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EDITORIAL

Aspergilli—aflatoxins: health threat

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Aspergillus species, the primitive eukaryotic microbes were not considered of medical importance till the first report of Allergic bronchopulmonary Aspergillosis was described by Hinson et al. [1]. Subsequent severe outbreak of Turkey X disease in UK lead to identification of aflatoxin, the causative toxin as a fluorogenic polyketide compound with dicoumarin structure from *Aspergillus flavus*.

The morphological and taxonomical features of various *Aspergillus* species show some similar and some characteristic features. The medical importance of *Aspergillus fumigatus*, *Aspergillus flavus* and *Aspergillus niger*, also recently *Aspergillus terreus* is well established. The molecular complexity of *Aspergillus* species can be better explained by the genomic and proteomic profiles of *Aspergillus* species. The agricultural and economic importance of the *Aspergillus* species is due to their secondary metabolic pathways namely polyketide biosynthetic pathways. *Aspergillus flavus* and *Aspergillus parasiticus* through their potential to synthesise and secrete aflatoxins, contaminate a number of economically important agricultural crops such as groundnut, maize, cotton, spices and several nuts etc. However the biological role of polyketide biosynthetic pathway is not very well understood although some role in the developmental stage of the fungus is speculated [2].

The aflatoxin contamination of crops, food and feed negatively impact human and animal health. International Agency for Research in Cancer (IARC) classified aflatoxins in group 1 human carcinogens. The toxigenic, carcinogenic, terratogenic effects of aflatoxins are studied and reported from different countries. However the mechanism of action of these toxins at cellular and tissue level are necessary for a better understanding and to counter the toxic effect of these toxins.

Aspergillus species, like *Aspergillus fumigates*, *Aspergillus flavus*, *Aspergillus niger* and *Aspergillus terreus* are involved in a wide spectrum of clinical conditions such as ABPA, chronic necrotising aspergillosis, invasive aspergillosis, pulmonary hypersensitivity pneumonitis etc. Several immunodominant allergens, antigens, virulent factors are implicated in causing immunological reactions and clinical conditions. Host pathogen interaction studies in allergic and invasive diseases of aspergillosis established the innate role of lung surfactant proteins and their potential therapeutic use [3]. Besides a plethora of macromolecules, the causative organisms also secrete highly versatile polyketide toxins. A number of polyketide based biologically active, pharmaceutically important compounds are characterised so far. The biotechnological importance of these compounds are already being exploited with respect to *A. niger*, *A. terreus*, *A. oryzae* etc. Industrial importance of *A. terreus* is due to its potential to secrete statins, the first commercially available cholesterol lowering agent.

Contamination of a wide variety of agricultural crops, food and feed by aflatoxins is continuously being reported from different parts of the world. Food and Agricultural Organisation of the world estimates an approximately 25% of the world food crops are contaminated of which aflatoxin B_1 is the major toxin. Based on scientific evidence of the carcinogenicity and toxicity of aflatoxins, USDA and FDA set cut of values of 20 ppb on foods. This scenario poses a major global scientific challenge for understanding

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the aflatoxin biosynthesis in order to develop preventive and management strategies for the toxigenic fungus and the toxin. Similarly specific, sensitive and affordable commercial diagnostic reagents are a necessity today for prevention and management of *Aspergillus* related diseases in humans and animals [4, 5].

Above challenges are being countered with the current knowledge of genomic and proteomic aspects of *Aspergilli*. Understanding on the aflatoxin biosynthetic pathway provides opportunities to explore novel polyketides of clinical and pharmaceutical importance for the benefit of mankind. However the goldmine of secondary metabolites of *Aspergilli*, basically polyketide compounds need to be further explored using advances in genetic manipulations.

Aflatoxin biosynthetic genes are organised in a 75 kb gene cluster in *A. flavus* and *A. parasiticus* along with transcription regulators. Although such gene clusters are present in some of the *Asperillus* species such as *A. oryazae* and *A. sojae* etc., aflatoxins are not synthesised by these species. In fact these species are being used in food industries and biotechnological production of industrially important compounds for several years.

In view of the hazardous impact of aflatoxigenic fungi on human health and agricultural crops, it is necessary to understand few important aspects of these toxins. Now genome sequencing data of several important *Aspergillus* species is available in public domain. Several studies are in progress to have a deeper insight into these important class of microbes. It is interesting to note some of the atoxigenic isolates of *Aspergillus* can limit the growth of aflatoxigenic isolates and function as biocontrol agents or biopesticides in the field against disease [6].

However in coming years we can anticipate effective methods of prevention and management of *Aspergillus* related diseases, aflatoxigenic fungi and aflatoxins in the world for improved quality of life. Further, the biotechnological potential of *Aspergillii* can be exploited better for the benefit of humans.

References

1. Hinson KFW, Moon AJ, Plummer NS. Broncho-pulmonary aspergillosis: a review and a report of eight new cases. Thorax. 1952;7(4):317–33.
2. Keller NP, Turner G, Bennett JW. Fungal secondary metabolism from biochemistry to genomics. Nat Rev Microbiol. 2005;13(12):937–47.
3. Madan T, Reid KBM, Clark H, Singh M, Nayak A, Sarma PU, Hawgood S, Kishore U. Susceptibility of mice genetically deficient in SP-A or SP-D gene to invasive pulmonary aspergillosis. Mol Immunol. 2010;47(10):1923–30.
4. Madan T, Priyadarsiny P, Vaid M, Kamal Neel, Shah A, Haq W, Katti SB, Sarma PU. Use of a synthetic peptide epitope of Asp f 1, a major allergen or antigen of *Aspergillus fumigatus*, for improved immunodiagnosis of allergic bronchopulmonary aspergillosis. Clin Diagn Lab Immunol. 2004;11(3):552–8.
5. Bhetaria PJ, Prajapathi M, Bhaduri A, Mandal RS, Varma A, Madan T, Singh Y, Sarma PU. Phylogenetic and structural analysis of polyketide synthases in Aspergilli. Evol Bioinform. 2016;12:101–19.
6. Bhatnagar D, Rajasekaran K, Payne GA, Brown RL, Yu J, Cleveland TE. The 'omics' tools: genomics, proteomics, metablomics and their potential for solving aflatoxin contamination problem. World Mycotoxin J. 2008;1(1):3–12.