

SPORE PRINTS

BULLETIN OF THE PUGET SOUND MYCOLOGICAL SOCIETY
Number 589 February 2023



OYSTER MUSHROOM FUNGUS USES NERVE GAS TO PARALYZE AND EAT TINY WORMS

Alice Klein

<https://www.newscientist.com/>, Jan. 18, 2023



Oyster mushrooms, *Pleurotus ostreatus*.

Oyster mushrooms are delicious, but they have a little-known dark side: the fungus that produces them paralyzes and kills nematode worms using a nerve gas, before sucking out their insides.

Oyster mushrooms are the reproductive structures—or fruiting bodies—of the fungus *Pleurotus ostreatus*. We have

known since the 1980s that this fungus preys on nematodes, which are microscopic roundworms, but how it does this has been a mystery.

Yen-Ping Hsueh at Academia Sinica, a research institute in Taiwan, and her colleagues previously discovered that *P. ostreatus* contains tiny, lollipop-shaped structures that break open when nematodes press their heads against them. They have now found that, once ruptured, these structures release a gas that is highly toxic to nematodes' nervous systems.

The researchers determined this by first inducing thousands of random genetic mutations in the fungus, after which they noticed that mutants lacking these lollipop structures were no longer toxic to the nematode *Caenorhabditis elegans*.

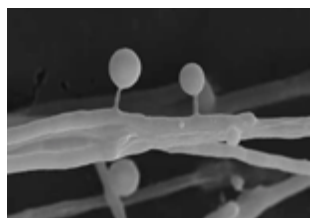
Next, the researchers analyzed the contents of the lollipop structures in non-mutant fungi and found that they were packed with a volatile chemical called 3-octanone. When they exposed four different nematode species to this chemical, it triggered a massive influx of calcium ions into nerve and muscle cells throughout their bodies, leading to rapid paralysis and death.

Hsueh calls this a “nerve gas in a lollipop” killing strategy.

The toxic lollipop structures are present on hyphae, the long, branching structures that grow inside rotting wood and make up most of the fungus. The oyster mushrooms themselves are nontoxic, says Hsueh.

After the fungus kills its prey, its hyphae grow into the nematodes' bodies to suck out their contents. It may do this to absorb nitrogen, since this nutrient is deficient in the rotting wood on which the fungus mostly grows, says Hsueh.

Nematodes are the most abundant animals in soil, which makes them a natural food choice for fungi, she



“Lollipop” structures on the hyphae of oyster mushrooms, viewed with an electron microscope.

Yi-Yun Lee, Academia Sinica

says. Other fungi use different tactics to catch nematode prey, including sticky traps and nooses that tighten around their necks.

The finding that *P. ostreatus* feeds on nematodes has led to some discussion in the vegan community about whether oyster mushrooms are a truly vegan food.

STUDIES ON MAGIC MUSHROOMS AND EXPERT OPINIONS

Montreal Times, <https://mtltimes.ca/>, Jan. 27, 2023

Nowadays, the popularity of magic mushrooms is increasing because they contain psychoactive compounds such as psilocybin, producing a range of effects including changes in perception, thought, and emotion. There has been a growing interest in the therapeutic potential of magic mushrooms, leading to a surge in research on the topic. Here are some of the current studies on magic mushrooms and the experts' opinions in the field.

Studies on Magic Mushrooms

Several studies have investigated the therapeutic potential of magic mushrooms with pretty impressive results. For example, a study by Imperial College London found that two doses of psilocybin were more effective than a commonly prescribed medicine for treatment-resistant depression. A study by the John Hopkins University School of Medicine found that a single dose of psilocybin led to a significant reduction in symptoms of anxiety and depression in cancer patients.



Magic mushrooms.

Another study in the *Journal of Psychopharmacology* showed that a single dose of psilocybin in combination with psychological support leads to long-term changes in personality, including increased openness and self-reflection.

Studies have also shown that magic mushrooms have the potential to help people with a range of other conditions, including PTSD, addiction, and OCD. So if you struggle with something like that, finding a magic mushroom dispensary and giving it a try can be worth it, but make sure you approach these substances with caution and under the guidance of a medical or therapeutic professional.

Expert Opinions

Experts in the field have spoken positively about the therapeutic potential of magic mushrooms. Dr. Robin Carhart-Harris, head

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CALENDAR

- Feb. 14 Membership meeting, in-person and via Zoom,
7:30 pm CUH
Feb. 20 Board meeting, 7:30 pm, CUH

BOARD NEWS

Marcus Sarracino

Happy New Year from your PSMS board! We took the month of December off for the holidays but came back refreshed and ready to tackle a full slate of topics. **Election** season is upon us with a great group of fantastic folks looking for your votes. Read all about them further down in this issue of *Spore Prints*. In related news we took a couple of unorthodox **votes**: (1) To allow me to return to my previously held board seat with a term expiring in 2024 after fulfilling this interim term as secretary; and (2) to allow Carolina Kohler to run for secretary even though she has not held a board seat previously. Both motions carried. We continue to make progress on the policies and paperwork for both the **library and the scholarship guidelines** and should publish them soon. We are accepting for nominations for the Patrice Benson **Golden**

Mushroom Award given yearly to someone who has shown exemplary dedication and long-standing service. Names may be submitted to myself (secretary@psms.org) or Randy Richardson (president@psms.org).

MEMBERSHIP MEETING

Scott Maxwell

February's general membership meeting on February 14, 2023, will once again be a hybrid meeting including both in-person and Zoom at the Center for Urban Horticulture. The Zoom link will be available on the web at www.psms.org at the beginning of February. We will start letting members in at about 7:00 pm. Please come share Valentine's Day with us learning about fungi.



During February in Washington State, one might think that macro fungi are largely done fruiting from Fall and waiting for Spring. However, our speaker this month, Noah Siegal, will enlighten us with his presentation "Stop Walking on Truffles: The Cryptic Life Underground."

According to Noah, The Pacific Northwest has an amazing diversity of hypogeous fungi (truffles and false truffles). Although truffles are renowned for their culinary properties, very few species are highly prized edibles. This talk will highlight the diversity and beauty of our underground fungi and how to find and identify them.

Noah's field mycology skills are extensive—he has spent over three decades seeking, photographing, identifying, and furthering his knowledge about all aspects of macrofungi. He has hunted for mushrooms throughout the United States and Canada, as well as on multiple expeditions to New Zealand, Australia, and Cameroon.

He is one of the premier mushroom photographers in the nation, having won numerous awards from the North American Mycological Association (NAMA) photography contest. His technique and attention to detail are unrivaled, arising from a philosophy of maximizing utility for identification purposes while maintaining a high degree of aesthetic appeal. His photographs have appeared on the covers and have been featured in articles of multiple issues of *FUNGI Magazine* (the primary mushroom enthusiast magazine in the United States) and numerous mushroom books, as well as many club publications.

He authored, along with Christian Schwarz, *Mushrooms of the Redwood Coast*, a comprehensive guide for the northern California coast, and *A Field Guide to the Rare Fungi of California's National Forests*. He is currently working on *Mushrooms of Cascadia*, a reference guide for Pacific Northwest fungi. Noah travels and lectures extensively across America, following the mushrooms from coast to coast, and everywhere in between.

*I came home after
a day of mushroom hunting
then the rain began*

—(Matsuo Bashō, 1644–1694)

[Mushroom] hunting in the forest is more than scenery or flavor; it means that we face many of the dangers that those who hunt for meat encounter: wild animals (not wounded, we hope), bad weather, dangerous terrain, and—in late autumn—meat hunters with excellent weapons, terrible eyesight, trigger-happy index fingers, and poor judgment. You can get lost—really and truly lost, which is the ultimate wilderness experience... You can die hunting mushrooms; indeed, many do. But the real difference in danger between the meat hunter and the mushroom hunter is that we can die after the hunt.

—Susan Goldhor, *Boston Myco. Club Bulletin*

BOOK REVIEW: *Kinoko: A Window into the Mystical World of Japanese Mushrooms* A.A. Sieger

Whether you're a mushroom enthusiast, a lover of poetry and language, or simply interested in the outdoors, you'll find something to enjoy in this beautifully written and carefully researched book. Written in easy-to-read English by former PSMS member Nathaniel Guy, a professional Japanese translator and interpreter, the book is available in paperback, Kindle, and PDF versions. Among other things it

- Provides a mini field guide, giving a comprehensive overview of common Japanese mushrooms, including identification tips and information about their characteristics and habitats.
- Delves into the colorful and interesting etymologies of these names, providing insight into the rich cultural history that contributed to various Japanese mushroom names.
- Features translated essays and stories from Japanese authors about mushrooms, offering a unique and fascinating perspective on the role of these fungi in Japanese culture.
- Gives new translations of over a hundred Japanese poems about mushrooms by both modern and classical poets.
- Offers a deeper understanding of the role of mushrooms in Japanese culture, including their historical and spiritual significance, their place in the culinary world, and their importance in the arts.
- Includes a glossary of Japanese terms related to mushrooms and mycology, as well as useful phrases for mushroom hunters and enthusiasts traveling in Japan.

Nathaniel Guy is an engineer, translator, and amateur mycologist currently serving as an officer in the Tokyo Mushroom Society. In 2020, he developed the app "Japanese Mushroom Dictionary: Become a Japanese Mushroom Expert" for Android and iPhone/iPad, a digital dictionary of all the documented Japanese common names for mushrooms and their up-to-date scientific equivalent. He has worked as a Japanese-English translator on over a dozen video games and contributed software and Guidance, Navigation & Control (GNC) algorithms to a number of high-profile space missions.

Paperback and Kindle copies are available from Amazon at \$22.19 and \$9.99, respectively. A PDF copy can be obtained by donating \$10 to one of the following charities

NRDC	iNaturalist
Sunrise Movement	NPO Mirai no Mori
Mushroom Observer	OISCA International

and sending the receipt to nathaniel.guy@gmail.com.

FUNGAL BAR CODES 101

Daniel Winkler

*Fruits of the Forest,
a Field Guide to Pacific Northwest Mushrooms, 2023*

The successful application of molecular research starting in the 1990s allowed analysis of fungal DNA using tiny segments such as the internal transcribed spacer (ITS). Made of a sequence of around 700 genetic base pairs shared by all fungi, the ITS forms a sort of "primary fungal bar code." Within this bar code, changes caused by mutations that have occurred across millions of years of evolution allow researchers to draw conclusions regarding the degree of closeness or relatedness in the tree of life. However, different DNA regions are used for different purposes, and ITS is excellent for differentiating closely related species. Still, ITS is more informative for some species of fungi than others; for some groups of fungi, like morels and boletes, researchers must evaluate three or four different genetic regions to draw conclusions about evolutionary, or phylogenetic, development.

Taxonomists apply complex statistical analysis to calculate the most likely evolutionary paths, which are depicted in a branching treelike scheme, grouping organisms together based on DNA similarities. On the phylogenetic tree, each branch (clade) contains only taxa (taxonomic units like order, family, genus, species) that are related.

Magic Mushroom Studies, *cont. from page 1*

of Imperial College London's Centre for Psychedelic Research, has said that "psilocybin has the potential to be a game-changer for the treatment of depression." Dr. Michael Pollan, author of "How to Change Your Mind," has said that magic mushrooms have "enormous therapeutic potential."

Dr. Roland Griffiths, a professor of psychiatry and neuroscience at the Johns Hopkins University School of Medicine, has said that "psilocybin has the potential to be one of the most important medicines of the 21st century."

However, it's necessary to note that while the research is promising, much more is needed before psilocybin and other psychedelics can be approved as medicine. These substances are still classified as Schedule 1 by the FDA and DEA, meaning they are considered to have a high potential for abuse and no medical value.

Conclusion

Recent studies have shown that magic mushrooms have the potential to be a powerful tool in the treatment of a variety of mental health conditions. Experts in the field have spoken positively about the therapeutic potential of magic mushrooms, with some suggesting that it could be a "game-changer" for the treatment of depression and other conditions.

While the research is quite promising, more studies are needed before psilocybin and other psychedelics can be officially approved as medicine. Who knows, maybe it won't take long to come to the point when people can use psilocybin without any restrictions, but for now, you need to keep in mind that these substances are still outlawed in many places, and possession and consumption of magic mushrooms can carry legal consequences.

FRAGRANCE AND MUSHROOM ID Daniel Winkler

*Fruits of the Forest,
a Field Guide to Pacific Northwest Mushrooms, 2023*

When learning about mushroom odors, it is crucial to smell the mushrooms themselves to make the connection. We invoke a range of descriptive terms, but the actual fungal odor has its own characteristics. Mushroom odors can be alluring or repellent, and people's perceptions of these smells vary. Here are some helpful examples of fungal odors of PNW mushrooms.



Almond, anise: The Prince (*Agaricus augustus*);
Almond Woodwax (*Hygrophorus agathosmus*)

Fruity: Wood Blewit (*Lepista (Clitocybe) nuda*);
Golden Chanterelle (*Cantharellus formosus*)

Spicy like Red-Hots cinnamon candy: Western Matsutake
(*Tricholoma murrillianum*)

Spicy veering off to skunky: Cloudy Funnel
(*Clitocybe nebularis*)

Farinaceous (cucumber/watermelon):
Sweetbread Mushroom (*Clitopilus prunulus*);
Cottonwood Mushroom (*Tricholoma ammophilum*);
Leopard Knight (*Tricholoma pardinum*) (poisonous)

Chlorine: Smith's Amanita (*Amanita smithiana*) (poisonous);
Bleach Cup (*Disciotis venosa*)

Fishy: Shrimp: Brittle Gill (*Russula xerampelina*);
Coccora (*Amanita calyptroderma*);

Phenolic (creosote-like, tarry): Buck's Agaricus
(*Agaricus buckmacadooli*) (nonedible)

Radishy: Poison pies (*Hebeloma crustuliniforme* & *H. velutipes*)

Spermatoc: Fiberheads (*Inocybe rimosa*)

Musky: Oregon White Truffle (*Tuber gibbosum* and
T. oregonense)

Election

Election

Election

2023 Election Instructions

Marian Maxwell

Elections are held electronically online. Voting opens on January 28 and will end on March 12 at midnight. An email with the link to vote will be sent out on February 1. This year we will be voting for President, Secretary, and five Trustees for the years 2023–2025. Please read the following candidate profiles carefully.

How to Vote Electronically

Go to the PSMS website at www.psms.org and click on "Members' Page" under the heading "Membership." You will need to log in with your username and password. If you have forgotten your password, please fill out the section "Forgot your password?" at the bottom of the page and click on "Reset your password." If you cannot remember your username, contact Pacita Roberts at membership@psms.org or Marian Maxwell at outreach@psms.org. Scroll to the bottom of the member's area page to "Member's Area Features." Under the heading "Engagement" click on the

link "Elections." This will open the ballot for the 2023 PSMS election. You may now make your selections. Be sure to click on "submit" on the bottom of the ballot when finished. If you have the PSMS app downloaded on your cell phone, it is also possible to vote via the app.

Please Note

Some biographies in *Spore Prints* have been abbreviated owing to space considerations. Online bios are as originally submitted. It will be helpful to have your *Spore Prints* issue with the candidates' photos and bios available to view when voting. You may only vote once. There are two votes per family membership; each person has to log in separately and use their individual user ID to vote. If you have any questions or confusion about voting, please contact Marian Maxwell at outreach@psms.org. Election results will be announced at the annual membership meeting on March 14.

Officers



Colin Meyer

President

Part of the club for 25 years, I feel two things are important. The first is public education: our annual show, public lectures, ID sessions, library and bookstore, field trips, forays, classes, outreach group, and more. The second is social. PSMS attracts diverse people who share enthusiasm for fungi. One makes lifelong friends here. As president, I'll do my best to keep the club running and make a few small improvements.

Secretary

Carolina Kohler

After a lifetime spent in Argentina, I arrived in the PNW in 2007. In 2013 my husband and I discovered PSMS and became members, and that is how I have learned most everything I know about mushrooms. After attending and hosting several PSMS field trips, I became Field Trip Host Coordinator in 2018.



Wren Hudgins

I have been member since 1974, with a major focus on field trips, identification, and education. I reorganized the field trip guides and formalized the safety rules. I have participated in the annual show and the Monday ID clinics, and the online identification group continues to be my focus. I hope to serve a second term on the Board of Trustees. What I bring are calmness and thoughtfulness.



Marion Richards

Mushroom and lichen foraging has given me a great deal of joy and sharing this passion with others who want to expand their knowledge on the fungal kingdom is very rewarding. I have been a PSMS member since 2018. My interests involve foraging for mushrooms and lichens used in natural fiber dyeing and other arts.

Krista Luoto

I joined PSMS in 2020 because I wanted to learn more about mushrooms and foraging in the PNW. I volunteered at the annual mushroom show and I have taken many of the classes offered by PSMS. I appreciate all of the knowledge and information shared by the PSMS organization, and I would like to volunteer for the board in order to help contribute to the mission.



Joe Zapotosky

I have enjoyed the various activities of PSMS since 2002. I have helped set up for the annual show, attended ID clinics, taken many of the mushroom classes, helped out as a field trip guide, and served one term on the Board of Trustees. I have benefited greatly from PSMS and would like, to repay some of this debt by serving a second term.

Peg Rutchick

I joined PSMS in 2017 to learn about wild mushrooms but gained much more. PSMS is a community of diverse people that share my passion—traipsing through the woods for mushrooms! I've made new friends, taken classes on identification, and volunteered as field trip host and at the wild mushroom show. I welcome the opportunity to support PSMS further by serving on the Board of Trustees.



Pei Pei Sung

I appreciate all the windows into nature that PSMS has opened for me. With a grounding in collaboration and creating human-centered experiences, I will continue building on the inclusive, educational, and community-building values of PSMS, contributing to equitable and accessible practices within club operations, and welcoming all to the continual wonders of the fungal kingdom.

Sandra Ruffner

I've wanted to be part of this great organization for a long time. In the short time that I have been a member, I've been part of the Bridle Trails project, been a field trip guide, helped with the fall show, and been an active participant in the Monday night ID clinics. I've begun the long journey to become an identifier. With your support, I'd like to serve you on the board.



Kelsey Hudson

Joining PSMS was the first thing I did when I moved to Seattle 5 years ago. I'm an IT Security manager who's passionate about mycology and the outdoors. I feel like I have a lot to offer the organization and want to be more involved, bringing diverse perspectives and civil discourse to the table.



MUSHROOM STAMPS FROM ESTONIA

Brian S. Luther

Introduction

Estonia became an independent country in 1991, after the downfall of the USSR, and is now a member of NATO. It's the northern most of the three European Baltic countries bordering the east side of the Baltic Sea (Estonia, Latvia, and Lithuania) and one-quarter the size of WA State. From 2012 to 2020, Estonia annually issued single postage stamps showing different poisonous fungi, for a total of nine different stamps with mushrooms so far. The nine stamps are shown in Table I.

In the table, M = mushrooms or fungi as the main stamp illustration; FDC = a first day cover, an envelope (cover) with the stamps affixed and cancelled on the first day the stamp was issued, and often with a cover illustration (cache) of the same theme; PC = presentation card, a sheet provided by the postal authority with the stamps affixed and giving further details about each; MC = maxicard, a postcard showing an illustration of what's on the stamp, also with the stamp affixed to it and cancelled on the first day of issue, like an FDC. All catalog numbers are from the Scott Postage Stamp Catalogue.

Table I. Mycostamp Issues from Estonia.

Issue Date	Scott Cat. #	Value	Type	Subject
8/30/2012	710	€0.45	M	<i>Amanita virosa</i>
9/12/2013	738	€0.45	M	<i>A. phalloides</i>
9/11/2014	768	€0.55	M	<i>Inocybe erubescens</i>
9/10/2015	795	€0.55	M	<i>Cortinarius rubellus</i>
9/8/2016	824	€0.65	M	<i>Amanita muscaria</i>
9/21/2017	852	€0.65	M	<i>Paxillus involutus</i>
8/23/2018	873	€0.65	M	<i>Gyromitra esculenta</i>
8/29/2019	903	€0.65	M	<i>Galerina marginata</i>
8/28/2020	931	€0.90	M	<i>Amanita pantherina</i>

Discussion

All the stamps are very fine colorful illustrations of the species and each is labeled with the common name in Estonian and the scientific name. All of these postage stamps are perforated and with gum.

Seven of these nine stamps have white skulls in black circles indicating they're deadly poisonous; the other two, although causing serious poisoning, are usually not lethal.

Categorizing these stamps this way, however, is quite subjective and very much based on several circumstances: for example, how much of the mushroom was consumed, the particular geographic strain of the mushroom, containing more or less of the toxin, the age and sex of the person eating it, and whether the person was healthy or unhealthy or already predisposed to other diseases. (As just one example, since some of the toxins in these fungi attack the

kidneys, a person who was either diabetic or on kidney dialysis would be exceptionally susceptible.)



Estonian poisonous mushroom stamps, 2012–2020.

There are several chemically different and unrelated toxins involved here. *Amanita virosa*, *A. phalloides*, and *Galerina marginata* contain similar toxins, which are cyclopeptides and are generally called amatoxin, or amanitins. They attack vital organs, with an unfortunate long latent period after consumption before serious, mostly irreversible, and often fatal symptoms set in.

Cortinarius rubellus contains the toxin orellanin, which causes a delayed-onset renal failure. There are several other species of *Cortinarius* containing similar compounds.

Gyromitra esculenta and many related species contain gyromitrin and other related hydrazones, which we metabolize after eating into a very toxic chemical called monomethylhydrazine (MMH), a type of rocket fuel which also attacks vital organs. One of its main causes of toxicity relates to interfering with vitamin B₆ (pyridoxine) use in the body. Vitamin B₆ regulates a number of vital metabolic processes.

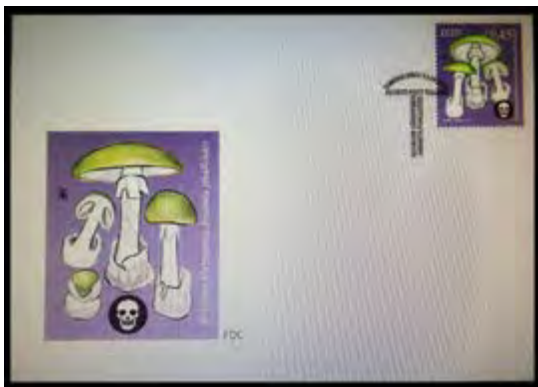
Inocybe erubescens contains muscarine, which is the fastest acting of all mushroom toxins and is a central nervous system poison. It over stimulates the parasympathetic nervous system, causing rapid and pronounced PSL symptoms (perspiration, salivation, lacrimation) and a significant decrease in blood pressure.

Amanita muscaria & *A. pantherina* both contain ibotenic acid and muscimol, but usually they're found in higher amounts in the latter species. Muscimol is responsible for most of the toxicity in humans (Benjamin, 1995) and is a central nervous system poison. For these two, although the symptoms can be violent, based on the amount consumed, generally this is not a lethal poisoning, with most people making a full recovery.

The toxin in *Paxillus involutus* is an antigen (or antigens) causing an immuno-allergic syndrome which can ultimately result in serious renal (kidney) damage or failure.

I've only very briefly discussed the toxins in the mushrooms shown on these stamps, but there are many other poisonous mushrooms with different toxins in addition to those mentioned here. Some of these toxins have antidotes that can be administered by a physician, but early accurate determination of the actual toxin involved is critical. The fungus eaten needs to be seen by a mushroom expert for ID, and then the physician told what the toxin is. All popular mushroom guides discuss the applicable mushroom poisons, but for further detailed reading on the subject you might want to consult Benjamin (1995).

FDCs were issued for these stamps and they all have a cache showing the same mushroom. Each has unique, but mostly very uninteresting cancels. I'll show only one FDC here.



FDC for Estonia stamp Scott 738 (2013).

The cancel on the FDC for the *Amanita virosa* stamp has the writing in two rows forming an arrow shape (presumably a pointed mushroom shape?); for *A. phalloides* the cancel is also outlined with two rows of words, but is mushroom shaped; the *Inocybe erubescens* cancel is made of words that form a mushroom shape, and the cache is very uninteresting, showing only faint b/w images of the mushroom, with a skull and cross bones. The cancel on the *Cortinarius rubellus* is also outlined with two rows of words, forming a mushroom shape, but with an eccentric cap; the *Amanita muscaria* cancel shows a stylized cap for that species, with the stem formed by the words describing the details; the *Paxillus involutus* cancel has words forming a dome shape; the *Gyromitra esculenta* cancel is also dome shaped, but having a cross-sectional view of the mushroom, showing it brain like inside; the *Galerina marginata* cancel has the words mostly in a circular form. I show only one FDC here.

Full page PCs were issued for all of them, showing the stamps and giving additional details about the mushroom on each stamp, and most I've seen are in English. I have not seen maxicards issued for any of these stamps.

Reference

Benjamin, Denis R., 1995. *Mushrooms: Poisons and Panaceas*. W. H. Freeman and Co., 422 pp.



MUSHROOM ASTROLOGY Bob Lehman, LAMS



Pisces (Feb. 19–Mar. 20): You love the idyllic romanticism of hunting mushrooms. You like mushrooms for being part of the wonder of nature and are little concerned about their details. Your examination of a mushroom is more apt to lead to a poem or a song than a taxonomic description. You don't have the physical endurance of other mushroomers and so you don't end up with as many mushrooms, but it doesn't matter because you can rhapsodize about one mushroom as well as about ten. Besides, you find plenty of wonderful mushrooms in your fantasies.

ROBOT MUSHROOM PICKER SOLVES MANPOWER PROBLEMS Bruno Lawrence

<https://www.wireservice.ca/>, Jan. 26, 2023

Mushroom growing companies around the world are facing the problem of labor shortage. In Canada and the United States, there is a labor gap of about 20 percent, and about \$200 million worth of mushrooms are lost each year owing to labor shortages.

"It's efficient work because mushrooms are very delicate to handle," says Michael Curry of Mycionics, developer of the robotic system for picking button mushrooms. "It takes about three months to become a skilled forager, but, because of the continuous nature of the job and the high humidity, it's a job that people don't like very much." With a turnover rate of over 40 percent, many workers leave the farm before learning the basics of the business.

One of the main factors for developing a robotic mushroom picking system is labor shortage. "Mushroom farms are perfect for automation," Curry said. "They work year-round and have a common infrastructure." The Dutch aluminum shelving system is six to seven shelves high and is the most widely used technology worldwide. This is another advantage for robotics as there is no need to change infrastructure. Also, mushrooms grow very fast at a rate of 4 percent per hour and for optimum yield, they should be harvested regularly when they reach 55 mm in size.

Digitization

All these characteristics play an important role in the development of a robotic system that mimics the way workers gather. The Mycionics collection system digitizes the collection by scanning the beds and can identify 98 percent of mushrooms. Data such as location, size, temperature, humidity, and CO₂ levels are collected and processed.

"It takes the computer about 30 minutes to scan a bed of 200,000 mushrooms or more." Based on the scan results, the overall collection strategy is decided and the system decides where to start the collection. "This system collects each mushroom at the right time and in the optimal amount." While growing mushrooms was earlier an art, the availability of crop/climate data and the use of robots are turning it into a science.

Benefits

The robotic mushroom picker not only helps solve labor problems but also promotes yield improvement of about 10 percent. First, digitization of harvesting ensures timely harvesting of mushrooms.

cont. on page 8

Automatic Mushroom Picker, *cont. from page 7*

Pickers work in 8- to 12-hour shifts, while a robotic system picks continuously around the clock, allowing mushrooms to be harvested at the optimal time and quantity. In addition, the computer allows you to cut the stems evenly.

“They are cut straight and to the right length, which allows for maximum stem length and increases product weight,” comments Curry. This results in about 3 percent yield improvement. Last, but not least, the mushrooms are weighed and placed in baskets. Since they cannot be underweight, they are usually a little overweight. “With binders, the overage is about 3–5 percent,” Curry said. “Thanks to the uniformity of the pieces, the surplus with robotic collection is reduced to around 1 percent.” The technology is designed to avoid contact with the top of the cap, so the mushrooms are harvested without damage.

For a video of how the system operates go to

www.mycionics.com



BOLETE BUTTER

Daniel Winkler

*Fruits of the Forest,
a Field Guide to Pacific Northwest Mushrooms, 2023*

One way to make the most of your life is to have bolete butter ready to enjoy 24/7 year-round! Bolete butter is very easy to make, holds up well refrigerated and frozen, and is extremely versatile. It is delicious on a slice of fresh sourdough bread or a hot piece of toast, either by itself or with some *Penicillium camembertii* in the form of a ripe Camembert cheese or any charcuterie. Bolete butter melts to spread its yummi-ness onto steamed veggies and adds savory flavor to steak as well. Cooks Jamie and Dennis Notman, members of PSMS, turned me on to the idea of this scrumptious butter, which, following my mother’s herb butter recipe, I’ve fine-tuned a bit.



Ingredients

- 1 lb (4 sticks) butter
- 1 oz. powdered porcini (*Boletus edulis*)
- ½ cup finely chopped parsley (about one-half bunch)
- 2 tsp Dijon mustard
- 1 tsp lemon juice (or more, to taste)
- Salt, to taste, when using unsalted butter

Instructions

In a small mixing bowl, set the butter out to soften. Mix in the powdered porcini, combining well. Stir in the finely chopped parsley and Dijon mustard and add the lemon juice and salt to taste.

Let it sit for a while—the butter becomes better infused with flavor at room temperature. Store in a closed container in the refrigerator or label it with the date and freeze it.

Makes several months’ worth.

Note: Before adding the powder, you can mix it with bit of water to make a paste, but normally there is enough water in commercial butter to rehydrate it.

Variation: Bolete butter is not limited to King Boletes. It is a great way to make good use of dried *Suillus* spp.—many of them offer a great bolete taste best brought to shine after drying and powdering. I enjoy adding a good dose of pressed fresh garlic, minced finely, to *Suillus* butter without worrying about over-powering the precious and delicate porcini aroma of King Boletes.

POWDERING MUSHROOMS

Daniel Winkler

*Fruits of the Forest,
a Field Guide to Pacific Northwest Mushrooms, 2023*

Powdering mushrooms goes way beyond spicing up your popcorn! It allows fungal aroma to really infuse soups and sauces, from subtle extra umami to bold fungal flavor. In addition, powders make excellent butters. Turning them into powder allows you to use mushrooms that may have good to great aroma but poor consistency or flavor when fresh; too soft or slimy, like some *Suillus* spp.); too tough, like big, old oyster mushroom caps or the stems of honey mushrooms, Shiitake, or shaggy parasols; are on the bitter side like Hawk’s Wings (*Sarcodon imbricatus*) or have a special flavor like Candy Caps or Pepper Boletes.

Keep in mind that by powdering, you substantially enlarge the surface area of the ground mushroom, which can speed up loss of aroma and decay. Thus, it’s best to grind up smaller amounts that will be used up quickly. However, we have had some mushroom powders sitting on our spice shelf for years and they are still useful. Boletes make a particularly delicious powder.

NEEDED: Information on Dr. Daniel E. Stuntz, co-founder of PSMS

Olivia Filialuna

I am a Master’s of Museum Studies student at the University of Washington, where I am working to catalog the history of the Burke Museum herbarium and make the information digitally accessible. My focus in particular is the legacy of Daniel Elliot Stuntz, UW mycologist and co-founder of the Puget Sound Mycological Society, on the herbarium’s fungal collections. Stuntz’s collection also contains original correspondence, collection and identification notes, Kodak slides, photo negatives, over 23,000 specimens, and an array of other items from a 50-year career. The purpose of my project is to digitize Stuntz’s archival materials and make them accessible to the public. But *I need your help!*

My requests for you are two-fold:

- additional D.E. Stuntz material
- input from prospective website users.

If you could fill out the following form to tell me a little bit about yourself and provide insight on the best way to make these objects available to you, it would be greatly appreciated. The input provided will allow me to tailor my final product, a website for individuals interested in fungi and the history of mycology. to learn about said history and its objects.

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<https://forms.gle/g8wg6Y1ZVKEEXP5G8>

