

The Fascinating *Spongiforma* Mushroom (SpongeBob Mushroom)

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ABSTRACT

Mushrooms are generous source of nutritional and medicinal compounds. SpongeBob fungi are a group of mushrooms belonging to Basidiomycota; Class; Agaricomycetes; Order Boletales; Family: Boletaceae. Their name derived from the Nickelodeon cartoon character SpongeBob SquarePants. They are considered from the Basidiomycetes mushrooms all over the world. It is usually found in Malaysia, in moisture environments even can survive in dried air. SpongeBob mushrooms Edibility, not clear. This review aims to *Spongiforma* (gastroid boletes) mushrooms under light spot through describing their morphology and ecology especially of the most common fungus, *Spongiforma squarepantsii*.

Keyword: SpongeBob fungi; *Spongiforma squarepantsii*; *Spongiforma thailandica*.

Introduction

The need to improve the life quality together with the increase in the frequency of threatening diseases direct the attention of many scientists to view food as a source of nutritional and therapeutical agents. Nature is considered an important source for the discovery of new medicines. A vast diversity of important biologically active compounds have arisen in the natural world, shaped by evolution and spanning a large diversity of species across different kingdoms. In the fungi kingdom, medicinal mushrooms have long been used for the treatment of pathogens and disease [1-5]. Since ancient times, several mushrooms have been reported as a nutritious food with valuable medicinal properties. Wild mushrooms have been consumed since ancient times due to their good taste and nutritional values. Also, mushrooms have the advantage of being rich in vital components such as proteins, vitamins, chitin, fibers, iron, zinc, selenium, sodium, And other. [6-10].

Mushrooms are abundant natural resources that have structurally unique compounds with diverse bioactivities. Mushrooms are generally basidiomycetous mostly and ascomycetes. Mushrooms have been reported to be from the most valuable microbes to humankind [11, 15]. Investigations on the therapeutic and nutritional properties of mushrooms are ongoing throughout the world. Mushrooms still need to be worked out for their biological activities [16-20]. Thanks to the richness of mushrooms in bioactive compounds that belong to different chemical classes such as phenols, terpenes, proteins, fatty acids, flavonoids, polysaccharides, polyketides, alkaloids, steroids, and other compounds. On the other hand, many studies have described the activities of the fruiting bodies, crude extracts, and purified compounds originated from mushrooms [21-25].

Many researchers are providing vital data on the collection of biologically active secondary metabolites originated from mushrooms. Mostly, mushrooms grow wild in many environments around the world and are also commercially cultivated for pharmaceutical and nutritional purposes. Nutritionally, mushrooms are healthy food which is rich in nutrients and vitamins. Alternatively, mushrooms have pharmaceutical and medical applications from centuries especially in Asian countries [26-29]. Recently, isolation and purification of biologically active secondary metabolites from mushrooms has been conducted mainly on the products of fruiting bodies. However, collection of fruiting bodies is a difficult work and is limited by collecting season and area. Also the small amounts of the collected samples are limited

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to find metabolites from mushrooms. Therefore, mycelial culture of basidiomycetes and ascomycetes originated from wild edible and non-edible mushrooms would be suggested as an alternative, reliable, and manageable method that can obtain various bioactive metabolites from mushrooms [30-40].

An unusual sponge-shaped (cf. *Spongia*, Porifera), terrestrial fungus was encountered by Peay et al. [41], during a recent study of ectomycorrhizal community structure in the dipterocarp-dominated forest of the Lambir Hills in Sarawak, Malaysia. The form of the sporocarp was unusual enough that before microscopic examination the collectors were uncertain whether the fungus was a member of the Ascomycota or the Basidiomycota. This review aims to but *Spongiforma* (gastroid boletes) mushrooms under light spot through describing their morphology and ecology especially of the most common fungus, *Spongiforma squarepantsii*.

The genus *Spongiforma squarepantsii* (SpongeBob fungi) ecology and description

The genus name *Spongiforma* refers to the sponge-like nature of the fruit body, while the specific epithet (Species name) *squarepantsii* is a Latinisation of the well-known Nickelodeon cartoon character SpongeBob SquarePants, whose shape was purported to share a resemblance to the fungus. Additionally, the authors note that the spore-bearing surface, when viewed with scanning electron microscopy, somewhat resembles a seafloor covered with tube sponges, reminiscent of the fictitious home of SpongeBob. SpongeBob mushrooms Edibility, not clear [42, 43].

Spongiforma squarepantsii is a species of fungus in the family Boletaceae, genus *Spongiforma*. Found in Malaysia (On the ground of Lambir Hills National Park, Sarawak State, Malaysia), temperatures ranging from 24 to 32 °C. The structure of the fruit body allows it to quickly revive when dry by absorbing moisture from the air. The distinctive odour of the species may indicate that spore dispersal is mediated by animals [42, 43]. It was described as new to science in 2011. It produces sponge-like, rubbery orange fruit bodies that have a fruity or musky odour. The fruit bodies reach dimensions of 10 cm (3.9 in) wide by 7 cm (2.8 in) tall. Like a sponge, they will resume their original shape if water is squeezed out. The spores, produced on the surfaces of the hollows of the sponge, are almond-shaped with rough surfaces, and measure 1012.5 µm by 67 µm. The name of the fungus is derived from the Nickelodeon cartoon character SpongeBob SquarePants from the show of the same name. *S. squarepantsii* is one of two species in *Spongiforma*; it differs from *Spongiforma thailandica* in its color, odour, and spore structure [42, 43].

The fruit body of *Spongiforma squarepantsii* is bright

orange coloured, roughly spherical to oval. The fruit body lacks a stipe, it has a rudimentary columella; a small cord of sterile tissue that extends to the centre of the fruit body. The surface of the fruit body has deep ridges and folds somewhat resembling a brain. It is sponge-like and rubbery (If water is squeezed out, it will resume its original shape). The surface has irregular, relatively large cavities, lined with fertile (spore-producing) tissue. The locules are between 2 and 10 mm in diameter. The ridges of the locules are pale orange or lighter and ciliate (having hair-like projections). Fruit bodies have a strong odour described as "vaguely fruity or strongly musty" [42].

Spores are a reddish-brown or deep mahogany colour. The edibility of the fruit body is unknown. The almond-shaped spores are typically 10–12.5 µm by 6–7 µm with thick walls measuring between 0.5–1.2 µm (Figure, 1). They have a small central apiculus. When mounted in distilled water, they have a coarsely warty surface and appear rusty brown in colour. The basidia are club-shaped, and four-spored with sterigmata up to 9.5 µm long. The ridges of the locules comprise erect cystidia mixed with chains of erect cylindrical hyphae measuring 4–6 µm in diameter. The cystidia are roughly cylindrical, and have dimensions of 20–60 µm by 4–9 µm [42].

Similar species

The related species *Spongiforma thailandica* (Belonging to Basidiomycota; Class; Agaricomycetes; Order Boletales; Family: Boletaceae), newly described in 2009, differs from *Spongiforma squarepantsii* in several ways: it has larger fruit bodies, 5–10 cm (2.0–3.9 in) wide by 4–7 cm (1.6–2.8 in) tall; its gleba is initially pale greyish-orange to brownish-grey before darkening to reddish-brown or dark brown; and it smells of coal tar (Figure, 1). Microscopically, *S. thailandica* has spores with less prominent surface warts [42].

The genus *Spongiforma squarepantsii* (SpongeBob fungi) as source of biologically active compounds

Screening of fungi for antimicrobial substances, antitumor substances and others in particular has been greatly enhanced. Ascomycetes and Basidiomycetes mushrooms are known to produce wide range of secondary metabolites. *Spongiforma* (SpongeBob mushrooms), until now much studies on these mushrooms group.

Conclusion

Due to appearance of new diseases, and spreading of lethal ones. The scientists are keep investigating all possible natural sources in an attempt to find efficient compounds capable of healing diseases and decrease mortality rates. SpongeBob fungi (*Spongiforma mushrooms*) worth studying as a new sources of compounds that could be of medical or biological control applications but until now no mush studies

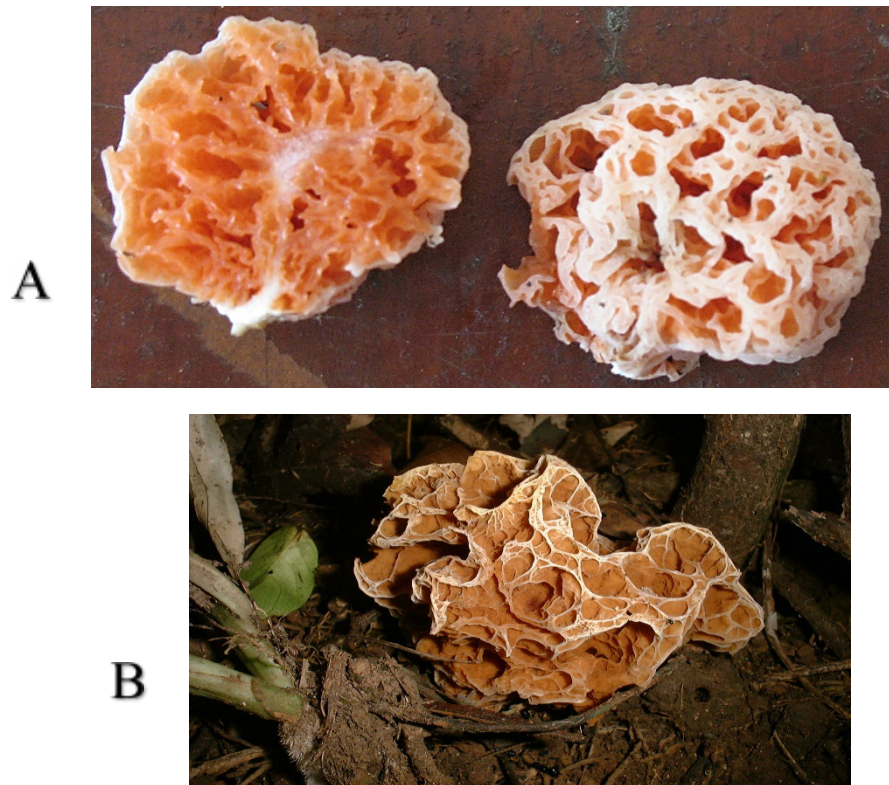


Figure (1). Different *Spongiforma* spp. (SpongeBob fungi). (A). *Spongiforma squarepantsii*. Locality: Malaysia. Cited in: <https://www.mycportal.org>. (B). *Spongiforma thailandica*. Locality: Thailand. Cited in: http://iucn.ekoo.se/iucn/species_view/540807/.

on these group. Repurposing such species can contribute in finding new cure or supporting used drugs in our battle against currently spreading diseases. Further researches and clinical trials have to be carried out to confirm SpongeBob fungi (*Spongiforma* mushrooms) as sources of bioactive compounds responsible for different biological agents in their extracts. Further research is required in order to isolate and identify these bioactive compounds.

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