ABSTRACT:

Fungal species are capable of producing toxic secondary metabolites commonly known as mycotoxins. One of the important group of mycotoxins are aflatoxins. There are mainly four kinds of aflatoxins AFB1, AFB2, AFG1 and AFG2. Other important mycotoxins are ochratoxin, trichothecens, fumonisins and ergot alkaloids. These aflatoxins are produced by the Aspergillus flavus, A. parasiticus and various other fungal species. These mycotoxins can infect our feed items before or after harvesting the crops. These can contaminate all kinds of food such as grains, spices, nuts and dry fruits. These toxins are also present in milk and milk products. They can be a potential source for major health problems in humans and livestock which results in greater economic loss. To overcome the problems related to mycotoxins we should need to have proper knowledge about sources, types and mechanism action of mycotoxins. Now a day's many kinds of toxin binders are available in markets. These toxin binders bind the fungal toxins and remove them from the product. Yeast and its cell wall components mostly contains glucan and mannan which have toxin binding ability. In this review we will analyze mycotoxins, with reference to mycotoxins outbreaks, characterization of bindins, and toxin binding potential of yeast.

Keywords: Aflatoxins, Alkaloids, Feed items, Mycotoxins, Toxin binder, Yeast

INTRODUCTION

Mycotoxins and feed

A large amount of human food and animal feed is contaminated with the mycotoxins. In developing countries, these toxins are responsible for major health problems and other agro-economic losses. These toxins affects the staple foods including grains, nuts, and cereals. There were...
which can be injurious and can produce bad health effects (Wild and Gong, 2009).

**Aflatoxins**

Some important mycotoxins are aflatoxins, ochratoxins, zearalenone, fumonisins, trichothecens and ergot alkaloids (Fakih et al., 2014). Their chemical structures are shown in Fig. 1.

Fig. 1: Chemical structures of some common mycotoxins (Malhotra et al., 2014)

Aflatoxin are the secondary toxic metabolites produced by the *Aspergillus flavus* and *Aspergillus parasiticus* contaminate many of the staple foods and also be present in the milk and milk products thus transferring to the human diet (Fruhauf et al., 2012). These aflatoxins required moderate temperature, low pH and humidity for rapid propagation. In naturally occurring aflatoxins: AFB1, B2, and G2 are mostly toxic in nature and serves as potent carcinogenic. These aflatoxin are mainly involved in the liver cancer (Henry et al., 2002; Liu et al., 2012). They also have many
adverse effects in agriculture, induce toxicity, immune impairment, as reported in various studies (Wild and Gong, 2009; Malhotra et al., 2014; Mwanza et al., 2013; Kang’Ethe et al., 2017).

**Outbreaks**

There were historic outbreaks regarding aflatoxins in India and Kenya. The outbreaks occur due to maize consumption on daily basis that causes aflatoxicosis (Wild and Yun Gong, 2009). Aflatoxin are lipophilic and can cross the placental barrier and be bio activated in utero. In West Africa, exposure to aflatoxin are shown in infants and once children are weaned they are less exposed to toxins. Whereas, high exposure is seen in adults. Breast feeding to children can prevent them from getting infected by mycotoxin. Their prevalence can be increased in areas where there is endemic condition. It sustains throughout life. It was seen AFB1 exposure leads to chronic mosaic liver, susceptible to further genetic modifications (Wild and Yun Gong, 2009). There were also major outbreaks in Russia in early 1940s and 1950s during the period of Second World War. This study reports the binding of mycotoxin to the yeast species that have ability to act as a probiotic and facilitates in binding toxins to cure fungal diseases. Milk contains mycotoxins particularly AFM1 that cannot be destroyed by the pasteurization and any other technique. These Mycotoxins are heat stable and come in food (Pincus et al., 2007; Richard, 2007).

**Toxin binding potential of yeast**

Different methods and techniques are available for the control of aflatoxins (Mishra and Das, 2003). Degradation of mycotoxins using microbes are attractive approach as it is environmentally friendly and cost effective (Zhu et al., 2017). Therefore, different types of microorganism are being evaluated as toxin binder. However, yeast cells are well known toxin binders (Dawson et al., 2001). The growth of yeast cells are associated with the sugar rich environments. The major component of yeast cell wall (polysaccharides) play an important role and multiple functions in interaction with the environment and cell recognition that defines the structure, and margins of the cell. In *Saccharomyces cerevisiae*, major component of the cell wall are glucan and mannan interacting with immune system of humans (Kogan and Kocher, 2007). By using yeast cells removal adsorption of mycotoxins can be enhanced instead of using complete cells (Joannis-Cassan et al., 2011). The carbohydrates component of yeast cell walls offers versatile binding sites for diverse toxins (Kelly et al., 1994).

The glucan and mannan present in the cell wall of yeast can bind to the human immune system. These components are also evaluated for toxin binding potential. Yeast can absorb the mycotoxins thus decreasing their toxic effect and removal from the contaminating material. Yeast...
polysaccharide act as a binder of wide range of mycotoxins. Thus if globally antibiotic growth promoters are banned then yeast polysaccharides can be used as growth stimulators. It will be able to perform dual function (Kogan and Kocher, 2007). However, it must be confirmed that yeast should be non-pathogenic. It should not have any harmful effect on host immune system and also on normal micro flora of humans. Non-pathogenicity of yeast isolates may be confirmed by checking their phospholipase activity. Candida pathogenic yeast cannot be used as toxin binder because it is found that it produced phospholipase. This is harmful for host cells. Their secretory activity was checked by growing yeast on solid media having egg yolk in it. Lipid products breakdown activity was analyzed (Hakim et al., 2013).

**Characterization of Toxin Binder**

The toxin binding yeasts are characterized by 18S (universal primer) polymerase chain reaction followed by sequencing. Amplicons are obtained using forward primers (5'-AACCTGGTTGATCCTGCCAGT-3') and Reverse primer (5'-GGCACACCAGACTTGCCCTC-3'). The amplicons are observed by agarose gel electrophoresis in gel documentation system. The toxin binding components like glucans and mannans are also analyzed by HPLC (Wang et al., 2014). PCR is also used to detect the presence or absence of phospholipase enzyme producing gene. It will confirm the pathogenicity or non-pathogenicity of the targeted yeast. PLBI gene is confirmed to be a most important contributive factor in phospholipase activity of *C. albicans*. The studies should be performed to check activity of enzymes in virulence of yeast and pathogenicity (Hakim et al., 2103). If toxin binding yeast is to be used as probiotic it must be able to survive in the gastrointestinal tract conditions. The most important of the yeast species is *Saccharomyces boulardii* that is a non-pathogenic yeast (Suvarna et al., 2018). Some yeasts are already considered as a GRAS (Generally Regarded as Safe) and QPS (Qualified Presumption of Safety), granted due to many factors like high in nutrition, low pH resistant and bile tolerance (Suvarna et al., 2018).

**CONCLUSION**

It was concluded that yeast is a potential candidate for toxin binding ability. The indigenous isolates must be evaluated for this potential and may reduce the toxic effects of mycotoxins in consumer.

**REFERENCES**


