Taxonomic Study on Korean Schizopora

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Schizopora paradoxa is a white rot fungus showing great variation in hymenophoral configuration. It has been often treated as close to Irpex or Hyphodontia and frequently confused with S. flavipora which was identified as an unrecorded species in Korea. Distinct features including sizes of basidia and basidiospores as well as hymenophoral shape make S. paradoxa differ from S. flavipora. Remarkable characters of hymenophores and microscopic structures are described and their significance is discussed for the taxonomy of Korean Schizopora.

KEYWORDS: Schizopora flavipora, Schizopora paradoxa

Schizopora Velenovsky is a genus of typical wood-rot fungi and decays various kinds of trees in forests. It causes a white rot by cellulase and lignase enzyme systems that enable to degrade all components of wood cell walls (Alexopoulos et al., 1996; Gilbertson and Ryvarden, 1986). This genus has been accepted as a saprophyte because it fruits on dead wood of fallen branches or logs and decays wood of trees that are already dead. Especially, S. paradoxa used to be collected from recently dead trees to extremely rotten trees.

The decay of dead trees by wood-rotting fungi including Schizopora prevents the continuous accumulation of large amounts of woody materials on the ground but releases organic compounds and mineral nutrients to the soil, maintaining its productivity and ability to support continuous stands over long periods of time (Gilbertson, 1974). Schizopora species occur on all kinds of hardwood trees in Korea and are considered to be responsible for nearly all the decay in Quercus forests that dominate Korean mountains.

Schizopora species were the most economically important fungi that frequently occur on the bedlog of shiitake (Lentinula edodes) and reduce fruitbody yield (Maekawa and Arita, 1984). They also occur on the bedlog of Phellinus linteus which is famous for its antitumor activity. In general, Schizopora species inhabit wood of both hardwoods and conifers and sometimes cross the hardwood-conifer boundary.

Schizopora has variable hymenophores from poroid, lacerate to more or less irpicoid forms. Due to its versatile forms, Schizopora was treated as morphologically close to Irpex and microscopically almost same as Hyphodontia (Jung, 1987). The microscopic features of Schizopora similar to those of Hyphodontia supported the true phylogenetic position of Schizopora was closely related to that of the corticioid genus Hyphodontia (Eriksen et al., 1984; Gilbertson and Ryvarden, 1987).

Recent phylogenetic analyses inferred from morphological characters (Langer, 1994) and molecular data (Lim, 2001; Paulus et al., 2000) showed that Schizopora was nested inside the main clade of Hyphodontia. Both Schizopora and Hyphodontia seemed to make a natural group although they crossed the borderline between corticioid and poroid forms each other. This kind of example already showed that it was more convenient to define strictly artificial families than natural ones during the transition period of the classification in the Hymenomycetes (Donk, 1971).

Langer (1994) once treated those two genera together in his monograph on Hyphodontia and proposed to conserve Hyphodontia against Schizopora (Langer et al., 1996). However, Schizopora has nomenclatural priority over Hyphodontia, and in the sense of Art. 14.1-2 of the ICBN Code, a disadvantageous change of nomenclature would result when both genera are combined into Schizopora. For that reason, many mycologists still use the genus name Schizopora.

Schizopora originally contained two species (Domański, 1969), S. paradoxa (type species) and S. flavipora. Then S. radula was added by Hallenberg (1983) and S. nothofagi by Cunningham (1965). Two species of Schizopora, S. paradoxa and S. flavipora, have been collected in Korea, and the latter species was confirmed new to Korea and is registered here with descriptions. Because of the great morphological variation of S. paradoxa, it is frequently confused with S. flavipora and believed to be of great interest to investigate the intraspecific hymenophoral variation and host specificity for the taxonomy of Korean Schizopora.

Materials and Methods

Fresh samples collected from field surveys and observed
in this study are listed in Table 1. The samples were deposited in SFC (Seoul National University Fungus Collection) after examination. For the observation of specimens, laboratory techniques of Largent et al. (1977) were used and the measurements and drawings were made from slide preparations stained with 1% (w/v) aqueous phloxine and KOH for 3% potassium hydroxide (Jung, 1987). For such a reason, Langer (1994) treated this genus as a member of Hyphodontia in his monograph. However, it is known that Schizopora requires a more extensive taxonomic investigation to solve the species delimitation (Gilbertson and Ryvarden, 1987). According to recent phylogenetic analyses based on molecular data (Paulus et al., 2000; Lim, 2001), Schizopora is nested inside the main Hyphodontia clade, showing that Schizopora and Hyphodontia might form a natural taxon together.

Remarks: Schizopora is morphologically close to Irpex but its microscopic structures are almost same as those of Hyphodontia (Jung, 1987). For such a reason, Langer (1994) treated this genus as a member of Hyphodontia in his monograph. However, it is known that Schizopora requires a more extensive taxonomic investigation to solve the species delimitation (Gilbertson and Ryvarden, 1987). According to recent phylogenetic analyses based on molecular data (Paulus et al., 2000; Lim, 2001), Schizopora is nested inside the main Hyphodontia clade, showing that Schizopora and Hyphodontia might form a natural taxon together.

Schizopora flavipora (Cooke) Ryvarden, Mycotaxon 23: 186, 1985 코크미황산버섯 (신천) (Figs. 1A, 2A)

= Poria flavipora Cooke, Grevillea 15: 25, 1886


= Schizopora carneo-lutea (Rodway & Cleland) Kotlaba & Pouzar, Cesk Mykol. 33: 21, 1979

Basidiomes annual, resupinate, coriaceous to tough fibrous; hymenophore poroid, white to cream, appressed, angular to daedaleoid or irpicoid, 5–6 mm wide, with thin dissepiments; margin usually sterile, whitish.

Remarks: Schizopora carcino-teres (Rodway & Cleland) Kotlaba & Pouzar, Cesk Mykol. 33: 21, 1979

Basidiomes annual, resupinate, orbicular, soon confluent, soft and coriaceous when fresh, firm and tough when dry, adnate; hymenophore tubular to irpical, of medium-sized pores; context whitish, thin; hyphal system monomitic; generative hyphae distinct, hyaline, thin- to somewhat thick-walled, septate with clamps; cystidioides present, thin-walled; basidia clavate, with 4 sterigmata; basidiospores hyaline, ellipsoid, smooth, non-amyloid.

Type species: Schizopora paradoxa (Fries) Donk

Table 1. List of Schizopora strains used in this study

<table>
<thead>
<tr>
<th>Species</th>
<th>Sources</th>
<th>Locality</th>
<th>Substrate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Schizopora flavipora</td>
<td>SFC 970926-4</td>
<td>Mt. Bukhan, Seoul</td>
<td>Quercus serrata</td>
</tr>
<tr>
<td></td>
<td>SFC 980125-7</td>
<td>Ilyung, Gyeonggi-do</td>
<td>Pinus densiflora</td>
</tr>
<tr>
<td>Schizopora paradoxa</td>
<td>SFC 970719-2</td>
<td>Mt. Bukhan, Gyeonggi-do</td>
<td>Pinus densiflora</td>
</tr>
<tr>
<td></td>
<td>SFC 970816-2</td>
<td>Jeundeung Temple, Gangwha Island, Incheon</td>
<td>Castanea crenata</td>
</tr>
<tr>
<td></td>
<td>SFC 970830-7</td>
<td>Mt. Daemo, Seoul</td>
<td>Pinus densiflora</td>
</tr>
<tr>
<td></td>
<td>SFC 970924-1</td>
<td>Mt. Bukhan, Gyeonggi-do</td>
<td>Pinus densiflora</td>
</tr>
<tr>
<td></td>
<td>SFC 971018-7</td>
<td>Mt. Bukhan, Gyeonggi-do</td>
<td>Quercus serrata</td>
</tr>
<tr>
<td></td>
<td>SFC 980201-10</td>
<td>Naega, Gangwha Island, Incheon</td>
<td>Quercus acutissima</td>
</tr>
<tr>
<td></td>
<td>SFC 980508-B14</td>
<td>Mt. Chilgap, Chungcheongnam-do</td>
<td>Quercus aliena</td>
</tr>
</tbody>
</table>

SFC : Seoul National University Fungus Collection.
described here. This species has been frequently confused with *S. paradoxa* and some intermediate forms always occur. However, the appressed form of hymenophore, small pores, small spores and basidia, small clamp connections, the absence of cystidioles, and the presence of thick-walled hyphae are distinctive features of *S. flavipora* (Lim, 2001).

Schizopora paradoxa (Fr.) Donk Persoonia 5: 76, 1967

= *Hydnum paradoxa* Fries, Syst. Mycol. 1: 424, 1821

= *Poria versipora* (Persoon) Romell, Svensk Bot. Tidsskr. 20: 15, 1926

Basidiomes annual, fully resupinate, coriaceous to tough fibrous; hymenophore usually poroid (3–4 per mm), irregularly hydnoid (up to 1 per mm), denticulate, to labyrinthine (1–3 per mm), white to cream; tubes of varying sizes; margin normally not differentiated, forming shallow or networked tubes, sterile, whitish.

Hyphal system monomitic; generative hyphae regularly clamped, hyaline, thin- to somewhat thick-walled, 3.2–4 \( \mu \text{m} \) in diam, often ending in a capitate globoid swollen apex up to 9.5 \( \mu \text{m} \) wide; cystidioles scattered, incrusted with granular crystals on hyphal tips of pore mouths; basidia clavate, with 4 sterigmata, 15–21×3.5–5 \( \mu \text{m} \), with a basal clamp; basidiospores ellipsoid, hyaline, smooth, 4–5.7×3–4 \( \mu \text{m} \), non-amyloid.

Specimens examined: On the lower side of fallen trees of *Prunus leveilleana*, Mt. Bukhan, Gyeonggi-do (SFC 970926-4), *Quercus* species, Mt. Moak, Cheonlabuk-do (SFC 970816-2), Naega, Gangwha Island, Incheon (SFC 980201-10), Mt. Chilgap, Chungcheongnam-do (SFC 980508-B14), and *Pinus densiflora*, Mt. Daemo, Seoul (SFC 970830-7), Mt. Bukhan, Gyunggi-do (SFC 970924-1); on dead standing wood of *Castanea crenata*, Jeundeung Temple, Gangwha Island, Incheon (SFC 970816-2) and *Pinus densiflora*. Mt. Moak, Cheonlabuk-do (SFC 970201-6).

Remarks: In the United States, *Schizopora* occurs on hardwoods in all kinds of forests (Gilbertson and Ryvarden, 1987). In Korea, it occurs on most of hardwood trees and seems to be really active in the decay of
Quercus trees throughout Korean mountains. This fungus represents the genus *Schizopora* and has been regarded as a highly variable species in morphology of fruitbodies. There are various hymenophores of rounded, angular, split pores to almost hydnoid forms (Fig. 1). However, these various forms are obviously different from appressed hy- menophoral forms of *S. flavipora*. Microscopically, *S. paradoxa* has cystidioles incrusted with crystals and there is again variation in sizes of basidiospores and basidia most of which are apparently larger than those of *S. flavipora*.

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**References**


