Wood Blewit (*Lepista nuda*)

Mushroom dyed yarn

Mushrooms can be useful for much more delicious dishes. They can be used both in hobby projects such as yarn dyeing and industrially as biofactories in the production of medicines and enzymes. Or as a tool in the probably oldest use of them all: alcohol production and bread raising.

C_2H_5OH

is the chemical formula for alcohol (ethanol). Alcohol is formed by fermentation, and this is where the fungi – or more precisely the yeasts – are essential.

When yeasts grow in an oxygen-free environment, they convert sugars into alcohol and carbon dioxide. The carbon dioxide bubbles away while the alcohol remains in the liquid, which may in this way be transformed into wine, beer or other beverages, depending on what sugars were used. If you close the bottle before the fermentation has stopped, the carbon dioxide gives a sparkling drink (e.g. beer or champagne).

It is the exact same process that is used when rising bread. Here it is the carbon dioxide that is the essential part, as it forms the bubbles in the bread – the alcohol is a waste product.

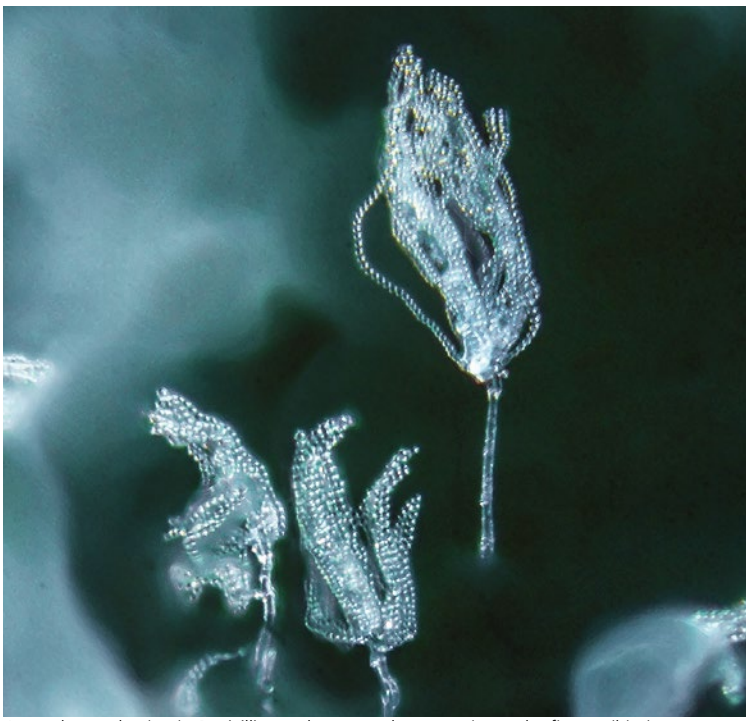
Dyeing yarn with fungi

The reason why fungi are coloured is a mystery, as the fungi don't need to attract insects for pollination or the like. Nevertheless, fungi can have very strong colours, including intense reds and blues. Many fungal dyes are unstable, and will disappear if you dry or heat the fruitbodies, but some species contain stable dyes that can be bound to yarn. The Surprise Webcap (*Cortinarius semisanguineus*) will for example colour the yarn in a splendid orange-red while the pore fungus Cinnamon Bracket (*Hapalopilus nidulans*) will result in rare purple coloures. You can make a fantastic palette from mushroom-dyed yarn!

Surprise Webcap (Cortinarius semisanguineus) produce orange red colours

Biofactories
In modern biotechnological production, fungi play a major role as biofactories. Yeast fungi are easy to grow in an oxygen-free environment, and if you engineer the genetic code for a desired protein or enzyme into a yeast fungus, the fungus will excrete the desired substance during its growth. This can then be extracted from the fermentation tank.

Enzymes
In order to release nutrients, the fungi have developed a large spectrum of enzymes. If you are looking for an enzyme that can enable washing powder to wash clean at lower temperatures or that can convert straw into biofuel, you should search among the fungal decomposers. When you find a species with a suitable enzyme, you can engineer the genetic code for that enzyme into a yeast fungus, which will then do the production.


Asexual reproduction in *Penicillium* – the genus that gave rise to the first antibiotic

Medicine
Finally, there are fungi, with healing properties. Wild edible fungi, such as Hen of the Woods, have long been used in Asian medicine, typically to strengthen the immune system. But since World War II, fungi have also played huge a role in the West. Moulds, for example of the genus *Penicillium*, are the main responsible for producing antibiotics. Due to these people no longer die from simple infections such as pneumonia or blood poisoning.

As with enzyme production, the genetic code for an antibiotic is genetically engineered into a yeast fungus, which then produces the desired substance in a fermentation tank. The fungi are thus both source and biofactories.

The purpose of fungal fruitbodies is to undertake the sexual reproduction and to produce sexual spores that can dissipate the species.

Although fungal fruitbodies can appear very fleshy and well-structured, they are formed by tubular fungal hyphae which are only woven together, much like an interwoven key of yarn.

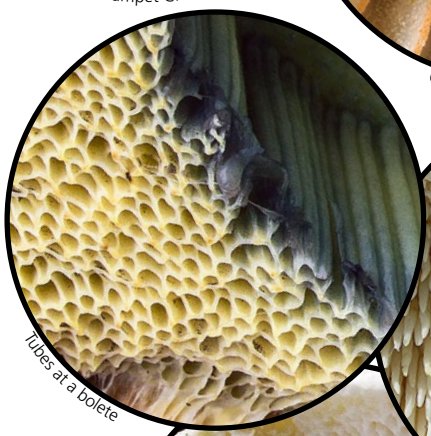
The small, very young Ferny Bonnet (*Mycena pterigena*) at the right is magnified about 100 times. At this magnification you can clearly see the hyphae that make up the fruitbody.

Very young Ferny Bonnet (*Mycena pterigena*) on a stalk a fern leave – enlarged about 100 times so that the hyphae of the fruit body are visible

A smooth hymenophore beneath the cap of the Horn of Plenty

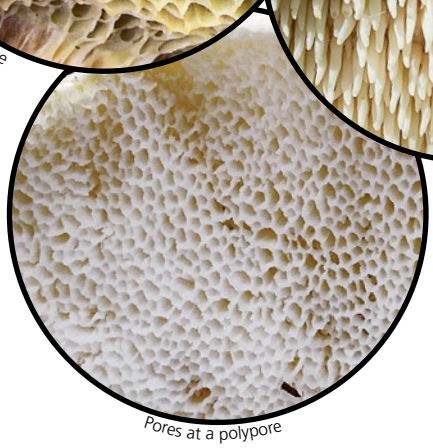
Veins at Trumpet Chantarelle

Gills at Ferny Bonnet



Tubes at a bolete

Spines at a Hedgehog



Pores at a polypore

The hymenophore

At most of the fungi in this book, the spores form on the underside of a cap. The area where the spore formation takes place is called the hymenophore. Placed under the cap, it is well protected from rain and drought, so that the spores can be produced and released undisturbed into the wind.

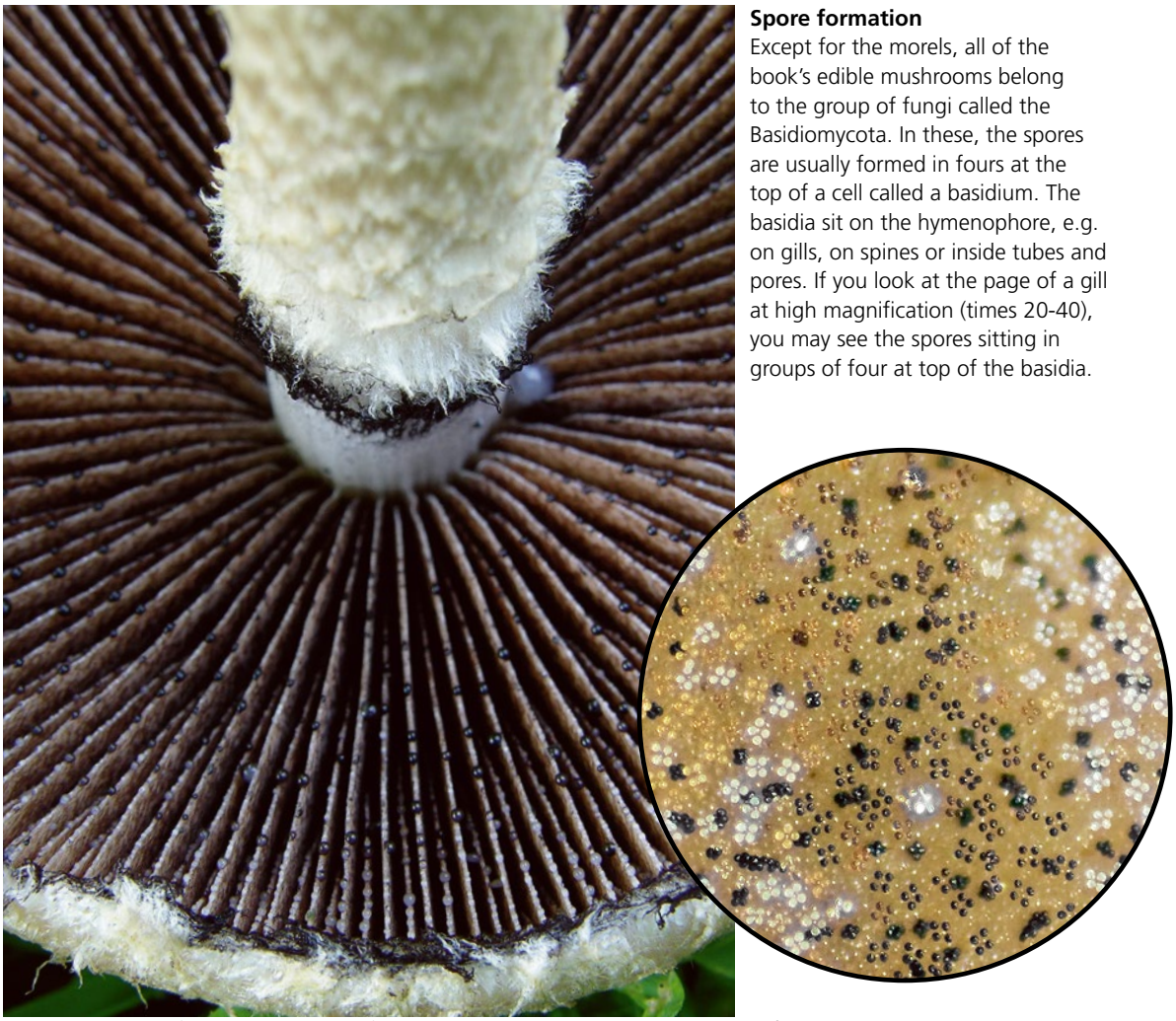
In some species, e.g. Horn of Plenty, the hymenophore is just a smooth surface. In the quest to form as many spores as possible per fruitbody, most fungal species have, however, developed folded structures with a much larger surface.

The wrinkles and veins of the chanterelles are the simple version. More advanced are the gills of the agarics, the spikes of the tooth fungi, the tubes of the boletes and the pores of the polypores. If you can identify the hymenophore of your fungus, you are already well on your way to identify the species (see key pages 46-47).

Fungi may form fruitbodies in many other shapes than cap and stem. For example, the morels produce spores all over their wrinkled head while the puffballs produce the spores inside the fruitbody and depend on an external event to force the spores out.

Black Morel (*Morchella conica*) produce spores all over the oblong, folded head

Spiny Puffball (*Lycoperdon echinatum*) produce the spores inside the fruitbodies



In this weeping widow (*Lacrymaria lacrymabunda*), the black spore color is revealed by the thousands of spores trapped in the veil remnants – a close study of the gills (right) shows white (immature) and black (mature) spores sitting in fours at the top of the basidia

Spore formation

Except for the morels, all of the book's edible mushrooms belong to the group of fungi called the Basidiomycota. In these, the spores are usually formed in fours at the top of a cell called a basidium. The basidia sit on the hymenophore, e.g. on gills, on spines or inside tubes and pores. If you look at the page of a gill at high magnification (times 20-40), you may see the spores sitting in groups of four at top of the basidia.

Spore colours

To identify an agaric, it is important to know the colour of its spores. Unfortunately he spores are so small that you cannot just see them. To be able to judge the colour, you have to look at a spore deposit.

If you have a good lens, you may search the gills or at the top of the stem. Here you can often find small spore deposits in wrinkles and remnants of the veil. If the fungi have grown with several caps on top of each other, there may also be spore deposits at the upper page of the lower caps. If nothing is found, you can make your own spore deposit.

The agarics are divided into these spore colours:

spore deposit whitish to greyish, page 112

spore deposit brownish pink to pink, page 130

spore deposit dark brown to black, page 132

spore deposit brown, page 142

Make a spore deposit
You take a fresh cap and cut off the stem. Then place the cap with the gills facing downwards on a piece of white paper and cover it with a bowl or a piece of plastic to prevent it from drying. If the fungus is fresh and alive, it will usually release spores to the paper within 2-4 hours.

START

as a ball or pear, at age with dark spores inside

puffballs, page 144

branched with acute tips

Upright Coral and Coral Tooth, page 53

folded

folded with a stem

morels, page 48

funnel-shaped, black

Horn of Plenty, page 92

crisp

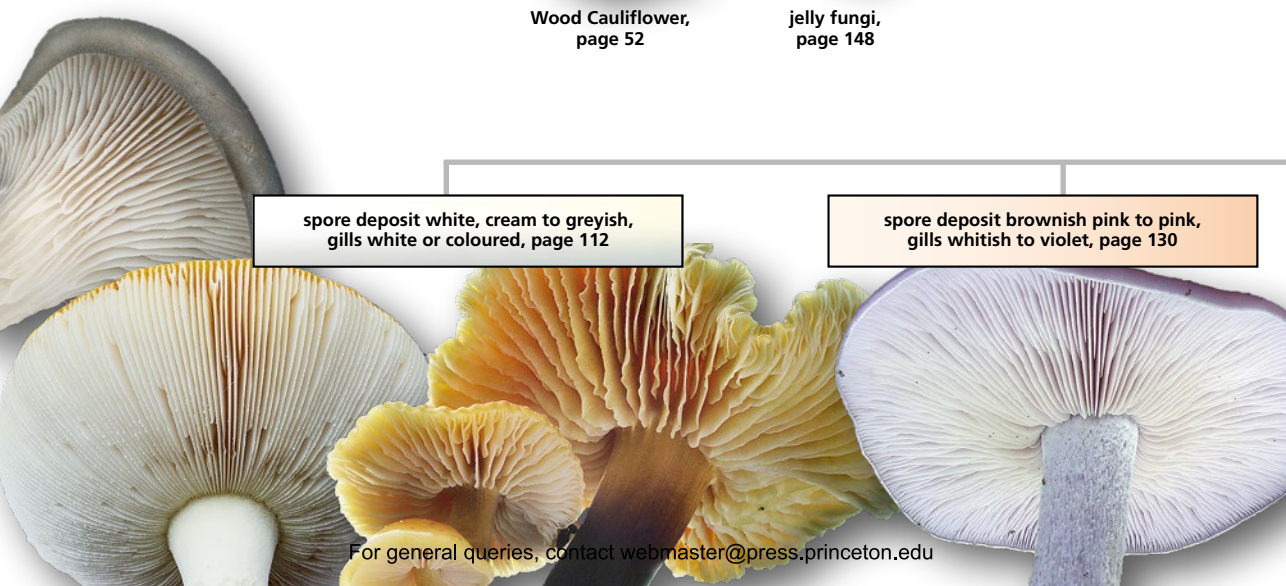
Wood Cauliflower, page 52

jelly-like to cartilaginous

jelly fungi, page 148

spore deposit white, cream to greyish, gills white or coloured, page 112

spore deposit brownish pink to pink, gills whitish to violet, page 130



overview of the included fungi

with veins below a cap

with gills below a cap

with spines below a cap

with tubes or pores below a cap

Chantarelles, page 86

tooth fungi, page 84

soft and crisp, on the ground

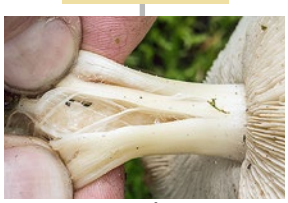
boletes, page 66

somewhat tough, on wood

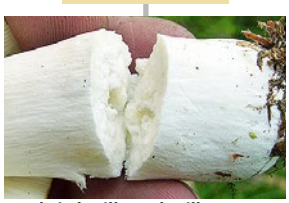
polypores, page 54

flesh fibred

flesh without fibres



agarics



brittlegills and milkcaps, page 94-104

spore deposit dark brown to black, gills dark at maturity, page 132

spore deposit brown, gills brown at maturity, page 142

Morels *are spring fungi that form large, almost club-shaped fruitbodies with a "head" with a honeycomb-like outside. The whole fruitbody is hollow.*

Other similar fungi:
– at the **False Morels**, the top is not hollow, but folded all the way through, p. 51.
– the **Saddles** are likewise not entirely hollow but folded, p. 51.

Morels are among the most famous edible mushrooms. For example, the menu included morels at the Danish Crown Prince Frederik and Crown Princess Mary's wedding in 2004.


A basket full of newly harvested common morels

•• **Common Morel** (*Morchella esculenta*) is the culinary best of the morels. It is a very characteristic edible mushroom with a chacteristic, powerful taste (a few drops of lemon are good). Not to be eaten raw.

The Common Morel is immensely variable in shape and colour and can also grow in very different habitats. Genetically there are several different species looking more or less alike.

Common Morel typically forms fruitbodies in during April and May. It is mostly found on soils with a high pH. It can be on soils with chalk or limestone, in gravel roadsides where the gravel exudes chalk or even in places affected by mortar and cement. In the latter places, the occurrence will often be a one-off affair, while habitats with a natural high pH can yield stable Morel harvest for years. The Common Morel lives in a mycorrhiza-like symbiosis with trees, perhaps especially elms.


Common Morel is hollow inside

•• **Semifree Morel** (*Morchella semilibera*) is a small, thin-fleshed and very slender Morel. Its head has a free lower edge – hence the name. It otherwise looks like a small Common Morel and is likewise a good edible mushroom – but you have to find quite a lot of fruitbodies for one dish. It must not be eaten raw.

Semifree Morel is mostly found in the cultural landscape, for example on old ramparts or other places where the soil has been disturbed and gained a high pH. It arrives in April and May, at the same time as the other species of Morel.

Semifree Morel in handfuls

•• **Black Morel** (*Morchella elata*) is less fleshy than the Common Morel. It has an elongated, pointed top, where the pattern is dominated by longitudinal ribs.

Unlike the Common Morel, Black Morel lives as a decomposer. One of the places where you can sometimes find it in large amounts is in beds of wood chips under, for example, roses or rhododendrons in parks and cities. In such places you can't count on a stable supply of morels through the years, but when you find them, there may be hundreds of fruitbodies. Otherwise, Black Morel is often found in places where the soil has been disturbed, for example in flower beds. Found April to May.

Black Morel is as tasty as the Common Morel. It must never be eaten raw.

†† **False Morel** (*Gyromitra esculenta*) is only distantly related to the true morels but looks a lot like them. The main difference is that the head of the False Morel does not have a large, internal cavity, but is instead folded in a brain-like manner.

False Morel is deadly poisonous as raw. After drying or drying, most of the toxins disappear, but there are still residues left, and it is therefore not advisable to experiment with species of *Gyromitra* for eating.

False Morel forms mycorrhiza with pine on poor, gravelly or sandy soil. The fruitbodies are found from late March to May.

False Morel in a pine forest

A sectioned False Morel is not entirely hollow

White Saddle in a roadside

• **White Saddle** (*Helvella crispa*) is another distant relative of the morels. It has a pitted or furrowed stem bearing a folded or saddle-shaped head. All parts are whitish.

The White Saddle grows in mull soil forests, especially in roadsides where it fruits during autumn. It is not poisonous, but also not worth eating.

There are many other species Saddel – for example the Elfin Saddle (*Helvella lacunusa*), which looks like a completely grey version of the White Saddle.

•• **Wood Cauliflower** *(*Sparassis crispa*)* grows on conifers. The fruitbodies can be as large as a football and consist of curly, flat, beige-coloured lobes. The flesh often has a slight chemical odour that disappears during cooking.

Other similar fungi:
– **Upright Coral** can have the same colour as the Wood Cauliflower but grows on hardwood. Its upward-pointing branches are cylindrical, not flat or lobed, see next page.
– **Coral Tooth** forms large, branched, white fruitbodies lined with white, downwards pointed spines. It grows on old beeches and is edible but rare, see next page.

Since the fruitbodies can be very large and can keep fresh for a lung time in the fridge, they can provide for many meals. The taste is fine and the texture crisp, but avoid old, brownish specimens – these may get a bitter taste. Try making a stew with cream and a little lemon, and mix it with paste before serving.

Wood Cauliflower is found scattered in conifer plantations with spruce or pine. It usually forms fruitbodies at the base of the trees, preferably in the gap between two roots and can be found throughout autumn.

• **Upright Coral** (*Ramaria stricta*) forms up to orange-sized, light brown, branched fruitbodies that arise from twigs and branches of beech. Unlike the Wood Cauliflower, the branches are largely round in cross section and the branching is upright.

Upright Coral is of no value as an edible fungus. It can be one of the most common fungi in the autumn beech forest.

There are many other species of coral fungi, some of which are edible. However, they look very much alike and should be avoided.

• **Coral Tooth** (*Hericium coralloides*) forms coral-like branched fruitbodies, where the white branches are clad with long, downwards-pointed spines. It grows on old beeches and is mostly seen quite in late autumn.

Coral Tooth can be eaten, but since it is rare and registered as vulnerable on the red list, you should leave it to beautify the forest.

Polypores *form fruitbodies where the underside filled with small holes (pores). The spores form at the inside of the pores and are dropped from the pore mouths. Polypores most often grow on wood.*

Other similar fungi:
– **Boletes** also have holes below the cap, but these are build as single tubes that usually can be separated from each other and from the flesh of the cap. Almost all boletes grow on the ground.

The fruitbodies of the polypores range from small to huge. Some species of polypores may form perennial and wood hard fruitbodies and the largest of these are measured in meters and multiple kilos. The polypore species included in this book are, however, all quite soft-fleshed and edible. They are also different from typical polypores by having a stem or a narrowed base. More typical polypores – such as the Tinder Bracket (*Fomes fomentarius*) – are broadly attached to the wood.


Tinder Bracket (*Fomes fomentarius*) form hard, broadly attached fruitbodies

Dryad's Saddle seen from below. The large pores are clearly visible


Caps with coarse scales

• **Dryad's Saddle** (*Cerioporus squamosus*) forms very large, rather soft-fleshed fruitbodies, which are attached to the tree with a short, dark stem. The upper side has coars scales and the pores are several millimetres wide.

Other similar fungi:
– **Tuberous Polypore** (*Polyporus tuberaster*) is similar but smaller. It is also edible.

Dryad's Saddle is common on old deciduous trees, especially on avenue trees. It mostly forms fruitbodies during May and June, but may also be found later in the year. Young specimens are edible and smell a bit like cucumber or watermelon. The stem and the mature fruitbodies are tough and can not be used.

Dryad's Saddle is not one of our top edible fungi. During the wave of New Nordic Cuisine it has, however, entered the menus of gourmet restaurants.


Very large, edgy and somewhat oblong pores

• **Chicken of the Woods** (*Laetiporus sulphureus*) is a polypore forming very large, orange-yellow fruitbodies that form magnificent tiered clusters on living trees. Some individuals develop fruiting bodies as early as late May, while others arrive in during autumn. It is most common on oak, but can also be found on a large number of other deciduous trees.

Other similar fungi:
– the even larger, also edible **Giant Polypore** (*Meripilus giganteus*) has the same basic shape. It is brown with a beige pore surface, which turns dark to the touch (see page 60). It grows on old beeches.

Young Chicken of the Woods where the pores are not yet properly developed are edible after thorough cooking. Cut them into thin slices or small cubes and fry them on the pan (they take up a lot of oil). Make sure the pieces are heated all the way through, as raw and poorly cooked Chicken of the Woods may cause upset stomach.

The pore surface with yellow pores. This specimen is older than the one above, and is too tough for eating

Chicken of the Woods tastes mild but has a very firm consistency that is quite reminiscent of chicken meat. Some say that Chicken of the Woods that have grown on oak taste more sour than those that have grown on other deciduous trees.

Various species of Chicken of the Woods are very popular edible fungi around the world. In Bhutan, where the species goes by the local name "Taa Shamong", it is offered from large plastic bags at the Thimphu market.

Stewed Chicken of the Woods with green pasta and basil

•• **Hen of the Woods** (*Grifola frondosa*) forms large, tiered fruitbodies with many small caps. Each brown-grey cap looks like a small tongue, attached attached to the rest of the fruitbody at the edge. The pore surface is white and the pores are quite large. Hen of the Woods grows on old oaks, where it typically emerges in a gap between two roots during autumn (see also page 17).

Other similar fungi:
– **Giant Polypore** (*Meripilus giganteus*) has similar colours, but its pore layer darkens at touch, it is much larger and it grows on beech (p. 60).
– **Umbrella Polypore** is very similar, but here the small caps are attached with a central stem (see next page).

Hen of the Woods is an excellent edible fungus with fine consistency and better taste than the other edible polypores. It is quite common in the southern parts of the UK. The species can also be grown on sawdust. In China and Japan, it is considered an important ingredient in the traditional medicine, and studies show that it stimulates the immune system. Its Japanese name is "Maitake".

The small caps underside with white pores

A mature Hen of the Woods, gnawed by snails and beetles, but still an excellent edible fungus

• **Umbrella Polypore** (*Cladomeris umbellatus*) resembles Hen of the Woods, but its small caps sit on a small, central stem. It grows on the ground near old beeches, but is also rarely found by oaks.

Umbrella Polypore is edible, but less tasty and much softer than Hen of the Woods. It is also often attacked by larvae. It fruits rather early, from July to September.

• **Giant Polypore** (*Meripilus giganteus*) is one of our most striking fungi forming gigantic, tiered, brown fruitbodies at the base of beech trees. It lacks the bright yellow and orange colours of Chicken of the Woods and its beige-coloured pore surface becomes greyish on touch.

Giant Polypore likes to grow on old beeches in the cultural landscape, for example in parks, avenues and cemeteries. It decompose the wood and eventually the tree falls. The fruitbodies typically appear in August and early September.

Other similar fungi:
– **Chicken of the Woods** (*Laetiporus sulphureus*) has almost the same size and shape, but is bright yellow to orange, see page 56
– **Hen of the Woods** (*Grifola frondosa*), which is also edible, is smaller but has more or less the same colours. It does not turn dark when touched and grows on oak, see page 58


A giant, inedible fruitbody with many layers of caps

Young and edible fruitbodies

There have been heated discussions about the edibility of the Giant Polypore. It is not poisonous, but its somewhat sour, slightly perfumed taste is not what most mushroom hunters expect from a good edible mushroom. This, however, does not stop the mycology students in the photograph from supplying themselves! Personally, I think young fruitbodies are quite OK. And as a special little twist, the whole dish will darken during cooking, and ends almost black – deliciously scary!

The pore surface become dark at touch

Rather old, but fortunately mycology students are optimists

• **Beefsteak Fungus** (*Fistulina hepatica*) forms peculiar, tongue-shaped fruitbodies filled with a red juice. When cut, a juicy, structured flesh resembling the flesh of a raw tongue is exposed. The underside is covered with small tubes which by young fruitbodies are pores and closed. As they mature, they transform into free, open tubes. The fruitbodies may have a short stem (see the picture at the bottom of page 66)

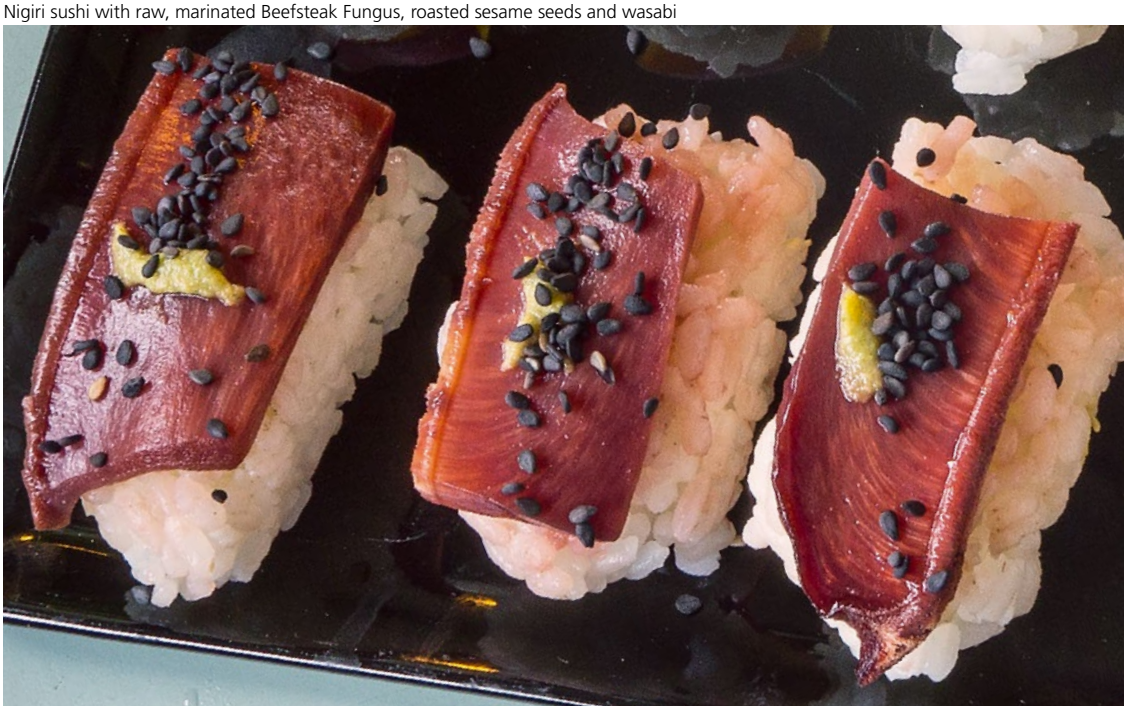
Beefsteak fungi only grow on old oaks, where they typically appears in August or September

OTHER SIMILAR FUNGI:
There are no other polypores with red juice.

Young Beefsteak Fungus

Beefsteak Fungus is edible, but has a very special, sour taste, and there are divided opinions about its gastronomic value. It's one of the few species that may be used raw. You can try salads or pickles, but the most spectacular use is probably on Nigiri sushi. Use young beefsteak fungi and expect a unique experience.

Nigiri sushi with raw, marinated Beefsteak Fungus, roasted sesame seeds and wasabi



Sectioned older fruitbody with red juice and free tubes

•• **Forest Lamb** (*Albatrellus ovinus*) is a polypore that grows on the ground. Its fruitbodies resemble very pale boletes but has a pore layer that is running down the stem. The cap is very pale brown, while the pore mouths are white, but change colour to pale yellow when touched. When fried, all parts turn yellow.

Other similar fungi:
– **Fused Polypore** (not known from the UK) is very similar, but has a browner cap, and the pore mouths do not turn yellow when touched or fried, see next page. It tastes bitter.
– **Boletes** may have the same shape, but are usually less pale and do not turn yellow when touched, see page 66.
– species of **Falsebolete** (*Boletopsis*) have more grey colours, taste bitter and do not turn yellow when touched. They are very rare but not poisonous.

yellowing when bruised and even more when fried (below)

Forest Lamb grows in old spruce forests, especially spruce forests on calcareous soils. It fruits during autumn but is extremely rare in the UK.

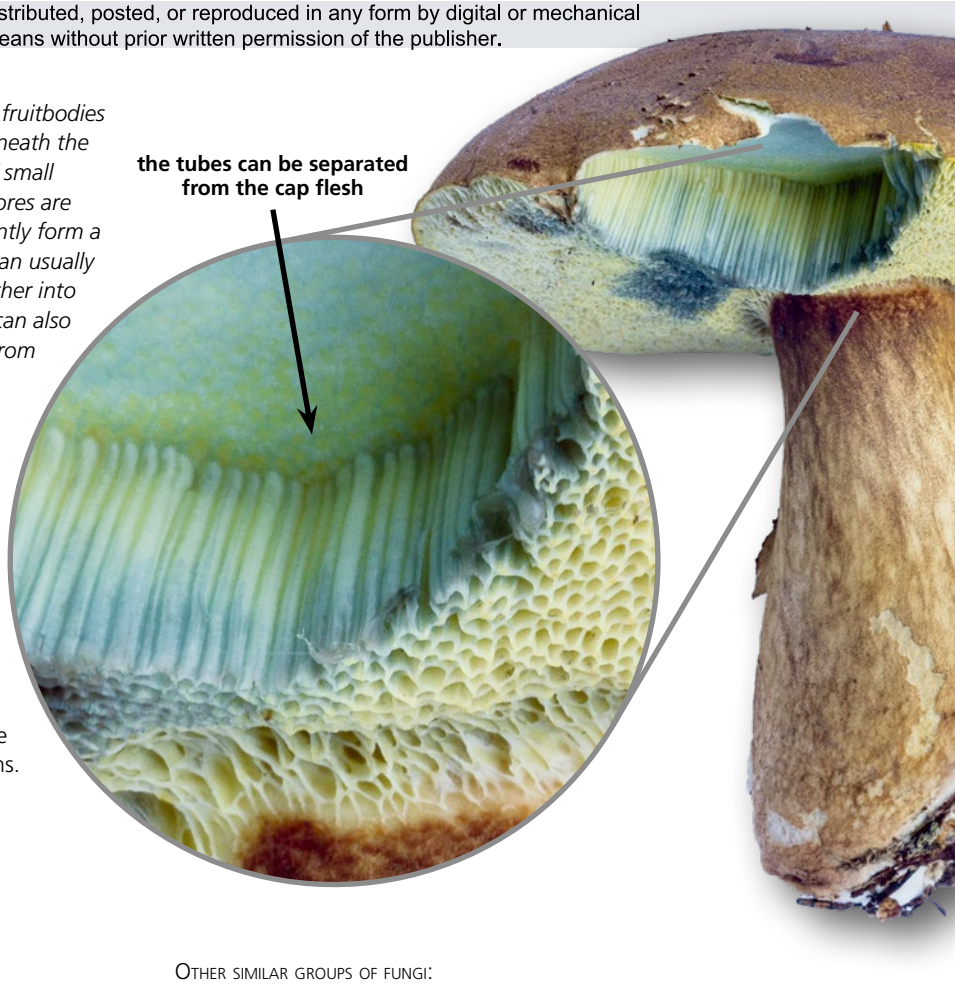
If you go to Norway, Sweden or the Alps, there is a much better chance to meet the lamb. Here you will discover that it is an excellent edible fungus. As usual, only young specimens should be collected and thoroughly cooked. Well fried, you will get a meal with a fine taste and a delicate consistency.

Forest lamb has white, edged spores

• **Fused Polypore** (*Albatrellus confluens*) resembles Forest Lamb, but has a somewhat browner cap and does not become turn yellow when touched. It tastes bitter and should not be mixed with the edible fungi, but it is probably not poisonous.

Boletes *form soft-fleshed fruitbodies with a cap and a stem. Beneath the cap a layer of hundreds of small tubes within which the spores are formed. The tubes apparently form a solid tube layer, but they can usually be separated from each other into individual tubes and they can also be separated quite easily from the cap flesh.*

Since the boletes are very easy to recognize, they are really good beginners mushrooms. There are a few moderately poisonous species (p. 79) and a few with a bitter taste (p. 75), but the majority are edible and Cep, the Scarletina Bolete and the Lurid Bolete are among the very best edible mushrooms.

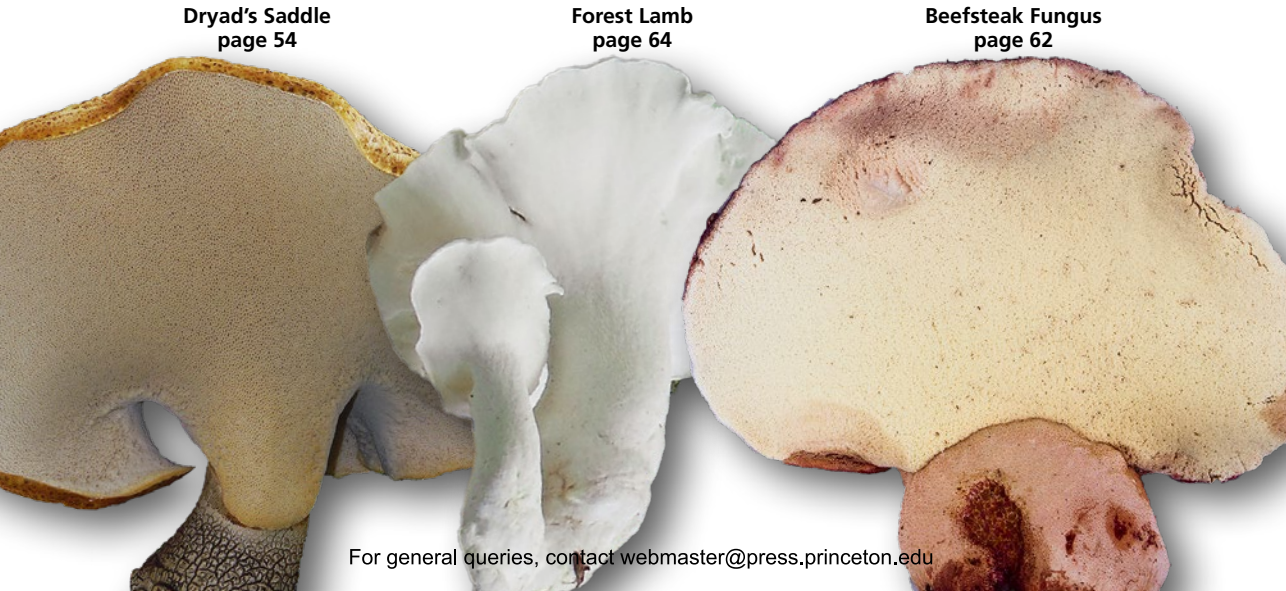


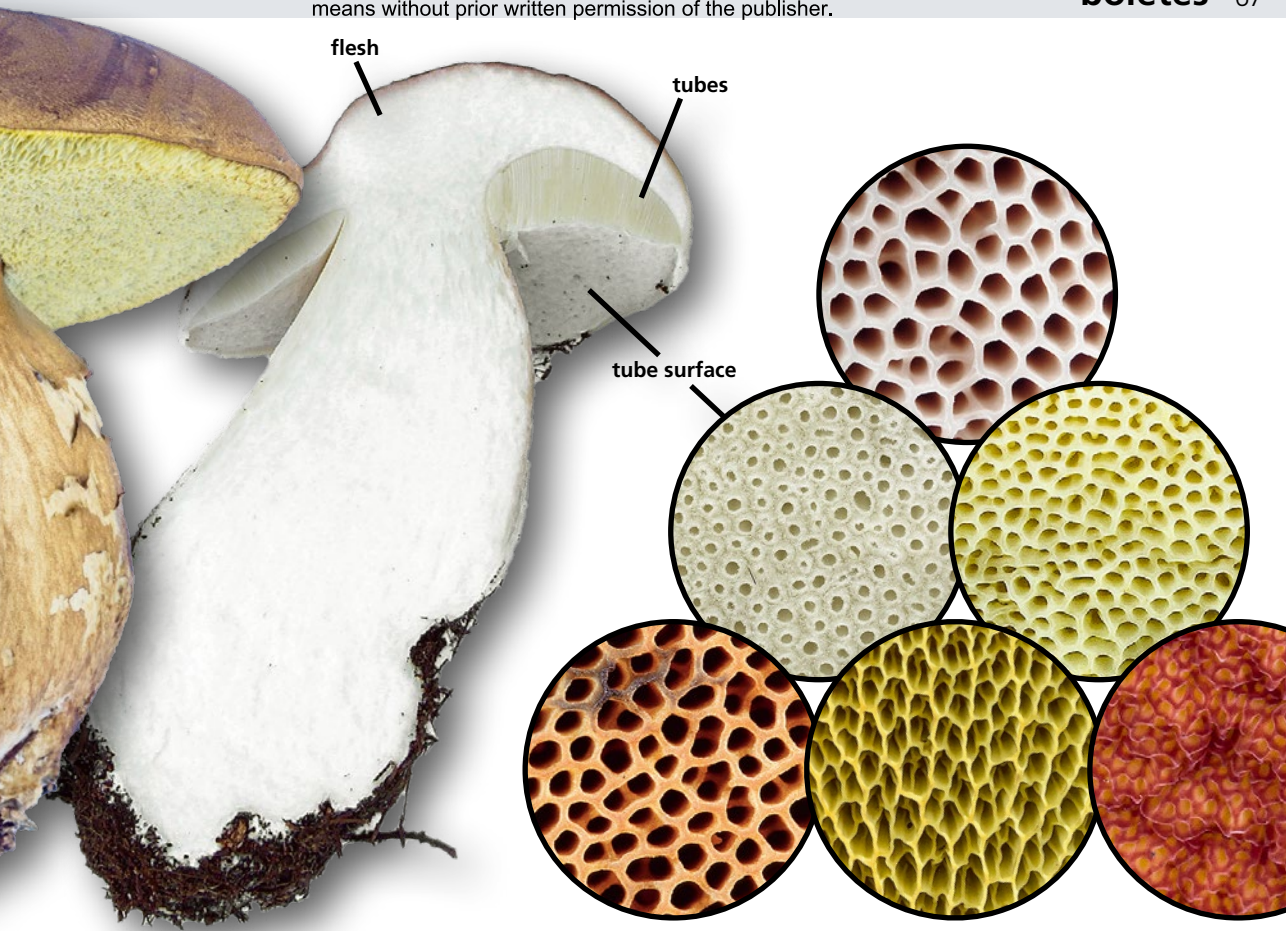
Other similar groups of fungi:

- **Dryad's Saddle** and similar polypores also have a cap and a stem. Their flesh is rather though and their pores are inseparable from each other and from the flesh of the cap. They mostly grow on wood, see page 54.

– **Forest Lamb** is soft-fleshed with a bolete-like shape and grows on the ground. However, it has typical, inseparable polypore pores, see page 64. No species are poisonous.

– **Beefsteak Fungus** is soft fleshed and has separable tubes like boletes. It grows on wood and is filled with reddish juice, see page 62. It is edible.





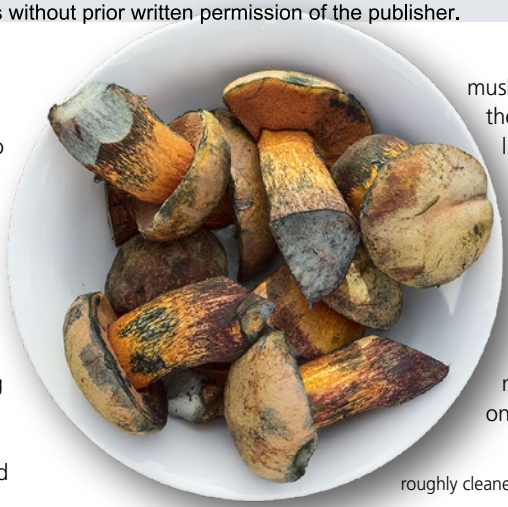
boletes
– see the various groups on the next spread

Preparation of boletes

Boletes contain a lot of water, and since some species can also be a bit slimy, it is a bit of an art to fry boletes and regain some structure. Thus, one should not be tempted to pick a lot of old, soft boletes. Make do with the young, firm fruitbodies, even though it may be difficult to resist picking the older, too.

Upon cooking do not add more than one layer of chopped mushrooms, fry at high heat and let the liquid boil away. Then add a little oil or butter and continue to fry until the mushrooms become crispy at the edges.

A variation is to slice young Cep very thin and fast fry these in plenty of very hot oil. In this way, the fungi hardly shrink and they keep some of their nut like raw taste. Unfortunately only a few slices can be processed



roughly cleaned Lurid Bolete (*Suillellus luridus*)

overview over the boletes

START

different

with a long, (dark-) scaly stem

Leccinum
page 80

different

with a slimy cap and often also with a ring

Suillus
page 82

boletes with first white, later yellow tube mouths, page 70

at a time, so a large meal will take its time.

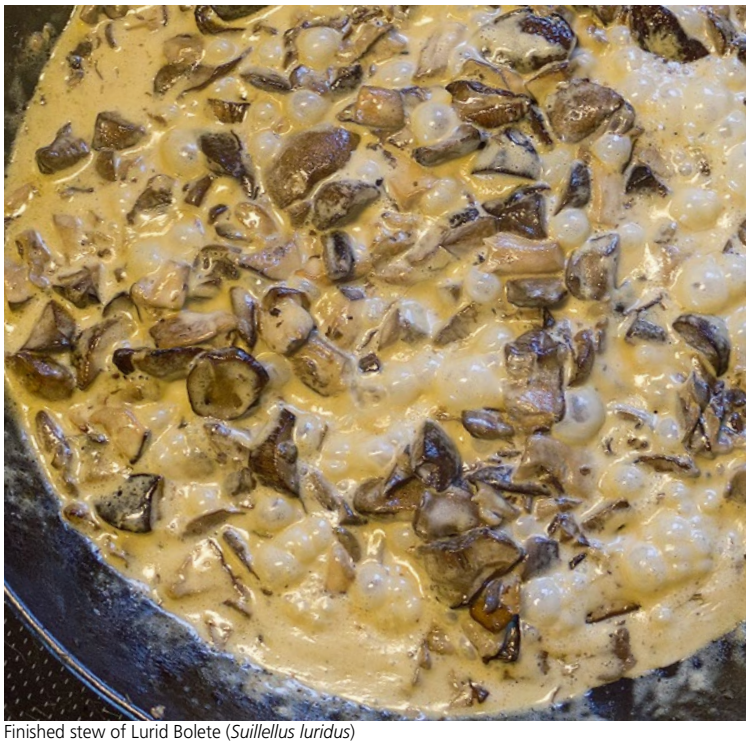
Have you found a lot of boletes, you can dry or freeze them and save them for leaner times, see page 38.

Drying

Since boletes are very fleshy, it is important that they are cut into thin slices before drying. It takes time to dry boletes, but they become easier to use afterwards, because they become less slimy during cooking.

Freezing

Boletes are very suitable for freezing. You can both freeze the raw mushrooms as small cubes or start by fry the water away first so they will take up less space.



Finished stew of Lurid Bolete (*Suillellus luridus*)

boletes with rose tube mouths, page 71

boletes with yellow tube mouths, page 72

boletes with orange to red tube mouths (many species blueing), page 76

boletes with first white, later yellow tube mouths

The champagne cork state of Cep

White tube mouths and a pale net ornament

Yellow tube mouths a an older fruitbody

Boletes, whose tubes start out completely white and then later turn yellow, belong to ***the Cep group****. They all have a pale net ornament down the stem and are all edible and good.*

Other similar fungi:

– the bolete genus ***Leccinum*** have long scaly stems and tubes that remain whitish to greyish, see page 80.

– **Forest Lam**b (*Albatrellus ovinus*) has white tubes that can not easily be detached from the cap, see page 64 (not found in the UK but e.g. in the Scandinavian coniferous forests).

The species of the Cep group of boletes form large fruitbodies with a club-shaped stem and a cap shaped as a bun. They never turn blue when touched or cut.

You have to start looking for Cep at the end of August or the beginning of September – three to four weeks after the first large summer showers. They then may fruit in a quite concentrated period of two to three weeks – the so-called Cep boom. You can still find Cep later in the year, but usually much more scattered.

Cep should be collected young. As long as they are shaped like champagne corks, they are among the best edible mushrooms, but as soon as the tubes start to turn yellow they become soft. If you want to use middle-aged fruitbodies with yellow tubes, remove the tubes before cooking or the dish will become very sticky. Old fruitbodies should be avoided.

The species of the Cep group form mycorrhiza with many different trees, e.g. beech, oak, birch, spruce, pine and fir. If you want to distinguish between the species, you must know the host tree and study the cap cuticle. Fortunately, all species are equally tasty.

(continued ...)

The icons of the book

- • acceptable edible after proper cooking
- •• excellent after proper cooking
- • useless
- † seriously poisonous
- †† deadly poisonous