Mycotoxins — A Real or Potential Problem — Introduction

A. WALLACE HAYES

Department of Pharmacology and Toxicology
University of Mississippi Medical Center
2500 North State Street, Jackson, Mississippi 39216

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It has been 17 years since the original report first appeared in England implicating the aflatoxins in "turkey X" disease. The 007 fashion leading to identification of the causal organism, Aspergillus flavus, isolation and characterization of the responsible compounds followed by the demonstration of aflatoxin B$_1$ as an extremely potent carcinogen and the significance of this compound in animal and human health rapidly focused worldwide involvement and attention upon the mycotoxins. It is interesting to note that, although knowledge of mold toxicoses developed only recently and is limited, one of the oldest foodborne diseases recognized was a mold infection. Ergotism known a thousand years ago as St. Anthony’s Fire, was a disease which killed thousands of people in Europe (1). This disease is caused by the fungus, Claviceps purpurea which grows on rye. The rye grain becomes completely replaced by sclerotia and turns black. Ingestion of between 1 and 1.5 g diseased rye grain daily can result in symptoms that range from peripheral thrombosis to gangrene of the extremities to nervous system involvement, lysis and death. It was not for hundreds of years until the discolored grain was recognized by Kaspar Schwenckfeld in the 1600’s as being the cause of the disease. This mold-induced foodborne disease continued to occur right into the nineteenth century in Europe and America and was last recorded on a large scale in Russia in the 1920’s and 30’s.

Considerable evidence, mostly epidemiological, is developing which would suggest that other mycotoxins indeed are of concern to humans. Data suggesting that the aflatoxins were ingested by population groups of several countries and that this ingestion can be related to hepatic diseases, particularly cancer, has come from three types of studies. The first of these consists of surveys of various food commodities for toxigenic fungi and for aflatoxin levels. A second general source of information has come from unusual outbreaks of disease among groups of people in which the cause was apparently related to consumption of a common type of food that was mold-contaminated and contained measurable levels of aflatoxin. Third, there have been reports of somewhat isolated cases where one or a few individuals, often children, became ill after consuming aflatoxin-laden food. Such reports which encompass one or more of these types of studies, have emerged from Uganda, Taiwan, Kenya, Swaziland, Mozambique, the Philippines, Southeast Asia, Senegal and India. With the exception of the Indian studies, all of these relate to epidemiological evidence supporting the relationship between liver cancer and aflatoxin. The Indian report describes outbreaks of acute toxic hepatitis with high fatality rates in adult humans; death was usually sudden and in most instances was preceded by massive gastrointestinal bleeding. Males were affected twice as commonly as females.

Reye’s syndrome, first described in 1963 as encephalopathy and fatty degeneration of the viscera, has since been recognized as a major cause of morbidity and mortality among infants and children. This disease syndrome and possible linkage to aflatoxin has been suggested.

Balkan nephropathy, another case in which epidemiological evidence is developing to relate mycotoxins to a human disease, is an endemic disease of people living in close proximity to the Danube River in Yugoslavia, Rumania and Bulgaria. Krogh (3) has indicated that 8 to 20% of the foodstuffs in one endemic village in Yugoslavia contained ochratoxin A, a well known nephrotoxin of swine and poultry; however, the late J. M. Barnes and his co-workers (2) from the U.K. recently published a report showing that Penicillium verrucosum var. cyclopium was the isolate obtained most frequently from food samples and other materials collected from five endemic areas of the disease. Culture extracts which did not contain ochratoxin A force-fed to young rats caused subtle histological changes in renal tissue.

This seminar was conceived as a means to communicate the status of the mycotoxin problem in man and in his animals and to convey information about some of the
current ongoing research in the mycotoxin field. As the title, "Mycotoxins — A Real or Potential Problem?", would indicate some hesitation exists on the part of workers in this field as to the importance of these compounds in agriculture, in animal health and particularly in human health. Hopefully, this hesitation can now be dispelled.

Dr. Hamilton, who has long been concerned with mycotoxicoses in real life, particularly in poultry, will deal with some of the fallacies in our understanding of mycotoxins. Dr. Hamilton will address the need to apply Koch's postulates as they relate to mycotoxins and will respond to the important question "What is a safe level of a mycotoxin?" The concept of a mycotoxin residue or "zero tolerance," and food safety also will be addressed by Dr. Hamilton. This will be followed by a discussion by Dr. Peter Scott, who will describe the occurrence of mycotoxins in feeds and ingredients and who will discuss their biogenic origin. The recent discovery that the mycotoxicoses, alimentary toxic aleukia and stachybachtrytoxicosis, reported in the Soviet literature in the early 40's, may have been due to tricothecene poisoning suggests an emerging problem because of the widespread occurrence of these mycotoxins. The tricothecenes, derivates of the 12, 13 epoxy 9,9'-trichothecene ring system, may be involved in toxicoses throughout the world, although there is distinct evidence implicating these compounds in only a few outbreaks. Dr. Ciegler will describe these outbreaks and will discuss this important group of compounds.

The best evidence to date suggests that mycotoxins are a clear and present hazard to man's animals, be they domesticated or companions. A major problem in veterinary medicine includes diagnosis of mycotoxicoses of livestock. In such case livestock production, and thus profit, is reduced. Dr. Cysewski will describe some of the very interesting studies that he and his colleagues at the National Animal Disease Laboratory have undertaken.

Finally the suggestion that mycotoxins could be responsible for human liver cancer and other human diseases opened up a whole new and important field of investigation. The concept that mold-produced toxins could cause chronic diseases in man was a major advance in thought, and it has proved to be the trigger which unleashed an avalanche of research in this field. In the context of human disease, particularly in developing nations, the idea that fungi might be responsible for chronic disease, particularly liver cancer, has received enthusiastic support. There are a number of factors which make study of such a hypothesis uniquely difficult. Not least among these is the inability to use the human organisms as an experimental model. Dr. Benjamin Wilson of Vanderbilt University School of Medicine will discuss field surveys and epidemiological and experimental data attempting to examine the possible relationship of mycotoxin contamination of foodstuffs in the incidence of human diseases. The role of native food customs and regional climatic factors appear important and these also will be discussed by Dr. Wilson.

This seminar has the promise of being an occasion which will be remembered because we have all the ingredients necessary for success. We have five dynamic researchers assembled to discuss a subject which is not only scientifically interesting but which is of great concern in many countries throughout the world. Finally, we have an audience with an interest in this subject, thus giving us the opportunity of exchanging ideas and learning.

ACKNOWLEDGMENTS

The seminar on "Mycotoxins — A Real or Potential Problem" was held at the Annual Meeting of the American Society for Microbiology, New Orleans, Louisiana, May 11, 1977. Papers given at the seminar and described in this Introduction will appear in the Journal of Food Protection.

REFERENCES