

= Gomphus clavatus =

Gomphus clavatus, commonly known pig 's ears or violet chanterelle, as is an edible species of fungus in the genus *Gomphus*, family Gomphaceae native to Eurasia and North America. The fruit body is vase- or fan @-@ shaped with wavy edges to its rim, and grows up to 15 cm (6 in) wide and 17 cm (6 3 ? 4 in) tall. The upper surface or cap is orangish @-@ brown to lilac, while its lower spore @-@ bearing surface, the hymenium, is covered in wrinkles and ridges rather than gills or pores, and is a distinctive purple color. Described by Jacob Christian Schäffer in 1774, *G. clavatus* has had several name changes and many alternate scientific names, having been classified as a chanterelle by several authorities, though it is not closely related to them.

Typically found in coniferous forests, *G. clavatus* is mycorrhizal, and is associated with tree species in a variety of coniferous genera, particularly spruces and firs. It is more common at elevations of greater than 2 @, @ 000 ft (600 m), in moist, shady areas with plenty of leaf litter. Although widespread, *G. clavatus* has become rare in many parts of Europe and extinct in Great Britain. It has been placed on the national Red Lists of threatened fungi in 17 European countries and is one of 33 species proposed for international conservation under the Bern Convention.

= = Taxonomy = =

German naturalist Jacob Christian Schäffer described *Elvela* (subsequently *Helvella*) *purpurascens* in 1774. Austrian naturalist Franz Xaver von Wulfen gave it the name *Clavaria elveloides* in 1781, reporting that it appeared in the fir tree forests around Klagenfurt in August and was common around Hüttenberg. He recorded that poor people ate it, giving it the local name hare 's ear. In 1796, mycologist Christian Hendrik Persoon described *G. clavatus* as *Merulius clavatus*, noting that it grew in grassy locations in woods. He noted it was the same species that Schäffer had described. The specific epithet ? derived from the Latin word *clava* (club) and meaning " club @-@ shaped " ? refers to the shape of young fruit bodies. In his 1801 *Synopsis methodica fungorum*, Persoon placed *Merulius clavatus* (recognising two varieties ? *violaceus* and *spadiceus*) in a section *Gomphus* within *Merulius*.

British botanist Samuel Frederick Gray used Persoon 's name, transferring the violet chanterelle to the genus *Gomphus* in 1821. As it is the first named member of the genus it became the type species. The starting date of fungal taxonomy had been set as January 1, 1821, to coincide with the date of the works of the ' father of mycology ', Swedish naturalist Elias Magnus Fries, which meant the name required sanction by Fries (indicated in the name by a colon) to be considered valid. Thus the species was written as *Gomphus clavatus* (Pers. : Fr.) Gray. A 1987 revision of the International Code of Botanical Nomenclature set the starting date at May 1, 1753, the date of publication of Linnaeus ' work, the *Species Plantarum*. Hence, the name no longer requires the ratification of Fries ' authority. Persoon followed suit in treating *Gomphus* as a separate genus in his 1825 work *Mycologia Europaea*. Here he recognized *M. clavatus* as the same species as *Clavaria truncata* described by Casimir Christoph Schmidel in 1796, calling the taxon *Gomphus truncatus*.

Fries himself declined to keep the genus separate, instead classifying *Gomphus* as a tribe within the genus *Cantharellus* in his 1821 work *Systema Mycologicum*, the species becoming *Cantharellus clavatus*. He recognized four varieties : *violaceo* @-@ *spadiceus*, *carneus*, *purpurascens* and *umbrinus*. Swiss mycologist Louis Secretan described three taxa ? *Merulius clavatus carneus*, *M. clavatus violaceus* and *M. clavatus purpurascens* ? in his 1833 work *Mycographie Suisse*. Many of his names have been rejected for nomenclatural purposes because Secretan had a narrow species concept, dividing many taxa into multiple species that were not supported by other authorities, and his works did not use binomial nomenclature consistently. Fries revised his classification in his 1838 book *Epicrisis Systematis Mycologici seu Synopsis Hymenomycetum*, placing it in a series ? *Deformes* ? in the genus *Craterellus*.

Paul Kummer raised many of Fries ' tribi (subgenera) to genus rank in his 1871 work *Der Führer in die Pilzkunde*, classifying the violet chanterelle in the genus *Thelephora*. Jacques Emile Doassans and Narcisse Théophile Patouillard placed it in the genus *Neurophyllum* (also spelt *Nevrophyllum*)

in 1886 , removing it from *Cantharellus* on account of its orange spores . However , Charles Horton Peck discarded the name in 1887 and returned *G. clavatus* to *Cantharellus* . In 1891 , German botanist Otto Kuntze published *Revisio generum plantarum* , his response to what he perceived as poor method in existing nomenclatural practice . He coined the genus *Trombetta* to incorporate the violet chanterelle , hence giving it the name *Trombetta clavata* . However , Kuntze 's revisionary program was not accepted by the majority of botanists .

Alexander H. Smith treated *Gomphus* as a section within *Cantharellus* in his 1947 review of chanterelles in western North America , as he felt there were no consistent characteristics that distinguished the two genera . In 1966 E.J.H. Corner described a small @-@ spored variety , *G. clavatus* var. *parvispora* , from specimens collected in Uganda ; it is not considered to have independent taxonomic significance .

Research combining the use of phylogenetic analyses of DNA sequences and more traditional morphology @-@ based characters has resulted in a reshuffling of the species concept in *Gomphus* ; as a result , *G. clavatus* is considered the only *Gomphus* species in North America . Comparison of the DNA sequences of species *Gomphus brevipes* and *Gomphus truncatus* has shown them to be genetically identical to *G. clavatus* , and they may be treated as synonyms .

Gomphus clavatus is commonly known as pig 's ears , alluding to the violet underside and yellowish cap of the fruit bodies , although this vernacular name is also used for *Discina perlata* . Other English common names for this species include clustered chanterelle and violet chanterelle . Gray coined the name clubbed gomphe . In the Sherpa language of Nepal the fungus is known as Eeshyamo (" mother @-@ in @-@ law ") , as its imposing fruit body is reminiscent of a mother @-@ in @-@ law , who has a dominant role in the Sherpa family .

= = Description = =

The basidiocarps , or fruit bodies , of immature *Gomphus clavatus* are club @-@ shaped and have one cap or pileus , but later spread out and have a so @-@ called merismatoid appearance ? several vase @-@ shaped caps rising from a common stem . The fruit body is up to 15 cm (6 in) wide and 17 cm (6 3 ? 4 in) tall , fan @-@ shaped with wavy edges . The upper surfaces of the fruit bodies are covered with brown hyphae that form small , distinct patches towards the margin , but combine to form a continuous felt @-@ like tomentum over the center of the cap . The color of the upper cap surface is orange @-@ brown to violet , but later in age fades to a lighter brown . The cap margins of older mushrooms can be quite ragged . The lower spore @-@ bearing surface ? the hymenium ? is wrinkled , often with folds and pits , and violet to brown in color . The solid stem , which is continuous with the cap , is 0 @. @ 8 ? 3 cm (3 ? 8 ? 1 1 ? 8 in) wide , 4 ? 10 cm (1 5 ? 8 ? 3 7 ? 8 in) tall , and covered with fine hairs (tomentum) that become more coarse (hispid) towards the base . It is often compound , with several fruit bodies arising from the basal portion . Fruit bodies may bruise reddish @-@ brown where handled . The flesh can be whitish @-@ pink to lilac or cinnamon @-@ buff . Thick under the center of the cap , it thins out towards the margins . It can be crunchy , though it is softer than that of the chanterelle . The taste and odor are mild . The spore print is yellow to orange @-@ yellow .

Basidiospores are elliptical , wrinkled or slightly warted , and 10 ? 14 by 5 ? 7 @. @ 5 ?m . The spores are nonamyloid , meaning they have a negative color reaction with the iodine in Melzer 's reagent . The spore @-@ bearing structures , the basidia , are elongated or club @-@ shaped , hyaline (glassy or translucent) , and four @-@ spored , with dimensions of 60 ? 90 by 8 @. @ 5 ? 11 @. @ 5 ?m . *G. clavatus* does not contain cystidia , the sterile cells associated with basidia in many species . Clamp connections are present .

= = Similar species = =

Gomphus crassipes , found in Spain and North America , can only be reliably distinguished from *G. clavatus* with the use of a microscope . Its basidiospores are generally longer (11 ? 17 by 5 @. @ 5 ? 7 ?m) and have a more finely wrinkled surface . The North American species *G. bonarii* features a

dull orange cap with erect scales , and a stalk with decurrent folds . It associates with conifers . *Pseudocraterellus pseudoclavatus* (formerly classified in *Gomphus*) is a lookalike species that grow under conifers in the central United States and westward , also differing on microscopic characters and reaction to potassium hydroxide . *Turbinellus floccosus* and *T. kauffmanii* are of similar shape but their caps are covered in scales . The edible blue chanterelle (*Polyozellus multiplex*) could be confused with *G. clavatus* , but has distinctive spores .

= = Habitat , distribution , and conservation = =

Gomphus clavatus grows singly , in clusters or clumps , or even occasionally fairy rings , on the ground , typically in coniferous forests , and with a preference for moist , shady areas with deep leaf litter , or rotten wood debris on the ground . The species is equally common in older or younger stands of trees . Fruit bodies are easily missed because their colors blend with those of the forest floor . It is more common at elevations of greater than 2 @, @ 000 ft (600 m) . *Gomphus clavatus* has been reported as forming symbiotic (mycorrhizal) associations with a variety of trees : *Abies alba* , *Abies cephalonica* , *Abies firma* , *Abies nephrolepis* , *Abies religiosa* , *Picea* species , *Pinus densiflora* , *Pseudotsuga menziesii* , and *Tsuga heterophylla* . It is also reported with beech (*Fagus sylvatica*) in Europe .

In Asia , *Gomphus clavatus* has been reported from China , Japan , Korea , Malaysia , Nepal , and Pakistan . European countries that have reported the fungus include Austria , the Czech Republic , France , Germany , Greece , Italy , Lithuania , Poland , Romania , Russia , Sweden , Switzerland , and Turkey . In North America , the fungus has been found across Canada , Mexico , and the United States , where it is abundant in the Pacific Northwest .

In Europe , *Gomphus clavatus* appears on the national Red Lists of threatened fungi in 17 countries and is one of 33 species proposed for international conservation under the Bern Convention . Due to a substantial decline in sightings , *Gomphus clavatus* became a legally protected species in Hungary on September 1 , 2005 . It also has legal protection in Slovakia and Slovenia . The species formerly occurred in England , but has not been seen since 1927 and is now regarded as extinct . The fungus faces loss and degradation of its habitat ; eutrophication is another potential threat . *Gomphus clavatus* was selected as the 1998 Pilz des Jahres (" Mushroom of the Year ") by the German Mycological Society , partly to highlight its vulnerable status .

= = Edibility = =

Gomphus clavatus is edible (and rated as choice by some) , while others find it tasteless . It has an earthy flavor and meaty texture that complements red meat dishes . Like many edible fungi , consumption may cause gastrointestinal distress in susceptible individuals . The flesh becomes bitter with age , and older specimens may be infested with insects . Insect infestation is unlikely if the weather is cool . *G. clavatus* has been used for cooking for some time ? Fries included it in his 1867 book *Sveriges ätliga och giftiga svampar* (Edible and Poisonous Mushrooms in Sweden) . It is highly regarded by the Zapotec people of Ixtlán de Juárez in Oaxaca , and the Sherpa people in the vicinity of Sagarmatha National Park in Nepal .

Extracts prepared from *G. clavatus* fruit bodies have a high antioxidant activity , and a high concentration of phenolic and flavonoid compounds . Phenolic compounds identified from the fungus include protocatechuic acid , gallic acid , gentisic acid , vanillic acid , syringic acid , cinnamic acid , caffeic acid , ferulic acid , and tannic acid . In a chemical analysis of collections from the South Aegean Region of Turkey , the fungus was shown to have bioaccumulated the toxic metal cadmium to levels exceeding the maximum intake recommended by the European Union Scientific Committee on Food .