= Gyroporus cyanescens =

Gyroporus cyanescens , commonly known as the bluing bolete or the cornflower bolete , is a species of bolete fungus in the family Gyroporaceae . First described from France in 1788 , the species is found in Asia , Australia , Europe , and eastern North America , where it grows on the ground in coniferous and mixed forests .

The yellowish to buff cap surface is fibrous and roughened , and reaches up to 12 cm (4 @.@ 7 in) in diameter . The thick stem , roughly the same color as the cap or lighter , is hollowed out into chambers . All parts of the mushroom turn an intense blue color within a few moments of bruising or cutting . The mushroom is edible , despite its hard stem . A less common variety occurs where the color change is to deep violet rather than blue . The bluing reaction results from the oxidation of a chemical called gyrocyanin .

= = Taxonomy = =

The species was first described scientifically by French botanist Jean Baptiste François Pierre Bulliard in his 1788 Herbier de la France . Later synonyms include Boletus constrictus by Christian Hendrik Persoon in 1801 , Leccinum constrictum by Samuel Frederick Gray in 1821 , Suillus cyanescens by Petter Karsten in 1882 , and Leucoconius cyanescens by Günther Beck von Mannagetta und Lerchenau in 1923 . The variety violaceotinctus was described by Roy Watling in 1969 from collections made in Michigan , USA .

The specific epithethe aquarist 's " green water " is commonly described as a dense bloom of free @-@ floating single @-@ cell algae is derived from the Ancient Greek ????o? , meaning " dark blue " , while the varietal epithet violaceotinctus means " having a violet tinge " . It is commonly known as the bluing bolete or the cornflower bolete .

= = Description = =

The cap of G. cyanescens is initially convex , but flattens out in maturity , sometimes becoming shallowly depressed ; it reaches a diameter of 4 ? 12 cm (1 @.@ 6 ? 4 @.@ 7 in) . The cap is dry , and ranges in color from buff to yellowish to pale olive , occasionally with darker streaks of color . Its surface is uneven , sometimes with wrinkles and pits . The cap margin is initially curved inward , and sometimes splits in maturity . The flesh is whitish to pale yellow , and has a brittle texture . On the underside of the cap , the pore surface is white to yellowish , sometimes with olive or tan tinges . There are roughly two circular pores per millimeter , and the tubes that comprise the pores are 5 ? 10 mm (0 @.@ 2 ? 0 @.@ 4 in) deep , but depressed around the top of the stem . Injury to the pores will cause them to stain first greenish yellow , then greenish blue or blue .

The stem is 4 ? 10 cm (1 @.@ 6 ? 3 @.@ 9 in) long by 1 ? 2 @.@ 5 cm (0 @.@ 4 ? 1 @.@ 0 in) thick , and is either roughly equal in width throughout its length , or has a basal or middle swelling . The stem tissue is hard and brittle ; it is initially stuffed with a soft pith that develops cavities , or becomes entirely hollow in maturity . Roughly the same color as the cap or lighter , the stem surface is dry and lacks reticulations . It is initially covered in coarse hairs that tend to disappear in maturity to leave a relatively smooth surface . All parts of the fruit body stain blue when cut or injured . The variety G. cyanescens var. violaceotinctus is nearly identical in appearance , but stains dark lilac to indigo when bruised . The odor and taste of the fruit bodies is indistinct .

The color of the spore print is pale yellow . Spores are ellipsoid , smooth , hyaline (translucent) , and have dimensions of 8 ? 10 by 5 ? 6 µm . The basidia (spore @-@ bearing cells) are club shaped , two- to four @-@ spored , and measure 24 ? 30 by 8 ? 10 µm . Pleurocystidia (cystidia on the inner walls of the tubes) are light yellow brown in color , club shaped , infrequent , and measure 25 ? 38 by 7 @.@ 2 µm ; the cheilocystidia (found on the tube edge) are colorless , numerous , and measure 32 ? 47 by 7 ? 10 µm . Clamp connections are present in the hyphae .

= = = Similar species = = =

Although there are a few lookalike species with similar overall appearance , in the field , Gyroporus cyanescens is typically readily recognized by its characteristic straw @-@ yellow color and nearly instantaneous dark blue bruising . G. phaeocyanescens is smaller , with a dull brownish @-@ yellow cap . Although its flesh has a bluing reaction to injury , its yellow pore surface does not . It has larger spores , measuring 9 ? 15 by 5 ? 7 µm . G. umbrinosquamosus , found along the Gulf Coast of the United States , is similar in appearance , but lacks the bluing reaction . Newly described from China in 2003 , G. brunneofloccosus closely resembles G. cyanescens , and was frequently confused with that species . It has a smaller fruit body , with a brownish cap up to 8 cm (3 @.@ 1 in) in diameter . Its staining reaction involves a change from light turquoise to dark turquoise or dark blue . Its spores are 5 ? 8 @.@ 5 by 4 ? 5 @.@ 3 µm . Suillus tomentosus has brownish pores that undergo a slower blue staining reaction . If the fruit bodies are not uprooted and only the top of the cap is examined , G. cyanescens can be confused with young Russula fellea mushrooms .

= = = Uses = = =

Gyroporus cyanescens is edible , and considered " choice " by several sources . The fruit bodies , even if mature , are typically free of insect larvae . Specimens collected in sandy soil , however , are difficult to clean , but cleaning may be facilitated by washing the fruit bodies in a bowl of water so that the sand sinks to the bottom . The blue color largely disappears after two minutes of sautéing . Cooked mushrooms have a meaty texture , and mild nutty flavor that is enhanced if fried to crispness . Drying the mushrooms strengthens the taste .

The variety violaceotinctus is used in mushroom dyeing , and produces a light yellow , beige , gold , or brownish @-@ orange color depending on the mordant used .

= = Ecology and distribution = =

Gyroporus cyanescens is an ectomycorrhizal species that has a broad host range . Fruit bodies of Gyroporus cyanescens grow singly or scattered on the ground in deciduous and mixed forests . Often found in association with birch and poplar , the fungus tends to prefer sandy soil , and also frequents road banks and woodland edges . Fruiting occurs in summer and early autumn . Fruit bodies can be parasitized by the mold Sepedonium ampullosporum . Infection results in necrosis of the mushroom tissue , and a yellow color caused by the formation of large amounts of pigmented aleurioconidia (single @-@ celled conidia produced by extrusion from the conidiophores) .

Gyroporus cyanescens is found in Asia , Australia , North America , and Europe . In China , it is known from Guangdong and Yunnan . The fungus appears in eucalypt woodland in Australia . In North America , it is widespread east of the Rocky Mountains . The geographical distribution ranges from eastern Canada to Florida , and west to Minnesota , although it has been occasionally reported from the Pacific Northwest . G. cyanescens var. violaceotinctus has been reported from Japan .

= = Chemistry = =

The identity of the chemical causing bluing upon tissue injury was reported in 1973 . The molecule , gyrocyanin , is a highly oxidized bis @-@ phenol @-@ substituted cyclopentenone that develops a blue color when it is oxidized . In contrast , the bluing of other boletes has been attributed to the oxidation of variegatic or xerocomic acid . Gyrocyanin is biosynthesized from intermediates supplied by the shikimate pathway , a metabolic route used by fungi for the synthesis of aromatic amino acids .