AFLATOXINS IN FOOD GRAINS: CONTAMINATION, DANGERS AND CONTROL

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ABSTRACT
The most concern postharvest safety issue in food grains is aflatoxins production in contaminated stored grains. Consumption of aflatoxins contaminated grains can lead to complicated health issues that can lead to death. Aflatoxins are secondary metabolites commonly produced by Aspergillus flavus and Aspergillus parasiticus. They were reported to disturb foetus development, causes changes in living cells, suppresses the immune system and causes many forms of cancers. Aflatoxin B1 was classified under group 1 carcinogens by the International Agency for Research on Cancer. Aflatoxins contamination affects food security and can hinder international trade due to the strict ban enforce by many nations. Contaminations were reported in raw and processed grains (including ready-to-eat), milk and meat of farm animals and human breastmilk and blood. Major causes of grains aflatoxins contamination are wrong harvesting time and method, improper drying, poor storage and processing and higher moisture in the grains. Literature was gathered through an online search on Google Scholar, attention was given to the articles published in the last 5 years. Causes of fungal contamination, aflatoxins production and their control measures were deliberated, possible means of mitigating aflatoxins contamination through consumption of food grains were also recommended.

Keywords: mycotoxins, storage, drying, cereals, legumes

INTRODUCTION
Fungi can attack grains before or after drying and cause serious damage to raw materials and processed foods during storage and transportation (Aldars-García et al., 2016). Appropriate drying to a moisture content below microbial thriving levels is critical to the stability, postharvest storage and processing qualities of all stable grains (Bradford et al., 2018). Inappropriate storage and packaging materials that allow moisture permeation rises relative humidity during storage and favours insects and microbial activities (Bradford et al., 2018). Postharvest grain losses cause great constrain to food and nutritional security (Afgognon et al., 2015; Likhaya et al., 2018; Mezgebe et al., 2016), economy and health (Khaneghah et al., 2018; Kumari et al., 2020).

Aflatoxins (AFs) are immunosuppressive, carcinogenic (Kachapulula et al., 2017), mutagenic and teratogenic (Blankson and Mill-Robertson, 2016; Kebede et al., 2020) secondary metabolites produced by fungi (Aron et al., 2017), mainly Aspergillus (Eljack, 2012; Maringe et al., 2016; Valencia-Quintana et al., 2020), Fusarium (Kebede et al., 2020) and Penicillium (Elias, 2016) during storage of contaminated grains. Aspergillus flavus and Aspergillus parasiticus occurs more frequently than other fungi in grains and produced more AFs including AFB1 (Mom et al., 2020). Ezeikiel et al. (2020) recently discovered new fungi species suspected to be potential toxin producers. Mycotoxins production depends on certain environmental factors, fungi grow optimally in a humid environment rich in nutrients essential to them (Adejeye, 2016). Grains can be contaminated by either field fungi, store fungi, or both (Ncube and Maphosa, 2020; Tola and Kebede, 2016). Ramirez et al. (2018) reported changes in the population and types of fungi during the storage of chickpea. AFs contamination accounts for about 25 % of global crop loss (Serdar et al., 2020).

There are four types of AFs; B1, B2, G1 and G2 (Ahmadi et al., 2020) Aflatoxin B1 (AFB1) is the most mutagenic, carcinogenic and teratogenic material found in foods (Ahmadi et al., 2020; Nesci et al., 2016). It is the most potent known liver carcinogen (Jallow et al., 2018). It was classified under group 1 carcinogens by the International Agency for Research on Cancer (Al-Zoreky and Saleh, 2019). AFB1 is very stable and can be toxic at a meagre dose (Ponzilacqua et al., 2018). The menace of AFB1 is common to many staple foods in most developing countries. Groundnut is the most disposed crop to AFB1 contamination (Jallow et al., 2018). More than 90 % of food samples collected by Eshe et al. (2020) from Sidama zone, Ethiopia contains AFB1 above the EU permissible limit. Traditionally processed infant food in Ouagadougou, Burkina Faso contains AFB1; 900 times higher than the EU limit of 0.1 µg/kg (Ware et al., 2017). More than 41 % of maize market samples in Ghana contain AFB1 above Ghana and EU permissible limits (Kortei et al., 2021). Sulaiman et al. (2018) associated urine AFB1 with cereal products consumption. AFB1 estimated daily intake of 0.23 µg/kg/bwd and 0.153 µg/kg/bwd were reported in Ghanaian infants and children respectively (Blankson and Mill-Robertson, 2016). The results of a laboratory experiment conducted by Brani et al. (2017) showed that Plerotus eryngii (king oyster mushroom) can degrade AFB1 in malt extract broth.

In addition to AFs, fungi also produced other carcinogenic and mutagenic secondary metabolites such as cyclopiazonic acid, aflatrem (Ojiambo et al., 2018), ochratoxin A, fumonisins (Sun et al., 2017), deoxynivalenol, zearalenone, T-2 toxin and HT-2 toxin (Kunz et al., 2020). Fusarium graminearum produces...
zearalenone and deoxynivalenol in grains particularly during slow drying or due to higher moisture in stored grains (Portell et al., 2020). Ochratoxin A and fumonisins were reported to cause renal cancer and liver cancer respectively (Huong et al., 2016).

The menace of mycotoxins contamination is a threat to food safety during storage and distribution (Aldars-García et al., 2016). AFs are persistent and their contamination can occur before or during harvesting (Kortez et al., 2019) and at various points along the supply chain depending on the handling condition (Mannaa and Kim, 2017; Neme and Mohammed, 2017; Udomkun et al., 2017). Bamba et al. (2021) reported AFs contamination in the spathes, cobs and grains of maize. Contamination occurs mostly during drying and storage (Njorge et al., 2019; Quellhorst et al., 2020).

**Aflatoxins Contamination**

Postharvest AFs contamination occurs when aflatoxicogenic strains of *Aspergillus* contaminates grains before harvest (Waliyar et al., 2015). Global consumption of AFs ranged from 3.0 to 17.1 ng/kg bw/day with rice, wheat and maize having the highest contributions (Andrade and Caldas, 2015). The maximum permissible limit for AFs in grains is 10 µg/kg (10 ppb) (Ayleign et al., 2018).

AFs contamination occurs in grains due to exposure to certain pre-and post-harvest conditions (Aron et al., 2017). Contaminations are mostly associated with poor agricultural practices (Nleya et al., 2018). Tuan et al. (2018) reported that non-dormant seeds and that with low levels of dormancy can germinate while attached to the mother plant, this can reduce yield and trigger mould growth and AFs accumulation before harvest. Kachapulula et al. (2017) reported that uncultivated lands are loaded with more AFs producing organisms than cultivated lands. Mould growth and AFs contamination depend greatly on grain moisture content and temperature and relative humidity of the storage or packaging environment (Neme and Mohammed, 2017; Tola and Kebede, 2016).

Major factors that account for AFs contamination are wrong harvesting time and method, improper drying, inadequate storage and processing and higher moisture in the grains (Chakwukere et al., 2021; Neme and Mohammed, 2017). Aron et al. (2017) also reported that poor postharvest handling of grains causes AFs contamination. Seetha et al. (2017) witnessed AFB1 increase in maize, sorghum, Bambara nut, groundnut, and sunflower during storage. Tibagonzeka et al. (2018) reported that grains dried on the bare surface are more prone to AFs contamination than grains dried on a covered surface.

Except for few crops such as rice, many kinds of cereal and legumes are disposed to AFs contamination (Gonçalves et al., 2019; Sun et al., 2017). Contaminations were reported during the pre-and postharvest stages in groundnuts, millet, sesame seeds, maize, wheat, rice, fig, spices, cocoa, and processed products such as peanut butter, cooking oil (Mahato et al., 2019), bakery products, coffee, macaroni (Serdar et al., 2020) and processed flours (Adeyeve, 2016) among other grain products. Legumes in general are more prone to AFs contamination (Eljack, 2012) and groundnut is more disposed than other legumes (Maringe et al., 2016). Sorghum, groundnut and maize contributed to AFs contamination more than other grains (Neme and Mohammed, 2017; Tibagonzeka et al., 2018), their prevalence of AFs contamination can be as high as 91 %, 55 % and 44 % respectively (Tibagonzeka et al., 2018). Maize, peanut and peanut oil are the most disposed food to AFs contamination in sub-Sahara Africa (Ingenbleek et al., 2019). Higher temperatures and relative humidity facilitate mould growth and AFs formation (Sun et al., 2017; Valencia-Quintana et al., 2020). The prevailing weather condition in sub-Sahara Africa characterized by heavy downfall and higher temperatures, facilitate mould growth and AFs production in grains (Ingenbleek et al., 2019; Ncube and Maphosa, 2020; Nleya et al., 2018).

The danger is more common and likewise more extreme in developing countries (Udomkun et al., 2017). Mycotoxins contamination is more common in African countries due to poor socio-economic conditions (Kebede et al., 2020). The results of the survey conducted by Wangia-Dixon et al. (2020) in Makueni and Siaya Counties, Kenya showed that children from low-income families are more prone to AFs contamination. About 49 % of complimentary food samples collected by Aron et al. (2017) from Bahi District, Tanzania reported being contaminated with AFs. A significant proportion of maize, sorghum and millet samples collected from Makueni and Nandi, Kenya contains AFs and fumonisins above the recommended levels of 10 ppb and 2 ppm respectively (Kang’Ethe et al., 2017). The AFs levels in recently harvested groundnuts, beans, cowpeas and Bambara nuts samples from Shampa and Makoni districts, Zimbabwe is alarming and may significantly upsurge during storage (Maringe et al., 2016). Blankson et al. (2019) reported that 96 % of processed infant food sold in Accra, Ghana possessed AFs above the EU permissible limit. The finding of Obade (2015) revealed that weaning foods commonly used Kisumu County, Kenya are contaminated with AFs above permissible amounts. About 93 and 42 % of household and industrially processed foods samples respectively collected from Lagos and Ogun States, Nigeria are contaminated with mycotoxins including AFs (Ojuri et al., 2019). Rice and beans samples collected from Enugu, Nigeria contain AFs above permissible limits (Dozie-Nwakille et al., 2020). Likewise, maize samples collected from Dutsinma, Nigeria was heavenly contaminated with *Aspergillus* fungi (Mzungu et al., 2018). About 58 % of basmati rice samples collected from Lahore, Narowal, Faisalabad and Multan, Pakistan reported to content aflatoxins above permissible limits (Mukhtar et al., 2016). Aflatoxins content between 0.09 and 579 µg/kg were reported in nutrient food samples collected from Jidda markets in Saudi Arabia (Tawila et al., 2020). More than 95 % of complimentary food samples collected from Amhara, Tigray and Oromia, Ethiopia were contaminated with AFs (Ayleign et al., 2018). About 72 % of infant foods samples collected from Accra, Ghana contains AFB1 above EU permissible limits (Blankson and Mill-Robertson, 2016). Total AFs content in maize, sorghum and millet flours collected from commercial milling centers in Nairobi, Kenya was found to be 59.73, 39.21 and 34.80 µg/kg respectively ( Wanjeri et al., 2017). Eshete et al. (2020) detected AFs above EU permissible limits in 5.3 % of breastmilk samples collected from Sidama zone, Ethiopia.

Developing countries with strict food regulations reported lower levels of AFs contamination. Values within permissible limits were reported by Ahmadi et al. (2020) in peas, red beans, lentils, mung bean and cotyledons samples collected from Tehran, Iran. Likewise, rice samples collected from imported bulk in Saudi Arabia (Al-Zoreky and Saleh, 2019). Fungal hydrolytic enzymes also lead to the degradation of proteins and carbohydrates in grains, this can lead to a poor
quality dough and bad baked products (Schmidt, 2018). AFs contamination is seriously affecting the economy of many developing nations due to strict AFs contamination regulations in international trade (Eljack, 2012; Tunukunde et al., 2020; Udomkun et al., 2017).

**Dangers Associated with Aflatoxins Contamination in Grains**

Inappropriate handling and storage of grains after harvesting expose them to optimum conditions for fungal growth and AFs production (Waliyar et al., 2015). The quality and safety of processed grains and their by-products depend to the large extent on the pre-and post-harvest qualities of the grains (Pratap et al., 2016). The danger of microbial postharvest losses is beyond losing grains qualities, it can as well lead to dangerous health problems including cancers (Schmidt et al., 2018).

Mycotoxin (including AFs) contaminations through consumption of inadequately dried and contaminated foods are affecting about 4.5 billion people in the world (Bradford et al., 2018). AFs can pass through the metabolic system unchanged and accumulate in body organs (Khaneghah et al., 2018). Therefore, AFs can be found in the milk and meat of farm animals fed on the contaminated diets (Wangia-Dixon et al., 2020). AFs were also found in human serum (Sabuncuoglu et al., 2015) and breastmilk (Eshele et al., 2020).

Consumption of foods contaminated with AFs is a threat to human and animal health (Mannaa and Kim, 2017; Ojiambo et al., 2018). Depending on cereal legume-based composites exclusively as complimentary food exposed children to malnutrition and AFs and fumonisins contaminations (Mollay et al., 2021). AFs contamination can lead to poor growth and development (Achaglinkame et al., 2017), vaccine interference (Wangia-Dixon et al., 2020) and iron deficiency (Opoku et al., 2018) in infants and children. Can also lead to grave health issues including liver cancer (Maringe et al., 2016), immune suppression, embryo toxicity and nutritional deficiencies (Granados-Chinchilla et al., 2017). Acute aflatoxicosis can lead to haemorrhage, severe liver damage, oedema, and death (Khaneghah et al., 2018). In addition to aflatoxicosis, food fungal contamination can also cause other serious diseases such as aspergillosis (Dozie-Nwakile et al., 2020) and infections in patients with immune-compromised and hypersensitive reactions such as asthma and allergic alveolitis (Muhie and Bayisa, 2020).

**Control of Aflatoxins Contamination in Grains**

Controlling AFs in grains is quite challenging because many fungal species are toxigenic and their mycotoxins synthetic pathways and factors affecting them are not yet fully understood (Aldars-García et al., 2016). Postharvest decontamination of grains is crucial to the postharvest quality and safety of grains and their products (Schmidt et al., 2019). Preventing the growth of AFs producing microorganisms will inevitably prevent AFs contamination in cereals and legumes (Achaglinkame et al., 2017). Sirma et al. (2018) opined that the addition of AFs absorbents and enzymes can significantly lower AFs contamination. Many plant extracts and essential oils were reported to mitigate fungal growth and AFs production (Ponzilacqua et al., 2018). Telles et al. (2017) reported that peanut and azuki bean phenolic extracts can protect beans against fungal contamination and AFs production.

AFs contamination can effectively be control in grains through decent agricultural practice, (Achaglinkame et al., 2017; Gonçalves et al., 2019), production of fungi resistant varieties (Neube and Maphosa, 2020), fast and proper drying, insects control, use of natural and synthetic antifungal, irradiation (Neme and Mohammed, 2017), cleaning and sanitizing storage facilities, avoiding conditions that will favour mould growth and AFs production (Gagi et al., 2018), avoiding grains damage, ensuring good postharvest practices (Mannaa and Kim, 2017), prevention legislation and policy (Khaneghah et al., 2018) and public enlightenment (Achaglinkame et al., 2017; Michael et al., 2018). Training farmers on AFs contamination mitigating techniques yielded positive results in Tanzania (Seetha et al., 2017). Neski et al. (2016) recommended the use of food-grade antioxidants microcapsules in the prevention of fungal attacks and AFs production. Incorporation of savannah tea leaves as bio-pesticide into hermetic bag reduces aflatoxins contamination in cowpea during 8 months of storage (Constant et al., 2016).

Cleaning and processing operations such as sorting, milling, fermentation, roasting, baking, flaking and extrusion cooking are reported to lower mycotoxins levels in food (Neme and Mohammed, 2017). Products of lactic acid fermentation were reported to prevent AFs synthesis (J. Prakash, 2016). Ibitoye et al. (2020) reported a decrease in the growth rate of A. flavus and a reduction in AFB1 and AFB2 production in sorghum and millet treated with monoculture and co-culture LAB. Processing methods and severity also affect AFs concentration, Ojiri et al. (2019) reported that household processed foods are more contaminated with mycotoxins than industrially proceed foods. Kamala et al. (2018) reported that sorting by handpicking, proper sun drying on an elevated surface, chemical treatment before storage and dehulling of maize before milling lower AFs intake in Tanzanian infants by 78 %. Microwave, vacuum packaging and high hydrostatic pressure inhibited fungal growth and AFs production in wheat (Schmidt et al., 2019). Waliyar et al. (2015) reported a higher concentration of AFB1 in groundnut paste than in groundnut seed in market samples collected from Kolokani, Kayes, and Kita districts, Mali. The higher concentration of the AF in the processed product may result from post-process exposure to environmental conditions that favours AFs production. The finding of Udomkun et al. (2019) showed that combining staple grains with other locally available crops reduces grains AFs contamination. While combining other grains with groundnut drastically increase AFs in the resultant composite (Temba et al., 2017). Similarly, much higher contaminations were reported in cereal legume-based foods than in cereal-based products (Opoku et al., 2018).

A meaningful advancement in controlling AFs contamination was reported in biological control using atoxigenic (nonAFs producing) strains of A. flavus (Ojiambo et al., 2018). Sarrocco and Vannacci (2018) reviewed the possibility of applying beneficial fungi at the pre-harvest stage to prevent postharvest fungal contamination and mycotoxins production in cereals, apples and grapes. N2 saturated atmosphere (98.5 %) greatly reduces growth and sporulation of all AFs producing Aspergillus and destroy Staphylococcus and Tribolium confusum after 3 and 7 days in wheat and its flour respectively (Lorenzo et al., 2020). AFs contamination in developing countries requires a collective approach that will simultaneously consider food safety, food production and humans and animal health (Aron et al., 2017). Most consumers in developing countries are not familiar with the dangers associated with the consumption of moldy foods.
(Adeyeye, 2020). Njoroge (2018) opined that success in the fight against AFs contamination will only be achieved in Africa if consumers realised the dangers associated with the consumption of AF-contaminated foods and start demanding better quality and safe foods. Technical and financial support from international donors is required to minimise or eliminate AFs contamination since many developing countries lack adequate resources (Elias, 2016). Achaglinkame et al. (2017) recommended the substitution of cereal-legume blend with a tuber-based blend for infant formula, this could not provide some essential nutrients and can only be possible if the blends will be enriched with the essential nutrients deficient in tuber crops. Farmers and other stakeholders in Africa need to be sensitized on the activities of Partnership for Aflatoxin Control in Africa (PACA), stakeholders are required to present valid evidence for AFs contamination to access AFs mitigation technologies (Njoroge, 2018).

**Recommendations**

1. Consumers should avoid crops with higher AFs accumulation. Sorghum, groundnut and maize were reported to habitually accumulate AFs. These can be substitute by underutilized grains such as millet which was reported to have excellent nutritional and health benefits (Birania et al., 2020)
2. Recently harvested grains with alarming levels of fungi and/or AFs contaminations should be processed immediately to avoid AFs accumulation during storage
3. Countries in sub-Saharan Africa need to urgently develop and enact regulations on AFs food contamination as the region is the most reported in the literature, possibly due to the prevailing weather condition that favours fungal growth.
4. Researches in plant genetics and molecular biology should be focused on developing grains that will be resistant to fungal contamination. The development of insect and mold resistance grains will surely improve safety and minimize storage challenges particularly among farmers that cannot afford modern storage and packaging materials.
5. The possibility of eliminating *Aspergillus* fungus during the storage of grains through microbiological succession using benign microorganisms should be studied.
6. Microorganisms and insects continue to develop resistance to the existing various postharvest treatments, hence unceasing research is necessary in this area.

**CONCLUSION**

The jeopardy of AFs contamination is a threat to public health in many developing countries. Inappropriate storage and packing systems with higher humidity and temperature allow the growth and proliferation of aflatoxins producing fungi. Contamination can also occur during harvest and pre-harvest time. Fungi metabolites can contaminate up to 25% of stored grains when exposed to unsuitable storage conditions. Higher levels of contaminations were reported in legumes grains, however, staples grains such as wheat, rice and maize account for greater contaminations in humans. Control of AFs contamination requires a holistic approach that will protect throughout the supply chain. The danger can be mitigated by decent agricultural, storage and processing practices; including production of resistance verities, proper and adequate drying, insect and mold control during storage, good manufacturing practices including proper and adequate cleaning and processing, education and enlightenment, and extenuating legislation and policy that will ensure acceptance of only good quality commodities.

**REFERENCES**

Achaglinkame, A. M., Opoku, N., & Amaglo, F. K. (2017). Aflatoxin contamination in cereals and legumes to reconsider usage as complementary food ingredients for Ghanaians infants: A review. *Journal of Nutrition and Intermediary Metabolism, 10*, 1–7. https://doi.org/10.1016/j.jnim.2017.09.001

Adeyeye, S. A. O. (2016). Fungal mycotoxins in foods: A review. *Cogent Food & Agriculture, 2*(1), 1–11. https://doi.org/10.1080/23311932.2016.1213127

Adeyeye, S. A. O. (2020). Aflatoxigenic fungi and mycotoxins in food: a review. *Critical Reviews in Food Science and Nutrition, 60*(5), 709–721. https://doi.org/10.1080/01448194.2018.1548429

Affognon, H., Mutungi, C., Sangina, P., & Borgemeister, C. (2015). Unpacking postharvest losses in sub-Saharan Africa: A Meta-Analysis. *World Development, 66*, 49–68. https://doi.org/10.1016/j.worlddev.2014.08.002

Ahmadi, M., Jahed Khiangi, G., Shariatifar, N., & Molae-Aghae, E. (2020). Investigation of aflatoxins level in some packaged and bulk legumes collected from Tehran market of Iran. *International Journal of Environmental Analytical Chemistry, 1*, 1–10. https://doi.org/10.1080/03067319.2020.1789614

Al-Zoreky, N. S., & Saleh, F. A. (2019). Limited survey on aflatoxin contamination in rice. *Saudi Journal of Biological Sciences, In Press*. https://doi.org/10.1016/j.sjbs.2017.05.010

Aldars-García, L., Ramos, A. J., Sanchis, V., & Marín, S. (2016). Modeling postharvest mycotoxins in foods: recent research. *Current Opinion in Food Science, 11*, 46–50. https://doi.org/10.1016/j.cofo.2016.09.005

Andrade, P. D., & Caldas, E. D. (2015). Aflatoxins in cereals: Worldwide occurrence and dietary risk assessment. *World Mycotoxin Journal, 8*(4), 415–431. https://doi.org/10.3920/WMJ2014.1847

Aron, L., Makangara, J. J., Kassim, N., & Ngoma, S. J. (2017). Post-harvest Practices Associated with Aflatoxins Contamination of Complementary Flours in Bahi District, Dodoma, Tanzania. *International Journal of Sciences: Basic and Applied Research, 36*(6), 174–186. http://gssrr.org/index.php?journal=JournalOfBasicAndAppliedResearch

Ayelign, A., WoldegOi, A. Z., Adish, A., & De Saeger, S. (2018). Total aflatoxins in complementary foods produced at community levels using locally available ingredients in Ethiopia. *Food Additives and Contaminants: Part B Surveillance, 11*(2), 111–118. https://doi.org/10.1080/19393210.2018.1437784
Bamba, S., Biego, H. M. G., Coulibaly, A., Yves, N. B., & Daouda, S. (2021). Determination of the Level of Aflatoxins Contamination in Maize (Zea mays L.) Produced in Five Regions of Côte d’Ivoire. *Asian Research Journal of Agriculture*, 4(2), 21–31. https://doi.org/10.9734/arja/2021/v14i230121

Birania, S., Rohilla, P., Kumar, R., & Kumar, N. (2020). Post harvest processing of millets: A review on value added products. *International Journal of Chemical Studies*, 8(1), 1824–1829. https://doi.org/10.22271/chemi.2020.v8.i1a.8528

Blankson, G. K., & Mill-Robertson, F. C. (2016). Aflatoxin contamination and exposure in processed cereal-based complementary foods for infants and young children in greater Accra, Ghana. *Food Control*, 64, 212–217. https://doi.org/10.1016/j.foodcont.2015.12.032

Blankson, G. K., Mills-Robertson, F. C., & Ofosu, I. W. (2019). Survey of occurrence levels of Aflatoxins in selected locally processed cereal-based foods for human consumption from Ghana. *Food Control*, 95, 170–175. https://doi.org/10.1016/j.foodcont.2018.08.005

Bradford, K. J., Dahal, P., Van Asbrouck, J., Kunusoith, K., Bello, P., Thompson, J., & Wu, F. (2018). The dry chain: Reducing postharvest losses and improving food safety in humid climates. *Trends in Food Science and Technology*, 71, 84–93. https://doi.org/10.1016/j.tifs.2017.11.002

Brànà, M. T., Cimmarusti, M. T., Haidukowski, M., Logriecco, A. F., & Altomare, C. (2017). Bioremediation of aflatoxin B1-contaminated maize by king oyster mushroom (Pleurotus eryngii). *PLoS ONE*, 12(8), 1–14. https://doi.org/10.1371/journal.pone.0128574

Chukwukere, V., Amah, N., & Jabil, I. (2021). Perceived Causes of Aflatoxin Contamination of Cereal and Legume Grains on Rural Farmers’ Livelihood In Jos South Local. *International Journal of Science and Applied Research*, 4(1), 39–44.

Constant, K. K., Adama, C., Daouda, S., Olivier, C., Godi, B., & Marius, H. (2016). Evolution of Aflatoxins Levels during Storage of Cowpeas (Vigna unguiculata L Walp) Bagged Pics Containing Lippia multiflora Moldenke Leaves and Ivorian Exposure Risk. *International Journal of Science and Research (IJSR)*, 5(7), 678–691. https://doi.org/10.21275/v57.ait.2016285

Dozie-Nwakile, O., Onyemelukwe, N., Nwakile, C., Okonwa, C., Okongwu, U., Ukpai, N., & Ilo, A. (2020). Nutritional Sustainability for a Child towards Isolation of Aspergillus Species from Some Cereals and Legumes Sold in Enugu. *Acta Scientica Nutritional Health*, 4(5), 55–59. https://doi.org/10.31080/asnh.2020.04.0702

Eljaj, A. E. T. M. (2012). *Level of Contamination with the Fungus (Aspergillus flavus) and Aflatoxins in Some Legume seeds and Cereal Grains*. University of Gezira.

Eljaj, A. E. T. M., & Akello, J., Bandiyopadhyay, R., & Cotty, Eshete, M., Gebremedhin, S., Alemayehu, F. R., Taye, M., Boshe, B., & Stoeker, B. J. (2020). Aflatoxin contamination of human breast milk and complementary foods in southern Ethiopia. *Maternal and Child Nutrition*, 17(1), 13081. https://doi.org/10.1111/mcn.13081

Ezekiel, C. N., Kraak, B., Sandoval-Denis, M., Sulyok, M., Oyedele, O. A., Ayeni, K. I., Makinde, O. M., Akinyemi, O. M., Kraska, R., Crous, P. W., & Houbraken, J. (2020). Diversity and toxigenicity of fungi and description of Fusarium madaense sp. nov. From cereals, legumes and soils in north-central Nigeria. *MycOKeys*, 67, 95–124. https://doi.org/10.3897/MYCOKEYS.67.52716

Gagiu, V., Mateescu, E., Armeanu, I., Dobre, A. A., Smeu, I., Cucu, M. E., Oprea, O. A., Jorga, E., & Belc, N. (2018). Post-harvest contamination with mycotoxins in the context of the geographic and agroclimatic conditions in Romania. *Toxins*, 10, 1–17. https://doi.org/10.3390/toxins10120533

Gonçalves, A., Gkrillas, A., Dorne, J. L., Dall’Asta, C., Palumbo, R., Lima, N., Battilani, P., Venâncio, A., & Giorni, P. (2019). Pre- and Postharvest Strategies to Minimize Mycotoxin Contamination in the Rice Food Chain. *Comprehensive Reviews in Food Science and Food Safety*, 18(2), 441–454. https://doi.org/10.1111/1541-4337.12420

Granados-Chinchilla, F., Molina, A., Chavarria, G., Alfaro-Cascante, M., Bogantes-Ledezma, D., & Murillo-Williams, A. (2017). Aflatoxins occurrence through the food chain in Costa Rica: Applying the One Health approach to mycotoxin surveillance. *Food Control*, 82, 217–226. https://doi.org/10.1016/j.foodcont.2017.06.023

Huong, B. T. M., Tuyen, L. D., Tuan, D. H., Brimer, L., & Dalsgaard, A. (2016). Dietary exposure to aflatoxin B1, ochratoxin A and fumonisins of adults in Lao Cai province, Viet Nam: A total dietary study approach. *Food and Chemical Toxicology*, 98, 127–133. https://doi.org/10.1016/j.fct.2016.10.012

Ibitoye, O. A., Olaniyi, O. O., Ogidi, C. O., & Akinyele, B. J. (2020). Lactic acid bacteria bio-detoxified aflatoxins contaminated cereals, ameliorate toxicological effects and improve haemato-histological parameters in albino rats. *Toxin Reviews*, 1–12. https://doi.org/10.1080/15569543.2020.1817088

Ingenbleek, L., Sulyok, M., Adegboye, A., Hoossou, S. E., Koné, A. Z., Oyedele, A. D., Kistiso, C. S. K. J., Dembélé, Y. K., Eyangoh, S., Verger, P., Leblanc, J. C., Le Bizec, B., & Kraska, R. (2019). Regional sub-saharan Africa total diet study in benin, cameroun, mali and nigeria reveals the presence of 164 mycotoxins and other secondary metabolites in foods. *Toxins*, 11(1), 1–23. https://doi.org/10.3390/toxins11010054

Jallow, E. A., Twumasi, P., Charles Mills-Robertson, F., & Dumevi, R. (2018). Assessment of aflatoxin-producing fungi strains and contamination levels of aflatoxin B1 in groundnut, maize, beans and rice. *Journal of Agricultural Science and Food Technology*, 4(4), 71–79. http://pearlresearchjournals.org/journals/jasft/index.html

Kachapulula, P. W., Akello, J., Bandiyopadhyay, R., & Cotty,
P. J. (2017). Aspergillus section Flavi community structure in Zambia influences aflatoxin contamination of maize and groundnut. *International Journal of Food Microbiology*, 261, 49–56. https://doi.org/10.1016/j.ijfoodmicro.2017.08.014

Kamala, A., Kimanya, M., De Meulenaer, B., Kolsteren, P., Jacxsens, L., Haesaert, G., Kilango, K., Magoha, H., Tiisetsk, B., & Lachat, C. (2018). Post-harvest interventions decrease aflatoxin and fumonisin contamination in maize and subsequent dietary exposure in Tanzanian infants: A cluster randomised-controlled trial. *World Mycotoxin Journal, In press*. https://doi.org/10.3920/WMJ2017.2234

Kang’Ethe, E. K., Sirma, A. J., Murithi, G., Mburugu-Mosoti, C. K., Owko, E. O., Korhornen, H. J., Nduhiu, G. J., Mungatu, J. K., Joutsjoki, V., Lindfors, E., & Ramo, S. (2017). Occurrence of mycotoxins in food, feed, and milk in two counties from different agro-ecological zones and with historical outbreak of aflatoxins and fumonisins poisonings in Kenya. *Food Quality and Safety*, 1(3), 161–169. https://doi.org/10.1016/j.fqsa.2017.03.008

Kebede, H., Liu, X., Jin, J., & Xing, F. (2020). Current status of major mycotoxins contamination in food and feed in Africa. *Food Control*, 110, 106975. https://doi.org/10.1016/j.foodcont.2019.106975

Khaneghah, A. M., Ismail, R., Raeisi, S., & Fakhri, Y. (2018). Aflatoxins in cereals: State of the art. *Journal of Food Safety*, 38(6), 1–7. https://doi.org/10.1111/jfs.12532

Kortei, N. K., Agyekum, A. A., Akumoa, F., Baffour, V. K., & Alidu, W. H. (2019). Risk assessment and exposure to levels of naturally occurring aflatoxins in some packaged cereals and cereal based foods consumed in Accra, Ghana. *Toxicology Reports*, 6, 34–41. https://doi.org/10.1016/j.toxrep.2018.11.012

Kortei, N. K., Annan, T., Akonor, P. T., Richard, S. A., Annan, H. A., Kyei-Baffour, V., Akumoa, F., Akpaloo, P. G., & Esu-Aamofo, P. (2021). The occurrence of aflatoxins and human health risk estimations in randomly obtained maize from some markets in Ghana. *Scientific Reports*, 11, 1–13. https://doi.org/10.1038/s41598-021-83751-7

Kumari, J. W. P., Wijayaratne, L. K. W., Jayawardena, N. W. I. A., & Egodawatta, W. C. P. (2020). Quantitative and Qualitative Losses in Paddy, maize and Greengram Stored under Household Conditions in Anuradhapura District of Sri Lanka. *Sri Lankan Journal of Agriculture and Ecosystems*, 2(1), 99–106. https://doi.org/10.4038/sljae.v2i1.32

Kunz, B. M., Wanko, F., Kemmllein, S., Balmann, A., Rohn, S., & Maul, R. (2020). Development of a rapid multi-mycotoxin LC-MS/MS stable isotope dilution analysis for grain legumes and its application on 66 market samples. *Food Control*, 109, 106949. https://doi.org/10.1016/j.foodcont.2019.106949

Likhayo, P., Bruce, A. Y., Tefera, T., & Mueke, J. (2018). Maize grain stored in hermetic bags: Effect of moisture and pest infestation on grain quality. *Journal of Food Quality*, 2515698, 1–9. https://doi.org/10.1155/2018/2515698

Lorenzo, M., Sabrina, S., Gianpaola, P., Antonio, M., Miriam, H., & Giovanni, V. (2020). N2 controlled atmosphere reduces postharvest mycotoxins risk and pests attack on cereal grains. *Phytoparasitica*, 48(4), 555–565. https://doi.org/10.1007/s12600-020-00818-3

Mahato, D. K., Lee, K. E., Kamle, M., Devi, S., Devangan, K. N., Kumar, P., & Kang, S. G. (2019). Aflatoxins in Food and Feed: An Overview on Prevalence. Detection and Control Strategies. *Frontiers in Microbiology*, 10, 1–10. https://doi.org/10.3389/fmicb.2019.02266

Mannaa, M., & Kim, K. D. (2017). Control Strategies for Deleterious Grain Fungi and Mycotoxin Production from Preharvest to Postharvest Stages of Cereal Crops: A Review. *Life Science and Natural Resources Research*, 25, 13–27. https://www.researchgate.net/publication/323028050

Maringe, D. T., Chiedewe, C., Benhura, M. A., Mvumi, B. M., Murashiki, T. C., Dembedza, M. P., Siziba, L., & Nyanga, L. K. (2016). Natural postharvest aflatoxin occurrence in food legumes in the smallholder farming sector of Zimbabwe. *Food Additives and Contaminants: Part B Surveillance*, 10, 1–7. https://doi.org/10.1080/19393210.2016.1240245

Mezgebe, A. G., Terefe, Z. K., Bosha, T., Muchie, T. D., & Teklegiorgias, Y. (2016). Post-harvest losses and handling practices of durable and perishable crops produced in relation with food security of households in Ethiopia: secondary data analysis. *Journal of Stored Products and Postharvest Research*, 7(5), 45–52. https://doi.org/10.5897/JSPR2016.0205

Michael, B., Chris, O., Babu, N., Aisha, A., Salisu Sanusi, G., Gaya, S., Alabi, O., & Adobe, K. (2018). Towards a successful management of aflatoxin contamination in legume and cereal farming systems in northern Nigeria: A case study of the groundnut value chain. *African Journal of Agriculture and Food Security*, 6(7), 269–276. www.internationalscholarsjournals.org

Mollay, C., Kassim, N., Stoltzfus, R., & Kimanya, M. (2021). Complementary feeding in Kongwa, Tanzania: Findings to inform a mycotoxin mitigation trial. *Maternal and Child Nutrition*, e13188, 1–10. https://doi.org/10.1111/mcn.13188

Mom, M. P., Romero, S. M., Larumbe, A. G., Iannone, L., Comerio, R., Smersu, C. S. S., Simon, M., & Vaamonde, G. (2020). Microbiological quality, fungal diversity and aflatoxin contamination in carob flour (Prosopis flexuosa). *International Journal of Food Microbiology*, 326(108655). https://doi.org/10.1016/j.ijfoodmicro.2020.108655

Muhie, O. A., & Bayisa, A. B. (2020). Is Aflatoxin a Threat to Human-Health in Ethiopia? A Systematic Review. *International Journal of Collaborative Research on Internal Medicine & Public Health*, 12(4), 1007–1015.

Mukhtar, H., Farooq, Z., & Manzoor, M. (2016). Determination of aflatoxins in sugar beet cake consumed in different regions of Punjab, Pakistan. *Journal of Animal and Plant Sciences*, 26(2), 542–548

Mzungu, I., Hamisu, H., & Umar, K. (2018). Evaluation of Microbiological Quality, Fungal Diversity and Aflatoxin Contamination in Carob Flour (Prosopis flexuosa). *Journal of Food Microbiology*, 326(108655). https://doi.org/10.1016/j.ijfoodmicro.2020.108655

Muhie, O. A., & Bayisa, A. B. (2020). Is Aflatoxin a Threat to Human-Health in Ethiopia? A Systematic Review. *International Journal of Collaborative Research on Internal Medicine & Public Health*, 12(4), 1007–1015.

Mukhtar, H., Farooq, Z., & Manzoor, M. (2016). Determination of aflatoxins in sugar beet cake consumed in different regions of Punjab, Pakistan. *Journal of Animal and Plant Sciences*, 26(2), 542–548

Mzungu, I., Hamisu, H., & Umar, K. (2018). Evaluation of Moulds Contamination of Cereals and Legumes Sold in Dutsinma Metropolis nd their Aflatoxin Production Potential. *FUDMA Journal of Sciences*, 2(4), 94–98.
AFLATOXINS IN FOOD… Abdullahi and Dandago FJS

https://doi.org/10.1088/1751-8113/44/8/085201

Ncube, J., & Maphosa, M. (2020). Current state of knowledge on groundnut aflatoxins and their management from a plant breeding perspective: Lessons for Africa. *Scientific African*, 7, e00264. https://doi.org/10.1016/j.sciaf.2020.e00264

Neme, K., & Mohammed, A. (2017). Mycotoxin occurrence in grains and the role of postharvest management as a mitigation strategies. A review. *Food Control*, 78, 412–425. https://doi.org/10.1016/j.foodcont.2017.03.012

Nesici, A., Passone, M. A., Barra, P., Girardi, N., García, D., & Etcheverry, M. (2016). Prevention of aflatoxin contamination in stored grains using chemical strategies. *Current Opinion in Food Science*, 11, 56–60. https://doi.org/10.1016/j.foods.2016.09.010

Njoroge, A. W., Baoua, L., & Baributsa, D. (2019). Postharvest Management Practices of Grains in the Eastern Region of Kenya. *Journal of Agricultural Science*, 11(3), 33–42. https://doi.org/10.5539/jas.v11n3p33

Njoroge, S. M. C. (2018). A critical review of aflatoxin contamination of peanuts in Malawi and Zambia: The past, present, and future. *Plant Disease*, 102, 2394–2406. https://doi.org/10.1094/pdis-02-18-0266-fe

Nleya, N., Adetunji, M. C., & Mwanza, M. (2018). Current status of mycotoxin contamination of food commodities in Zimbabwe. *Toxins*, 10(5), 1–12. https://doi.org/10.3390/toxins10050089

Obade, M. (2015). Exposure of children 4 to 6 months of age to aflatoxin in Kisumu County, Kenya. *African Journal of Food, Agriculture, Nutrition and Development*, 15(2), 9950–9963.

Ojiambó, P. S., Battilani, P., Cary, J. W., Blum, B. H., & Carbone, I. (2018). Cultural and genetic approaches to manage aflatoxin contamination: Recent insights provide opportunities for improved control. *Phytopathology*, 108(9), 1024–1037. https://doi.org/10.1094/PHYTO-04-18-0134-RVV

Ojurí, O. T., Ezeekiel, C. N., Eskola, M. K., Šarkanš, B., Babalola, A. D., Sulyok, M., Hajšlová, J., Elliott, C. T., & Krška, R. (2019). Mycotoxin co-exposures in infants and young children consuming household- and industrially-processed complementary foods in Nigeria and risk management advice. *Food Control*, 98, 312–322. https://doi.org/10.1016/j.foodcont.2018.11.049

Opoku, N., Achaglinkame, M. A., & Amaglo, F. K. (2018). Aflatoxin content in cereal-legume blends on the Ghanaian market far exceeds the permissible limit. *Food Security*, 10(6), 1539–1545. https://doi.org/10.1007/s12571-018-0849-5

Ponzilaquila, B., Corassin, C. H., & Oliveira, C. A. F. (2018). Antifungal Activity and Detoxification of Aflatoxins by Plant Extracts: Potential for Food Applications. *The Open Food Science Journal*, 10(1), 24–32. https://doi.org/10.2174/1874256401810010024

Portell, X., Verheecne-Vaessen, C., Torrelles-Rafales, R., Medina, A., Otten, W., Magan, N., & García-Cela, E. (2020). Three-dimensional study of f. Graminearum colonisation of stored wheat: Post-harvest growth patterns, dry matter losses and mycotoxin contamination. *Microorganisms*, 8, 1–18. https://doi.org/10.3390/microorganisms8081170

Prakash, J. (2016). Safety of Fermented Cereals and Legumes. In V. Prakash, O. Martín-Belloso, L. Keener, S. Astley, S. Braun, H. McMahon, & H. Lelieveld (Eds.), *Regulating Safety of Traditional and Ethnic Foods* (1st ed., pp. 283–310). Elsevier Inc. https://doi.org/10.1016/B978-0-12-800605-4.00014-1

Pratap, A., Mehandi, S., Pandey, V. R., Malviya, N., & Katiyar, P. K. (2016). Pre- and Post-harvest Management of Physical and Nutritional Quality of Pulses. In U. Singh, C. S. Praharaj, S. S. Singh, & N. P. Singh (Eds.), *Biofortification of Food Crops* (pp. 421–431). Springer India. https://doi.org/10.1007/978-81-322-2716-8

Quellhorst, H. E., Njoroge, A., Venort, T., & Baributsa, D. (2020). Postharvest management of grains in Haiti and gender roles. *Sustainability*, 12, 1–13. https://doi.org/10.3390/su12114608

Ramirez, M. L., Cendoya, E., Nische, M. J., Zachetti, V. G. L., & Chulze, S. N. (2018). Impact of toxigenic fungi and mycotoxins in chickpea: a review. *Current Opinion in Food Science*, 23, 32–37. https://doi.org/10.1016/j.cofs.2018.05.003

Sabuncuoğlu, S., Erkçokoglu, P., Aydin, S., Şahin, G., & Kocer-Gunusel, B. (2015). The effects of season and gender on the serum aflatoxins and ochratoxin A levels of healthy adult subjects from the Central Anatolia Region, Turkey. *European Journal of Nutrition*, 54, 629–638. https://doi.org/10.1007/s00394-014-0744-6

Sarrocco, S., & Vannacci, G. (2018). Preharvest application of beneficial fungi as a strategy to prevent postharvest mycotoxin contamination: A review. *Crop Protection, In Press*. https://doi.org/10.1016/j.cropro.2017.11.013

Schmidt, M. (2018). *Thesis presented by [University College Cork, Ireland]*. http://intranet.colecrop.eu/library/repository/2014_thesis_peebles.pdf

Schmidt, M., Zannini, E., & Arendt, E. K. (2018). Recent advances in physical post-harvest treatments for shelf-life extension of cereal crops. *Foods*, 7, 1–22. https://doi.org/10.3390/foods7040045

Schmidt, M., Zannini, E., & Arendt, E. K. (2019). Screening of post-harvest decontamination methods for cereal grains and their impact on grain quality and technological performance. *European Food Research and Technology*, 245(5), 1061–1074. https://doi.org/10.1007/s00217-018-3210-5

Seetha, A., Munthali, W., Msere, H. W., Swai, E., Muzanila, Y., Sichone, E., Tsusaka, T. W., Rathore, A., & Okori, P. (2017). Occurrence of aflatoxins and its management in diverse cropping systems of central Tanzania. *Mycotoxin Research*, 33, 323–331. https://doi.org/10.1007/s12550-017-0286-x

Serdar, S. A., Tawila, M. M. El, Madkour, M. H., & Alrasheedi, A. A. (2020). Determination of Aflatoxins (AFs) in Different Food Samples: A Case Study from Jeddah, Saudi Arabia. *Met., Env. & Arid Land Agric. Sci.*, 29(1), 23–34.
Sirma, A. J., Lindahl, J. F., Makita, K., Senerwa, D., Mitmert, N., Kang’ethe, E. K., & Grace, D. (2018). The impacts of aflatoxin standards on health and nutrition in sub-Saharan Africa: The case of Kenya. *Global Food Security*, 18, 57–61. https://doi.org/10.1016/j.gfs.2018.08.001

Sulaiman, S. H., Jamaluddin, R., & Sabran, M. R. (2018). Association between urinary aflatoxin (AFM1) and dietary intake among adults in Hulu Langat District, Selangor, Malaysia. *Nutrients*, 10(4), 1–15. https://doi.org/10.3390/nu10040460

Sun, X. D., Su, P., & Shan, H. (2017). Mycotoxin Contamination of Rice in China. *Journal of Food Science*, 82(3), 573–584. https://doi.org/10.1111/1750-3841.13631

Tawila, M. El, Sadeq, S., Awad, A. A., Serdar, J., Madkour, M. H. F., & Deabes, M. M. (2020). Aflatoxins contamination of human food commodities collected from Jeddah markets, Saudi Arabia. *Open Access Macedonian Journal of Medical Sciences, 8*(E), 117–126. https://doi.org/10.3889/omjms.2020.4643

Telles, A. C., Kupski, L., & Furlong, E. B. (2017). Phenolic compound in beans as protection against mycotoxins. *Food Chemistry, 214*, 293–299. https://doi.org/10.1016/j.foodchem.2016.07.079

Tembta, M. C., Njobeh, P. B., & Kayitesi, E. (2017). Storage stability of maize-groundnut composite flours and an assessment of aflatoxin B1 and ochratoxin A contamination in flours and porridges. *Food Control, 71*, 178–186. https://doi.org/10.1016/j.foodcont.2016.06.033

Tibagonzeka, J. E., Akumu, G., Kiyimba, F., Atukwase, A., Wambete, J., Bbemba, J., & Muyonga, J. H. (2018). Post-Harvest Handling Practices and Losses for Legumes and Starchy Staples in Uganda. *Agricultural Sciences, 09*, 141–156. https://doi.org/10.4236/as.2018.91011

Tola, M., & Kebede, B. (2016). Occurrence, importance and control of mycotoxins: A review. *Cogent Food & Agriculture, 2*(1), 1–26. https://doi.org/10.1080/23319326.2016.1191103

Tuan, P. A., Kumar, R., Rehal, P. K., Toora, P. K., & Ayele, B. T. (2018). Molecular mechanisms underlying abscisic acid/gibberellin balance in the control of seed dormancy and germination in cereals. *Frontiers in Plant Science, 9*, 1–14. https://doi.org/10.3389/fpls.2018.00668

Tumukunde, E., Ma, G., Li, D., Yuan, J., Qin, L., & Wang, S. (2020). Current research and prevention of aflatoxins in China. *World Mycotoxin Journal, 13*(2), 121–138. https://doi.org/10.3920/WMJ2019.2503

Udomkun, P., Tirawattanawanchi, C., Ilukor, J., Sridonpai, P., Njukwe, E., Nimbona, P., & Vanlauwe, B. (2019). Promoting the use of locally produced crops in making cereal-legume-based composite flours: An assessment of nutrient, antinutrient, mineral molar ratios, and aflatoxin content. *Food Chemistry, 286*, 651–658. https://doi.org/10.1016/j.foodchem.2019.02.055

Udomkun, P., Wiredu, A. N., Nagle, M., Müller, J., Vanlauwe, B., & Bandyopadhyay, R. (2017). Innovative technologies to manage aflatoxins in foods and feeds and the profitability of application – A review. *Food Control, 76*, 127–138. https://doi.org/10.1016/j.foodcont.2017.01.008

Valencia-Quintana, R., Milić, M., Jakšić, D., Klarić, M. Š., Tenorio-Arvide, M. G., Pérez-Flores, G. A., Bonassi, S., & Sánchez-Alarcón, J. (2020). Environment changes, aflatoxins, and health issues, a review. *International Journal of Environmental Research and Public Health, 17*, 1–10. https://doi.org/10.3390/ijerph17217850

Waliyar, F., Osiru, M., Ntare, B. R., Vijay Krishna Kumar, K., Sudini, H., Traore, A., & Diarra, B. (2015). Post-harvest management of aflatoxin contamination in groundnut. *World Mycotoxin Journal, 8*(2), 245–252. https://doi.org/10.3920/WMJ2014.1766

Wangia-Dixon, R. N., Quach, T. H. T., Song, X., Ombaka, J., Githanga, D. P., Anzala, O. A., & Wang, J. S. (2020). Determinants of aflatoxin exposures in Kenyan School-aged children. *International Journal of Environmental Health Research*. https://doi.org/10.1080/09603123.2020.1854192

Wanjeri, K. R., Kathenya, I. J., & Obimbo, L. P. (2017). Diversity of Micro, Small and Medium Cereal Milling Enterprises in Nairobi County, Kenya and Levels of Aflatoxins in Their Milled Products. *World Journal of Nutrition and Health, 5*(2), 33–40. https://doi.org/10.12691/jnh-5-2-2

Ware, L. Y., Durand, N., Nikkiema, P., Alter, P., Fontana, A., Montet, D., & Barro, N. (2017). Occurrence of mycotoxins in commercial infant formulas locally produced in Ouagadougou (Burkina Faso). *Food Control, 73*, 518–523. https://doi.org/10.1016/j.foodcont.2016.08.047

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