A Research Note

**Sporothrix schenckii Isolated from Edible Black Fungus Mushrooms**

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**ABSTRACT**

*Sporothrix schenckii*, a fungus which is pathogenic to humans, was recovered from imported desiccated black fungus mushrooms [*Auricularia polytrichia* (Mont.) Sacc.] usually used in preparing Far Eastern cuisine. Identification was based on microscopic and gross morphology, dimorphism at 25 and 37°C and reactivity with fluorescein-labeled antibodies specific for the yeast-cell form of the fungus. This is the first known report of *S. schenckii* in or on edible mushrooms.

*Sporothrix schenckii* and other pathogenic fungi are thermally dimorphic, i.e., their morphology at room temperature (20 to 25°C) differs from that at body temperature (37°C). In brain heart infusion agar at 37°C, these fungi are indistinguishable from their in vivo, or parasitic, forms; *S. schenckii* looks like a yeast in the tissues of infected individuals. According to McGinnis (16), *S. schenckii* colonies grow rapidly in vitro at 25°C; they are moist, flat, white and, at first, yeast-like. Later the colonies develop aerial hyphae and usually darken, becoming brown to black. All-white strains, however, also exist (2).

*S. schenckii* is ubiquitous, but has seldom been isolated from foods. Lettuce was incriminated only once as a food source (9); however, meat frankfurters have been shown to support the growth of this fungus (11,17). We suspected that mushrooms would be a likely source of *S. schenckii* because of the way they are often grown, i.e., in compost made of soil, straw and manure or on moist wood chips—a favorable milieu for many microfungi, including pathogens. This paper reports our initial findings.

**MATERIALS AND METHODS**

A bag of edible, desiccated black fungus mushrooms [*Auricularia polytrichia* (Mont.) Sacc.] was purchased in April 1981 in a New York City retail store specializing in East Asian foods. The mushrooms, which were packaged in a sealed cellophane bag, had been imported from Taiwan.

After being removed aseptically from the cellophane bag, the mushrooms were weighed and about four of them (10 g) were soaked in 90 ml of a sterile solution (0.85% NaCl in 0.05% Tween 80) for 100 min at room temperature. The mushrooms and the solution were transferred to a sterile disposable polyethylene bag and blended in a Stomacher 80 (Colwell, Seward Laboratory, London) for 3 min. (The mushrooms were of a wooden texture and proved to be difficult to blend). A dilution was prepared with 1 ml of the blend material and 99 ml of diluent. One ml each of the blended suspension and the 100-fold dilution were plated in triplicate on Rose bengal agar medium. The plates were incubated at room temperature and read when growth was observed. Fungal colonies on plates were counted, and representative types were isolated in pure culture and identified by standard morphological and physiological criteria.

The microanatomy of the fungus was examined from isolates grown on modified Sabouraud's dextrose agar medium (Difco Laboratories, Detroit, MI) at ambient temperatures. Colonies suggestive of *S. schenckii* were inoculated onto the surface of brain heart infusion (BHI) agar slants and incubated at 37°C for conversion to the yeast form. When growth was apparent, the colonies were examined microscopically for the presence of budding yeast cells. Cells from BHI agar at 37°C were inoculated onto Sabouraud's dextrose agar and incubated at ambient room temperature for reversion to the mycelial form. The yeast cells were also tested with antisera that was labeled with fluorescein isocyanate and was specific for the yeast form of *S. schenckii* (12).

**RESULTS**

Fungal colonies on Rose bengal agar plates were counted and isolated on the 13th day of incubation at 22 to 25°C. Of the three plates inoculated with the blended suspension, two contained 22 and 23 colonies, of which 4 and 6 colonies, respectively, had a microscopic morphology strongly suggestive of *S. schenckii* and were thus selected for further study. Other isolates from Rose bengal agar pour plates represented various fungi and were lyophilized in skim milk for future characterization. No *Sporothrix* spp. were recovered on plates with the 100-fold dilution of blended mushroom suspension.

At ambient temperatures of 22 to 25°C on Sabouraud's dextrose agar, the presumed *S. schenckii* produced delicate branching and septate hyphae-bearing conidia which developed as solitary bodies on denticles along the hyphae. Conidia also grew laterally from sympodial, slender, tapering, erect conidiophores and in terminal clusters at the apices of swollen conidiophores (Fig. 1). Macroscopically, the colonies were at first yeast-like and buff-colored, but in 3 wk they became glabrous and wrinkled, with some producing light to dark brown centers or sectors.

On BHI agar incubated at 37°C, growth was apparent by the third day of incubation and budding cells were ob-
Pathogenic fungi in or on foods. Nevertheless, the selective growth of some of these pathogenic fungi is supported by certain foods: Cryptococcus neoformans by peaches and peach juice (23); Candida parapsilosis by meat products (13,22), butter (28) and human milk (5); and S. schenckii by meat sausage of the frankfurter type (1).

In its microscopic and gross morphologies, its dimorphism and specific reactivity with fluorescein-labeled antibody specific to the S. schenckii yeast form (12) and reconverted to typical cells of the vegetative form when inoculated onto Sabouraud’s dextrose agar and incubated at 20 to 25°C.

DISCUSSION

Compared with studies of foodborne toxigenic fungi, little work has been done on the occurrence of human pathogenic fungi in or on foods. Nevertheless, the selective growth of some of these pathogenic fungi is supported by certain foods: Cryptococcus neoformans by peaches and peach juice (23); Candida parapsilosis by meat products (13,22), butter (28) and human milk (5); and S. schenckii by meat sausage of the frankfurter type (1).

In its microscopic and gross morphologies, its dimorphism and specific reactivity with fluorescein-labeled antibody, the Sporothrix sp. isolated from desiccated black fungus mushrooms is similar to the S. schenckii isolate of Ahearn and Kaplan (1), which adapted readily to growth on meat at cold storage temperatures (5°C). Scharing and Kelly (17) obtained some all-beef frankfurter emulsion from a meat packer, inoculated it with a human strain of S. schenckii and produced frankfurters similar to those sold commercially. They reported that the fungus survived processing and that their procedure is one used by many meat packers. They also recovered 10% of the inoculated S. schenckii from these sausage samples after cooking for 50 min.

The strain of S. schenckii isolated from desiccated black fungus mushrooms may have been introduced during picking or packaging or may be native to the mushrooms. In nature, S. schenckii exists as a saprophyte and has been isolated from soil, water, animal dung, decaying wood, plants and plant products, sphagnum moss, hay and straw (4,6,8,14,21). Commercial mushrooms are grown in compost, manure, straw and soil or on wood chips. Therefore, S. schenckii could easily contaminate commercial edible mushrooms. Bell (3) has demonstrated the growth of a potential pathogen for humans and cattle, Pseudoallescheria boydii, in beef-cattle manure. The mushrooms may have been contaminated after drying, before the retail package was sealed.

The recovery of S. schenckii from lettuce (9), frankfurter sausage and desiccated black fungus mushrooms is of public health interest. This fungus is the etiological agent of human and animal sporotrichosis—a chronic, granulomatous infection usually limited to skin, subcutaneous tissues and the lymphatic system. Firm, round, tender nodules may appear at the entry site, usually on an extremity of the host, and the infection may spread along the lymphatic system. The nodules may be ulcerative and/or suppurrative, discharging a thin seropurulent exudate in humans (10) and sometimes a thick, brown-red exudate in animals (18). The infection may also be disseminated after a primary lyphatic or respiratory infection (26), and may involve joints, bone, lungs and most other tissues (11,24,26,27).

S. schenckii does not appear to attack healthy skin. The most common sources of sporotrichosis (25) are soil in a wound or an abrasion caused by material contaminated with fungal conidia. However, S. schenckii may penetrate the walls of the respiratory tract and enter the mucosa (15,19,20). It is also speculated that S. schenckii might penetrate the gastrointestinal tract (7,9), possibly leading to foodborne sporotrichosis.

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REFERENCES


7. Tuomi, S., M. E. Matthews, and E. H. Marth. 1974. Temperature and microbial flora of refrigerated ground beef gravy subjected to holding and heating as might occur in a school foodservice operation.
