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# Smallholder farmers' perceptions of aflatoxins in maize in kamuli district, Uganda


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## Extended Abstract


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Aflatoxins are a family of highly toxic and carcinogenic compounds produced by fungi commonly found on maize. Aflatoxins have been estimated to be widespread in maize in Africa (Wagacha and Muthomi, 2008). Consumption of aflatoxins in foods is associated with liver cancer in adults and stunted growth and development in children. Studies have shown that over 50% of maize in Ugandan markets contain over 10 ppb aflatoxins, the safety limit set by Uganda National Bureau of Standards. Present in maize fields, these fungi (molds) continue to grow on maize when it is insufficiently dried and then stored, thereby increasing aflatoxin levels. Maize is an important staple crop for smallholder farmers. They often have difficulty properly drying and storing maize and thus face the risk of aflatoxin consumption. Previous published studies revealed that many smallholder farmers do not know what aflatoxin is nor the risks they face from it (e.g., Magembe et al., 2016).

Iowa State University Uganda Program (ISU-UP) works in smallholder farmer communities in the Kamuli district of Uganda to improve peoples' health, nutrition and rural livelihoods (www.csrl.cals.iastate.edu). It operates eight Nutrition Education Centers (NECs) where pregnant women and mothers of nutritionally challenged children within their first 1000 days of life can receive nutritious meals. Mothers are instructed about nutrition and health issues and how to grow and serve nutritious food to their families. Once their children are no longer at nutritional risk, they "graduate" from the program and no longer receive assistance. Nearly all these women or their spouses/partners are smallholder farmers. Additionally, ISU-UP works with other smallholder farmers in the community to improve their livelihood through livestock and improved agricultural practices. ISU-UP will be starting outreach programs in postharvest techniques and practices, providing education in how to reduce postharvest losses and protect themselves against spoilage and the risk of aflatoxin.

This study sought to understand the perceptions and knowledge of smallholder farmers in the Kamuli District of Uganda about their postharvest practices and specifically about aflatoxin to establish a baseline for evaluating future postharvest outreach programs.

During the summer of 2017, 109 face-to-face interviews were conducted with smallholder farmers in the Kamuli District of Uganda with the use of an interpreter. Interviewees were chosen by stratified sampling methods and interviewees shared the characteristic of growing maize. 60 smallholder farmers were chosen at random and 49 were members of an ISU-UP Nutrition Education Center. At least ten farmers were interviewed in each of seven parishes in the Butansi and Namasagali sub-counties. 102 interviews resulted in complete data for analyses. The demographic distribution of the interviewees is shown in Table 1.

Interviewees were asked 37 open-ended questions that took an average of 30 minutes. Responses were transcribed into English. Transcripts were analyzed using grounded theory methodology to identify emergent themes in farmer perception and knowledge of aflatoxins, maize drying, and maize storage practices. Statistical analysis of associations between demographic characteristics and response frequencies used the chi-square test of independence with statistical significance declared at $p < 0.05$.

**Table 1.** Number of study interviewees by category (n = 102)

| | | | | |
|---|---|---|---|---|
| **Gender** | **Female** | **Male** | | |
| | 83 | 19 | | |
| **Age Group** | **18 to 29** | **30 to 39** | **40 to 49** | **50 and over** |
| | 29 | 30 | 18 | 25 |
| **Education** | **None** | **Primary School** | **Secondary School** | |
| | 23 | 56 | 23 | |
| **NEC Membership** | **Current** | **Graduate** | **None** | |
| | 31 | 14 | 57 | |

Table 2 summarizes the results of the survey relevant to interviewees knowledge of aflatoxin. There were no significant differences in responses due to gender, age, education, or NEC membership for the questions "have you heard of the word aflatoxin," and "are you aware of aflatoxin contamination in crops." Nearly all participants had heard of aflatoxin before, which is different than previous published studies that showed smallholder farmers generally unaware of aflatoxin. When asked if they were "aware of harmful effects of aflatoxin in humans" there was a significant difference between male and female responses – all males said they were aware and only 71% of the females said they were aware. There were no differences in responses due to age, education of NEC membership.

**Table 2.** Interviewees awareness of aflatoxin

| Question | Female (n=83) | Male (n=19) |
|---|---|---|
| Have you heard of the word aflatoxin? | Yes: 92% | Yes: 100% |
| Are you aware of harmful effects of aflatoxin in humans? | Yes: 71% | Yes: 100% |

When asked what the harmful effects on humans were, it was difficult for farmers to correctly articulate those effects (Table 3). There were several misperceptions about the effect of mycotoxins on human health. While 36% correctly identified "disease," they could not describe the kind of disease. Only 1% identified cancer.

**Table 3.** Harmful effects perceived by those aware of harmful effects in humans (n=78).

| Disease | Stomach Ache | Don't Know | Diarrhea | Bad Smell | Malaria | Loss of Taste | Cancer |
|---|---|---|---|---|---|---|---|
| 36% | 25% | 8% | 6% | 4% | 3% | 2% | 1% |

The farmers in this study were also asked about postharvest practices that might affect their exposure to aflatoxin. Although the visual presence or absence of mold does not determine the presence or absence of aflatoxin, moldy maize has a higher probability of the presence of aflatoxin. When asked if they "check for moldy maize before feeding to your family," 79% indicated yes and 21% indicated no, with no significant difference between gender, age, education or NEC membership. When asked what they do with moldy maize, a variety of responses were obtained (Table 4). Many of these actions do not reduce the risk of exposure of people or animals to aflatoxin.

**Table 4.** What interviewees that check for moldy maize do with it when they find it (n=96)

| Discard | Animal Feed | Human Food | Mill it | Sell it | Dry Before Use | Blend w/ non-moldy maize |
|---|---|---|---|---|---|---|
| 44% | 18% | 15% | 9% | 7% | 5% | 2% |

92 % of the farmers indicated that they try to avoid moldy maize. These farmers were asked what they do to avoid moldy maize (Table 5). Most farmers said they repeatedly dried the maize.

**Table 5.** Practices used to avoid mold in maize (n=94)

| Repeat Drying | Nothing | Avoid long-term storage | Dry before storage | Add Red Pepper |
|---|---|---|---|---|
| 71% | 11% | 10% | 2% | 1% |

From these results, it is clear that there were numerous misunderstandings about aflatoxin, its effect on humans and practices that could be adopted to limit the risk of exposure to aflatoxin. Women smallholder farmers were significantly less aware (only 71%) that aflatoxin had harmful effects on humans, yet they are often the ones that are feeding their families. There exists a clear and important need to educate smallholder farmers in the Kamuli District of Uganda about the dangers of aflatoxin and the postharvest measures that could be taken to prevent exposure. These results provide further impetus for ISU-UP to implement outreach education programs. The Nutrition Education Centers are a good first place to start. Future surveys will follow up with these interviewees to determine the effectiveness of these programs.

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## The mycoflora of bulk stored cocoa

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In modern times, agricultural commodities are handled in ever-growing volumes. Nowadays not only cereals but further soft commodities like raw coffee and cocoa are transported as bulk cargo in containers or directly stowed into a ship's hold and stored in silos or bulk stores. This change of environmental conditions impacts upon the development of stored product pests. A typically encountered implication is the incidental occurence en masse of fungivorous beetle species, which becomes especially conspiciuous when the lot is moved. At that point, the initial area of infestation is hardly traceable.