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Short communication

Concentrating aflatoxins on the domestic market through groundnut export: A focus on Malawian groundnut value and supply chain

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ABSTRACT

Economies of most sub-Saharan African countries are predominantly agricultural-based. In order to export foodstuffs to high value markets, a certain set of minimum safety standards must be met. For groundnuts, hand-sorting is performed at farmer and exporter level to eliminate contaminated kernels. A meta-analysis was performed on aflatoxin data generated by a laboratory in Malawi in order to determine the fate aflatoxins in the groundnut value and supply chain in Malawi. Additionally the public knowledge on aflatoxin issues was evaluated. Groundnut products on the local market contained distinctly higher aflatoxin levels compared with samples of groundnuts destined for exports. The results demonstrated that through hand sorting of the nuts farmers can potentially access high value markets with stringent aflatoxin regulatory limits. However, considering that there are no channels for diversion of the grade-outs the exportation of the nuts is projected to be concentrating aflatoxins on the local market. Moreover public knowledge on aflatoxin issues was limited. In view of this it is recommendable that future strategies should not only focus on meeting exports requirements but should begin with ensuring safety of the local food through rigorous public awareness campaigns. Well informed farmers are more likely to take care on the whole production chain thus making the local food safe and the exportation much easier.

1. Introduction

Groundnuts play an integral role in the livelihoods of the majority of the population in Africa through the provision of dietary nutrients and income (Gowda, Rao, & Bhagavatula, 2009; Diop, Beghin, & Sewadeh, 2004). In Malawi, groundnuts are widely cultivated throughout the country, however over 70% of the production comes from central Malawi (Nguluwe et al., 2001), with Smallholder farmers accounting for over 90% of the groundnut production. Groundnuts account for 25% of a household's agricultural income, which in turn accounts for 63.7% of the total income for the rural population (Diop et al., 2004).

Groundnuts rank top on the list of alternative crops to replace tobacco, Malawi's main foreign exchange earner (Mataya & Tsonga, 2001) and are featured in the Malawi's National Export Strategy 2013-2018 (Government of Malawi, 2012). Malawi is currently 9th largest exporter of groundnuts in the region (Simtowe et al., 2010), with South Africa as the largest importer of Malawian groundnuts. It has been estimated that Malawi formally exports about 15% of its total groundnut production (Derlagen & Phiri, 2012) but much more is smuggled across the borders (Minde & Nakhumwa, 1998).

However, groundnuts are prone to pre- and post-harvest toxigenic fungal colonization and mycotoxin contamination. Among the currently most significant mycotoxins (aflatoxins (AFs) ochratoxin A, patulin, fumonisins, zearalenone and some trichothecenes including deoxynivalenol), AFs are most frequently found in groundnuts (Bankole, Schollenberger, & Drochner, 2006; Ezekiel, Sulyok, Warth, Odebode, & Krska, 2012; Gonçalez et al., 2008; Siame, Mpuchane, Gashe, Allotey, & Teffera, 1998) and indeed aflatoxins were reported to be widespread in groundnuts across Malawi (Monyo et al., 2012).

In order to export foodstuffs to high value markets, a certain set of minimum safety standards must be met. In that respect, ways of

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removing of AF contaminated nuts particularly through dry blanching and manual sorting have been extensively explored and methods for achieving low levels were optimized (Galvez, Francisco, Lustre, & Resurreccion, 2002, 2003). By following such methods, the groundnut sector has been able to gain access to markets with very stringent AF regulatory limits (Derlagen & Phiri, 2012). However without proper aflatoxin management and control the non-compliant groundnuts may be concentrated into the local food products with detrimental consequences on public health.

Therefore, the present study focuses on the fate of AFs in the groundnut value and supply chain in Malawi. The distribution of AFs in the groundnut value and supply chain was analysed to determine the sections of the chain where AFs are concentrated. Furthermore, the public knowledge of aflatoxins was analysed.

2. Methodology

A meta-analysis was performed on data of AF (AFB1, AFB2, AFG1 and AFG2) contamination levels of raw groundnuts and groundnut-based products analysed in Chitedze Mycotoxin laboratory (Lilongwe) between July 2012 and January, 2013. Data were obtained using immunoaffinity column clean-up coupled with high performance liquid chromatography and on-line post-column photochemical derivatization-fluorescence detection (IAC-HPLC-PCD-FLD) according to the method described by Matumba et al., 2014.

The samples included 69 raw groundnuts aggregated samples (1–5 kg, depending of lot size) randomly purchased from informal local markets across Malawi (between July and August, 2012), 27 aggregated samples (1–5 kg depending of lot size (mostly 5 kg)) intended for the export market and brought to Chitedze Mycotoxin laboratory (Lilongwe) between July 2012 and January, 2013 for quality control, and 49 groundnut based-products purchased from the supermarkets in Lilongwe City, Malawi (in December 2012 previously reported by Matumba et al., 2014). The groundnut based-products included 14 cans of peanut (groundnut) butter manufactured in Malawi (300g-1 kg); 11 cans of peanut butter imported from South Africa (500 g); 15 packs of de-skinned roasted groundnuts and 9 packs of un-skinned roasted groundnuts (500g-1 kg). With exception to the peanut butters which were already fine, other samples were ground using a laboratory blender in whole before a sub-sample was drawn.

AFs data were not normally distributed, and were log transformed for statistical analysis. The difference between the means was assessed by analysis of variance (ANOVA) and the Tukey HSD test. All the analyses were performed using SPSS® (version 16) statistical software (SPSS Inc., Chicago, Illinois,. USA). The level of confidence required for significance was set at $P \leq 0.05$. Additionally, data on public knowledge of AF issues obtained through a survey carried in 2010 involving 47 agriculturalists, 32 medical specialists and 119 farmers was analysed.

3. Results

Samples of raw groundnuts from local informal markets had the highest levels of aflatoxins (frequency, 64/69; maximum, 501.0 μg/kg; mean, 122.3 μg/kg; median, 79.3 μg/kg; Fig. 1). However, significantly ($P < 0.05$) lower levels of AFs were detected in samples of raw groundnuts destined for the export market (frequency, 16/27; maximum 9.3 μg/kg; mean, 2.6 μg/kg; median, 2.1 μg/kg; Fig. 1) compared with groundnuts for the local informal market (according to Tukey's multiple testing). Out of the 27 samples of groundnut destined for the export market, only 3 samples exceeded EU aflatoxin regulatory limits (Fig. 1) (EC, 2010).

In samples of locally processed peanut butter, AF levels ranged from 34.2 to 115.6 μg/kg; median, 72.0 μg/kg (Fig. 1). On the other hand, significantly ($P < 0.05$) lower AF levels were detected in samples of imported peanut butter (South African) (median, 2.7 μg/

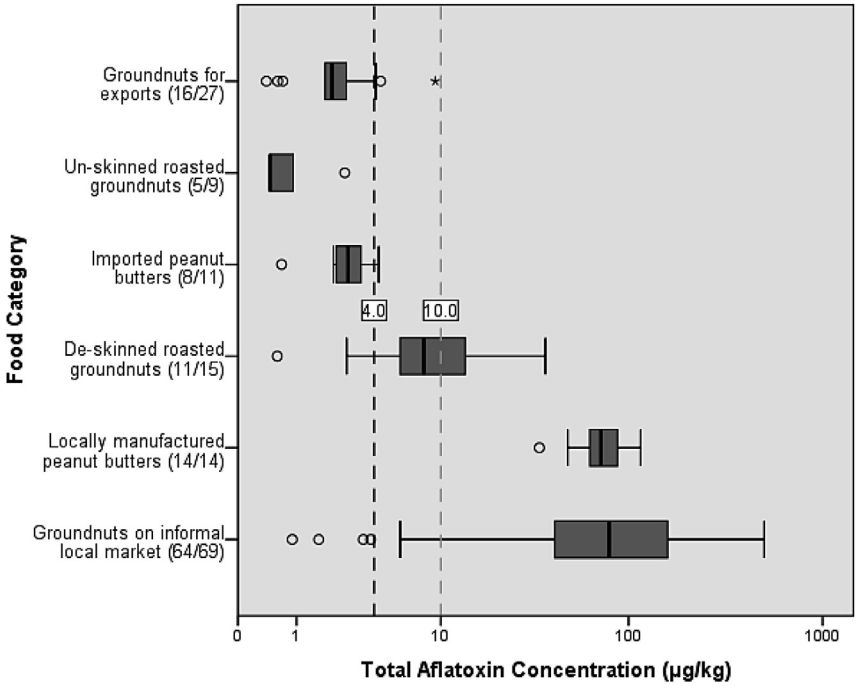

Fig. 1. Distribution of total AFs (AFB1 + AFB2 + AFG1 + AFG2) in raw groundnuts samples found on informal local markets across Malawi, industrial processed groundnuts-based products marketed in Lilongwe City and samples of groundnuts intended for exports. A vertical line within the box represents the median. The front and back ends of the box represent first and third quartiles, respectively. The front and back whiskers extend from the box to the smallest or largest non-outliers in the data set (relevant quartile ± 1.5 * (interquartile range, IQR)). Circles depict mild outliers (1.5 × IQR) and asterisks depict extreme outliers (3 × IQR). Figures in parenthesis indicate the fraction of AF positive samples. Reference lines (dotted) indicate the following maximum level set for total AFs in groundnuts (4 μg/kg) (EC, 2010) and median for total of aflatoxins limits used worldwide (10 μg/kg) (FAO, 2004).