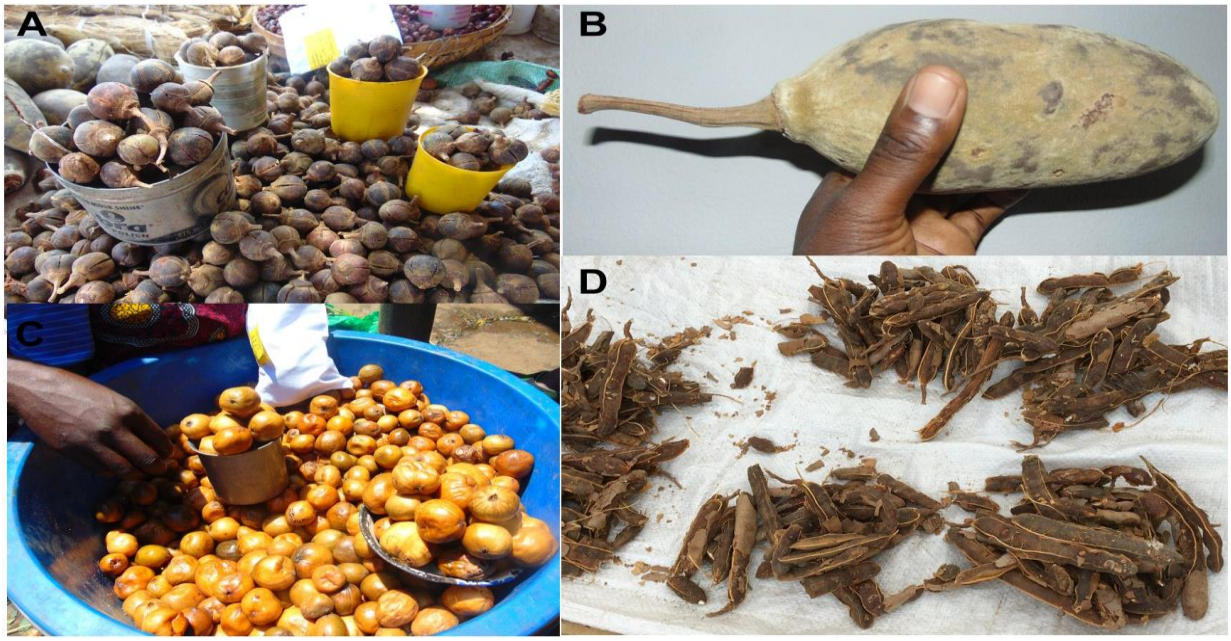
Overview of Aflatoxin Contamination in Zambia

Executive Summary

In Zambia, Aflatoxin contamination remains a significant threat to food safety, public health, and international trade. Aflatoxins cannot be seen with the naked eye and do not have a particular taste or odour. Hence, it is not easy to convince farmers and consumers about the presence of these substances in foods and feeds. Consumption of foodstuffs contaminated with Aflatoxin can result in a myriad of illnesses, including diarrhoea, childhood stunting, and liver cancer.

The susceptibility of groundnuts and maize to Aflatoxin contamination may result in significant Aflatoxin-associated risks, as the majority of the Zambian population heavily relies on these two staple crops. The recent contamination events in 2024 have highlighted the potential for significant Aflatoxin exposure and associated health risks to consumers, including pets, as well as economic losses.

Therefore, there is an urgent need to scale up effective Aflatoxin management strategies to ensure the safety and quality of key staple crops, such as maize, groundnuts, and sorghum, as well as processed foods and animal feeds. For instance, the development of tailored interventions and trainings for farming households, extension officers, and frontline health workers to prevent and manage Aflatoxin contamination at different stages of crop production.



Introduction

Aflatoxins are naturally occurring, cancer-causing, immunosuppressive mycotoxins produced by certain types of mould or fungi, most notably *Aspergillus flavus* and *Aspergillus parasiticus*. *Aspergillus flavus* naturally resides in soils on dead and decaying organic matter, and the green growth of *Aspergillus* fungi on maize and groundnuts is indicative of the likelihood of Aflatoxin presence (Figures 1 and 2).

Aflatoxins contaminate many dietary staples, such as maize, groundnuts, rice, sorghum, and cassava. Certain climatic conditions, including conditions approaching crop maturity, elevated moisture levels during harvest, and insufficient drying and storage of crops, facilitate the proliferation of Aflatoxin-producing fungi and, consequently, the synthesis of Aflatoxin in crops during cultivation and storage.[1]

Green growth of *Aspergillus* on groundnuts

Green growth of *Aspergillus* on maise grain

Furthermore, climate change could exacerbate Aflatoxin contamination of agricultural products due to rising temperatures and more unpredictable rainfall patterns. Prevalence data from many African countries, including Zambia, suggest that Aflatoxin contamination in essential staples exceeds acceptable thresholds compared to those of 20 ppb for the USA and four ppb of total Aflatoxin and two ppb of Aflatoxin B1 for food crops in European nations.[2]

The regulatory limits for total Aflatoxin in crops intended for human consumption in Zambia is 10 μg kg^{-1}.[3]

Impacts on Agriculture, Economy and Public Health

Agriculture and Food Security

The contamination of important crops by Aflatoxin could negatively impact agricultural productivity and the four pillars of food security (availability, access, utilisation, and stability). Food availability can be reduced by Aflatoxin contamination. At the same time, producers of the affected crop may experience reduced earnings due to product rejection, a decrease in market value, or limited access to lucrative international trade and formal markets.

Consequently, reduced farmer earnings restrict the household's ability to obtain food, which results in decreased food accessibility. Contaminated produce limits its utilisation, thus rendering it useless or possibly used in other safe ways.

Economy

Aflatoxins predominantly impact crops such as cereals (maize, rice, sorghum, millet, wheat), root crops (cassava), nuts (cashews), oilseeds (groundnuts, cottonseed, sesame), spices (especially chillies), and by-products of these crops. As such, many countries have instituted restrictions to restrict Aflatoxin exposure, often quantified in parts per billion (ppb). The enforcement of regulatory limitations on Aflatoxin levels in food and feed results in market losses for agricultural products and reduced revenue for farmers.[4]

Certain countries impose varying limitations based on the intended use, with the most stringent regulations governing human consumption and exports, while the least restrictive pertain to industrial items. For instance, Europe and South Africa, with regulatory thresholds of 4 and 10 ppb total Aflatoxin, respectively, have been significant markets for Zambian agricultural exports.

In the 1960s, the country exported over 8000 metric tons of groundnut to Europe. However, this industry deteriorated partly owing to the implementation of Aflatoxin legislation in Europe.[5]

The direct financial implications of Aflatoxin contamination in crops mostly stem from a decrease in marketable volume, lower selling prices in national markets, and the inadmissibility or rejection of products by the international market.

Public Health

The consumption of Aflatoxin-contaminated crops or foodstuffs by humans can result in Aflatoxin poisoning (i.e., aflatoxicosis) and a myriad of illnesses, including diarrhoea, childhood stunting, and liver cancer. Aflatoxin may potentially enter the human diet through livestock products if the animals consume feed contaminated with Aflatoxins.

Aflatoxin-contaminated food poses a food security problem due to its documented links to liver cancer, synergistic effects with Hepatitis B, and probable relationship with stunting and immunosuppression.

Potential Solutions for Aflatoxin Control

Awareness and sensitisation of farmers and all stakeholders along the maize and groundnut value chains to Aflatoxins is an essential part of any intervention strategy to manage the problem. Measures must also ensure that information and resources for Aflatoxin management are directed towards sectors that yield significant effects, whether in agriculture, commerce, or health.

Furthermore, effective management of Aflatoxin necessitates an integrated strategy, including many proven methods. These encompass biological control, promoting Good Agricultural Practices (GAPs), and Good Manufacturing Procedures (GMPs).

Biocontrol technology – AflasafeZM

In Zambia, a product called AflasafeZM01 was developed through a collaboration involving the International Institute for Tropical Agriculture, the United States Department of Agriculture-Agricultural Research Service, the National Institute for Scientific and Industrial Research, and the Zambia Agriculture Research Institute, dating back to 2012.

Lunch of AflasafeZM at the Radisson Blu Hotel in Lusaka

This product contains beneficial strains of toxigenic fungi native to Zambia that outcompete Aflatoxin-producing fungi, thus suppressing the production of Aflatoxin. The field testing of Aflasafe across countries produced extremely positive results, indicating it is a cost-effective technology. When appropriately used, the product consistently reduces Aflatoxin contamination of maize

and groundnuts by more than 80 percent and up to 100 percent when compared to crops in untreated fields.

Adopting and applying fail safes in farmers' fields could significantly address Aflatoxin contamination, thereby improving the health and livelihoods of millions of families while reducing food losses. The Zambia Environmental Management Agency approved the commercial production and use of Aflasafe ZM01.

Good Agricultural Practices

Good agricultural practices (GAPs) for crop production contribute to maintaining soil fertility and promote healthy crops, thereby enhancing their resilience to diseases and environmental stressors. Pre-harvest good practices include using certified and improved varieties, practising crop rotation, applying appropriate soil amendments (such as lime), animal manure, and compost, using suitable Integrated Pest Management (IPM) options, and practicing timely planting. It is worth noting that Aflatoxin mitigation during pre-harvest is inadequate to prevent Aflatoxin contamination.

Aflatoxin management must continue during both the harvest and post-harvest periods. Post-harvest strategies are crucial in avoiding Aflatoxin contamination due to the capacity of *Aspergillus* to grow spread during this phase. Employing suitable sorting, drying, and storage methods can markedly decrease Aflatoxin contamination by 63-88 percent.[6]

Additionally, the use of hermatic storage technologies to store grains provides an opportunity to improve health by mitigating the impact of Aflatoxin while reducing insecticide use.

Challenges and Gaps

Aflatoxin-related management practices are not fully implemented throughout maize and groundnut production in Zambia, posing a health risk and contributing to malnutrition. Public awareness of Aflatoxins, their causes, and their health effects, especially chronic health risks, is lacking.

In Zambia, rural farming households, where Aflatoxin contamination is prevalent, often have significant knowledge gaps regarding Aflatoxins and their prevention and control. Thus, educating rural farming households and other stakeholders about

Aflatoxin control and prevention in food crops could reduce community exposure to Aflatoxins.[7]

Strategic Policy Recommendations

Strengthen Aflatoxin Testing Capacity

The development and equipping of national Aflatoxin testing laboratories, including mobile units, should be enhanced under the auspices of the Ministry of Agriculture's Department of Research (Zambia Agriculture Research Institute) and the Ministry of Health.

The current centralised testing capacity is constrained, rendering it inaccessible to the majority of farmers and small to medium-sized enterprises (SMEs). The decentralisation system facilitates prompt identification and targeted intervention in contamination incidents.

These actors employ different procedures and processes in determining the safety of the commodities. As such, the process becomes not only cumbersome but unstandardised.

Harmonise and Enforce Aflatoxin Standards

Aflatoxin limits in food and feed should be reviewed, aligned, and enforced in accordance with international standards, including those of the Codex Alimentarius, the Common Market for Eastern and Southern Africa (COMESA), and the European Union. The rationale is that inconsistent enforcement weakens compliance and increases the likelihood of market rejection. The initiative improves food safety, facilitates trade, and fosters confidence in Zambian commodities.

In addition, having many actors with different mandates involved in regulating foods and food products, there is a need to harmonise the testing protocol for use by relevant stakeholders along the food value chain.

Promote Farmer Training and Awareness

Measures should be implemented to institutionalise Aflatoxin awareness through agricultural extension services, radio programmes, and educational curricula. The rationale is that numerous smallholder farmers lack awareness regarding the risks associated with Aflatoxin and the available control measures. The initiative enhances the adoption of GAPs and mitigates post-harvest losses.

Promote PPPs for Safe Value Chains

Certification programmes and buyer incentives, such as price premiums, for commodities that are safe from Aflatoxin contamination should be established. The rationale is that market incentives can promote improved practices throughout the supply chain; stimulates private investment; and enhances value-added food safety.

Certification and labelling of Aflatoxin-tested foods as "Aflatoxin safe" will assist regulators in facilitating trade. Further, labelling will enable consumers to make informed choices.

Boost Post-Harvest Infrastructure and Tech

Credit facilities should be implemented to support the establishment of drying facilities, hermetic storage technologies, and threshing equipment. The rationale is that post-harvest handling serves as one of the significant entry points for Aflatoxins, primarily due to inadequate infrastructure; reduces Aflatoxin levels; and enhances grain quality and market appeal.

Integrate Aflasafe into GAP

Aflasafe application should be incorporates as a standard component of Good Agricultural Practices. This integration is seen as essential for: i) Aflatoxin-Free Fields - achieving a widespread reduction of Aflatoxin contamination in agricultural produce. Ii) Enhanced Market Access - facilitating access to premium markets, particularly the South African market as well as the European Union, where stringent food safety standards are enforced.

The adoption of Aflasafe and other management practices available to minimise Aflatoxin contamination will build confidence in the quality and safety of domestically produced goods.

Conclusion

Comprehensive, multi-sectoral strategies are crucial in addressing the complex Aflatoxin issue and improving the health, income, and livelihoods of Zambian farmers, farm households, and consumers.

An effective Aflatoxin control programme will encompass various complementary elements, including policies, standards, and regulations on food security and health evaluations; initiatives to elevate consumer demand for safe, high-quality food;

dissemination and adoption of advanced inputs and technological solutions, alongside improved production quality; mechanisms for inspecting commodities, regulating quality, and ensuring proper storage; access to safe and high-quality food ingredients.

All these actions must be implemented at all levels throughout the value chain to mitigate Aflatoxin prevalence and exposure in Zambia.

Endnotes

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