Peanut Aflatoxin Levels on Farms and in Markets of Uganda

A.N. Kaaya*[1], C. Harris[2], and W. Eigel[3]

ABSTRACT

A study was conducted between July 2003 and July 2004 to determine aflatoxin content of peanut from farmers and dealers (wholesalers and retailers) in Mayuge, Iganga and Mubende districts of Uganda, and from St. Balikuddembe, Nakawa, and Kalerwe, the three busiest peanut markets in Kampala, the capital city. Information on peanut storage and processing practices as well as aflatoxin awareness was obtained from dealers. At farm level, the mean aflatoxin levels ranged from 7.3 to 12.4 ppb which is lower than the FDA/WHO regulatory limit of 20 ppb. These levels tend to increase as peanut are processed and stored both at wholesale and retail levels where most samples routinely exceeded 20 ppb. All forms of peanut obtained from retailers in all markets had levels of aflatoxin significantly higher than corresponding samples obtained from wholesalers. In all markets, the highest levels of aflatoxin were found in unsorted kernels and white flour, while the sorted kernels and dark-roasted paste had lower aflatoxin contents. Thus, sorting and roasting appear to reduce aflatoxins in peanut. None of the wholesalers or retailers was aware of aflatoxin and related health issues. It is recommended that the Government of Uganda designs aflatoxin awareness campaigns and management strategies for peanut.

Key Words: Groundnuts, AIDS, processing practices, dealers, awareness, national standards.

Peanut (*Arachis hypogaea* L.), also known as groundnut, in one form or other is one of the main components of the diet of most Ugandans. It is used in many different forms, as whole grain and processed (Mukankusi *et al.*, 1999). The processing may include making into peanut butter or flour; the former may be roasted to a greater or lesser extent. The flour can be used for making stew, which is eaten with other foodstuffs like banana, sweet potato, cassava, and corn meal; but preparation methods and consumption patterns vary across cultures (Busolo-Bulafu and Obong, 2001).

Although peanuts are an excellent source of amino acids and as such form a vital part of the Ugandan diet, especially for the vast majority of the population unable to afford animal protein on a regular basis, there can also be negative health consequences. Peanut is one of the most vulnerable crops to *Aspergillus flavus* contamination (Dorner and Cole, 1997). This fungus produces aflatoxins, which are highly carcinogenic mycotoxins.

The FDA classifies aflatoxins as a class A carcinogen that particularly affects the liver especially of those already infected with Hepatitis B or C. In acute form aflatoxins can cause immediate deaths, such as the outbreak in January–July 2004 in Eastern and Central provinces of Kenya (*CDC, 2004*).

More commonly, Ugandans are exposed to chronic subacute doses of aflatoxins. These have been shown to significantly reduce available vitamin A, C, zinc, and other important micronutrients in both humans and animals (Williams *et al.*, 2004). Moreover, research in progress suggests that aflatoxins depress the immune system, thereby creating considerable synergy with HIV (Williams, *et al.*, 2004; Williams, 2005), of which there is a high incidence in the Ugandan population

While the US and the EU have strict laws limiting aflatoxin levels in human nutrition to 20 pbb and 4 pbb respectively, few developing countries have enforceable laws in place. Uganda's National Bureau of Standards has an official limit of 10 pbb. However, they have no mechanism for enforcing this partly because they do not have access to research showing the extent of the exposure of the Ugandan population to aflatoxins.

The Virginia Tech-Makerere University (VT-Mak) subproject of the USAID-funded Peanut Collaborative Research Support Program (CRSP) is one of the few research projects to have collected hard data for assessing aflatoxin risk levels in regard to peanut consumption in Uganda. In this study, the research started from the hypothesis that aflatoxin levels in peanut were likely to be affected by on-farm practices, including harvest, drying and storage. A further hypothesis was that length of storage and processing practices would affect aflatoxin levels of peanut in markets. Given that processing almost always involves grinding the grain and thus exposing larger surfaces to fungal

[1]Department of Food Science and Technology, Makerere University, P.O. Box 7062, Kampala, Uganda.

[2]Institute of Development Studies, Brighton, Sussex, UK.

[3]Department of Food Science and Technology, Virginia Tech, Blacksburg, VA 24061, USA.

*Corresponding author.

infection, a third hypothesis was that peanut sold in whole grains would have lower aflatoxin levels than that sold in ground form and that current practices with regard to handling, processing, packaging, and storage tend to increase contamination. Since purchasing peanut in ground form has become extremely popular among Ugandan households, this is of great concern. The last hypothesis was that the issue of aflatoxin is not well understood in Uganda and that indeed very few are even aware of its existence or its implications for human and animal health. This lack of knowledge makes it difficult even to address the issue.

A limited number of studies have been conducted on aflatoxin contamination of peanut in Uganda (Lopez and Crawford, 1967; Sebunya and Yourtee, 1990; Kaaya *et al.*, 2000, 2001). These studies have shown that peanut are among those foods contaminated in the country. However, they have not adequately established aflatoxin levels in the different forms of peanut produced either at farm or market levels. They did not even look at awareness levels. This study aimed at filling these gaps, including testing the above hypotheses.

Materials and Methods

Sampling. Two peanut commercial varieties — Roxo 531 and Red Beauty (B1) were sampled. Sampling was carried out in four test villages and the markets where their produce is sold, as well as in markets in Kampala that sell products from all over Uganda and even Kenya. Kampala has a population of over one million people and, in the majority of households, peanut form a major part of the diet. Samples from the villages were taken immediately after drying while market samples were taken from a range of different processed nuts.

Sampling Regions. Peanut samples were collected from two main regions consisting of Mayuge and Iganga districts on the one hand and Mubende district on the other. These were selected because they are among the most peanut producing districts in the country. Besides, high aflatoxin levels have been reported in corn originating from these districts (Kaaya *et al.*, 2000; Ssebukyu, 2000).

Mayuge district lies at approximate altitude of 1070 m and 1167 m above sea level, with rainfall totaling 2200 mm per year. Temperatures are high at over 21 C. Samples were collected from Bugodi village, Bayitambogwe sub-county, and from market retailers and wholesalers in Magamaga trading center.

Iganga district lies at similar altitude with annual rainfall ranging between 1250 and 2200 mm. Temperatures are generally higher than 21 C. Samples were collected from farmers in Kiboyo village, Nakigo sub-county, and from market retailers and wholesalers in Iganga town.

Mubende district lies at an altitude of 1372 m and 1448 m above sea level with high temperatures and extremely low rainfall (Rwabwoogo, 2002). Samples were collected from farmers in Kabulamuliro and Gayaza villages, Madudu sub-county, and from market retailers and wholesalers in Mityana town.

In each district, towns or trading centers where samples were collected represent those with the largest volumes of peanut wholesalers, retailers and processors. In Kampala, samples were collected from retailers and wholesalers in St. Balikuddembe, Nakawa and Kalerwe, the three busiest peanut markets in this city.

Sampling Methods. At farm level, one recently dried peanut sample (at least 2 kg) in unshelled form was randomly obtained from farmers in each test village while at market level stratified random sampling was used. One sample form (1 kg) was purchased from each peanut dealer. These samples had all been stored for some time. The number of wholesalers and retailers varied depending on the size of these populations in the markets.

Information Gathering. In each market, 5 to 15 wholesalers, retailers and, where possible, peanut processors (millers) were randomly selected and interviewed using a semi-structured questionnaire (Table 1) to obtain information on peanut storage and processing practices as well as aflatoxin awareness. Questions on drying were administered to wholesalers only to determine whether inadequately dried peanut delivered from farmers undergoes further drying. Observations were made regarding practices and the general state of the markets in relation to hygiene.

Aflatoxin Analysis. Samples obtained from farmers and markets in each district were transported the same day to the Department of Food Science and Technology, Makerere University, and stored at -20 C until analysis to prevent post-harvest accumulation of aflatoxins (Anderson *et al.*, 1995). Each sample was analyzed in triplicate. Total aflatoxins were extracted using methanol-water solution (80:20 vol) and quantified (ppb) using an AflaTest® Fluorometer, following methods recommended in the Manufacturer's Manual (VICAM L. P. 313 Pleasant street, Watertown, MA 02472, USA).

Data Analysis. Data were analyzed using SPSS Statistical Programme (SPSS for Windows, Release

Table 1. Questionnaire concerning aflatoxin awareness and peanut handling and processing activities administered to peanut dealers in Magamaga, Iganga, Mityana, and Kampala markets.

Storage practices
How long do you store peanuts? ____
In what form do you store peanuts? shelled____, unshelled____, milled____ others____
What packages do you use during storage?____
What storage problems are experienced? insects____, rodents____, molds____, others____

Processing practices
Do you dry peanut upon delivery to the market? ____
Do you mill peanut into flour/paste? ____
What kind of machine do you use to mill peanut into flour? ____
Do you normally clean the machines after milling? ____
Do you sort to remove diseased, moldy, discolored, broken or shriveled kernels before processing? ____
What do you do to the sorted-out/poor quality kernels? ____

Aflatoxin awareness
Are you aware of health problems related to peanut? ____
Have you ever heard of aflatoxins? ____
If yes, what are they? ____

10.01, Standard Version 1999; SPSS Inc. 1989–1999). Frequencies of responses were computed and ANOVA was performed on aflatoxin data. Significant aflatoxin levels in samples from the four villages and in the different peanut forms from the six markets were separated using LSD ($P = 0.05$).

Results and Discussion

Peanut Storage Practices by Market Dealers.

Period of Storage. Wholesale Peanut storage reported by wholesalers varied from 1 to 3 weeks, with the majority storing peanut for 1 week only. In Magamaga market, 30% of wholesalers reported storage up to 3 weeks. In St. Balikuddembe, no wholesalers reported storage exceeding 1 week since this market is very busy. Since there were no wholesalers found in Kalerwe market, the peanut storage period by this category could not be established. In this market, retailers reported that they obtain the different forms of peanut from St. Balikuddembe and other markets around Kampala.

Storage reported by retailers showed a greater range, from 1 to over 4 weeks. However, the average storage time was 2 weeks. Only Magamaga market retailers reported storage in excess of 4 weeks.

Storage Form. Middlemen purchase nuts in the shells from farmers and shell them. Shelling is usually done mechanically and may damage the nuts. The peanuts are then packaged in 100 kg. polypropylene-woven bags. These nuts are not presorted. Thus, the bags may contain a mixture of broken, moldy, shrivelled, discolored, and sound grains and even foreign material.

Wholesalers reported storage of peanut in unsorted, sorted, and processed forms, in descending order of magnitude (Table 2). Sorted kernels are primarily sold to retailers, while processors purchase unsorted kernels, commonly using broken grains. Some wholesalers in Iganga, Mityana, and St. Balikuddembe markets also reported processing peanut into white flour, pressed but not roasted, and three colors of paste: dark brown, brown, and light brown, produced by roasting nuts for about 1 hour, 30 and 5–10 minutes, respectively. The first resembles peanut butter and can be smeared on bread or used as sauce.

Retailers in Iganga, Magamaga, Mityana, and Kalerwe markets sold all forms of peanut discussed (Table 3). Sorted kernels, the form most preferred by consumers, were provided by a great majority of retailers. Among the processed forms of peanut, white flour was most common, followed by light brown paste, with dark brown paste being the least available (Table 3).

Packaging. Retailers and wholesalers reported use of 3 types of packaging: Inter-woven polypropylene bags, holding up to 100 kg, used to store all forms of peanut, including flour, kernels, and paste; transparent, low-density polyethylene bags mainly used for storing processed peanut; and, in St. Balikuddembe and Nakawa markets plastic buckets are used for processed products.

During working hours, packages are displayed wide open to enable consumers to see contents prior to purchasing. Afterwards, the bags are tied, the buckets closed and all containers covered with plastic sheets to protect them from rain and moisture pick-up. However, contamination with foreign material such as dust and molds as well as

Table 2. Wholesalers' responses (%) concerning storage forms of peanut in different markets in Uganda.

	Market					
Storage form	Iganga[a]	Magamaga[a]	Mityana[a]	St. Balikuddembe[a]	Kalerwe	Nakawa[a]
Unsorted kernels	100	100	100	100	—	100
Sorted kernels	70	60	80	70	—	70
White flour	50	—	60	50	—	—
Pressed	40	—	40	40	—	—
Light brown paste	40	—	60	50	—	—
Brown paste	30	—	30	40	—	—
Dark brown paste	30	—	30	30	—	—

[a]Multiple responses obtained.
—No responses were obtained.

Table 3. Retailers' responses (%) concerning storage forms of peanut available in different markets in Uganda.

	Market					
Storage form	Iganga[a]	Magamaga[a]	Mityana[a]	St. Balikuddembe[a]	Kalerwe[a]	Nakawa[a]
Unsorted kernels	30	30	40	-	10	-
Sorted kernels	80	80	90	100	100	100
White flour	60	70	60	80	70	60
Pressed	50	40	30	50	40	40
Light brown paste	50	40	50	70	60	60
Brown paste	30	50	40	50	40	40
Dark brown paste	30	30	30	40	30	40

[a]Multiple responses obtained.

moisture pick-up can take place during the day. This contamination is aggravated by the open, disorganized, and dirty environment of the markets.

Storage Problems. The chief storage problems are rodents and insects — especially cockroaches, which live in the crevices of buildings and even inside the dirtier stalls of retailers, and rain — especially for retailers selling from open stalls with no shelter. Although respondents were unable to supply good information on the contamination of peanut by molds, the observed storage conditions do not seem to protect the nuts against fungal infection and multiplication.

Processing Practices.

Drying. Wholesalers reported frequently receiving inadequately dried peanut. However, only two wholesalers, both located in the Mityana market, reported carrying out further drying; and both use tarpaulins placed on the ground. When they are particularly pressed for time, especially when peanut are scarce and demand is high, wholesalers reported not bothering even to check dryness. In Nakawa market, one retailer reported drying humid peanut; all other retailers reported they do not further dry peanut. Neither wholesalers nor retailers reported using modern methods for detecting moisture content. They use experience and such practices as biting kernels. Those that split open at once are judged to be adequately dried.

Sorting. Sorting of peanut is primarily performed by retailers who sell whole kernels and those processors who sell peanut flour and paste. The former manually sort out moldy, discolored, shrivelled and broken kernels, and foreign materials. They thereby obtain sacks of clean whole seeds that can be sold directly to consumers, while the rejects are used for chicken feed. However, processors remove only stones and other foreign materials using wire meshes. Unlike retailers, they rarely remove moldy, discoloured, broken, or shriveled kernels, since they are not easily detectable after processing and their removal will decrease profits.

Milling. Milling of peanut into flour or paste is widely performed by both wholesalers and retailers. The latter purchase unsorted kernels from wholesalers and prepare flour or paste using 3 types of processing machines. Hammer mills are used to grind peanut into white flour. Screw mills serve to press raw nuts into thick flour. Blenders are used to roast and grind nuts into thick paste.

Machines are not regularly cleaned after processing because the owners claim they do not get

Table 4. Aflatoxin levels of peanut sampled from farmers in Iganga, Mayuge, and Mubende districts in Uganda.

Village	No. of samples	Aflatoxin positive		Aflatoxin content (ppb)
		No.	%	
Kiboyo[a]	25	20	80	12.4 ± 5.31
Bugodi[b]	20	15	75	10.5 ± 6.15
Gayaza[c]	15	9	60	7.3 ± 4.98
Kabulamuliro[c]	12	8	67	9.8 ± 4.32
LSD ($P \leq 0.05$)				1.842

[a]Village in Iganga district.
[b]Village in Mayuge district.
[c]Villages in Mubende district.

dirty since the oil in the peanuts keeps the interiors shiny. Observation suggests that processing machines are dirty both inside and outside and thus likely to contribute further to cross contamination of products with both molds and aflatoxins. Additionally, they are locally fabricated from scrap, the surface of which can contain toxins such as leaded paint. These easily rub off during milling.

Other than in Nakawa, peanuts are processed in the open air, in disorganized, dirty stalls exposed to dust/mud and other foreign materials. The situation is worsened by rain since there is no adequate protection against water contamination; it drips from the roofs of stalls and collects on the ground.

Aflatoxin Awareness By Wholesalers and Retailers. Wholesalers and retailers showed a complete lack of awareness of health problems associated with peanuts. None had ever heard the term aflatoxins. However, a few wholesalers, retailers and processors mentioned that the small, moldy and shrivelled kernels sometimes taste bitter; they have offensive odors and can irritate the throat. Nevertheless, economic considerations force inclusion in their flour and pastes. This lack of awareness means they see no reason to sort, and pay little attention to the issues of processing and storage discussed above. For the same reason they feed moldy nuts to chickens.

Educating traders on the health consequences of aflatoxins is unlikely to be effective in producing change without corresponding economic compensation. In the Ugandan situation, when government regulations are practically impossible to enforce, it is likely that only educated consumers, willing to pay more for uncontaminated products, could induce traders to produce real improvements in the conditions of the peanut they sell. The majority of consumers, however, are too poor to be able to take this into consideration, which will mean a differential in health consequences for those willing and able to pay extra for products low in aflatoxins.

Aflatoxin Levels.

Farm Level. In all villages, at least 60% of the peanuts sampled had detectable levels of aflatoxins (Table 4). This confirms earlier findings that aflatoxin contamination of peanut in Uganda starts at farm level (Kaaya *et al.*, 2000). Mean levels in Kiboyo (12.4 ppb) and Bugodi (10.5 ppb) villages slightly exceeded the Uganda National Bureau of Standards (UNBS) regulatory limit of 10 ppb (P. Ssekitoleko, UNBS Standards Officer, pers. Commun.) but the mean aflatoxin level for all villages was lower than the FDA/WHO regulatory limit of 20 ppb (Grybauskas *et al.*, 2000; Mphande, 2004). However, earlier analysis from the villages of Olupe (Kumi District) and Kiboyo of peanuts after lengthy storage showed levels in the 40–50 ppb range (Kaaya and Harris 2003). Moreover, the low farm levels are still sufficient to produce far higher levels in markets.

Markets. It was not possible to take equal numbers of samples from all markets because there were no peanut wholesalers found at Kalerwe market. The majority of peanut and products are obtained by retailers from St. Balikuddembe and other markets around Kampala. In Magamaga and Nakawa markets, wholesalers do not process peanut into flour or paste (Table 5).

St. Balikuddembe is located in the center of Kampala city and is the largest market in Uganda. It handles the largest volume of peanut and, therefore, more samples were collected from this market than from any other. However, in this market retailers do not store unsorted kernels.

Aflatoxin Levels. In Iganga, Magamaga, Mityana, St. Balikuddembe, and Nakawa markets, kernels sampled from retailers had significantly higher aflatoxin levels than those from wholesalers (Table 5). In all markets, higher aflatoxin levels were found in unsorted kernels and peanut flour, while sorted kernels and roasted nuts had considerably lower levels. Among processed peanut from both wholesalers and retailers, white flour con-

Table 5. Aflatoxin levels (ppb) of different peanut forms sampled from wholesalers and retailers in markets of Uganda.

		Markets						
Peanut form	Market Segment	Iganga[ac]	Magamaga[ad]	Mityana[ac]	St. Balikuddembe[be]	Kalerwe[ac]	Nakawa[ac]	LSD ($P \leq 0.05$)
Unsorted kernels	Wholesale	52.0 ± 7.73	44.5 ± 3.85	40.4 ± 6.74	42.0 ± 5.68	-	35.4 ± 4.94	4.874
	Retail	62.4 ± 4.72	65.4 ± 4.72	53.4 ± 6.65	-	60 ± 5.60	38.9 ± 8.41	8.763
Sorted kernels	Wholesale	12.0 ± 8.65	11.8 ± 7.27	16.3 ± 3.76	10.0 ± 4.36	-	8.3 ± 4.66	1.661
	Retail	18.0 ± 7.60	20.5 ± 4.60	23.5 ± 3.90	22.5 ± 6.14	16.6 ± 2.26	21.2 ± 9.89	2.141
White flour	Wholesale	42.5 ± 5.76	-	35.5 ± 2.55	45.0 ± 7.25	-	-	8.426
	Retail	54.4 ± 8.29	59.4 ± 5.43	50.4 ± 5.82	55.8 ± 6.76	55.4 ± 3.95	43.5 ± 3.54	5.643
Pressed	Wholesale	39.2 ± 2.64	-	24.2 ± 5.52	24.7 ± 7.85	-	-	3.711
	Retail	46.3 ± 2.28	51.1 ± 2.22	32.5 ± 2.39	32.3 ± 6.19	28.4 ± 5.62	29.6 ± 5.29	2.621
Light brown paste	Wholesale	22.5 ± 5.55	-	22.3 ± 2.64	28.6 ± 4.45	-	-	2.934
	Retail	33.2 ± 2.09	28.3 ± 4.41	25.3 ± 4.78	28.5 ± 4.48	23.4 ± 3.57	24.3 ± 2.38	3.872
Brown paste	Wholesale	28.4 ± 3.36	-	20.8 ± 4.48	22.4 ± 4.32	-	-	3.141
	Retail	30.6 ± 4.67	29.5 ± 3.94	20.9 ± 6.66	27.8 ± 4.56	19.1 ± 3.41	17.4 ± 2.29	3.435
Dark brown paste	Wholesale	20.5 ± 4.46	-	11.2 ± 2.65	15.5 ± 3.65	-	-	2.984
	Retail	25.5 ± 3.31	22.6 ± 2.26	15.5 ± 7.76	25.6 ± 2.92	15.2 ± 2.88	12.7 6.76	3.054
LSD ($P \leq 0.05$)		3.454	8.361	6.341	7.131	7.892	3.222	

[a]Means are for five samples for each form of peanut from wholesalers.
[b]Means are for ten samples for each form of peanut from wholesalers.
[c]Means are for ten samples for each form of peanut from retailers.
[d]Means are for eight samples for each form of peanut from retailers.
[e]Means are for fifteen samples for each form of peanut from retailers.
-No samples were obtained from wholesalers or retailers.

tained the highest levels of aflatoxins followed by pressed non-roasted flour, while dark brown paste was the least contaminated.

Comparing aflatoxin levels across markets shows generally higher aflatoxin levels in Iganga market while some of the lowest levels were found in Nakawa (Table 5). Generally, Nakawa had considerably better conditions than the other markets. We believe this to be owing to indoor processing and superior organization.

It is notable that, apart from a small percentage of sorted kernels and dark brown paste, peanut samples from the markets had mean aflatoxin levels higher than the 20 ppb level established by FDA/WHO. Lopez and Crawford (1967) reported aflatoxin levels greater than 20 ppb in only 25 out of 152 peanut sampled from Ugandan markets. Thus, it appears that there has been a significant increase in aflatoxin contamination over the last 40 years.

One important reason for high aflatoxin levels is poor storage. Under such conditions, length of storage is crucial for contamination levels with mold and mycotoxins (Hell *et al.*, 2000; Kaaya *et al.*, 2002; Smith and Moss, 1985). It is assumed that this is why all forms of peanut obtained from retailers had higher levels of aflatoxin than corresponding samples obtained from wholesalers.

Additional contamination can take place while peanut packages are left open to the dirty and disorganized environment. This is aggravated by moisture pick-up, especially when it rains. This is an important factor in mold proliferation and aflatoxin production (Bankole and Adebanjo, 2003). To reduce aflatoxin risk in storage, it is necessary to prevent biological activity through adequate drying of produce to safe storage moisture content levels of $\leq$ 12% (Vincelli *et al.*, 1995).

In all markets, sorting and roasting appear to reduce aflatoxins in peanut (Table 5). Galvez *et al.* (2003) also found that proper sorting of raw peanut significantly reduced aflatoxin levels. Sorted kernels prepared for direct purchase by consumers contained from 27 to 54% the mean aflatoxin level of corresponding unsorted kernels at each market. Clearly, culling moldy, discolored, shrivelled, and broken kernels does reduce aflatoxin levels. Unfortunately, this is rarely done for peanut to be milled.

The purchasing trend for peanut in Uganda is currently undergoing change towards milled rather than kernel form. The majority of consumers, especially those in urban and peri-urban areas, do not have time to pound peanut at home, and thus prefer to purchase them already milled so they simply have to mix with water to make sauce. The problem is that an informal survey of consumers shows them to be largely unaware of the dangers of aflatoxin poisoning, so that they aggravate the situation in the home through further storage under inadequate conditions. This means that consumers are likely to be exposed to dramatically higher levels of aflatoxin contamination than those obtained in markets. This is particularly problematic because white flour is currently the preferred form of peanut purchased by consumers, while in all markets this form was found to have aflatoxin levels well above 20 ppb, largely because it is made from unsorted kernels.

It would be a positive step to encourage consumers to purchase dry roasted peanut kernels since our study showed roasting appears to reduce aflatoxin concentrations somewhat even if not always to acceptable concentrations (see also Bagley, 1979; Njapau *et al.*, 1998). Note that temperatures required to reduce aflatoxin content are higher than those used in normal roasting processes, so that some loss in food and feed value can be expected at such high temperatures (Vincelli *et al.*, 1995).

Conclusions

Ugandan consumers are clearly exposed to far higher levels of aflatoxins than is safe. Liver problems, including cancer, are endemic in Uganda, where the overall morbidity rates are high. It is suspected that the incidence of malaria and even of HIV/AIDS could be significantly reduced by reducing levels of aflatoxicosis among the population.

Thus, we believe it is imperative for the Government of Uganda to undertake steps to start consumer awareness campaigns and to regulate aflatoxin levels both at farm level and market. Our Peanut CRSP sub project is currently working to support this effort.

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