Do Dead Spores Cause Allergies?

By Dr. Harriet Burge

Do non-living fungal spores release allergens? A few years ago I would have said categorically "YES." However, several recent publications have indicated that spores may have to actually germinate before their allergens can be released. One reason for this is the presence of a strongly hydrophobic outer wall layer on spores composed of small proteins called hydrophobins. Note that hydrophobins are not associated with other allergens sources such as pollen, cat dander, or dust mite feces.

Fungal spore germination is a complex process. Three of the steps involved are 1) wetting of the spore, 2) initiation of respiration, and 3) detection of appropriate nutrients. When these steps are satisfied the spore can thin the outer cell wall to allow absorption of nutrients, a germ tube can be formed and the germ tube can release enzymes and other proteins (i.e., allergens) into the environment and begin digesting complex food sources. Spores probably do not have to proceed to the germ tube stage to release allergens. The principal factor appears to be the disruption or thinning of the hydrophobin layer.

In order to release allergens that could lead to sensitization and subsequently symptoms, a spore must land in the respiratory mucous, absorb enough water, sugar, and oxygen to initiate respiration, thin out its cell wall, and begin to produce and release enzymes. This process may take from a few minutes to many hours.

The environmental conditions that control each of these steps are different for different fungi. Some fungi can initiate the germination process in nearly pure water (e.g., *Stachybotrys*) and germination is inhibited when nutrients are abundant. Others require one or more soluble sugars and probably other nutrients as well. A few (e.g., some basidiospores) require pretreatment before they will germinate. In the "wild" some mushrooms are eaten by snails, and the spores only germinate after passage through the snail! These spores, and probably many others, do not germinate in the human respiratory tract, and therefore do not release their allergens. This explains the many fungal spores that do not appear to be “allergenic."

These facts may explain some of the conundrums in the field of fungal allergy. First, not all fungi can germinate in the human respiratory tract. Needless to say, all of the fungi that can cause human infections are able to germinate, and most of the studies on fungal germination in respiratory mucosa have been done on the opportunistic pathogens such as *Aspergillus fumigatus*. *Alternaria alternata*

must be able to germinate readily, since this is the most common sensitizer among fungi in spite of the fact that concentrations in air are generally much lower than for many other fungi, including *Cladosporium*. *Cladosporium* may fall into a group for which the germination percentage in the respiratory tract is quite low. It is also important to remember that many fungal allergens are digestive enzymes produced by a variety of different fungi. Thus, a positive skin test to *Cladosporium* may be the result of sensitization by *Alternaria*.
Obviously it would be lovely to know just which fungi are important with respect to this germination ability, and that information may be eventually available.

Meanwhile, undoubtedly, a dead spore cannot germinate, and therefore is unlikely to release allergens. This means that if you are trying to trace disease-causing exposures, cultural analysis, or some other approach where viability is indicated is probably important. On the other hand, if you are trying to map sources in an environment, which is the goal of most of us, then spore counting remains the method of choice.
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