

Editorial

Mycotoxins, mycotoxicoses, mycotoxicology and *Mycopathologia*

J. W. Bennett*

Department of Biology, Tulane University, New Orleans, LA 70118, USA

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Summary

Mycotoxins are fungal poisons. This definition does not stipulate whether fungi are the targets of poisoning or are the producers of the poisons. The following is suggested as a useful working definition: Mycotoxins are natural products produced by fungi that evoke a toxic response when introduced in low concentration to higher vertebrates and other animals by a natural route. Some mycotoxins have multiple effects, and may cause phytotoxic and antimicrobial syndromes in addition to animal toxicity. By convention, mushroom and yeast poisons are usually excluded from discussions of mycotoxins.

The eclectic nature of the discipline and the international scope of the problem has attracted scientists from many different backgrounds. The publishers and editors of *Mycopathologia* intend for this journal to become a major forum for mycotoxin research.

Mycotoxin

Toxins are poisons; poisons are compounds that harm or kill living things. Phytotoxins are compounds toxic to plants; zootoxins are compounds toxic to animals. If the same linguistic convention were followed, mycotoxins would be compounds toxic to fungi. Rather they are toxins produced *by* fungi.

The vocabulary used to describe the toxic metabolites of plants, animals, and microbes has developed out of different scientific traditions. The rules followed in forming compound words have not been applied consistently. For an excellent discussion of these semantic vagaries, the etymology of 'toxin' and 'poison', and the use of 'toxin' in plant pathology, see Graniti [4].

If one were encountering the word 'mycotoxin' ('fungal poison') out of current context, it would not

be clear whether fungal toxins are compounds that poison fungi or compounds produced by fungi that poison other organisms. 'Mycotoxin' refers to the latter. This still leaves open the question of what is getting poisoned. For example, penicillin is a fungal metabolite that destroys bacteria quite efficiently, but we don't classify penicillin as a mycotoxin, but rather as an antibiotic.

The word antibiotic has been subjected to more semantic scrutiny than the word mycotoxin. The great Waksman himself published a definition:

An antibiotic is a chemical substance, produced by microorganisms, which has the capacity to inhibit the growth of and even to destroy bacteria and other microorganisms [5].

For antibiotics, both the producing organisms and the susceptible organisms were clearly delineated as microorganisms. When the term mycotoxin was introduced to the literature, the producing organisms

* Coordinating editor *Mycopathologia*.

were delineated, but the susceptible organisms were not. The prototype mycotoxin, aflatoxin, was first described in the early 1960's as the etiological agent of Turkey X disease. A number of the early workers were recruited from veterinary medicine, and these scientists did not feel it necessary to state the obvious: they were dealing with animal diseases. To paraphrase John Bu'Locks's aphoristic phrase, mycotoxins are fungal metabolites that happen to be toxic to humans or some of our more favoured domestic animals. Even this definition is inadequate. Quite illogically a tacit tradition excludes the mushroom and yeast poisons and limits the study of mycotoxins to poisonous fungal metabolites produced by molds.

Finally, the concept of a toxin, as used in pathology, usually means substances that are lethal or injurious in low concentration. Substances that are toxic only in high doses are not usually considered toxins. By these criteria, alcohol, which can be toxic at certain concentrations, is not a toxin [4].

Mycotoxicoeses

The animal diseases produced by mycotoxins are mycotoxicoeses, to be distinguished from mycoses, the diseases produced by direct pathogenic invasion of fungi. In the first major review on the subject, Forgacs and Carll gave the following definition:

Mycotoxicoeses are poisonings of the host which follow entry into the body of a toxic substance of fungal origin... Mycotoxicoeses affect animals and man ([3], p. 274).

Eating of mold-contaminated foods and feeds is the most common route of entry, and some purists limit the definition of mycotoxicoeses to those metabolites which are toxic when ingested. Most scientists apply a broader rubric and accept as mycotoxins those substances that cause disease upon contact, inhalation, or other natural route of exposure. There is controversy about metabolites that are toxic only upon injection or other 'unnatural' means of entry.

As with other poisons, there are enormous interspecies and intraspecies differences in susceptibility to mycotoxins, and factors such as age, sex, and

nutritional status affect the course of mycotoxicoeses. Mycotoxicoeses may be acute or chronic. Sometimes, low level mycotoxin contamination merely creates a predisposition to a variety of other infectious and nutritional diseases. At other times, low level exposure induces cancer. Modern agricultural practices involving feeding with bulk commercial feeds and high density housing of single species tend to make mycotoxicoeses easier to detect and diagnose, nevertheless, the episodic character of these diseases makes veterinary mycotoxicology a difficult field. Finally, even in the absence of overt disease, the immunomodulation and poor weight gains associated with mycotoxin-contaminated feeds have important economic ramifications.

Mycotoxicology and Mycopathologia

Mycotoxicology is the study of mycotoxins and mycotoxicoeses. The scientists who do the research are mycotoxicologists. It is easier to parse the terms than it is to circumscribe the discipline. The number of compounds classified as mycotoxins is large and includes a chemically diverse group of fungal secondary metabolites such as aflatoxin, aflatrem, brevianamide A, citreoviridin, citrinin, cyclopiazonic acid, cytochalasin, ergot alkaloids, erythroglaucon, janthitrems, luteo-skyrin, moniliformin, ochratoxin, patulin, penicillic acid, penitrem, PR toxin, roquefortine, sterigmatocystin, tenuazonic acid, the trichothecenes (over forty of them), viomellein, xanthomegnin, and others [2]. Some of these compounds were originally isolated and classified as 'antibiotics' because they demonstrated strong antimicrobial properties. Patulin, for example, was heralded as a cure for the common cold [1] until the recognition of its toxicity to animals rendered it clinically unacceptable.

Mycotoxicology is a young, vigorous and eclectic science that has recruited scientists from a wide range of disciplines including microbiology, toxicology, plant and animal pathology, pharmacology, biochemistry, analytical and organic chemistry, veterinary medicine and immunology. The diversity of disciplines is reflected in the literature: papers concerning mycotoxins are published in a great variety

of journals. No single journal has emerged as the general publication to serve all mycotoxicologists. Our hope is to make *Mycopathologia* this outlet.

Mycopathologia is an established journal with a broad, international circulation. Given the international nature of the mycotoxin problem, *Mycopathologia* is ideally suited to serve the community of scientists who study fungal toxins.

This editorial constitutes an open invitation to mycotoxicologists around the world to submit papers to *Mycopathologia*. With the help of an expanded Editorial Board, composed of experts in the field, we foresee that *Mycopathologia* will grow to be the premier journal for mycotoxin research.

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