

Edible mushroom

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Edible mushrooms are the fleshy and edible fruit bodies of several species of macrofungi (fungi which bear fruiting structures that are large enough to be seen with the naked eye). They can appear either below ground (hypogeous) or above ground (epigeous) where they may be picked by hand.^[1] Edibility may be defined by criteria that include absence of poisonous effects on humans and desirable taste and aroma.^{[2][3]}

Edible mushrooms are consumed for their nutritional value and they are occasionally consumed for their supposed medicinal value. Mushrooms consumed by those practicing folk medicine are known as medicinal mushrooms.^[4] While hallucinogenic mushrooms (e.g. psilocybin mushrooms) are occasionally consumed for recreational or religious purposes, they can produce severe nausea and disorientation, and are therefore not commonly considered edible mushrooms.^[5]

Edible mushrooms include many fungal species that are either harvested wild or cultivated. Easily cultivatable and common wild mushrooms are often available in markets, and those that are more difficult to obtain (such as the prized truffle and matsutake) may be collected on a smaller scale by private gatherers. Some preparations may render certain poisonous mushrooms fit for consumption.

Before assuming that any wild mushroom is edible, it should be identified. Accurate determination and proper identification of a species is the only safe way to ensure edibility, and the only safeguard against possible accident. Some mushrooms that are edible for most people can cause allergic reactions in some individuals, and old or improperly stored specimens can cause food poisoning. Great care should therefore be taken when eating any fungus for the first time, and only small quantities should be consumed in case of individual allergies. Deadly poisonous mushrooms that are frequently confused with edible mushrooms and responsible for many fatal poisonings include several species of the *Amanita* genus, in particular, *Amanita phalloides*, the *death cap*. It is therefore better to eat only a few, easily recognizable species, than to experiment indiscriminately. Moreover, even species of mushrooms that normally are edible, may be dangerous, as mushrooms growing in polluted locations can accumulate pollutants such as heavy metals.^[6]



White mushrooms - while common, they are just one of the many types of mushrooms cultivated and eaten



Assorted picked edible mushrooms in a basket



Edible mushrooms on sale in Warsaw

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History of mushroom use

Mycophagy /maɪˈkɑːfədʒi/, the act of consuming mushrooms, dates back to ancient times. Edible mushroom species have been found in association with 13,000-year-old archaeological sites in Chile, but the first reliable evidence of mushroom consumption dates to several hundred years BC in China. The Chinese value mushrooms for medicinal properties as well as for food. Ancient Romans and Greeks, particularly the upper classes, used mushrooms for culinary purposes.^[5] Food tasters were employed by Roman emperors to ensure that mushrooms were safe to eat.^[7]

Mushrooms are also easily preserved, and historically have provided additional nutrition over winter.

Many cultures around the world have either used or continue to use psilocybin mushrooms for spiritual purposes as well as medicinal mushrooms in folk medicine, although these are not considered "edible" mushrooms in the culinary sense.

Current culinary use

Commercially cultivated

Mushroom cultivation has a long history, with over twenty species commercially cultivated.

Mushrooms are cultivated in at least 60 countries^[8] with China, the United States, Netherlands, France and Poland being the top five producers in 2000.

A fraction of the many fungi consumed by humans are currently cultivated and sold commercially. Commercial cultivation is important ecologically, as there have been concerns of depletion of larger fungi such as chanterelles in Europe, possibly because the group has grown popular, yet remains a challenge to cultivate.

Commercially harvested wild edibles

Some species are difficult to cultivate; others (particularly mycorrhizal species) have not yet been successfully cultivated. Some of these species are harvested from the wild, and can be found in markets. When in season they can be purchased fresh, and many species are sold dried as well. The following species are commonly harvested from the wild:



Commercially cultivated Japanese edible mushroom species - clockwise from left, enokitake, bunashiimeji, bunapi-shimeji, king oyster mushroom and shiitake

- *Boletus edulis* or edible Boletus, native to Europe, known in Italian as Fungo Porcino (plural 'porcini') (Pig mushroom), in German as Steinpilz (Stone mushroom), in Russian as "white mushroom", in Albanian as (Wolf mushroom), in French the *cèpe* and in the UK as the Penny Bun. It also known as the king bolete, and is renowned for its delicious flavor. It is sought after worldwide, and can be found in a variety of culinary dishes.
- *Cantharellus cibarius* (The chanterelle), The yellow chanterelle is one of the best and most easily recognizable mushrooms, and can be found in Asia, Europe, North America and Australia. There are poisonous mushrooms which resemble it, though these can be confidently distinguished if one is familiar with the chanterelle's identifying features.
- *Cantharellus tubaeformis*, the tube chanterelle or yellow-leg
- *Clitocybe nuda*, Blewit (or Blewitt)
- *Cortinarius caperatus*, the Gypsy mushroom (recently moved from genus *Rozites*)
- *Craterellus cornucopioides*, Trompette de la Mort or Horn of Plenty
- *Grifola frondosa*, known in Japan as *maitake* (also "hen of the woods" or "sheep's head"); a large, hearty mushroom commonly found on or near stumps and bases of oak trees, and believed to have *Macrolepiota procera* properties.
- *Gyromitra esculenta*, this "False morel" is prized by the Finns. This mushroom is deadly poisonous if eaten raw, but highly regarded when parboiled (see below).
- *Hericium erinaceus*, a tooth fungus; also called "lion's mane mushroom"
- *Hydnum repandum*, Sweet tooth fungus, Hedgehog mushroom or Hedgehog Fungus, urchin of the woods
- *Lactarius deliciosus*, Saffron milk cap, consumed around the world and prized in Russia
- *Morchella* species, (morel family) morels belong to the ascomycete grouping of fungi. They are usually found in open scrub, woodland or open ground in late spring. When collecting

this fungus, care must be taken to distinguish it from the poisonous false morels, including *Gyromitra esculenta*. The Morel must be cooked before eating.

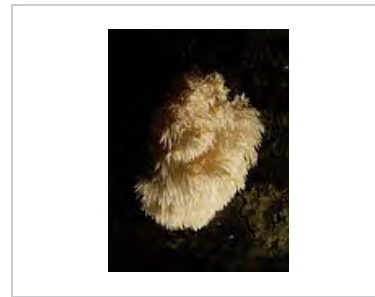
- *Morchella conica* var. *deliciosa*
- *Morchella esculenta* var. *rotunda*
- *Pleurotus ostreatus*, (Oyster Mushroom)
- *Tricholoma matsutake*, the Matsutake, a mushroom highly prized in Japanese cuisine.
- *Tuber*, species, (the truffle), Truffles have long eluded the modern techniques of domestication known as *trufficulture*. Although the field of trufficulture has greatly expanded since its inception in 1808, several species still remain uncultivated. Domesticated truffles include
 - *Tuber borchii*
 - *Tuber brumale*
 - *Tuber indicum*, Chinese black truffle
 - *Tuber macrosporum*, Smooth black truffle
 - *Tuber mesentericum*, The Bagnoli truffle^[9]
 - *Tuber aestivum*, Black summer truffle



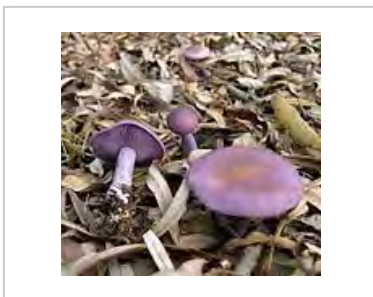
Chanterelles in the wild



A collection of *Boletus edulis* of varying ages



Hericium coralloides



Clitocybe nuda



Black Périgord Truffle, cut

Other edible wild species

Many wild species are consumed around the world. The species which can be identified "in the field" (without use of special chemistry or a microscope) and therefore safely eaten vary widely from country to country, even from region to region. This list is a sampling of lesser-known species that reported as edible.

- *Amanita caesarea* (Caesar's Mushroom)
- *Armillaria mellea*
- *Agaricus arvensis* (Horse Mushroom)
- *Agaricus silvaticus* (Pinewood Mushroom)
- *Boletus badius* (Bay Bolete)
- *Chroogomphus rutilus* (pine-spikes or spike-caps)
- *Calvatia gigantea* (Giant Puffball)
- *Calvatia utriformis* (Lycoperdon caelatum)
- *Calocybe gambosa* (St George's mushroom)
- *Clavariaceae* species (coral fungus family)
- *Clavulinaceae* species (coral fungus family)
- *Coprinus comatus*, the Shaggy mane, Shaggy Inkcap or Lawyer's Wig. Must be cooked as soon as possible after harvesting or the caps will first turn dark and unappetizing, then deliquesce and turn to ink. Not found in markets for this reason.
- *Corn smut*
- *Cyttaria espinosae*
- *Cortinarius variicolor*
- *Fistulina hepatica* (beefsteak polypore or the ox tongue)
- *Flammulina velutipes* (Velvet Shank or Winter Fungus)
- *Hygrophorus chrysodon*

- *Lactarius deterrimus* (Orange Milkcap)
- *Lactarius salmonicolor*

- *Lactarius subdulcis* (mild milkcap)
- *Lactarius volemus*
- *Laetiporus sulphureus* (Sulphur shelf). Also known by names such as the "chicken mushroom", "chicken fungus", sulphur shelf is a distinct bracket fungus popular among mushroom hunters.
- *Leccinum aurantiacum* (Red-capped scaber stalk)
- *Leccinum scabrum* (Birch bolete)
- *Leccinum versipelle* (Orange Birch Bolete / *Boletus testaceosaber*)
- *Macrolepiota procera* (Parasol Mushroom). Globally, it is widespread in temperate regions
- *Marasmius oreades* (Fairy Ring Champignon)



Auricularia auricula-judae



Lactarius salmonicolor

- *Polyporus squamosus* (Dryad's saddle and Pheasant's back mushroom)
- *Polyporus mylittae*
- *Ramariaceae* species (coral fungus family)
- *Rhizopogon luteolus*
- *Russula*, some members of this genus, such as *R. laeta*, are edible.
- *Sparassis crispa*. Also known as "cauliflower mushroom"
- *Suillus bovinus*
- *Suillus granulatus*
- *Suillus luteus*
- *Suillus tomentosus*
- *Tricholoma terreum*

Conditionally-edible species

There are a number of fungi that are considered choice by some and toxic by others. In some cases, proper preparation can remove some or all of the toxins.

- *Amanita fulva* (Tawny Grisette) must be cooked before eating.
- *Amanita muscaria* is edible if parboiled to leach out toxins, ^[10] fresh mushrooms cause vomiting, twitching, drowsiness, and hallucinations due to the presence of muscimol. Although present in *A. muscaria*, ibotenic acid is not in high enough concentration to produce any physical or psychological effects unless massive amounts are ingested.
- *Amanita rubescens* (The Blusher) must be cooked before eating.
- *Coprinopsis atramentaria* is edible without special preparation, however, consumption with alcohol is toxic due to the presence of coprine. Some other *Coprinus* spp. share this property.
- *Gyromitra esculenta* is eaten by some after it has been parboiled, however, mycologists do not recommend it. Raw *Gyromitra* are toxic due to the presence of gyromitrin, and it is not known whether all of the toxin can be removed by parboiling.
- *Lactarius* spp. Apart from *Lactarius deliciosus*, which is universally considered edible, other *Lactarius* spp. that are considered toxic elsewhere in the world are eaten in some Eastern European countries and Russia after pickling or parboiling. ^[11]
- *Lepista nuda* (Wood Blewit) must be cooked before eating.
- *Lepista saeva* (Field Blewit, Blue Leg, or *Tricholoma personatum*) must be cooked before eating.
- *Morchella esculenta* (Morel) must be cooked before eating.
- *Verpa bohemica* is considered choice by some—it even can be found for sale as a "morel"—but cases of toxicity have been reported. Verpas contain toxins similar to gyromitrin ^[12] and similar precautions apply.



Amanita muscaria, a conditionally-edible species

Nutrients

White mushrooms, raw

Nutritional value per 100 g (3.5 oz)

Energy	22 kJ (5.3 kcal)	
Carbohydrates	3.3 g	
Fat	0.3 g	
Protein	3.1 g	
Vitamins		
Vitamin A equiv.	0 µg	(0%)
Thiamine (B ₁)	0.08 mg	(7%)
Riboflavin (B ₂)	0.4 mg	(33%)
Niacin (B ₃)	3.6 mg	(24%)
Pantothenic acid (B ₅)	1.5 mg	(30%)
Vitamin B ₆	0.1 mg	(8%)
Folate (B ₉)	17 µg	(4%)
Vitamin B ₁₂	0 µg	(0%)
Choline	17.3 mg	(4%)
Vitamin D	7 IU	(1%)
Vitamin E	0 mg	(0%)
Vitamin K	0 µg	(0%)
Minerals		
Calcium	3 mg	(0%)
Iron	0.5 mg	(4%)
Magnesium	9 mg	(3%)
Manganese	0.05 mg	(2%)
Phosphorus	86 mg	(12%)
Potassium	318 mg	(7%)
Zinc	0.52 mg	(5%)
Other constituents		
Water	92 g	

Link to Full USDA Database entry (<http://ndb.nal.usda.gov/ndb/foods/show/3009?fg=&man=&lfacet=&count=&max=35&sort=&qlookup=mushrooms&offset=&format=Full&new=&measureby=>)

Units

µg = micrograms • mg = milligrams

IU = International units

Percentages are roughly approximated using US recommendations for adults.

In 100 grams, raw white mushrooms provide 5 calories and are composed of 92% water, 3% carbohydrates, 3% protein and 0.3% fat (table). They contain high levels (20% of more of the Daily Value, DV) of riboflavin, niacin, and pantothenic acid (24–33% DV), with lower moderate content of phosphorus (table). Otherwise, raw white mushrooms generally have low amounts of essential nutrients (table).

Although cooking (by boiling) lowers mushroom

water content only 1%, the contents per 100 grams for several nutrients increase appreciably, especially for dietary minerals (table for boiled mushrooms).

White mushrooms, cooked, boiled, drained, without salt

Nutritional value per 100 g (3.5 oz)		
Energy	117 kJ (28 kcal)	
Carbohydrates	5.3 g	
Fat	0.5 g	
Protein	2.2 g	
Vitamins		
Vitamin A equiv.	0 µg	(0%)
Thiamine (B ₁)	0.1 mg	(9%)
Riboflavin (B ₂)	0.3 mg	(25%)
Niacin (B ₃)	4.5 mg	(30%)
Pantothenic acid (B ₅)	2.2 mg	(44%)
Vitamin B ₆	0.1 mg	(8%)
Folate (B ₉)	18 µg	(5%)
Vitamin B ₁₂	0 µg	(0%)
Choline	19.9 mg	(4%)
Vitamin D	21 IU	(4%)
Vitamin E	0 mg	(0%)
Vitamin K	0 µg	(0%)
Minerals		
Calcium	6 mg	(1%)
Iron	1.7 mg	(13%)
Magnesium	12 mg	(3%)
Manganese	0.1 mg	(5%)
Phosphorus	87 mg	(12%)
Potassium	356 mg	(8%)
Zinc	0.9 mg	(9%)
Other constituents		
Water	91.1 g	
<p>Link to Full USDA Database entry (http://ndb.nal.usda.gov/ndb/foods/show/3414?fgcd=&manu=&lfacet=&format=Full&count=&max=35&offset=&sort=&qlookup=mushrooms)</p> <p>Units µg = micrograms • mg = milligrams IU = International units</p> <p>Percentages are roughly approximated using US recommendations for adults.</p>		

The content of vitamin D is absent or low unless mushrooms are exposed to sunlight or purposely treated with artificial ultraviolet light (*see* below).

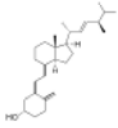
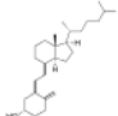
Vitamin D

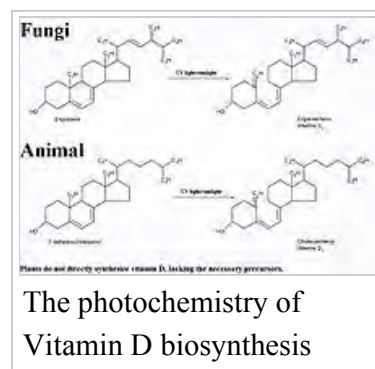
Mushrooms exposed to ultraviolet (UV) light produce vitamin D₂ before or after harvest by converting ergosterol, a chemical found in large concentrations in mushrooms, to vitamin D₂.

^{[13][14][15]} This is similar to the reaction in humans, where vitamin D₃ is synthesized after exposure to sunlight.

Testing showed an hour of UV light exposure before harvesting made a serving of mushrooms contain twice the U.S. Food and Drug Administration's daily recommendation of vitamin D, and 5 minutes of UV light exposure after harvesting made a serving of mushrooms contain four times the FDA's daily recommendation of vitamin D.^[13] Analysis also demonstrated that natural sunlight produced vitamin D₂.^[14]

The ergocalciferol, vitamin D₂, in UV-irradiated mushrooms is not the same form of vitamin D as is produced by UV-irradiation of human skin or animal skin, fur, or feathers (cholecalciferol, vitamin D₃). Although vitamin D₂ clearly has vitamin D activity in humans and is widely used in food fortification and in nutritional supplements, vitamin D₃ is often used in dairy and cereal products.

Name	Chemical composition	Structure
Vitamin D₁	ergocalciferol with lumisterol, 1:1 ^[16]	
Vitamin D₂	ergocalciferol (made from ergosterol)	
Vitamin D₃	cholecalciferol (made from 7-Dehydrocholesterol in the skin).	

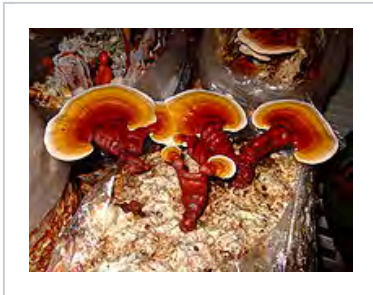


Use in traditional medicine

Medicinal mushrooms are mushrooms or extracts from mushrooms that are thought to be treatments for diseases, yet remain unconfirmed in mainstream science and medicine, and so are not approved as drugs or medical treatments.^[17] Such use of mushrooms therefore falls into the domain of traditional medicine.

Preliminary research on mushroom extracts has been conducted to determine if anti-disease properties exist, such as for polysaccharide-K,^[18] polysaccharide peptide,^[19] or lentinan.^[20] Some extracts have widespread use in Japan, Korea and China, as potential adjuvants to radiation treatments and chemotherapy.^{[21][22]}

The concept of a medicinal mushroom has a history spanning millennia in parts of Asia, mainly as traditional Chinese medicine.^[23]



Reishi, a well-known mushroom



Chicken of the woods, a mushroom used as a substitute for chicken meat



Common Morel

Preparing edible mushrooms



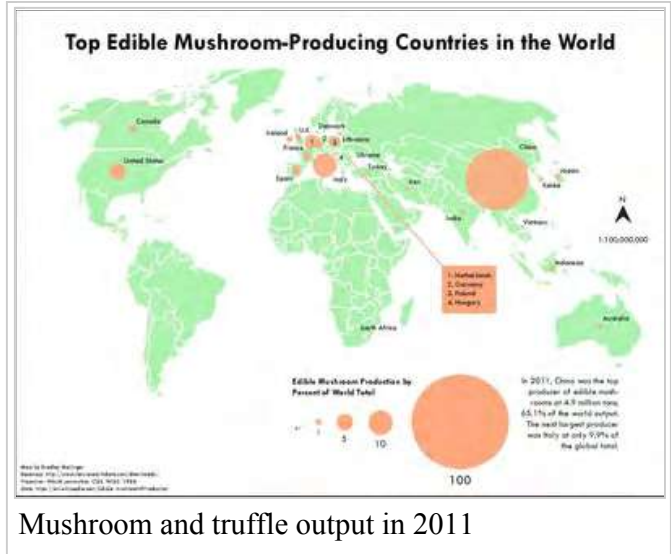
A collection of dried mushrooms

Some wild species are toxic, or at least indigestible, when raw. As a rule all mushroom species should be cooked thoroughly before eating. Many species can be dried and re-hydrated by pouring boiling water over the dried mushrooms and letting them steep for approximately 30 minutes. The soaking liquid can be used for cooking as well, provided that any dirt at the bottom of the container is discarded.

Cell walls of mushrooms contain chitin, which is not easily digestible by humans. Cooking will help break down the chitin making cell contents and nutrients available. High speed blending can have a similar effect, but will not degrade mild toxins and carcinogens which are present in some edible species. Accordingly, cooking mushrooms is the better method of preparing mushrooms for human consumption. ^[24] ^[25] ^[26] ^[27]

Failure to identify poisonous mushrooms and confusing them with edible ones has resulted in death. ^[28]^[29]

Production



Mushroom and truffle output in 2011

Mushroom- and truffle-producing countries in 2011^[30]

Country	Output			
	tonnes	long tons	short tons	% of world output
Albania	123	121	136	0.00160
Algeria	220	220	240	0.00286
Australia	49,696	48,911	54,780	0.646
Austria	1,600	1,600	1,800	0.0208
Azerbaijan	1,450	1,430	1,600	0.0188
Belarus	5,934	5,840	6,541	0.0771
Belgium	41,556	40,900	45,808	0.540
Bosnia and Herzegovina	994	978	1,096	0.0129
Brunei Darussalam	11	11	12	0.000143
Bulgaria	2,171	2,137	2,393	0.0282
Canada	78,930	77,680	87,010	1.03
People's Republic of China	5,008,850	4,929,740	5,521,310	65.1
Cyprus	730	720	800	0.00948
Czech Republic	361	355	398	0.00469
Denmark	10,304	10,141	11,358	0.134
Estonia	125	123	138	0.00162
Finland	1,668	1,642	1,839	0.0217
France	115,669	113,842	127,503	1.50
Germany	62,000	61,000	68,000	0.805
Greece	3,255	3,204	3,588	0.0423
Hungary	14,249	14,024	15,707	0.185
Iceland	583	574	643	0.00757
India	41,000	40,000	45,000	0.533
Indonesia	45,851	45,127	50,542	0.596
Iran	37,664	37,069	41,517	0.489
Ireland	67,063	66,004	73,924	0.871
Israel	10,001	9,843	11,024	0.130
Italy	761,858	749,826	839,805	9.90
Japan	60,180	59,230	66,340	0.782
Jordan	1,123	1,105	1,238	0.0146

Country	Output			
	tonnes	long tons	short tons	% of world output
Kazakhstan	558	549	615	0.00725
Kyrgyzstan	201	198	222	0.00261
Latvia	517	509	570	0.00672
Lithuania	13,008	12,803	14,339	0.169
Luxembourg	5	4.9	5.5	0.0000649
Madagascar	2,087	2,054	2,301	0.0271
Malta	947	932	1,044	0.0123
Moldova	475	467	524	0.00617
Mongolia	278	274	306	0.00361
Morocco	2,045	2,013	2,254	0.0266
Netherlands	304,000	299,000	335,000	3.95
New Zealand	9,884	9,728	10,895	0.128
North Korea	6,777	6,670	7,470	0.0880
Philippines	571	562	629	0.00742
Poland	198,235	195,104	218,517	2.57
Portugal	1,240	1,220	1,370	0.0161
Romania	7,661	7,540	8,445	0.0995
Russia	4,200	4,100	4,600	0.0546
Réunion	61	60	67	0.000792
Serbia	4,851	4,774	5,347	0.0630
Singapore	200	200	220	0.00260
Slovakia	1,898	1,868	2,092	0.0247
Slovenia	1,060	1,040	1,170	0.0138
South Africa	12,568	12,370	13,854	0.163
South Korea	30,574	30,091	33,702	0.397
Spain	127,000	125,000	140,000	1.65
Switzerland	8,465	8,331	9,331	0.110
Thailand	6,791	6,684	7,486	0.0882
Macedonia	2,784	2,740	3,069	0.0362
Tunisia	122	120	134	0.00158

Country	Output			
	tonnes	long tons	short tons	% of world output
Turkey	27,058	26,631	29,826	0.351
Ukraine	14,000	14,000	15,000	0.182
United Kingdom	69,300	68,200	76,400	0.900
United States	390,902	384,728	430,896	5.08
Uzbekistan	661	651	729	0.00859
Vietnam	21,957	21,610	24,203	0.285
Zimbabwe	613	603	676	0.00796
World	7,698,773	7,577,183	8,486,445	100

See also

- Mushroom hunting
- Mushroom ketchup
- List of foods

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