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Agni's fungi: heat-resistant spores from the Western Ghats, southern India

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ABSTRACT

This study concerns the thermotolerance of spores of mesophilic fungi isolated from a tropical semi-arid habitat subject to dry season fire in the Western Ghats, southern India. Among 25 species of Ascomycota isolated from leaf litter, nine were able to grow after incubation in a drying oven for 2 h at 100 °C; the spores of two of these species survived 2 h incubation at 110 °C, and one survived exposure to 115 °C for 2 h. The range of thermotolerance among mesophilic fungi isolated from the leaf litter was surprising: filamentous fungi from other habitats, including species that colonize scorched vegetation after fires and thermophilic forms occurring in self-heating plant composts, cannot survive even brief exposure to such high temperatures. It is possible that the exceptional heat resistance of the Indian fungi is related to adaptations to surviving fires. Genetic analysis of the physiological mechanisms of heat resistance in these fungi offers prospects for future biotechnological innovations. The discovery of extreme thermotolerance among common saprotrophs shows that this physiological trait may be more widespread than recognized previously, adding to concern about the evolution of opportunistic pathogens on a warmer planet. The fungi in this study are among the most heat-resistant eukaryotes on record and are referred to here as 'Agni's Fungi', after the Hindu God of Fire.

Introduction

Thermophilic prokaryotes can flourish at temperatures above 100 °C, but eukaryotes are unable to grow at temperatures above 60 °C (Tansey & Brock 1972). Thermotolerant fungi include *Aspergillus fumigatus*, which thrives in compost piles and is an important human pathogen, and a variety of species that cause food spoilage (Maheshwari *et al.* 2000; Magan 2007). These microorganisms can sustain fast growth rates at temperatures above 37 °C. Most fungi, however, are mesophiles with temperature optima between 25 °C and 35 °C, but extreme heat tolerance has been reported in some instances. Thermotolerant mesophiles include black yeasts with multilayered cell walls that flourish on rock surfaces and can survive short-term incubation at temperatures above 100 °C (Sterflinger 1998). Here, we examine the heat tolerance of spores isolated from leaf litter of trees in a semi-arid habitat in the Western Ghats, southern India that is subject to frequent fires (Kodandapani *et al.* 2008).

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