

= Hydnum repandum =

Hydnum repandum , commonly known as the sweet tooth , wood hedgehog or hedgehog mushroom , is an edible mushroom with no poisonous lookalikes . A basidiomycete fungus of the family Hydnaceae , it is the type species of the genus *Hydnum* . The fungus produces fruit bodies (mushrooms) that are characterized by their spore @-@ bearing structures ? in the form of spines rather than gills ? which hang down from the underside of the cap . The cap is dry , colored yellow to light orange to brown , and often develops an irregular shape , especially when it has grown closely crowded with adjacent fruit bodies . The mushroom tissue is white with a pleasant odor and a spicy or bitter taste . All parts of the mushroom stain orange with age or when bruised .

A mycorrhizal fungus , *Hydnum repandum* is broadly distributed in Asia , Australia , North America and Europe where it fruits singly or in close groups in coniferous or deciduous woodland . This is a choice edible species , although mature specimens can develop a bitter taste . Mushrooms are collected and sold in local markets of Europe , Mexico , and Canada .

= = Taxonomy = =

First officially described by Carl Linnaeus in his 1753 *Species Plantarum* , *Hydnum repandum* was sanctioned by Elias Fries in 1821 . The species has been shuffled to several genera : *Hypothele* by Jean @-@ Jacques Paulet in 1812 ; *Dentinum* by Samuel Frederick Gray in 1821 ; *Tyrodon* by Petter Karsten in 1881 *Sarcodon* by Lucien Quélet in 1886 . After a 1977 nomenclatural proposal by mycologist Ronald H. Petersen was accepted , *Hydnum repandum* became the official type species of the genus *Hydnum* . Previously , supporting arguments for making *H. repandum* the type were made by Marinus Anton Donk (1958) and Petersen (1973) , while Zden?k Pouzar (1958) and Kenneth Harrison (1971) thought that *H. imbricatum* should be the type .

Several forms and varieties of *H. repandum* have been described . Forms *albidum* and *rufescens* , found in Russia , were published by T.L. Nikolajeva in 1961 ; the latter taxon is synonymous with *H. rufescens* . Form *amarum* , published from Slovenia by Zlata Stropnik , Bogdan Tratnik and Garbrijel Seljak in 1988 , is illegitimate as per article 36 @.@ 1 of the International Code of Nomenclature for algae , fungi , and plants , as it was not given a sufficiently comprehensive description . Jean @-@ Baptiste Barla described *H. repandum* var. *rufescens* in 1859 . Carleton Rea described the white fruit bodied version as a variety ? *H. repandum* var. *album* ? in 1922 .

Molecular studies have shown that the current species concept for *H. repandum* may need revision as there is a poor overlap between morphological and molecular species concepts . Phylogenetic analysis of European specimens , based on internal transcribed spacer and 5.8S DNA sequences , indicates that *H. repandum* specimens form two distinct clades , whose only consistent morphological distinction is cap size . These genetic differences may indicate the presence of undescribed cryptic species , and that the taxon may currently be undergoing intensive speciation .

The specific epithet *repandum* means " bent back " , referring to the wavy cap margin . The varietal epithet *album* means " white as an egg " . *Hydnum repandum* has been given several vernacular names : " sweet tooth " , " yellow tooth fungus " , " wood urchin " , " spreading hedgehog " , " hedgehog mushroom " , or " pig 's trotter " . The variety *alba* is known as " white wood " .

= = Description = =

The orange- , yellow- or tan @-@ colored pileus (cap) is up to 17 cm (6 @.@ 7 in) wide , although specimens measuring 25 cm (9 @.@ 8 in) have been documented . It is generally somewhat irregular in shape (it may be convex or concave at maturity) , with a wavy margin that is rolled inward when young . Caps grow in a distorted shape when fruit bodies are closely clustered . The cap surface is generally dry and smooth , although mature specimens may show cracking . Viewed from above , the caps of mature specimens resemble somewhat those of chanterelles . The flesh is thick , white , firm , brittle , and bruises yellow to orange @-@ brown . The underside is densely covered with small , slender whitish spines measuring 2 ? 7 mm (0 @.@ 1 ? 0 @.@ 3 in)

long . These spines sometimes run down at least one side of the stipe . The stipe , typically 3 ? 10 cm (1 @. @ 2 ? 3 @. @ 9 in) long and 1 ? 3 cm (0 @. @ 4 ? 1 @. @ 2 in) thick , is either white or the same color as the cap , and is sometimes off @-@ center . It is easy to overlook the mushrooms when they are situated amongst gilled mushrooms and boletes , because the cap and stipe are fairly nondescript and the mushrooms must be turned over to reveal their spines . The pure white variety of this species , *H. repandum* var. *album* , is smaller than the main variety , with a cap measuring 2 ? 7 cm (0 @. @ 8 ? 2 @. @ 8 in) wide and a stipe that is 1 ? 3 in (2 @. @ 5 ? 7 @. @ 6 cm) long .

The spore print is pale cream . Spores are smooth , thin @-@ walled and hyaline (translucent) , roughly spherical to broadly egg @-@ shaped , and measure 5 @. @ 5 ? 7 @. @ 5 by 4 @. @ 5 ? 5 @. @ 5 μ m . They usually contain a single , large refractive oil droplet . The basidia (spore @-@ bearing cells) are club @-@ shaped , four @-@ spored , and measure 30 ? 45 by 6 ? 10 μ m . The cap cuticle is a trichodermium (where the outermost hyphae emerge roughly parallel , like hairs , perpendicular to the cap surface) of narrow , club @-@ shaped cells that are 2 @. @ 5 ? 4 μ m wide . Underneath this tissue is the subhymenial layer of interwoven hyphae measuring 10 ? 20 μ m in diameter . The spine tissue is made of narrow (2 ? 5 μ m diameter) , thin @-@ walled hyphae with clamp connections .

= = = Similar species = = =

North American lookalikes include the white hedgehog (*Hydnum albidum*) and the giant hedgehog (*Hydnum albomagnum*) . *H. albidum* has a white to pale yellowish grey fruit body that bruises yellow to orange . *H. albomagnum* is large and paler than *H. repandum* . *Hydnum umbilicatum* is smaller , with caps measuring 3 ? 5 cm (1 @. @ 2 ? 2 @. @ 0 in) in diameter , and thinner stipes that are 0 @. @ 5 ? 1 cm (0 @. @ 2 ? 0 @. @ 4 in) wide . Its caps are umbilicate (with a navel @-@ like cavity) , sometimes with a hole in the center of the cap , unlike the flattened or slightly depressed caps of *H. repandum* . Microscopically , *H. umbilicatum* has spores that are larger and more elliptical than those of *H. repandum* , measuring 7 @. @ 5 ? 9 by 6 ? 7 @. @ 5 μ m . A European lookalike , *Hydnum rufescens* , is also smaller than *H. repandum* , and has a deeper apricot to orange color . *Hydnum ellipsosporum* , described as a new species from Germany in 2004 , differs from *H. repandum* by the shape and length of its spores , which are ellipsoid and measure 9 ? 11 by 6 ? 7 @. @ 5 μ m . Compared to *H. repandum* , it has smaller fruit bodies , with cap diameters ranging from 3 to 5 cm (1 @. @ 2 to 2 @. @ 0 in) wide .

= = Ecology , habitat and distribution = =

Hydnum repandum is a mycorrhizal fungus . The fruit bodies grow singly , scattered , or in groups on the ground or in leaf litter in both coniferous and deciduous forests . They can also grow in fairy rings . Fruiting occurs from summer to autumn . The species is widely distributed in the northern temperate zone , and is one of the most common of the tooth fungi . It has been recorded from Australia , Europe , northern Asia , and North America . In Europe , it has been listed as a vulnerable species in the Red Data Lists of the Netherlands , Belgium , and Germany ; Sweden lists it as being of Least Concern .

= = Edibility = =

The hedgehog mushroom is considered to be a good edible , having a sweet , nutty taste and a crunchy texture . Some consider it the culinary equivalent of the chanterelle . Author Michael Kuo gives it an edibility rating of " great " and notes that there are no poisonous lookalikes , and that they are unlikely to be infested with maggots . Delicately brushing the cap and stipe of specimens immediately after harvest will help prevent soil from getting lodged between the teeth . *Hydnum repandum* mushrooms can be cooked by pickling , simmering in milk or stock , and sautéing , which creates a " tender , meaty texture and a mild flavor . " The mushroom tissue absorbs liquids well and assumes the flavors of added ingredients . The firm texture of the cooked mushroom

makes it suitable for freezing . Its natural flavor is reportedly similar to the peppery taste of watercress , or oysters . Older specimens may have a bitter taste , but boiling can remove the bitterness . Specimens found under conifers can taste " unpleasantly strong " . The form amarum , locally common in Slovakia , is reportedly inedible because its fruit body has a bitter taste at all developmental stages .

Hydnum repandum is frequently sold with chanterelles in Italy , and in France , it is one of the officially recognized edible species sold in markets . In Europe , it is usually sold under its French name *Pied de Mouton* (mutton 's foot) . It is also collected and sold in local markets of Mexico , Spain and British Columbia , Canada . *H. repandum* mushrooms are also used as a food source by the red squirrel (*Sciurus vulgaris*) .

As a widespread edible species , *Hydnum repandum* has been the subject of several scientific studies determining its nutritional and chemical composition . *H. repandum* fruit bodies contain 10 % moisture and 2 % ash . The organic acid composition includes malic acid (0.31 grams per 100 g of mushroom , dry weight) and citric acid (0.65 %) . One study assessed the proportion of essential amino acids (value expressed as a percentage of the total amino acids) : valine , 9 % ; leucine , 14.5 % ; isoleucine , 3.2 % ; threonine , 4.4 % ; methionine , 1 % ; lysine , 4.2 % ; phenylalanine , 3.4 % ; tryptophan , 1.4 % . Lipid content is 4.7 % (expressed as a percent of dry matter) . Major fatty acids include palmitate (15.7 %) , stearate (0.9 %) , oleate (26.4 %) , lineoleate (47.5 %) , and linolenate (20.3 %) . The mycosterol content has been recorded as 628 milligrams of ergosterol and 85 mg of fungisterol (both values per 100 grams of dry matter) .

= = Chemistry = =

Both *H. repandum* and the variety *album* contain the diepoxide compound repandiol (2R , 3R , 8R , 9R) -4,6-decadiyne-2,3:8,9-diepoxy-1,10-diol , which was shown to have potent cytotoxic activity against various tumor cells in laboratory culture . At the molecular level , repandiol is an alkylating agent . It inserts crosslinks between strands of DNA , making it difficult for the genetic material to be expressed or replicated .

The volatile chemicals responsible for the fruity aroma of the mushroom are known . The 12 compounds include eight carbon derivatives such as 1-octen-3-ol , (E) -2-octenol , and (E) -1,3-octadiene .

European studies conducted after the 1986 Chernobyl disaster have shown that the fruit bodies have a high rate of accumulation of the radioactive isotope cesium .

= = = Cited literature = = =

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