and traders mentioned that sorting fetches higher profit and averts health risks. However, the remaining farmers and traders explained that sorting groundnut is not only time consuming but also reduces groundnut quantity by at least 5 % on average.

When supply chain actors were asked about the criteria used to identify spoiled groundnut, approximately 94.6 % of the farmers and 80.0 % of the traders reported a change in groundnut color as the obvious criteria used. The most common color changes indicated were brown, black and greenish. When supply chain actors were asked about what they usually do to spoiled groundnut, about 93.3 % of farmers and 86.7 % of the traders indicated that they would throw away or dump to garbage. However, 6.5 % of farmers and 13.3 % of traders told that they process spoiled or moulded groundnut into *dawadawa* (a spice used for stews, sauces and soups). Generally, the farmers were unaware of the important ways and means of management of pre-harvest and post-harvest aflatoxin contamination of groundnut.

When asked about the mechanical injury onto pods that leads to aflatoxin contamination, about 53.3 % of the farmers and 66.7 % of the traders had no appropriate replies to the question. Approximately, 66.7 % of farmers and 83.3 % of traders disagreed on the point that the end-of-season-drought for more than 20 days leads to aflatoxin contamination. However, this is an important reason for aflatoxin contamination in practice.

Discussion

Aflatoxins are the secondary metabolites of the fungi namely *Aspergillus flavus* and *A. parasiticus*. Aflatoxins

Table 3 Farmers' and traders' perception on pre-and post-harvest practices that lead to aflatoxin contamination (n = 105, %) in eastern Ethiopia in 2014

Questions	Responses	Proportions	
		Farmers	Traders
1. Do you dry nuts?	Yes	69 (92 %)	25 (83.3 %)
	No	6 (8 %)*	5 (16.7 %)
2. What drying method(s) do you use? Or are you aware of drying method(s)?	Spreading on the ground	65 (86.7 %)	23 (76.7 %)
	On raised platform	10 (13.3 %)	7 (23.3 %)
3. Do you store in mixed used structures?	Yes	70 (93.3 %)	20 (66.7 %)
	No	5 (6.7 %)	10 (33.3 %)
4. What storage method do you use?	Polythene sacks	72 (96 %)	21 (70 %)
	Jute sacks	3 (4 %)	9 (30 %)
5. Do you sort nuts?	Yes	55 (73.3 %)	27 (90 %)
	No	20 (26.7 %)	3 (10 %)
6. How do you identify spoiled nuts?	Change in Color	71 (94.6 %)	24 (80 %)
	Insect Infestation	4 (5.4 %)	6 (20 %)
7. What do you do to spoiled nuts?	Throw away	70 (93.3 %)	26 (86.7 %)
	Processed to soup	5 (6.7 %)	4 (13.3 %)
8. Does mechanical injury to pods lead to AF contamination?	Yes	35 (46.7 %)	10 (33.3 %)
	No	40 (53.3 %)	20 (66.7 %)
9. Does end of season drought for 20 days lead to AF contamination?	Yes	25 (33.3 %)	5 (16.7 %)
	No	50 (66.7 %)	25 (83.3 %)
10. Does aflatoxin contamination occur at any time during pre-harvest?	Yes	20 (26.7 %)	3 (10 %)
	No	55 (73.3 %)	90 %)

*Respondants that uses nuts in boiled form but they knows methods of nut drying

are potent carcinogenic substances and have also been implicated in human diseases, like hepatitis B, and tuberculosis, by suppressing immune system. Perception of groundnut quality among actors of the groundnut value chain has been summarized and tabulated (Table 2). The tabulated indices are conditions necessary for aflatoxin contamination in groundnut and reduction in the quality of groundnut due to contamination by aflatoxin, making them unattractive to buyers and unhealthy for human consumption. The absence of these variables in groundnuts obviously reduces aflatoxin contamination.

From 165 respondents, almost all farmers (98.7 %) and majority of traders (93.3 %) disagreed on consequences of the eight indices of the groundnut quality, including groundnut with a change in taste (organoleptic), a change in colour, mouldy growth, broken and bruised nuts, insect-attacked beans, shriveled kernels, stored damp and contained foreign materials (twigs, leaves, dead insects, sand, etc.) as they do promote aflatoxin contamination. This observation is different from the report of Bonner and Nelson (1985) who asserted that high quality of food is most often associated with attributes such as rich/full flavor, taste, freshness, pleasant aroma and looks appetizing. This is because, in this case,

the majority of the respondents did not measure the quality of the groundnuts on similar parameters. However, according to Holm and Kildevang (1996), individual assessments of quality are personal and situational, and that they are often based on incomplete information about the products they purchase. This may be the reason for this choice by the majority of respondents. Hence, these groups of consumers are, therefore, not likely to be protected from the negative aflatoxin effects through their groundnut consumption habits.

It may be concluded that the majority of farmers and traders are at a great risk of aflatoxin contamination, whereas 83.3 % of supporters agreed that all of the eight indices of the groundnut quality, such as groundnuts with a change in taste, a change in colour, mouldy growth, broken and bruised nuts, insect-attacked beans, shriveled kernels, stored damp and contained foreign materials as they do promote aflatoxin contamination. This group would obviously reject groundnuts which contain one or two of the variables which project the possible presence of aflatoxin in groundnuts. Their perception of groundnut quality would influence their consumption habits and hence would reduce the risk of aflatoxicosis. This group, however, consists of only

83.3 % and this shows that the habits of groundnut consumers in the region would largely expose the majority of the respondents to aflatoxin contamination.

The present study is similar with the findings of Harder (2005) who reported the factors used to measure the perception of groundnut quality include an increase in the level of aflatoxin contamination and fungal proliferation to a large extent when present in groundnuts. The perception of groundnut quality that the consumers generally hold, therefore, plays an important role in their groundnut consumption decisions, which could result in negative health implications some of which include liver cancer, stunted growth, increased prevalence of hepatitis, and low immune strength against HIV infection, among others.

The perception of farmers and traders on pre-and post-harvest practices that affect aflatoxin contamination has been tabulated (Table 3). About 92 % of the respondent farmers and 83.3 % of the interviewed traders dried their groundnut seeds in the open sun. About 86.7 % of the farmers and 76.7 % of the traders spread the groundnut seeds on the bare ground during drying. As many as 13.3 % of farmers spread groundnuts on a raised platform above the ground. All the farmers and traders were involved in the storage of groundnuts. About 93.3 % of the farmers and 66.7 % of the traders stored groundnut in mixture with other crop(s) in previously used structures. According to the respondents, maize was reported to be the number one crop stored with groundnut. All the respondents stored groundnut in rooms dedicated to crop storage. The most commonly used storage material was the polythene sack, which was used by as many as 96.0 % of the farmers and 70.0 % of the traders. About 73.3 % of farmers and 90.0 % of traders told that they sorted their groundnut to attract customers or the market. Both farmers and traders mentioned that sorting fetches higher profit and averts health risks. However, the remaining farmers and traders explained that sorting groundnut is not only time consuming but also reduces groundnut quantity by at least 5 % on average.

When supply chain actors were asked about the criteria used to identify spoiled groundnut, approximately 94.6 % of the farmers and 80.0 % of the traders reported a change in groundnut color as the obvious criteria used. The most common color changes indicated were brown, black and greenish. When supply chain actors were asked about what they usually do to spoiled groundnut, about 93.3 % of farmers and 86.7 % of the traders indicated that they would throw away or dump to garbage. However, 6.5 % of farmers and 13.3 % of traders told that they process spoiled or moulded groundnut into *dawadawa* (a spice used for stews, sauces and soups). Generally, the farmers were unaware of the important

ways and means of management of pre-harvest and post-harvest aflatoxin contamination of groundnut.

When asked about the mechanical injury onto pods that leads to aflatoxin contamination, about 53.3 % of the farmers and 66.7 % of the traders had no appropriate replies to the question. Approximately, 66.7 % of farmers and 83.3 % of traders disagreed on the point that the end-of-season-drought for more than 20 days leads to aflatoxin contamination. However, this is an important reason for aflatoxin contamination in practice. The farmers' problem of awareness of this fact was due mainly to the lack of visual symptoms of aflatoxin contamination. A similar finding was reported by Kumar *et al.* (2001) who claimed that delayed harvesting was one of the major reasons for post-harvest aflatoxin contamination in groundnut. But, farmers disagreed with this aspect because delayed harvesting was a routine practice for them due to shortage of labour during peak harvest season. Also, 73.3 % of farmers and 80.0 % of traders replied that aflatoxin contamination does not occur at any time during pre-harvest operation in the field or growth period.

Conclusion

The occurrence of aflatoxins in agricultural commodities is a major health concern for livestock and humans. Aflatoxins are potent carcinogenic substance and have also been implicated in human diseases like hepatitis B and tuberculosis and can suppress immune system. Aflatoxins are secondary metabolites of the mycotoxigenic fungi, namely *Aspergillus flavus* and *A. parasiticus*. From 165 respondents, almost all (98.7 %) farmers and 93.3 % of the traders disagreed that the eight groundnut quality indices, including change in taste, change in colour, groundnut mouldiness, broken and bruised beans, insect-attacked kernels, shriveled kernels, damp stored grains and groundnuts containing foreign materials (twigs, leaves, dead insects, soil, and sand), etc. do not promote aflatoxin contamination.

Farmers and traders were ignorant of the important ways and means of pre- and post-harvest aflatoxin contamination of groundnut. When asked about whether or not mechanical injury to pods leads to aflatoxin contamination, about 53.3 % of the farmers and 66.7 % of the traders replied that no such effect occurs. Lack of awareness of farmers' was due mainly to lack of visual symptoms of aflatoxin contamination on the groundnut. The findings of the present study imply the need for launching a concerted campaign to augment awareness among the farming community, traders, consumers and similar end-users about aflatoxigenic fungi development, aflatoxin generation, contamination and management and quality maintenance in value chain of groundnut production and marketing. There is a need to explore

the possibility of incorporating aflatoxin awareness into routine talk to increase the level of awareness of the stakeholders. It is recommended to discard groundnuts with a change in taste, a change in colour, mouldy growth, broken and bruised nuts, insect-attacked beans, shriveled kernels, stored damp and contained foreign materials as they do promote aflatoxin contamination and are highly risky to the health. It is also of paramount importance to create collaboration between agricultural and public health communities as well as among local, regional, national, international governing bodies and policy-makers for raising awareness of the different actors of the groundnut value chain. Further researches are also appealing and necessary for analyzing factors influencing individuals' beliefs and knowledge about the aflatoxin problem in Ethiopia; health risks, aflatoxigenic fungal development, generation, contamination and aflatoxin management in groundnut production and marketing business.

Competing interests

The author declares that he has no competing interests.

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