**Research Area 2**

**Plant based Antimicrobial compounds against Aspergillus flavus and A. parasiticus in Peanuts**

In addition to gene manipulation to control Aspergillus sps in peanuts, my research also focuses on use of plant based antimicrobial compounds such as essential oils/vapors and probiotics to prevent Aspergillus contamination. According to FAO, approximately 25 million dollars are lost per year due to the contamination of peanuts by Aspergillus spp. and aflatoxins. *A. flavus* is the common fungus contaminating peanuts and destroying peanuts shells before they are harvested and produce aflatoxins which are known to be both highly toxic and carcinogenic, threatening humans, livestock and crops worldwide. Prevention and decontamination of the mycotoxigenic Aspergillus species and aflatoxins in peanuts is of paramount importance because, it is the world's fourth most important source of edible oil and third most important source of vegetable protein. At present, disease management in crop fields is practiced solely through adaptation of suitable cultural practices such as rotation, use of quality seed and fungicides and altering the time of planting. In addition to post-harvest procedures through use of chemicals for aflatoxin prevention, several other viable means to prevent the contamination process in crops before harvest are being undertaken in several laboratories around the world. Use of chemicals to control Aspergillus species has proven to be unsuccessful and detrimental to the environment. Further, many disadvantages are associated with the use of chemical preservatives as antifungal agents. Extensive use of these substances might produce several side effects such as carcinogenicity, teratogenicity and toxicity to consumers.
There is an increasing interest in use of alternative antimicrobial agents from plants to control toxigenic Aspergillus species. One such alternative is the use of natural plant products with antifungal properties. Recently, there has been considerable interest in the use of essential oils and their vapors from aromatic plants with antimicrobial activities for controlling Aspergillus species in peanuts. The main reason for considering the essential oils and the vapors, as antifungal agents, is that the majority of the essential oils are classified as Generally Recognized As Safe (GRAS), their use in foods as preservatives is often limited due to flavor considerations. This will obviously reduce exposure to the legal, environmental, and public safety hazards. While the quest to control Aspergillus spp., using both conventional and advanced techniques continues here in Georgia and US as a whole, the aflatoxin contamination in peanuts is far from over. This study identifies edible plants based essential oils for their antifungal properties against \textit{A. flavus} and \textit{A. parasiticus}. This research is a novel idea to pest management program and aflatoxin contamination peanuts. Moreover, the use of essential oil as antimicrobial agents, over protectant fungicides or developing a resistant cultivar either by conventional or genetic engineering may apply directly to the growers’ margin of profit and at the same time keeping peanut consumers healthy.

\textbf{Specific Objectives:}

1. To screen and select plant-based essential oils for their antifungal activity to prevent the growth of aflatoxigenic \textit{A. flavus}.

2. To chemically characterize the active principles of essential oils for their antifungal properties.

3. To determine Minimal Inhibitory Concentration (MIC) and Minimal Fungicidal Concentration (MFC) of the essential oil components.
4. To quantify aflatoxin (B1) production by *A. flavus* exposed to specific essential oils.

5. To understand the mechanism of action of active principles of essential oil components against *A. flavus*.

**Potential contributions of the study include the following:**

- The present study will shed light on efficacy of essential oils to control *A. flavus* in peanut from different agro-climatic zones of Georgia and elsewhere in the US.

- The study may form part of further research to ease the management practices for the prevention of aflatoxins by Aspergillus species in peanut, other nuts, and food grains in the US.

- Our research findings can be used to overcome growers’ problems with Aspergillus species in peanut growing countries around the globe and to enhance consumer value in peanut and peanut products.

- The efficacy of essential oils as antifungal agents against *A. flavus* in our study may become suitable for applications in food industry. The purpose for their suitability is their natural origin, which consumers find comforting, and eco-friendly and which is beneficial to the environment. These beneficial characteristics could increase food safety and shelf life.

- In view of Kennesaw State University’s commitment to Global Learning, this partnership will strengthen the existing international research collaboration between the US and India and promote transfer of technology.
Abstract

A. flavus is the most common cause of Aspergillus that causes severe contamination and is known to the peanut industry. This fungus is used for various techniques in the food industry. In the USA, A. flavus contamination is a major threat in the peanut industry. A. flavus with antifungal resistance is being explored to reduce chemical based fungicides. Although genetically engineered strains are being pursued for another method of control, it is not as effective.

Materials and Methods

Determination of Minimum Inhibitory Concentration (MIC) of essential oil of A. flavus from peanuts in Georgia. Inoculated in PDA (Potato Dextrose Agar) for seven days at 37°C. Essential oil-based antifungal activity at various concentrations. Pure essential oil at the optimal concentration inoculated on inoculated agar Petri dishes (Budak et al., 2005). A. flavus at seven days of incubation at 30°C, 70%, and 150 ppm. Each concentration added on each gel. Blue disc (Cm) and grows outwards, the top cover of Petri-plate. Min-80 served as control. Inhibition zones of inhibition (mm) protein of less than 10 mm diameter considered to be MIC.

Results

Fig. 5. MIC of clove oil suspension with A. flavus at 1500 ppm. 75% successful.

Discussion

Variations in the zones of inhibition after exposure to clove and essential oil were related to concentration and time. A. flavus at clove inhibited mycelial growth. Better than clove and essential oil and shows a greater zone of inhibition at concentration as low as 1500 ppm. In 15 days of exposure compared to 1500 ppm of clove oil on A. flavus after seven days of incubation (Fig. 5 & Fig. 6).

Conclusion

Our results indicate the essential oil of clove (E. globulus) has been used as antifungal agents against A. flavus in contaminated peanuts. Since plant based essential oils are considered as GRAS items, replacing chemical fungicides, currently used by the peanut industries, with these antifungal agents will be beneficial in the environment and the consumers' health. The isolation and purification of active ingredients of both these oils should be further investigated to establish their antifungal properties and an alternate preparation. As the study of essential oil evolves, these bioactive agents may become part of integrated Pest Management (IPM) system in the control of A. flavus and other filamentous fungi.

References


