

# Mycology and mycotechnology on postal stamps

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*Mycology, the study of fungal biology, and philately, the study of postage stamps, are rarely connected, as they are very different activities. However, philatelic mycology can raise awareness of the facets of fungi which contribute significantly to human welfare. Fungi are photogenic and exhibit physiological wonders such as luminescence. They are important in biotechnology for their secondary metabolites. So, stamps depicting fungi signal the recognition of problems and prospects of prosperity posed by fungi in nutrition and health, agriculture, engineering, industry and ecology. Many countries have issued thousands of stamps on fungi. India with a rich heritage of fungal diversity lags in this respect. This article hopes to inspire action by celebrating the beauty and significance of fungi in the art of philately.*

**Keywords:** Mycotechnology, mycology, mycophilately, photogenic appeal, postal stamps.

PHILATELY is the collection, study and appreciation of stamps and related items. It includes research on stamps and other philatelic products. Proctor<sup>1</sup> suggested using philately in geography teaching. Senanayake<sup>2</sup> used philately to promote paediatrics, especially in priority areas. Bandopadhyay<sup>3</sup> described food and nutrition education through philately. Zagkotas and Niaoostas<sup>4</sup> used philately as a teaching aid by implementing a project in a Greek primary school. As a teaching aid, it is useful for classifying flora and fauna, and to understand their evolution, history, physiology, discoveries and applications. Luther<sup>5</sup> extensively studied postal stamps, old postcards and other postage materials showing fungi. However, mycophilately was largely neglected till a monumental book, *Philatelic Mycology: Families of Fungi* in 2014 by Marasas *et al.*<sup>6</sup> found favour with both stamp-collectors and mycologists.

Though many countries have now released stamps with mushrooms in natural environments, there is no standardized cataloguing. Stamp collectors in the United Kingdom use the Stanley Gibbons Catalogue of Postage Stamps. However, the Scott Postage Stamp Catalogue is more popular. Though India refers to both catalogues, it

has no stamp depicting fungi. In this article, we deal with the significance of fungal organisms and the need for mycophilately. We also highlight attempts by many countries to promote mycophilately.

## Importance of fungi

Fungi are eukaryotes, like plants and animals. The main distinguishing feature is the structural component of the fungal cell wall – chitin – a polymer. This makes fungi different from plants, which have cellulose in the cell wall. Another feature of fungi that distinguishes them from other eukaryotes is their typical nuclear division, where the nuclear membrane remains intact during mitosis. Fungi are the second largest group of species on earth after insects. There are more than 81,000 known fungal species and recent assessments suggest that the estimated number of fungal species on earth could be 5.1 million<sup>7</sup>. They usually outnumber plants 6 to 1. Moreover, their physiological activities render fungi model systems in developmental studies and in biotechnology. The first applications of fungi were reported in 2000 BC from Egypt, China and Sumeria. In ancient times people used yeast, maybe unknowingly, for bread leavening and beer or wine fermentation. Today, fungi have a wide range of applications from single-cell protein production, as biosensors, and in cancer therapy to electricity generation. They play significant roles in all subdivisions of biotechnology: red (e.g. antibiotic production), white/grey (e.g. organic acid fermentation), green (e.g. mushroom cultivation, mycoinsecticides) and blue (e.g. oil pollution bioremediation in marine environments). Yet fungi are

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neglected for various reasons, including the historical dilemma about their positioning with respect to other eukaryotes.

### Framing fungi in stamps

Most fungi are microscopic, but the reproductive structures that appear as a signature of the mushroom species are easily visible. Several countries have released stamps on mushrooms as they are photogenic. For instance, the edible parasol mushroom, *Macrolepiota procera* (or *Lepiota procera*) appears on stamps as a prominent fruiting body resembling a light umbrella<sup>8</sup>. In 2008, the Irish post released four stamps of fungi featuring the parasol mushroom. The first fungus that appeared on a Romanian stamp, in 1958, was also *M. procera*. Soon after, Czechoslovakia and Poland released sets of mushroom stamps<sup>9</sup>. Eventually, several countries issued stamps using mushroom-like fungi as a theme. In 1973, Bhutan issued a commemorative 3D set of mushrooms and mushroom-like fungi that remain world renowned in the philately community for their colourful creativity. Though some mushroom stamps are unfamiliar and, therefore, incomprehensible without legends, they are a major revenue generator for Bhutan<sup>10</sup>. In 2002, New Zealand chose six species, *Aseroe rubra*, *Entoloma hochstetteri*, *Hericium coralloides*, *Hygrocybe rubrocarnosa*, *Ramaria aureorhiza* and *Thaxter ogasterporphyreus* (*Cortinarius porphyroideus*), for first day covers and miniature sheets, to display the wonderful diversity of indigenous bracket fungi, cup fungi, jelly fungi and puff ball fungi. The description of fungi raises awareness about their phenotypic specialties, origin and unique features. For example, *T. porphyreus* has a unique mechanism of dispersing spores. Instead of opening the mushroom cap to disperse spores, it attracts insects and birds which feed on the caps, consume spores and distribute them through droppings. *A. rubra* resembles a sea anemone and its spores are produced in slimy mucus at the centre. The striking blue-coloured *E. hochstetteri*, the most vivid and impressive *H. rubrocarnosa*, the coral fungus *R. aureorhiza*, and the spiny, much-branched icicle fungus *H. coralloides* were also selected for their unique photogenic appeal<sup>11</sup>. The New Zealand Reserve Bank launched banknote designs in the late 1980s, featuring blue *E. hochstetteri* on the \$50 note. This was retained in 2014 due to the perseverance of a mycologist, Peter Buchanan (<https://sporesmouldsandfungi.wordpress.com/2014/07/12/hochstetteris-blue-pinkgill/>). Further, it is suggested that the kōkako bird probably got its blue wattles from rubbing on the little blue mushroom and, therefore, it also shares space on the same US\$ 50 note<sup>11</sup>. In 2008, the Netherlands released attractive stamps of *Amanita muscaria*, *Clathrus archerii*, *Coprinus comatus*, *Cyathus striatus* and *Geastrum triplex* to coincide with the 100th year of

the Netherlands Mycological Society. A sheetlet titled 'Experience nature-mushrooms' was released in 2018. The process and criteria used to select only ten mushrooms out of the 5000 species found in Dutch soils are a unique example of taking into account the diversity, biology and photogenic appeal of fungi<sup>12</sup> (Table 1). An example is bonnet mould, *Spinellus fusiger*, a sporangiospore-forming fungus which is a parasite on a number of mushrooms. Figure 1 presents such a case on *Mycena hematopus*.

In 2018, the US released stamps of bioluminescent life. In addition to eight bioluminescent organisms from oceans, two land-based species (mushroom and firefly) were also featured<sup>13</sup>. For mycophilately, this was indeed a breakthrough. The US Post Office Department was established in 1792 and it took 226 long years to release a stamp on fungi, after constant petitioning from researchers. Previously, mushrooms were represented on stamps as part of larger forest scenes, but not individually. *Mycena lucentipes*, a mushroom capable of producing light through yellow–green bioluminescence, is one of the species that appears on the stamp. There are more than 80 species of mushrooms capable of emitting light, and helpful in attracting insects that spread the mushroom spores. Earlier, countries like Romania, the Solomon Islands, Vietnam, Indonesia and Malaysia released postal stamps on bioluminescent fungi<sup>14</sup>. Interestingly, *Armillaria mellea* appeared on a Romanian postage stamp in 1958 not for the distinctive bioluminescence, but as edible mushroom. Malaysia, on the other hand, has a postal stamp of an unidentified and non-luminescent fungus marked as bioluminescent. The Mayotte Island in the Mozambique Channel, is trying to preserve fungal biodiversity through philatelic promotion of the photogenic features of different fungal fruit bodies. In 2007 and 2010, Peru issued two sets of mushroom stamps. The 2007 set was indented on a mushroom-shaped souvenir sheet<sup>15</sup>. It is not only the artistic and design criteria, but also their biology that make fungi suitable candidates for postal stamps. Other releases were the orange birch bolete (*Leccinum versipelle*), representing the fungus–plant relationship, pink wax cap (pink ballerina, *Hygrocybe calyptriformis*) as an indicator species for habitat loss and scarlet elf cup (*Sarcoscypha austriaca*) which ejects a puff of spores with a 'puffing' sound<sup>8</sup>. One of the first stamps on fungi was about mycotechnology, an indirect depiction of yeast which produces ethanol<sup>9</sup>. To celebrate the tenth anniversary of the alcohol industry, the Japanese Government issued a stamp with a line of budding yeast at the bottom<sup>10</sup>.

### Edible mushrooms

A number of edible mushrooms have appeared on postal stamps released from different countries (Table 1). For

## GENERAL ARTICLES

**Table 1.** Fungi on stamps

Fungus	Country (year)
Photogenic appeal (structural features/uniqueness)	
<i>Armillaria melleo</i> , <i>Astraeus hygrometricus</i> , <i>Boletus edulis</i> , <i>Hyphaloma fasciculare</i> , <i>Sarcoscypha coccinea</i>	Comoro Islands (1985)
<i>Aseroe rubra</i> , <i>Entoloma hochstetteri</i> , <i>Hericium coralloides</i> , <i>Hygrocybe rubrocarnosa</i> , <i>Ramaria aureorhiza</i> , <i>Thaxterogaster porphyreus</i>	New Zealand (2002)
<i>Entoloma hochstetteri</i> (on stamps as well as on currency notes)	New Zealand (2014)
<i>Amanita muscaria</i> , <i>Clathrus archerii</i> , <i>Coprinus comatus</i> , <i>Cyathus striatus</i> , <i>Geastrum triplex</i>	The Netherlands (2008)
<i>A. muscaria</i> (fly amanita), <i>Clavaria argillacea</i> , <i>Marasmiellus ramealis</i> (twig parachute), <i>Mycena haematopus</i> (bleeding fairy helmet), <i>Plicaturopsis crispa</i> (crimped gill), <i>Pterula multifida</i> , <i>Russula fragilis</i> (fragile brittlegill), <i>Sparassis crispa</i> (cauliflower fungus), <i>Spinellus fusiger</i> (bonnet mould), <i>Stropharia aeruginosa</i> ( <i>Verdigris</i> agaric)	The Netherlands (2018)
<i>Macrolepiota procera</i> or <i>Lepiota procera</i> (parasol mushroom)	Romania (1958), Czech Republic (1958), Poland (1959), Malawi (2008)
Edible mushrooms (some of the genera, species or strains can be poisonous)	
<i>M. procera</i> , <i>Russula virescens</i>	Japan (1974)
<i>B. edulis</i> , <i>Macrolepiota rhacodes</i>	Afganistan (1996)
<i>Flammulina velutipes</i> , <i>Kuehneromyces mutabilis</i> , <i>Lyophyllum connatum</i> , <i>Lyophyllum decastes</i>	Armenia (2013)
<i>Cantharellus cineris</i> , <i>Hydnum repandum</i> , <i>Lactarius torminosus</i> , <i>Rozites caperatus</i>	Belarus (1999)
<i>Agaricus silvaticus</i> , <i>Amanita caesarea</i> , <i>Armillariella mellea</i> , <i>B. edulis</i> , <i>Lactarius deliciosus</i> , <i>Macrolepiota procera</i> , <i>Pleurotus ostreatus</i> , <i>Suillus grevillei</i> (imperforated stamps)	Belarus (2013) Bulgaria (1961) Bulgaria (1987)
<i>Amanita rubescens</i> , <i>Boletus regius</i> , <i>C. cibarius</i> , <i>Coprinus comatus</i> , <i>Leccinum aurantiacum</i> , <i>Russula vesca</i>	Cameroon (1975)
<i>Trametes versicolor</i>	Cambodia (1985)
<i>Amanita panterina</i> , <i>A. muscaria</i> , <i>A. caesarea</i> , <i>Coprinus micacius</i> , <i>C. comatus</i> , <i>Gymnopilus spectabilis</i> , <i>Hebeloma crustuliniforme</i> (some of them are poisonous)	Canada (1989)
<i>Boletus mirabilis</i> , <i>C. cinnabarinus</i> , <i>Clavulinopsis fusiformis</i> , <i>Morchella esculenta</i>	Central African Republic (1967)
<i>Leucocoprinus africanus</i> , <i>Phlebopus sudanicus</i> , <i>Psalliota sebedulis</i> , <i>Synpodia arborescens</i> , <i>Termitomyces schimperi</i> , <i>T. entolomoides</i> , <i>T. microcarpus</i> , <i>T. aurantiacus</i> ,	Congo (1970)
<i>T. mammiformis</i> , <i>Tremella fuciformis</i> , <i>Volvaria esculenta</i> , <i>A. caesarea</i> , <i>Lentinus cubensis</i> ,	Cuba (1989)
<i>Pleurotus levis</i> , <i>Pleurotus floridanus</i> , <i>P. ostreatus</i> , <i>Coprinus comatus</i> , <i>Cortinarius cumatilis</i> ,	Cuba (2002)
<i>Clitocybe infundibuliformis</i> , <i>Pholiota caperata</i> , <i>Lactarius deliciosus</i> , <i>Morchella elata</i> ,	Cuba (2005)
<i>Pleurotus eryngii</i> var. <i>ferulae</i> , <i>Sparassis crispa</i>	Cyprus (1999)
<i>A. rubescens</i> , <i>Leccinum rufescens</i>	Czech Republic (2018)
<i>Lactarius torminosus</i> , <i>Leccinum versipelle</i> , <i>Russula paludosa</i>	Finland (1980)
<i>Chanterelle violette</i> , <i>Lactarius indigo</i> , <i>Russula palomet</i> ( <i>Agaricus palomet</i> ) (first day cover with cancellation stamp)	France (1987)
<i>Agaricus campester</i> , <i>B. edulis</i> , <i>B. erythropus</i> ,	Germany (1980)
<i>B. edulis</i> , <i>C. cibarius</i> , <i>Leccinum scabrum</i> , <i>Xerocomus badius</i>	Germany (2018)
<i>Morchella esculenta</i>	Ghana (2015)
<i>Amanita groenlandica</i> , <i>Lecinum species</i> , <i>Russula subrubens</i>	Greenland (2005)
<i>Calvatia cretacea</i> , <i>Lactarius dryadophilus</i> , <i>Rozites caperata</i>	Greenland (2006)
<i>Amanita phalloides</i> (death cap)	Hungary (1986)
<i>B. edulis</i> , <i>Russula xerampelina</i> (12 mushroom stamps from 1999–2012)	Iceland (2012)
<i>Termitomyces letestui</i> , <i>T. schimperi</i>	Ivory Coast (1995, 1998)
<i>T. schimperi</i>	Kenya (1989)
<i>Leccinum scabrum</i> , <i>Morchella conica</i> , <i>Pleurotus eryngii</i> , <i>Pleurotus ostreatus</i>	Kyrgyzstan (2017)
<i>Boletus radicans</i> , <i>Gomphus clavatus</i> (pig's ear mushroom)	Lietuva (2016)
<i>Termitomyces eurrhizus</i>	Malawi (1985)
<i>Macrolepiota procera</i> (slightly toxic when eaten raw), <i>Tricholoma fulvum</i>	Malawi (2008)
<i>Volvariella bombycina</i> , <i>Morchella anteridiformis</i> , <i>Lentinus tuber-regium</i>	New Caledonia (1998)
<i>Pleurotus cornucopiae</i> , <i>Catathelasma ventricosum</i> , <i>Pleurotus ostreatus</i>	North Korea (1985)
<i>Lactarius deterrimus</i> , <i>Lepista nuda</i>	Norway (1988)
<i>Amanita phalloides</i> , <i>A. muscaria</i> , <i>Boletus luteus</i> , <i>B. edulis</i> , <i>Boletus scaber</i> , <i>Cantharellus cibareus</i> ,	Poland (1959)
<i>Lactarius deliciosus</i> , <i>Psalliota campestris</i> (not all are edible)	
<i>Auricularia polytricha</i> , <i>Lentinus edodes</i> , <i>Pleurotus sajor-kaju</i> , <i>Vovariella volvacea</i>	Phillipines (1988)

(Contd)

Table 1. (Contd)

Fungus	Country (year)
<i>Cantharellus cibarius</i> (Rossinyol)	Principality of Andorra (1993)
<i>Amanita rubescens</i> , <i>Amanita caesarea</i> , <i>B. edulis</i> , <i>C. cibarius</i> , <i>Morchella conica</i>	Republique du Burundi (2012)
<i>B. edulis</i> , <i>Craterellus cornucopioides</i> , <i>Lepista nuda</i> , <i>Lycoperdon perlatum</i>	Romania (1994)
<i>B. edulis</i> , <i>Clitopilus prunulus</i> , <i>Lepiota procera</i> , <i>Russula paludosa</i> , <i>Tricholoma gambosum</i>	San Marino (1967)
<i>Agaricus campestris</i> , <i>Coprinus atramentarius</i>	Senegal (1999)
<i>B. edulis</i> , <i>C. cibarius</i> , <i>Lycoperdon perlatum</i> (common puffball); <i>M. procera</i> (parasol mushroom),	Sweden (1978)
<i>Ramaria botrytis</i> (cauliflower clavaria), <i>Russula decolorans</i> , <i>B. edulis</i> in a basket with <i>C. cibarius</i>	Sweden (2004)
<i>Leccinum</i> sp. L. ( <i>Clitocybe</i> ) <i>nuda</i>	Switzerland (1994)
<i>Agaricus bingensis</i> , <i>Agaricus campestris</i> , <i>Agrocybe brodwayi</i> , <i>Camarophyllus olidus</i> ,	Uganda (1991)
<i>Chlorophyllum molybdites</i> , <i>Marasmius arborescens</i> , <i>Marasmiellus subcinereus</i> ,	Uganda (2001)
<i>Vovariella bingensis</i> <i>Coprinus cinereus</i> , <i>Armillaria mellea</i> , <i>Agaricus</i> , <i>Lentinus</i> , <i>Macrolepiota</i> ,	Uganda (2002)
<i>Termitomyces</i>	
<i>A. campestris</i> , <i>B. edulis</i> , <i>C. cibarius</i> , <i>Morchella vulgaris</i>	Yugoslavia (Jugoslavija) (1983)
<i>Amanita zambiana</i> , <i>B. edulis</i> , <i>Cantharellus densitollus</i> , <i>C. longisporus</i> , <i>C. cibarius</i> , <i>Termitomyces</i>	Zimbabwe (1992)
	Zambia (1981) reissued in (1989 and 1991)
<b>Truffles</b>	
<i>Terfezia leonis</i>	Algeria (1983)
<i>Tuber melanosporum</i>	Andorra (1996)
<i>Choeromyces meandriformis</i> , <i>T. aestivum</i> , <i>T. melanosporum</i> , <i>Tuber melanosporum</i>	Chad (1998)
<i>Tuber melanosporum</i> , <i>T. magnatum</i>	Congo Republic (2011)
<i>Terfezia boudieri</i>	Croatia (2013)
White and black truffles against the background of a forest	Djibouti (1987)
<i>Tuber aestivum</i>	Italy (2015)
<i>Terfezia arenaria</i>	Ivory Coast (2009)
<i>Melanogaster ambiguus</i>	Kuwait (1983)
	Papua New Guinea (2005)
<b>Poisonous mushrooms</b>	
<i>Amanita muscaria</i> (fly agaric/fly Amanita)	
<i>Amanita citrina</i> (false death cap/Citron Amanita), <i>A. muscaria</i> , <i>Boletus satanas</i>	Canada (2011)
(Devil's bolete/Satan's mushroom), <i>Hypholoma fasciculare</i> (sulphur tuft/clustered woodlover),	
<i>Inocybe patouillardii</i> (deadly fibrecap/brick-red tear mushroom/Redstaining inocybe),	Cuba (1988)
<i>Paxillus involutus</i> (brown roll-rim/common roll-rim), <i>Tylophilus felleus</i> (bitter bolete/bitter Tylophilus),	
<i>Amanita junquillea</i> , <i>Lepiota puellaris</i>	Cuba (2002)
<i>Clathrus cancellatus</i> , <i>L. puellaris</i>	Cuba (2005)
<i>Rhodophyllum sinuatus</i> (a poisonous, livid entoloma or livid agaric mushroom)	East Germany (1974)
<i>Agaricus xanthodermus</i> , <i>Clitocybe dealbata</i> , <i>Hypholoma fasciculare</i> , <i>Lepiota brunneoincarnata</i>	Kyrgyzstan (2019)
<i>Amanita phalloides</i> , <i>Amanita virosa</i>	Malawi (2008)
<i>A. phalloides</i> , <i>A. virosa</i>	Senegal (1999)
<i>Scleroderma aurantium</i> (puff ball)	Uganda (2001)
<b>Plant pathogens</b>	
<i>ScLEROSpora graminicola</i> (Sacc.) Schroeter (downy mildew disease, on pearl millet and	Senegal (1982)
foxtail millet), and <i>Tolyposporium penicillariae</i> (pearl millet smut)	
<i>Pestalotiopsis palmarum</i> (grey leaf spot), <i>Pseudoepicoccum cocos</i> (brown leaf spot),	Tuvalu (1989)
<i>Rigidoporus microporus</i> (white root rot disease of cacao, cassava, tea, etc.), <i>Rigidoporus zonalis</i>	
(root rot of forest trees)	
<i>Ustilago maydis</i> (corn smut)	Mexico (1988)
<b>Medicinal mushrooms</b>	
<i>Ganoderma lucidum</i> , <i>Pleurotus ostreatus</i> , <i>Cantharellus cibarius</i> , <i>Tremetes versicolor</i> ,	Bosnia and Herzegovina Republic of
<i>Pholliota adiposa</i>	Srpska 2016 Cuba 2002
<b>Human pathogens</b>	
<i>Schizophyllum commune</i> (chronic sinusitis in AIDS patients)	Tuvalu (1989)
<i>Microsporium canis</i> , <i>Fomitopsis</i> (dermatophytes)	Uruguay (2013)
<b>Antibiotic producer</b>	
<i>Penicillium notatum</i>	Great Britain (1967); Mauritius (1978); Republic of Djibouti (1980); Hungary (1981); Faroe islands (1983); USA (1999); Mozambique (2011, 2012); The Netherlands (2011); Maldives (2017); Republic of Chad, Republique du Congo, Monaco (2003) Monaco (1974)
<i>Penicillium glaucum</i>	

(Contd)

## GENERAL ARTICLES

**Table 1.** (Contd)

Fungus	Country (year)
Pollution indicator; indicator for sulphur dioxide pollution String-of-sausage lichen <i>Usnea articulata</i>	Self-Governing British Crown Dependency, Mann (1986)
<i>Santessonia</i> sp.	Namibia (2008)
<i>Hypogymnia physodes</i> , <i>Xanthoria parietina</i>	Finland Aland (1999)
Fermentation	
<i>Zlaty bazant</i> (golden pheasant) – Dark Yeast Beer	Slovakia (2011)
<i>Trametes muelleri</i> and <i>Trametes cingulata</i> (lignin hydrolysing enzymes)	Tuvalu (1989)
Chitosan production	
<i>Benjaminiella poitrasii</i> (Cancellation stamp)	India (2018)
Bioluminescence	
<i>Mycena lucentipes</i> (edible?)	USA (2018)
Cheese	
<i>Penicillium roqueforti</i> (Roquefort), <i>Penicillium camemberti</i> (Camembert)	Canada (2006)
<i>Penicillium roqueforti</i> (Roquefort)	France (2006)
Mycologists	
Michel Adanson ( <i>Microlepiota procera</i> ), Alexander Fleming ( <i>Penicillium notatum</i> )	Union des Comores (2008)
Edward Fischer ( <i>Phallus impudicus</i> ), Charles Edwin Bessey ( <i>Armillariella mellea</i> ),	
Peter Adolph Karsten ( <i>Marasmius oreades</i> ), Charles Horton Peck ( <i>Chroogomphus vinicolor</i> ),	
Andrea Cesalpino ( <i>Tricholoma flavovirens</i> ), Miles Joseph Berkeley ( <i>Paxillus involutus</i> ),	
H. Anton de Bary ( <i>Boletus lupines</i> ), A. H. R. Buller, J. B. Ellis ( <i>Agaricus peziza</i> sp.), F. J. Seaver,	Central African Republic (2012)
R. G. Wasson	

Compiled from refs 10, 17, 22, 25, 26, 33–35.

instance, in 1999 and 2013, Belarus released *Cantharellus cinereus* and other species rich in antioxidant carotenoids such as  $\beta$ -carotene, canthaxanthin and vitamin D. *Hydnum repandum*, also known as sweet tooth or hedgehog fungus, is widely marketed in Europe, Mexico and Canada. *Lactarius torminosus* is a big agaric fungus widely known as woolly milkcap mushroom. It tastes acrid and may be toxic if eaten raw. In 1989, Canada released stamps depicting *Boletus mirabilis*, *C. cinnabarinus*, *Clavulinopsis fusiformis* and *Morchella esculenta*. Some species such as *M. esculenta*, though edible, are a gastrointestinal irritant if not cooked. Cuba published mushroom stamps in 1989, 2002 and 2005, including *Pleurotus ostreatus*, a pearl oyster mushroom, originally grown in Germany during the First World War. This fungus is also useful for mycoremediation, and making mycelia bricks and myco-furniture. Haneef *et al.*<sup>16</sup> described the fabrication and tuning of physical properties of advanced materials from two mushrooms, *P. ostreatus* and a medicinal fungus, *Ganoderma lucidum*<sup>16</sup> (Table 1). The largest edible mushroom in the world is a species of *Termitomyces*, *T. titanicus*, which has a cap that is 3 ft in diameter. It is found in West Africa and Zambia. In 2007, this fungus appeared on a souvenir sheet issued by the Postal Department of the Republic of Guinea. Interestingly, the postage stamp depicting a barn owl and *A. muscaria* together, is categorized as MID. However, outer portion of the souvenir sheet shows a person holding *T. titanicus*<sup>17</sup>. As pointed out by Luther<sup>17</sup>, the fungus is misidentified as *Boletus edulis*.

### Truffles

A truffle is a round, warty fungal fruiting body which develops underground. Interestingly, truffles cannot be cultivated, but farmers plant specific trees and truffles grow near their roots. There appears to be a symbiotic relationship between the mycelia of truffles and the roots of tree species such as beech, birch, hornbeam, hazel, oak, pine and poplar. Before the First World War, France produced as many as 1000 tonnes of edible truffles. Kuwait was the first country to release a postal stamp of *Terfezia* in 1983, as part of a set depicting 50 desert plants and fungi from Kuwait (Table 1). As the scientific names are missing on the stamps, *Terfezia* species was suggested to be either *T. arenaria* or *T. leonis*<sup>18</sup>. A small nation, Andorra, was the first European country to issue a truffle, *Tuber melanosporum*, on a stamp in 1996. The Congo Republic issued three mushroom stamps in 2011 and a truffle *T. melanosporum* was depicted outside on the sheet. Surprisingly, the species on the stamp is not found in the Republic of Congo<sup>18</sup>.

### Poisonous mushrooms

The Postal Department of the Kyrgyz Republic strategically released stamps of edible mushrooms<sup>19</sup> in 2017 and poisonous mushrooms<sup>20</sup> in 2019 (Table 1). The Department expressed the hope that these stamps would contribute to spreading knowledge about mushrooms and help protect these remarkable representatives of Kyrgyzstan's



Figure 1. Different mushrooms on the postal stamps.

biodiversity. The official first day cover was also released with *Agaricus xanthodermus* as cancellation stamp. It was emphasized that mushrooms, both edible and poisonous, are important in ecological systems and therefore need protection. The genus *Amanita* consists of approximately 600 species, some edible and some extremely toxic (reportedly causing >90% fatalities due to mushroom poisoning; Table 2). The  $\alpha$ -amanitin is a potent toxin present in these mushrooms. In 1974, the then East Germany dedicated stamps to poisonous mushrooms, not only for their beauty, but also to raise awareness. Cuba released stamps of poisonous mushrooms<sup>10</sup> in 1988 and in 2005, a set titled 'Hongos y Polimitas', mushrooms and snails – an unusual combination. Four mushrooms, *Clitocybe infundibuliformis* and *Pholiota caperata* (edible) and *Clathrus cancellatus* and *L. puellaris* (poisonous) were described, but *P. caperata* was not depicted on the stamp (Table 1). In 1995, Malaysia released stamps of four mushrooms: *Microporus xanthopus*, *Cookeina tricholoma*, *Dictyophora phalloidea* and *Ramaria* sp. Luther<sup>21</sup> suggested that according to Ronald H. Petersen, *Ramaria* sp. could be *R. polypus*, thus highlighting the importance of stamps in taxonomy too. Figure 1 depicts some of the mushrooms.

## Infections and treatments

In 1997, Uruguay issued the first ever official postage stamp showing a human fungal pathogen, a dermatophyte, *Microsporum canis*<sup>22</sup>. The stamp depicts a dog, natural host to the pathogen, being hugged by a girl, and an inset with a microscopic view of an infected human hair with distinctive spores of the pathogen. Though fungi cause many diseases, some quite difficult to treat, there are not many examples of philatelic recognition of the problem. However, fungi as sources of medicine seem to be better appreciated. *Penicillium chrysogenum*, a mould commonly found indoors, is involved in food spoilage. This genus came into limelight because of the accidental discovery by Alexander Fleming of the antibacterial activity of *P. rubens*, formerly known as *P. notatum* (Fleming species, member of *P. chrysogenum* complex)<sup>23</sup>. During the Second World War, penicillin became a wonder drug, reducing the number of deaths and amputations. *Penicillium* appeared on the postal stamps of many countries. The first US postage stamp with a scanning electron microscope image of *Penicillium*, issued in 1999, was artificially coloured. *Penicillium roqueforti* and *Penicillium glaucum* are used for producing blue cheese,

**Table 2.** Diversity in the genus *Amanita*

Edible <i>Amanita</i> species	Toxic <i>Amanita</i> species	Deadly poisonous species
<i>A. fulva</i> ,	<i>A. brunnescens</i> ,	<i>A. abrupta</i> ,
<i>A. vaginata</i> ,	<i>A. ceciliae</i> ,	<i>A. arocheae</i> ,
<i>A. calyptrata</i> ,	<i>A. cokeri</i> (Coker's amanita),	<i>A. bisporigera</i> (eastern NA destroying angel),
<i>A. crocea</i> ,	<i>A. crenulata</i> ,	<i>A. exitialis</i> ,
<i>A. rubescens</i> ,	<i>A. farinosa</i> (eastern American floury amanita),	<i>A. magnivelaris</i> ,
<i>A. caesarea</i> ,	<i>A. frostiana</i> ,	<i>A. ocreata</i> ,
<i>A. jacksonii</i> ,	<i>A. flavorubescens</i> ,	<i>A. phalloides</i> ,
<i>A. zambiana</i> and <i>A. citrina</i>	<i>A. muscaria</i> ,	<i>A. smithiana</i> ,
	<i>A. pantherina</i> and <i>A. porphyria</i>	<i>A. subjunquillea</i> ,
		<i>A. verna</i> and <i>A. virosa</i>

flavouring agents, antifungals, polysaccharides, proteases and other enzymes. These fungi are well known for producing cheese varieties like Roquefort, Stilton, Danish blue, Cabrales and Gorgonzola. In 2006, the Canadian Postal Service published stamps that display a cheese wheel coated with *P. roqueforti* or *P. camemberti*. The stamps were designed and shaped like cheese labels<sup>24</sup>.

### Plant pathogens

In 1982, Senegal released a set of stamps depicting *Sclerospora graminicola*, the causative agent of the downy mildew disease on pearl millet and foxtail millet and *Tolyposporium penicillariae*, the smut fungus infecting pearl millet<sup>25</sup>. The pests infesting pearl millet, *Arnsacta moloneyi* and *Raghewa albipunctella*, also appear on the stamps<sup>25</sup>. In 1989, Tavalu released stamps with photographs of the pathogenic lesions caused by *Pestalotiopsis palmarum* (grey leaf spot), *Pseudoepicoccum cocos* (brown leaf spot), *Rigidoporus microporus* (white root rot disease of cacao, cassava, tea, etc.), and *Rigidoporus zonalis* (forest tree root rot). The first fungal stamp depicting corn smut causing *Ustilago maydis* is from Mexico<sup>26</sup> (Table 1). Though there are many fungi that are useful for crop productivity and crop protection, they have not yet been popularized through stamps.

### Symbiotic mushrooms

Almost 30–40 species of the genus *Termitomyces* are dependent on termites for survival. *Termitomyces* mushrooms produce various enzymes to help termites digest lignocellulosic substrates. This genus appears on the postal stamps of a number of countries such as the Ivory Coast, Kenya, Malawi, Uganda and Zimbabwe (Table 1).

### Pollution indicator

Lichens are important sulphur dioxide pollution indicators. Self-Governing British Crown Dependency, Mann, released a stamp of *Usnea articulate* Hoffm., an Ascomycota fungus, also known as the string-of-sausage lichen, a

pale greenish-grey, densely branched lichen with a pendent growth form. One of the areas in Mann, i.e. Ayres, has a specific biodiversity of rare lichens like *U. articulate*<sup>25</sup>. In 2008, the Postal Service of Namibia released a stamp of lichen, *Santesonnia* sp. along with *Xanthoria* sp. In 1999, Finland Aland depicted *Hypogymnia physodes* and *Xanthoria parietina* on postal stamps (Table 1).

Different countries have fungal postal stamps for a variety of reasons and there are thousands of such stamps. It is difficult to list all. Table 1 describes some of them. The corticioid fungi, an attractive but neglected group, are seen on the undersides of dead tree trunks or branches. For example, cobalt blue *Terena caerulea*, bright-red *Phanerochaete sanguinea*, wine-red *Cytidia salicina*, yellow hydroid *Mucronella flava* and green-blue *Byssocorticium atrovirens* are reported from different countries. In 2013, a stamp depicting *T. caerulea* inhabiting hard wood was released by Macedonia<sup>27</sup>. Figure 2 gives a general overview of some fungi with different applications and their diverse roles in nature.

### Fungi in ecotourism

In 1989, Tuvalu, formerly Ellice Islands, an island country located midway between Hawaii and Australia, promoted ecotourism by releasing a set of commemorative stamps featuring *Ganoderma appalantum* (antioxidant and flavour compounds), *R. microporus* (white root rot disease of cacao, cassava, tea, etc.), *R. zonalis* (forest tree root rot), *Pestalotiopsis palmarum* (grey leaf spot), *P. cocos* (brown leaf spot) and *Schizophyllum commune* (omnipresent, industrially important, model organism for developmental studies and opportunistic pathogen in AIDS patients), *Trametes muelleri* and *Trametes cingulata* (a number of species are important for lignin hydrolysing enzymes). For reasons unknown, it is indicated that though stamps are available, they will not be posted to India<sup>28</sup>.

### Mycologists on postal stamps

Alexander Fleming has extensively appeared on stamps from several countries around the globe, except India and



Figure 2. Fungi with different roles and applications on postal stamps.

a few others countries (Figure 2). In 1978, Mauritius released a stamp set commemorating Fleming's discovery of the antibacterial activity of *Penicillium*. Later, commemorative stamps were released by several African countries: Guinea and Mozambique in 2002, St Thomas in 2003 and Prince Islands in 2007.

Mycologists who spent their lives studying fungi have been commemorated in 2011 issues from the Central African Republic<sup>10</sup>. These include William A. Murrill, an American mycologist who worked on agarics and polypores; Fred J. Seaver, an American expert on discomycetes, A. H. R. Buller (British–Canadian mycologist), and Elsie Maud Wakefield, English mycologists and plant pathologists, and Anton De Bary (Germany), father of modern mycology and plant pathology. In 2011, Guinea-Bissau commemorated Christiaan Hendrik Persoon, another founding father of mycology. A portrait and a brief biography of Louis Pasteur appeared on a souvenir sheet issued in 2006 by the Democratic Republic of Congo. Earlier, in 2002, the country released three stamps commemorating three Nobel Prize winners in Chemistry, each with a distinct (unidentified) fungus (Table 1).

## Epilogue

Fungi on stamps from different countries were compiled in 2012 by David Moore<sup>29</sup>. However, neither in his data nor in searches made later, was a single fungus stamp

found from India. Some attempts have been made to release at least a special postage cover for fungi. A special cover was released in October 2015 to mark the Asian Mycological Congress held in Goa under the aegis of the Asian Mycological Association and the Mycological Society of India. Fungi are also a major source of chitin and, therefore, during the seventh Indian Chitin and Chitosan Society Meeting held at CSIR-National Chemical Laboratory (NCL), Pune in 2018, a special cover was released depicting fungi as a source of chitin<sup>30,31</sup>. The cancellation stamp was of *Benjaminiella poitrasii*, a zygomycetous fungus as a chitosan source with commercial potential. India has one of the world's richest fungal diversity. Fungi with the potential to be featured on postage stamps include *Termitomyces*, an edible mushroom from Goa; *Metarhizium*, an insect pathogenic fungus used as mycoinsecticide in agriculture; *Trichoderma*, a highly rated biocontrol and biofertilizer organism, and smut and rust-causing plant pathogens. *Xylaria hypoxylon*, a luminescent fungus found on dead wood in the Western Ghats, can also be a candidate. Subramanian<sup>32</sup>, reviewed the progress and status of mycology in India, since E. J. Butler arrived in 1901 to energize mycology and myco-technology. Today, India has two mycology societies: the Mycological Society of India and the Indian Society for Mycology and Plant Pathology, functioning since 1973 and 1970 respectively. A number of other societies also deal with fungi and fungal metabolites. In spite of such a

long history and wide following, the Indian Post has not issued any postage stamp on mushrooms or any other fungus so far, and not a single Indian mycologist appears on a postal stamp. One reason could be the lack of awareness of the significance of philately in education, research and in spreading knowledge. Or should we attribute it to the apathy and lack of perseverance of Indian mycologists?

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