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The Use of Smart Devices for the Detection of Aflatoxin in Ground Corn Feeds

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I. INTRODUCTION

Aflatoxins are toxic and carcinogenic secondary metabolites produced predominantly by two fungal species: *Aspergillus flavus* and *Aspergillus parasiticus* (Gourama, H., & Bullerman, L., 1995). These fungal species are contaminants of food crops as well as animal feeds, and are responsible for aflatoxin contamination of these agricultural products. The toxicity and potency of aflatoxins make them the primary health hazard as well as responsible for losses associated with contaminations of processed foods and feeds (Gourama, H., & Bullerman, L., 1995). Determination of aflatoxins concentration in food crops and animal feeds is thus very important for Food Safety Regulatory Agencies (FRSA) to create effective policies (Shane, S.H. & Groopman, J.D., 1994). However, the current mechanism of aflatoxin detection does not provide an immediate result, requires technical expertise, and are costly (Paniel, N., Radoi, A. & Marty, J., 2010).

Different methods were explored for aflatoxin detection. Such methods include High-Performance Liquid Chromatography (HPLC), thin layer chromatography, fluorescence, and immunoenzymatic assays. However, detection using a smart device has not been fully explored when it comes to detecting toxins. The use of a smart device has received quite an attention in the research field and is currently being explored due to its simple and abrupt mechanism of detection with its application as a real-time evaluation instrument of aflatoxin presence in agricultural food materials. This research developed a method for aflatoxin extraction, and detection in ground corn feeds obtained from the Bureau of Animal Industry (BAI). However, the study was limited to the detection of Aflatoxin B1 ($C17H12O6$).

II. RESULTS AND DISCUSSION

Three bottles of ground corn feeds with different concentrations were provided from BAI. The exact concentration of aflatoxin for each bottle was made unknown to lessen any bias in the experiment. Two tablespoons of aflatoxin from each bottle were taken and the samples were mixed in a 100 mL water-methanol solution with 1:4 ratio. In the study conducted by Wacoo, A., Wendiro, D., Vuzi, P. & Hawumba, J., (2014), aflatoxin can be extracted using a polar protic solvent such as acetone, ethanol, methanol, or acetonitrile. Among these organic solvents, methanol has the least effect on toxins. Thus, the natural composition of the toxin is somewhat preserved (Wang, et al., 2014). All preparations were done under a fume hood with observed safety precautions for aflatoxin. The samples were studied using a smart device pH sensor. As a reference sample, 100 mL of water and 100 mL of water-methanol were studied in comparison to the samples with water-methanol solution and aflatoxin.

Using a smart device sensor, the pH of each sample was measured with 30 seconds running time. Five trials were made for all samples for consistency of measurements. The average pH reading was calculated for each sample and was plotted with the concentration of aflatoxin in corn feed samples where the pH was converted to its equivalent parts per billion with respect to time. The result showed that the highest pH reading was measured from the setup with pure distilled water followed by the setup with water and methanol solution. Amongst the three bottle that contains aflatoxin, Bottle 1 has the highest pH while Bottle 3 has the lowest. The concentration in parts per billion (ppb) showed a reverse reading from the pH graphs. The higher the pH, the lower its concentration. Bottle 1 showed the least content of aflatoxin B_1 concentration while Bottle 3 has the highest amount of toxin.

To confirm observations and results, cyclic voltammetry (CV) test was conducted. A CV plot thus provides the electrochemical properties of the sample analyte. The CV device is composed of three working electrodes; counter, reference, and the working electrode. The surface structure of the counter and working electrode were examined by Scanning Electron Microscopy (SEM) which showed carbon microstructures while the reference electrode has silver microstructures. The composition of the electrodes was characterized using Energy Dispersive X-Ray (EDX). It was found that the counter and working electrode has 100% carbon in atomic composition while the reference electrode has 38.97% Silver, 35.31% Carbon, 23.90% Oxygen, and 1.82% Chlorine.

Readings from the cyclic voltammogram showed that the current vs. voltage plot for the three bottles that contains different concentrations of aflatoxin has an insignificant difference as compared to that of pure distilled water and water-methanol solution. Based on the results, the mixture of water-methanol with or without aflatoxin is irreversible; thus, transfer of electrons from the analyte to the electrodes are slow. The potential also dropped when the aflatoxin sample was added to the mixture of water and methanol. This is possibly due to the breakage of the intermolecular forces of the aflatoxin molecules. Thus, extraction of aflatoxin was successful using the water-methanol solution. In addition, the results from the obtained pH and calculated ppb concentrations were comparable to the standards set from the literature.

III. POLICY RECOMMENDATION

The following phases are the recommended policies to be implemented by the FSRCB with reference to the Republic Act No. 10611, Food Safety Act of 2013 (Refer to APPENDIX A) and to be followed by the LGUs and Food Safety Regulatory Agencies (FSRAs).

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.

IV. REFERENCES

Gourama, H., & Bullerman, L. (1995) Aspergillus flavus and Aspergillus parasiticus: Aflatoxigenic fungi of concern in foods and feeds: A review. *Journal of Food Protection, 58*(12), 1395–1404.

McPherson, M. (2015). Mycotoxin Testing with Aran Gas: Aflatoxin B1 Mycotoxin Destruction using Allotropic Oxygen O4, O5, and O6. Journal of Microbiology & Experimentation. Vol. 2, Issue 6.

Paniel N., Radoi, A. & Marty, J. (2010). Development of an electrochemical biosensor for the detection of aflatoxin M1 in milk. *Sensors, 10*, 9439–9448.

Shane, S.H. & Groopman, J.D. (1994). The Toxicology of Aflatoxins: Human Health, Veterinary and Agricultural Significance; Academic Press: San Diego, CA, USA. 513-527.

Wacoo, A., Wendiro, D., Vuzi, P. & Hawumba, J. (2014). Methods for detection of aflatoxins in agricultural food crops. *Journal of Applied Chemistry, Volume 2014* (Article ID 706291), 1–15.

APPENDIX A

Republic Act No. 10611: Strengthening the Philippine Food Safety Regulatory System

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Link: http://ap.fftc.agnet.org/ap_db.php?id=214

Food Safety Act of 2013

Republic Act (RA) No. 10611, also known as the "Food Safety Act of 2013" defines food as any substance or product whether processed, partially processed or unprocessed that is intended for human consumption. It includes drinks, chewing gum, water and other substances, which are intentionally incorporated into the food during its manufacture, preparation and treatment (Section 4.g). On the other hand, food safety refers to the assurance that food will not cause harm to the consumer when it is prepared or eaten according to its intended use (Section 4.n).

The law primarily aims to strengthen the food safety regulatory system in the country. Food safety regulatory system is the combination of regulations, food safety standards, inspection, testing, data collection, monitoring and other activities carried out by food safety regulatory agencies (FSRAs) and by the Local Government Units (LGUs) in the implementation of their responsibilities for the control of food safety risks in the food supply chain (Section 4.q). Specifically, it aims to: protect the public from food-borne and water-borne illnesses and unsanitary, unwholesome, misbranded or adulterated foods; enhance industry and consumer confidence in the food regulatory system; and achieve economic growth and development by promoting fair trade practices and sound regulatory foundation for domestic and international trade (Section 3)

In general, RA 10611 works in the principles of achieving food safety to protect human life and health in the production and consumption of food and protect consumer interests through fair practices in the food trade. The protection of consumer interests shall be geared toward the prevention of adulteration, misbranding, fraudulent practices and other practices which mislead the consumer, and the prevention of misrepresentation in the labelling and false advertising in the presentation of food. In order to support this food legislation, standards for food safety measures shall be developed. Food safety standards refer to the formal documents containing the requirements that foods or food processors have to comply with to safeguard human health. It should be noted that the food safety standards shall be based on risk assessment which is anchored to sound scientific evidence.

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