Nanofeed Detector
A Simple Gadget that Protects the Health of Farm Animals and it’s Industry from Contaminated Feeds

Dr. Gil Nonato C. Santos
THE USE OF SMART DEVICES FOR THE DETECTION OF AFLATOXIN IN GRINDED CORN FEEDS

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Aflatoxins are toxic / carcinogenic
- Aspergillus flavus and Aspergillus Parasiticus
- Contaminants of food crops
- Toxicity and potency makes it primary health hazard

**Root Causes**
- High temperature combined & High relative humidity (80-90% wet season and 50-70% dry season)
- Improper Storage

**Trade Losses due to Aflatoxins**
- Export compliance with food safety and quality standards.
- Total losses: $1.2 billion
- World Bank estimate of unrealized trade
  - 2005 study: ~ Tens of millions of $
  - Reasonable estimate: US$ 450 million
- Some countries active to meet standards by putting in place relevant institutions
- Best quality exported; poorer quality consumed domestically.

Introduction
Aflatoxin & Liver Cancer

- MIT Scientists verified that exposure to aflatoxin can lead to liver cancer
  - Can inflict damage to kidney, nervous system, circulatory system
- Data show that people who test positive for hepa B are also exposed to aflatoxin in diet
- In December 1990, Iraq produced aflatoxin, 1,580 liters were used in biological warheads
  - 16 R400 bombs and 2 (SCUD) warheads were filled with the toxin

Typically found in tropical and subtropical regions

Liver cancer data from the GLOBOCAN 2002 database (http://www-dep.iarc.fr/GLOBOCAN_frame.htm)
Problem (Aflatoxin in Crops)

- Can contaminate food crops (i.e. Corn, Peanuts, Coconut, Cassava)
  - Food crops can become contaminated both before and after harvesting
- Pre-harvest Contamination:
  - Maize (corn), Cottonseed, Peanuts, & Treenuts
- Post-harvest Contamination:
  - Coffee, Rice, & Spices

“Aflatoxins also pose a significant economic burden, causing an estimated 25% or more of the world’s food crops to be destroyed annually.” (WHO, February 2018).”

Allowable Aflatoxin: Limit per commodity and species

<table>
<thead>
<tr>
<th>Aflatoxin level (in parts per billion)</th>
<th>Commodities and species</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>All products, except milk, designated for humans</td>
</tr>
<tr>
<td>0.5</td>
<td>Milk</td>
</tr>
<tr>
<td>20</td>
<td>Corn for immature animals and dairy cattle</td>
</tr>
<tr>
<td>100</td>
<td>Corn for breeding beef cattle, swine and mature poultry</td>
</tr>
<tr>
<td>200</td>
<td>Corn for finishing swine</td>
</tr>
<tr>
<td>300</td>
<td>Corn for finishing beef cattle</td>
</tr>
<tr>
<td>300</td>
<td>Cottonseed meal (as a feed ingredient)</td>
</tr>
<tr>
<td>20</td>
<td>All feedstuff other than corn</td>
</tr>
</tbody>
</table>
Philippines FDA issues *aflatoxin* warning for prepackaged peanuts.
CORN PROGRAM

Region IV-A is the primary consumer of yellow corn due to existence of 100 feed millers which utilized corn as ingredient. Corn is also processed into high value products, such as corn grits, cornstarch, corn syrups, corn oil, gluten and snack foods and processed as corn silage for livestock.

The Department of Agriculture’s Corn Program in CALABARZON aims to increase farmers’ income by increasing production of quality corn and cassava for human consumption, feeds and industrial uses.

The strategies for increasing quality corn and cassava are focused on provision of intervention such as Production Support Services, Market Development Services, Extension Support Education and Training Services, Research and Development and provision of Irrigation Network Services as well as Farm Mechanization and Post-Harvest Equipment and Facilities.

PROGRAM COMPONENTS

I. PRODUCTION SUPPORT SERVICES

A. Seed Buffer stocks

E. Aflatoxin Prevention Program
Implementation of an aflatoxin prevention program among corn farmers in partnership with bureau of Agricultural and Fisheries Standards (BAFS), Philippine Centre for Post-Harvest.
Corn Industry

• “Corn is the most important locally grown crop for the PhP 110-billion swine and poultry industry of the Philippines.” (Delos Santos, 2002)

• According to surveys, raw dried whole corn and peanut butter have the highest aflatoxin contents

• **Feedmillers:** 44% don’t consider *Aflatoxin* contamination as a problem
  - Conducts physical analysis on moisture content, broken grains, impurities, damaged grains, discolored grains, moulds

• **Food Processors:** 67% consider *Aflatoxin* contamination as a problem
  - Has stricter regulations compared to feedmillers
Problems (Weak enforcement and Regulation)

- Improper practice of storage systems by Feedmillers and Food Processors
- Lack of training programs on Aflatoxin sensing & prevention for farmers, feedmillers and food processors
- Stricter enforcement of food safety regulations
- Lack of laboratories and sensing equipment to detect Aflatoxin
- Lack of routine & random inspections for feedmiller & food processing companies
- Lack of a database management on aflatoxin contamination in corn
Alternatives in the Market

- Immunochemical Methods
- Electrochemiluminescence
- Electrochemical immunosensors
- Optical Immunosensors

- Chromatographic Methods
- TLC & HPLC
- Fluorescence Spectrophotometric Methods
Overview of the Research

• Simple method of Aflatoxin detection
• Real-time evaluation instrument
• Portable and cost efficient

Corn samples from BAI were mixed with water-methanol for safe handling of toxins

The samples were tested using printed sensors and the concentration (ppb) of the toxin were obtained using a computer based aflatoxin sensor.
Policy Proposal

- **Phase 1:** Acquire voltage signals of *aflatoxin* to determine the levels of risk when certain values are displayed with reference to the permissible limits based on the International Standard followed by local FSRA (Department of Agriculture, National Food Authority, Bureau of Animal Industry, and Department of Health)

- **Phase 2:** Propose to FSRCB (Food Safety Regulation Coordinating Board) the significance of rapid diagnostics for the detection of *aflatoxin*. The FSRCB shall provide a list of recommended agencies that needs to be trained for the use of the sensors

- **Phase 3:** Produce a manual for the sampling, testing, and analysis procedures for aflatoxin detection to be used in the training program of the FSRAs

- **Phase 4:** Assist in providing certified training or workshops by the FSRCB for FSRA personnel

- **Phase 5:** FSRAs can now coordinate with LGUs to implement inspection of food business operators (big and small), poultry, and farm owners
Thank you.