MYCOTOXINS: ARE WE NEGLECTING THEM!

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Mycotoxins, secondary metabolites of moulds, are estimated to affect as much as 25 percent of the world's crop each year. With respect to mycotoxins, it is pertinent to note the following:

1. the presence or absence of mycotoxigenic fungi is a poor indicator of the presence or absence of mycotoxins;
2. mycotoxins are mainly produced by the genera *Aspergillus, Penicillium* and *Fusarium;*
3. current information has shown that in addition to *Aspergillus flavus* and *A. parasiticus, Aspergillus nomius* can produce aflatoxins. In addition to *Aspergillus ochraceus* and *Penicillium verrucosum*, both *Aspergillus niger* and *Aspergillus carbonarius* can produce ochratoxin A. (particularly in cereals and oil seeds in warm and tropical climate). Critrinin, a mycotoxin associated with *Penicillium critrinum*, has now been found to be produced also by *Monascus* spp.
4. high temperatures and pressures used during drying and milling of cereals may reduce fungal loads but, mycotoxins are resistant to the temperatures that will kill moulds.
5. mycotoxins can persist in grains in the absence of evidence of fungal contamination and are chemically stable.

At this juncture, it is necessary to classify production of mycotoxins production into two types: (a) Field fungi - These are fungi that grow in crops prior to harvest and (b) Storage fungi – are fungi that develops during the storage of food crops (or feeds). *Aspergillus flavus* is a typical mould that can be a storage and field mould – thus it is important from the standpoints of economics and health (man and animals). A typical example of field mould is the *Fusarium* spp. Storage fungi may be pathogenic or saprophytic and they include the genera *Aspergillus* and *Penicillum* which between themselves produce many of mycotoxins of economic and health importance. Field fungi are particularly sensitive to: (a) weather (b) moisture and (c) temperature - these factors

usually interact. On its own, weather can affect the host plant making it more susceptible or less susceptible to infection. Mycotoxin production can be further modulated by: (1) stress factors, drought and symbiotic growth with other fungi and microbes (2) Substrate and (3) moisture (4) temperature (5) pH and (6) a_w. At this juncture one may ask why is it necessary to store grains at a moisture content not more than 14 percent and preferably in an insulated storage container!. The reasons are not far fetched grain that is above optimum moisture content for storage may continues to respire to produce water and this increase in moisture can be supportive of mould growth and toxin production. Warm and cool weather conditions can all favour water migration and condensation within a storage vessel thus creating condition for mould growth and toxin production.

With respect to Nigeria, it is safe to infer that economic tree crops, feeds, cereals and cereal products, beverages (alcoholic and non alcoholic), wines and nectars including fruit juices and sources of mycotoxins. moreso, that from our laboratory works, aflatoxins have been found in (1) dairy products (2) maize (3) maize products (4) poultry products (5) pepper (6) cassava (7) wheat bread (8) cassava bread (9) biscuits.

Furthermore, we have recently detected ochratoxin. A in cocoa and cocoa products (unpublished data). Arising from these investigations, plant foods and animal feeds should be targeted for:

(a) Monitoring and surveillance for mycotoxins (season to season).

(b) Careful and purposeful and screening at all entry points to Nigeria.

(c) Establishment of regulatory limits for some target foods - for a start.

Without doubt, aflatoxins (and indeed mycotoxins) became popular with Turkey X disease (hepatic necrosis) of 1960. However, it is now known that trichocethene T-2 was responsible for the deaths of several people in Russia from 1942-1947 due to the build up of T-2 toxin in grains left in the field during winter. Target human organs of some mycotoxins are: liver (aflatoxin), kidney (octratoxin A), mucosa (trichocethenes), peripheral vascular system (ergot alkaloids) and uro-genital tract (zearalenone). It is

known that the presence together of aflatoxins and hepatitis B virus can increase the risk of liver cancer as they are co-carcinagens. Apart from aflatoxins, other mycotoxins of public health importance are: (a) ochratoxin A. which causes kidney damage in man, (2) trichocethenes – exposure to these toxins causes in man dermatitis, cough and haemorrhage with some underlying immunosuppressive activities; (3) zearalenone is associated with endocrine disruption because it binds to eostrogen receptors (4) fumonisins have been associated with human esophageal cancer in China.

The economic and public health importance of mycotoxins demands prompt and accurate testing procedures for (a) aflatoxins (b) ochratoxins (c) zearalenone (d) vomitoxin and (e) patulin or citrinin. In testing for mycotoxins, important factors to consider are: (1) technical expertise (2) economics (affordability; intenational trade) (3) type of commodity (4) prevalence and health risks (5) limits of detection (LOD) and quantification (LOQ) (6) sensitivity. For testing purposes, only authorised persons should collect incremental samples from multiple areas of each lot or sublot. Thereafter, the incremental samples are combined and finely ground to obtain a thoroughly homogenized sample for analysis as it is not usual for mycotoxin contamination to be evenly distributed within any given foodstuff or feed. It is also advisable that 4 to 5 kg of well homogenized grain samples be kept frozen or at 12 percent moisture for mycotoxin analysis cannot be overemphasized. Thus it is useless to test for all mycotoxins in a crop prior to harvest or at points of utilization/processing. The assistance of FAO, WHO, WHO-JECFA and IEAE can be sought for training in mycotoxin testing. Futhermore, contacts can be made with the EU's joint Research Centers, Gent Belgium and CSL York, UK for state-of-the-art testing procedures for mycotoxins. However, ELISA (enzyme-linked immunosorbent assay) kits are now available for (a) aflatoxins (b) ochratoxins A. (c) vomitoxin (d) zearalenone and (e) fumonisins - they are accurate and can measure concentrations of several different mycotoxins. Thin layer chromatography (TLC) and

concentrated fruit juices, spirit drinks, cider and other fermented drinks derived from apples or containing apple or containing apple juices; the limit for solid apple products including apple puree for direct consumption is 25.0 μg/kg for infants, young children and other baby foods other than processed cereal-based foods, the maximum permitted level of patulin is 10.0 μg/kg. Attaining these levels is not impossible in developing countries like Nigeria. However, the following salient points are helpful in the prevention and control of mycotoxins:

1. instituting a workable HACCP plan for each commodity;
2. genetic breeding of mycotoxin-resistant crops;
3. competitive exclusion of toxigenic moulds with non-toxigenic strains in the field- expertise is needed.
4. drying commodities to safe moisture level e.g. 12% and during storage keeping them below 0.70 water activity.
5. cleaning grains and keeping them cool during storage also reduces insect and fungal growth.
6. use of mould inhibitors like propionic acid (organic acid). It must be noted that organic acids do not destroy preformed toxins.
7. Dilution method – diluting contaminated grains with clean grains to reduce mycotoxin levels to below toxic levels can be recommended where mould growth and indeed mycotoxin production have ceased otherwise it is not useful as the entire mixture can be contaminated.
8. use of binding agents - the binding agent to be used must not bind vitamins or minerals making them unavailable for absorption by the host.

Binding agents that can be used are bentonite, aluminosilicates, spent canola oil, bleaching clogs, phyllosilicate clay and alfa alfa fibre. Mannanoligosaccharide - a modified yeast cell wall component binds aflatoxins, ochratoxin and to a lesser degree *Fusarium* toxins. Whichever technique is adopted for management purposes, an

IMMEDIATE ACTION PLAN is necessary vis-a-vis adoption of HACCP for mycotoxin control in Nigeria. To achieve this, we need to take urgent action on the following:

1. the practice of wiping off mouldy grains, surfaces of bread, yams, onions and using same for sale and consequent consumption has to stop forthwith;

2. setting up of mycotoxin awareness corps (MAC) that will address

(a) monitoring and surveillance of mycotoxins in food and feeds from different ecological zones of the country

(b) providing detailed reports on the types, magnitude and significance of mycotoxins in foods and feeds;

(c) developing a mycotoxin occurrence map (MOP) for Nigeria;

(d) organising awareness programmes in all recognized languages;

(e) locating training centres within and outside Nigeria for mycotoxin testing, standard procurement etc.

(f) identifying and establishing sustainable links with scientists, agric extension workers, medical and veterinary doctors, farmers, industrialists, exporters and importers associated with commodities of economic importance prone to mycotoxin contamination.

In conclusion, with respect to the research support, awareness, funding and global impact, mycotoxins all combined cannot surpass HIV-AIDS. But aflatoxins were discovered earlier in 1960 and HIV-AIDS only early 1980s. I hope that we are not waiting for pandemics associated with mycotoxins before we do something about them. Mycotoxins are too important - economically and health-wise to be neglected.

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