Mushrooms in the food system

How do we approach a food that most of us don't understand?

Ernie Wheeler
The Fungal Network
Pinnacle, NC

What can you expect from this talk?

- Initially, I thought I would give you lots of information and data points.
- I settled on a focus on “vibes,” with supporting information and a few short sight-seeing detours.

My hope is that you leave this talk with a general notion of the state of things and a motivation to learn more.

Global trends in fungus research

(Leaving aside fungal plant pathogens)

- I think this is a good barometer of where the supply end is, and reflects (with some lag) where the demand is
- Sharply divided between the developed countries and developing countries

First, a quick biology lesson

- Mushrooms are fruit
  - They grow from a body, called mycelium
  - Their purpose is to produce spores for sexual reproduction
  - Mostly these are spread by wind

OPEN ACCESS PEER-REVIEWED

RESEARCH ARTICLE

Mushrooms as Rainmakers: How Spores Act as Nuclei for Raindrops

Maribeth O. Hassett, Mark W. F. Fischer, Nicholas P. Money

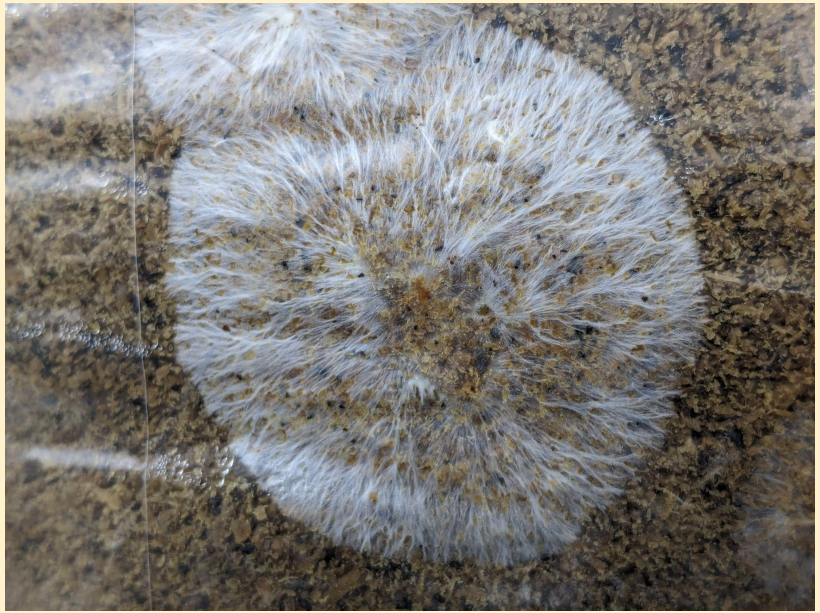
Published: October 28, 2015 • https://doi.org/10.1371/journal.pone.0140407

Abstract

Millions of tons of fungal spores are dispersed in the atmosphere every year. These living cells, along with plant spores and pollen grains, may act as nuclei for condensation of water in clouds. Basidiospores released by mushrooms form a significant proportion of these aerosols, particularly above tropical forests. Mushroom spores are discharged from gills by the rapid displacement of a droplet of fluid on the cell surface. This droplet is formed by the condensation of water on the spore surface stimulated by the secretion of mannitol and other hygroscopic sugars. This fluid is carried with the spore during discharge, but evaporates once the spore is airborne. Using environmental electron microscopy, we have demonstrated that droplets reform on spores in humid air. The kinetics of this process suggest that basidiospores are especially effective as nuclei for the formation of large water drops in clouds. Through this mechanism, mushroom spores may promote rainfall in ecosystems that support large populations of ectomycorrhizal and saprotrophic basidiomycetes. Our research heightens interest in the global significance of the fungi and raises additional concerns about the sustainability of forests that depend on heavy precipitation.

Figures

- Mushroom cultivators almost entirely operate using cloning
  - Mushroom spawn is generally a grain (like rye or wheat) that has been sterilized and has a fungus culture growing through it. Those grains are used to inoculate an appropriate substrate.



Buttons / portobellos / crimini grow on composted manure.

- They are secondary decomposers

Most of the “gourmet” mushrooms are primary decomposers.

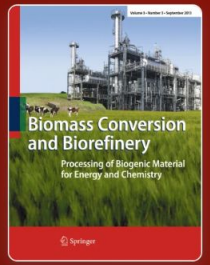
- In nature you would mostly find them on dead wood.

Then there are the mycorrhizal fungi, which don’t lend themselves to cultivation at all

Utilization of arecanut leaf sheath and orange peel as environmentally friendly alternative substrates for cultivating *Pleurotus ostreatus*

Original Article | Published: 31 May 2024

(2024) Cite this article



Biomass Conversion and Biorefinery

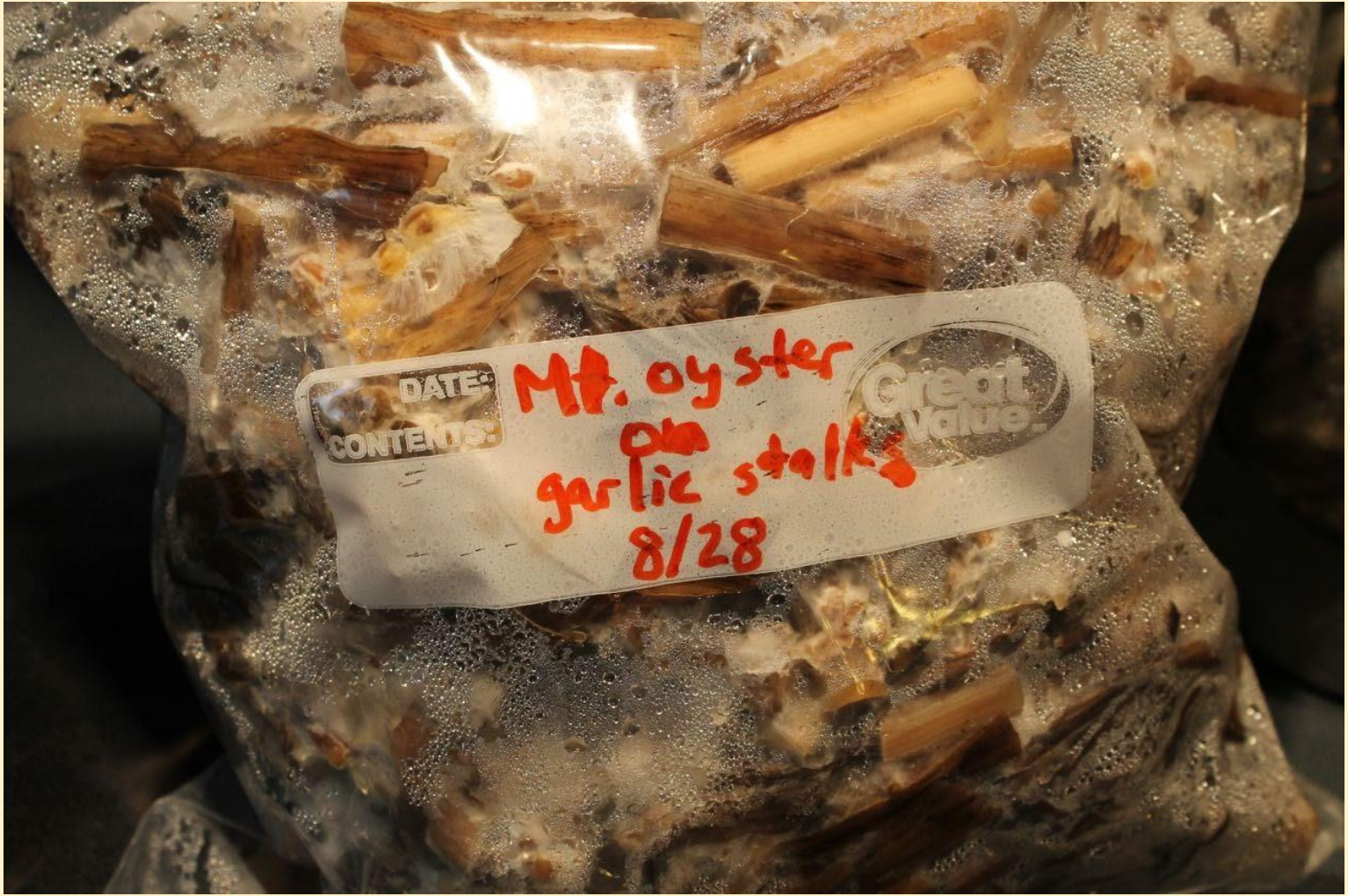
Aims and scope →

Submit manuscript →

Saravanan Monisha, Rajendran K. Selvakesavan, Reena Navaroja, Chinnasamy Krishnaveni & Marimuthu Kanchana

Abstract

In the current era, harnessing agricultural waste recycling for the production of high-value nutritional products not only addresses sustainability challenges but also holds immense potential for meeting the growing demand for nutritious food sources worldwide. In this


DATE:
CONTENTS:
Mt. oyster
garlic stalks
8/28
Great Value

Assessment of the productive and biodegradative non-enzymatic performance of *Pleurotus* mushrooms grown on agricultural wastes of sugarcane bagasse and banana leaves

Research | Published: 29 April 2025

Volume 41, article number 157, (2025) Cite this article

World Journal of Microbiology and Biotechnology

Aims and scope →

Submit manuscript →

Sabrina Alves da Silva, Jhonatan Rafael Zárate-Salazar, Robson Eduardo Pereira Monteiro, Rossana Lucena de Medeiros, Háimyk Andressa Nóbrega de Souza, Bruno de Oliveira Dias & Fillipe de Oliveira Pereira

JOURNAL OF BIOMEDICAL RESEARCH & ENVIRONMENTAL SCIENCES
ISSN: 2766-2276
SUBJECT AREA(S): ENVIRONMENTAL IMPACTS
DOI: 10.37871

RESEARCH ARTICLE

Performance of Waste Paper as a Substrate for Oyster Mushroom (*Pleurotus ostreatus* L.) Cultivation

Tsega Mussie, Sirak Berhe, Selamawit Teklemichael and Tedros Gebrezgiabhier*

Department of Biology, Mai Nefhi College of Science, Asmara, Eritrea (East Africa)

Abstract

Purpose: Cultivation of *Pleurotus* spp. (Oyster mushroom) is economically feasible, exploiting its great capacity to degrade cellulose, lignin and hemicelluloses present in organic wastes. Waste paper is a very common pollutant thrown as garbage with no recycling plan in the environment. In view of the growing importance of food security and environmental sanitation this study was conducted to evaluate the performance of waste paper as a substrate for cultivation of Oyster mushroom (*Pleurotus ostreatus L.*), supplemented with sawdust and wheat bran.

***Corresponding author(s)**

Tedros Gebrezgiabhier, Department of Biology, Mai Nefhi College of Science, Asmara, Eritrea (East Africa)

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DOI: https://doi.org/10.36349/easjnfs.2025.v07i01.006

Original Research Article

Advancing Sustainable Mushroom Production in Developing Countries: A Pathway to Nutritional Security and Economic Growth

Calista Odinachi Itubochi[1*], Jerry Obeta Ugwuanyi[2], Ifeanyi Boniface Ezea[3]

[1]Department of Microbiology, K.O. Mbadiwe University Ideato, Imo State, Nigeria
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[3]Department of Applied Microbiology and Brewing, Enugu State University of Science and Technology, Enugu State, Nigeria

Article History
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Published: 01.02.2025

Journal homepage:
https://www.easpublisher.com

Quick Response Code

Abstract: Mushroom production represents a promising industry with significant economic and environmental benefits and offers a viable strategy for addressing the nutritional deficits prevalent in these regions. Its low capital requirements make it an accessible tool for poverty alleviation and wealth creation, providing extensive job opportunities and contributing to national economic growth. The utilization of agro-forestry waste as raw material for mushroom cultivation aligns with the waste-to-wealth approach, fostering environmental sustainability. Despite the popularity of mushrooms as a food source, most of the mushrooms consumed in developing countries are gathered from the wild. The commercialization of mushroom production, which has the potential to become a sustainable and profitable agro-industrial sector, remains largely untapped, underexplored, underutilized, underexploited, and underrepresented. Various challenges impede the growth of the mushroom industry in developing countries, including socio-economic and cultural barriers, inadequate technical and scientific expertise, lack of supportive government policies, fluctuating market prices, and inefficient marketing systems. However, increased awareness of the nutritional, health, and economic benefits of mushrooms, coupled with the establishment of mushroom farming enterprises, could significantly enhance the industry's visibility and accelerate its industrial development in a short time. This review examines the development and sustainability of mushroom production for nutritional security and national

Some are explicit in their goals of increasing nutritional security and economic growth

JURNAL AKSI AFIRMASI
Jurnal Pengabdian kepada Masyarakat

Empowering Rural Economics through Sutainable Oyster Mushroom Cultivation: a Community Based Approach in Bambang Village

Joko Wibowo
Universitas Al-Qolam, Malang

PDF

ShodhPrabandhan: Journal of Management Studies
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MUSHROOM FARMING FOR YOUTH EMPOWERMENT: A HIGH-VALUE CROP WITH MINIMAL LAND REQUIREMENTS

M.S Sadiq
Department of Agricultural Economics and Agribusiness, FUD, Dutse, Nigeria
Author

If you face an issue in Submission Online, please send the manuscript by email:
editor@shodhprabandhan.com

sustainability

Article Menu

Open Access Review

A Review of Nature-Based Solutions for Valorizing Aromatic Plants' Lignocellulosic Waste Through Oyster Mushroom Cultivation

by Mirca Zotti, Grazia Cecchi *, Laura Canonica and Simone Di Piazza

Laboratory of Mycology, Department of Earth, Environment and Life Science, University of Genoa, Corso Europa 26, 16132 Genoa, Italy

* Author to whom correspondence should be addressed.

Sustainability **2025**, *17*(10), 4410; **https://doi.org/10.3390/su17104410**

Submission received: 18 March 2025 / Revised: 24 April 2025 / Accepted: 9 May 2025 / Published: 13 May 2025

(This article belongs to the Special Issue **Research Progress and Evaluation Challenges of By-Product and Waste Valorization**)

Abstract

A creative, nature-based way to solve environmental issues and promote sustainable development could be the cultivation of *Pleurotus* spp. mushrooms to use the lignocellulosic waste from Medicinal and Aromatic Plants (MAPs). *Pleurotus* species are characterized by flexibility and biodegradative capacities to generate bioactive compounds with antibacterial, antioxidant, and nutraceutical properties using lignocellulosic substrates. Aromatic plant residues, such as those from lavender, sage, and mint, can improve the resultant mushrooms' metabolic profiles and act as nutrient-rich substrates. Higher levels of phenols, flavonoids, and terpenoids can be among these enhancements, which could make mushrooms useful as functional foods. This strategy could provide scalable and affordable waste

recycling

Article Menu

Open Access Communication

A Business Model for Circular Bioeconomy: Edible Mushroom Production and Its Alignment with the Sustainable Development Goals (SDGs)

by Viviany Viriato [1,*], Silvia Angélica Domingues de Carvalho [2], Bruno de Lima Santoro [3] and Filipe Pereira Giardini Bonfim [1]

[1] Department of Crop Science, Division of Horticulture, School of Agricultural Sciences, São Paulo State University (UNESP), Campus Botucatu, Av. Universitária, 3780, Altos do Paraíso, Botucatu 18610-034, SP, Brazil

[2] Department Rural Engineering and Socioeconomics, School of Agricultural Sciences, São Paulo State University (UNESP), Campus Botucatu, Av. Universitária, 3780, Altos do Paraíso, Botucatu 18610-034, SP, Brazil

[3] Luiz de Queiroz College of Agriculture, University of São Paulo, Av. Pádua Dias, 11, Piracicaba 13418-900, SP, Brazil

* Author to whom correspondence should be addressed.

Recycling **2024**, *9*(4), 68; **https://doi.org/10.3390/recycling9040068**

Submission received: 12 July 2024 / Revised: 12 August 2024 / Accepted: 13 August 2024 / Published: 15 August 2024

Abstract

Agricultural wastes (AWs) generated from farming practices pose environmental threats if not properly disposed of or recycled through biological processes. Mushroom production presents a sustainable solution by converting AWs into

ELSEVIER

Journal of Environmental Management

Volume 373, January 2025, 123970

Review

Spent mushroom substrate: A review on present and future of green applications

Xiaoyu Ma [a], Siyu Yan [b], Menglu Wang [c]

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https://doi.org/10.1016/j.jenvman.2024.123970 ↗

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Highlights

- The review is on unique features and environmentally friendly applications of SMS.
- The distinctive features in the morphology and composition of SMS are illustrated.

- Everything that is being learned in developing countries can just as well be applied to our own areas.
    - The same problems that are being addressed in the developing world exist and need to be addressed here in the southeastern United States.

In developed countries, a focus on technology

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PAPER • OPEN ACCESS

Understanding mushroom farm environment using TinyML-based monitoring devices

Segun Adebayo, Halleluyah Oluwatobi Aworinde, Oluranti Olayinka Olufemi, Christian Okechukwu Osueke*, Abidemi Emmanuel Adeniyi and Oluwasegun Julius Aroba*

Published 9 April 2025 • © 2025 The Author(s). Published by IOP Publishing Ltd

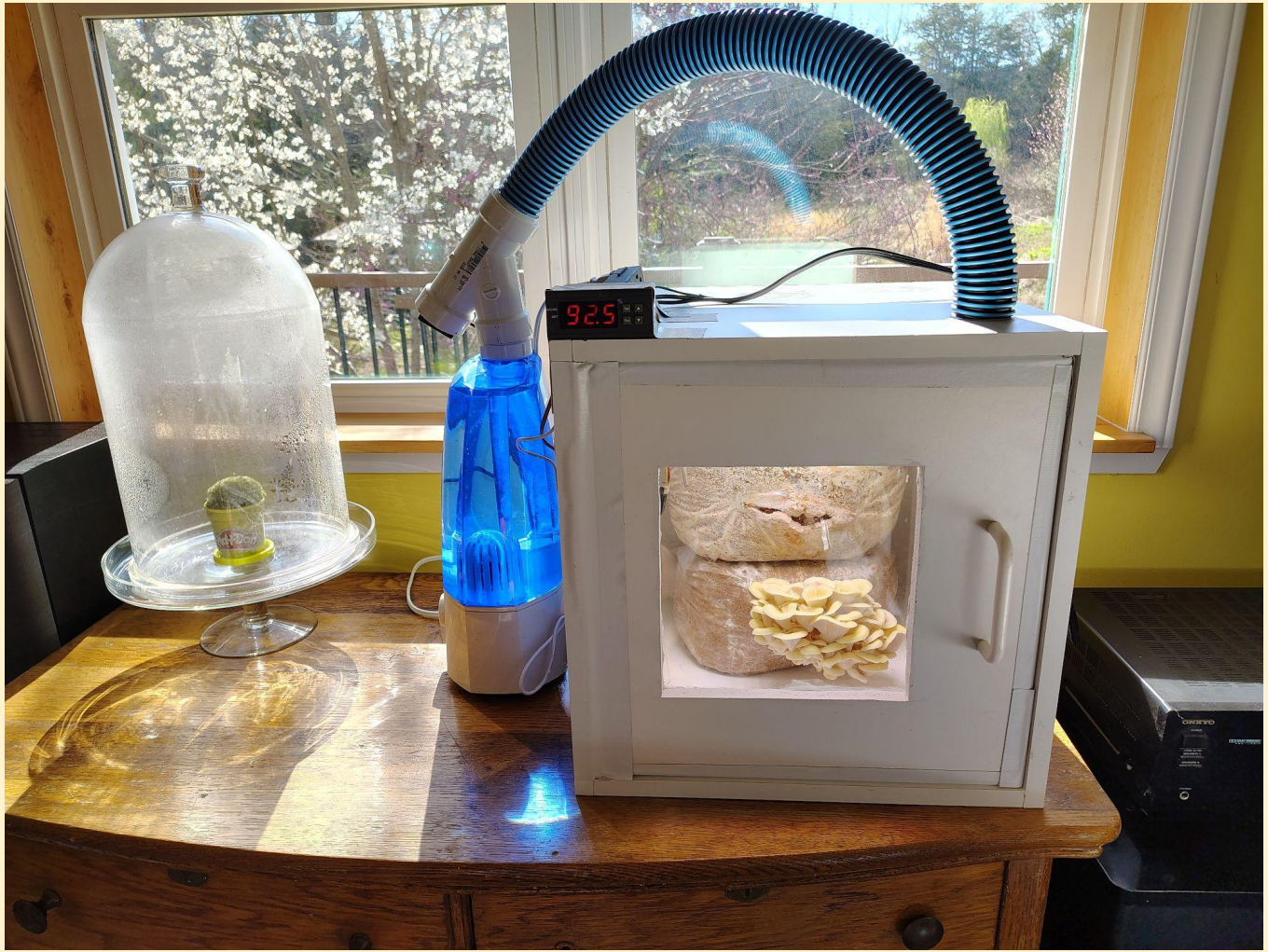
Environmental Research Communications, Volume 7, Number 4

Citation Segun Adebayo *et al* 2025 *Environ. Res. Commun.* **7** 045014

DOI 10.1088/2515-7620/adc5cd

Article PDF

A typical study involving “tiny machine learning” and “internet of things”


92.5

training will enable you to scale mushroom production quickly and efficiently.

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Item subtotal (0 variations 0 items)	$0.00
Shipping total	To be neg
Subtotal	**$0.00**

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- So far, local markets for gourmet mushrooms are dominated by very local small farms, many growing a diversity of mushrooms and focused on local farmers markets and restaurant sales

- As they say, “the future is here, it’s just not evenly distributed.”
  - Highly automated factory style farming is happening in some areas, and it will certainly show up in the southeast eventually.

Research (production) trends:

- New substrates
- Integration with traditional crops
- Environmental benefits
- Food and economic security
- Tech integration and automation

But culturally, we’re still here

While the food system in general relies on the knowledge and integrity of the experts, this is especially true with mushrooms.

Morbidity and Mortality Weekly Report (*MMWR*)

Search

Outbreak Linked to Morel Mushroom Exposure — Montana, 2023

Weekly / March 14, 2024 / 73(10);219–224

Print

Heather Demorest, MPH[1]; Rachel Hinnenkamp, MPH[2]; Maggie Cook-Shimanek, MD[2]; Alyssa N. Troeschel, PhD[3]; Michael Yeh, MD[3]; Thao-Phuong Christy Hallett, MD[3]; David Kuai, MD[3]; Johnni Daniel, DHSc[3]; Andrea Winquist, MD, PhD[3] (VIEW AUTHOR AFFILIATIONS)

View suggested citation

Summary

What is already known about this topic?

Although morel mushrooms are generally considered edible, rare cases of illness have been reported after consumption; little is known about the human health effects of morels. During March–April 2023, a total of 51 persons reported gastrointestinal illness after dining at a Montana restaurant; two patients died.

What is added by this report?

A case-control study identified morel mushrooms as the likely outbreak source. Consumption of raw morels was more strongly associated with illness than was consumption of cooked or partially cooked morels.

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"I told my wife on her deathbed that I would hold those accountable for what they've done to her," he said.

Donna's illness and death came after two other people fell ill, with one dying as a result, after eating at Dave's Sushi between March and April of 2023, according to the Gallatin County Health Department's records. An investigation was later opened where it was discovered the morel mushrooms sold at the restaurant were likely sourced from China.

In July 2023, health officials released a statement that suggested the morel mushrooms were responsible for the illnesses.

"Study results indicated that consuming morel mushrooms at the restaurant was strongly associated with developing [gastrointestinal] illness," the statement read, per *The Montana Free Press*. "Additionally, individuals who reported consuming a greater quantity of sushi containing morels were

Dave's Sushi temporarily closed in April after several customers that dined there fell ill. The restaurant said in an Instagram post that they believe the common ingredient was cultured morel mushrooms, imported from China via a distributor in California.

Donna Ventura, 64, and William Lewis, 74, died days after eating at the restaurant. At least 30 other diners are believed to have been infected, local news station KBZK reported.

Controlled Indoor Cultivation of Black Morel (Morchella sp.) All-year-round

Published: 3 December 2021

By: Jacob Kirk and Karsten Kirk

Centers for Disease Control and Prevention
MMWR
Morbidity and Mortality Weekly Report
Weekly / Vol. 73 / No. 10
March 14, 2024

Outbreak Linked to Morel Mushroom Exposure — Montana, 2023

Heather Demorest, MPH[1]; Rachel Hinnenkamp, MPH[2]; Maggie Cook-Shimanek, MD[2]; Alyssa N. Troeschel, PhD[3]; Michael Yeh, MD[3]; Thao-Phuong Christy Hallett, MD[3]; David Kuai, MD[3]; Johnni Daniel, DHSc[3]; Andrea Winquist, MD, PhD[3]

after consumption of morels, which were consumed raw or cooked to varying degrees, as well as neurologic symptoms, including cerebellar effects, and, in some cases, death (*3*–*6*).

Morels should be refrigerated at a temperature of ≤40°F (≤4.4°C), in breathable type packaging, such as a paper bag. Morels should be cooked thoroughly before consumption because cooking is likely to reduce toxin levels present in the mushrooms (*1*).

Limitations

The findings in this report are subject to at least five limitations. First, this investigation could not determine the specific characteristic of the morels that caused the outbreak. Morel storage and preparation methods, in addition to the differences in cooking methods described, that were not identified during the outbreak investigation might have differed between April 8 and 17, and might have played a role in causing illness. Second, morel mushroom toxins are not well characterized; therefore, the presence of a specific toxin could not be confirmed through laboratory testing (*1*). Third, limitations inherent to the epidemiologic studies included the small sample size and the possibility of unidentified confounding by something closely associated with the morels. Fourth, the study could have

Summary

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What is added by this report?

A case-control study identified morel mushrooms as the likely outbreak source. Consumption of raw morels was more strongly associated with illness than was consumption of cooked or partially cooked morels.

What are the implications for public health practice?

This outbreak investigation highlights the importance of prompt cross-agency communication, collaboration, and the use of epidemiologic studies to guide outbreak investigations. Morel mushrooms should be cooked before eating to mitigate potential toxic effects.

public safety. These findings also highlight gaps in knowledge regarding morels that need further research to better understand how they affect human health, and to identify effective treatment for morel toxicity beyond supportive care. Morel mushrooms should be cooked before human consumption to

Photo **StockFood**

Michelin star chef exonerated as morel death case dismissed

24 JAN 2020

BY **HUGO MCCAFFERTY**
JOURNALIST

SAVE

Riff restaurant in Valencia made global headlines last year when it was reported that a **46-year-old woman had died after eating morel mushrooms** in a dish there last February. A year later, Valencia's Supreme Justice dismissed the case against the restaurant after a forensic report concluded that the woman had suffered from **acute respiratory failure as well as mild food poisoning which "cleared up without treatment"**, according to a report by Spanish news agency EFE,

Over 70 diners were interviewed for the report, with 30 of them reporting mild symptoms of food poisoning after eating at *Riff* between the 13th and 16th of February 2019. The report concluded that the **woman died of natural causes and that she suffered acute respiratory failure as a result of a pre-existing kidney disorder.**

The case dismissal, therefore, ends the case against head chef and owner **Bernd Knöller.**

Knöller closed *Riff* after the incident in March, however, the restaurant retained its Michelin star in the **2020 Spain and Portugal guide**, published before the report's conclusions were published.

Inspectors visited Riff restaurant immediately after the incident, however, they failed to identify any obvious cause for the food poisoning. Knöller explained that the **probable cause of the food poisoning was the morel mushrooms he used in a rice dish**.

Morels are **mildly toxic when eaten raw**, however, the toxicity **usually disappears when the mushrooms are cooked**. Knöller believes the problem with the morels started before they reached the Riff kitchen.

"We had sourced them [the mushrooms] from our regular mushroom supplier who I have been working with for over 25 years. As I remember, these particular morels were the most beautiful and uniform specimens we had ever seen. The mushrooms apparently had not come from Spain or from Europe but were from China, probably from Sichuan where the Chinese successfully cultivate them.

Deadly mushrooms cooked by chef for co-workers

6 January 2012

The chef who cooked the death cap mushrooms mistook them for an edible delicacy

The death cap mushrooms that killed two people in Australia were prepared by a chef for his co-workers, officials say.

Liu Jun, 38, cooked the private dinner for colleagues on New Year's Eve at the Chinese Bistro in the Harmonie German Club in Canberra.

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'Mistaken identity'

The bistro is closed until further notice.

"This was just a one-off and an unfortunate mistake with dire consequences for two people," Mr Thamer said. "Everyone is devastated."

It is believed that Mr Liu could have mistaken the poisonous death cap mushrooms for the Paddy Straw mushroom. The latter is an edible fungi that is commonly found in Asia and considered a delicacy.

"It's just mistaken identity. Liu Jun would have been walking past it, picked it up," Tom O'Dea, a friend of the late chef, told ABC Radio.

According to the Australian National Botanic Gardens, the death cap mushroom can be found in many Canberra suburbs, usually near oak trees.

It is also common in Melbourne suburbs and in some Victorian country towns.

Eating the mushrooms can cause stomach pains, vomiting, diarrhoea and jaundice. Liver and kidney failure can also occur.

Mr O'Dea added that the Chinese community in Canberra is in shock over the tragic incident.

Mr Liu was working temporarily in Australia to send money home to his family

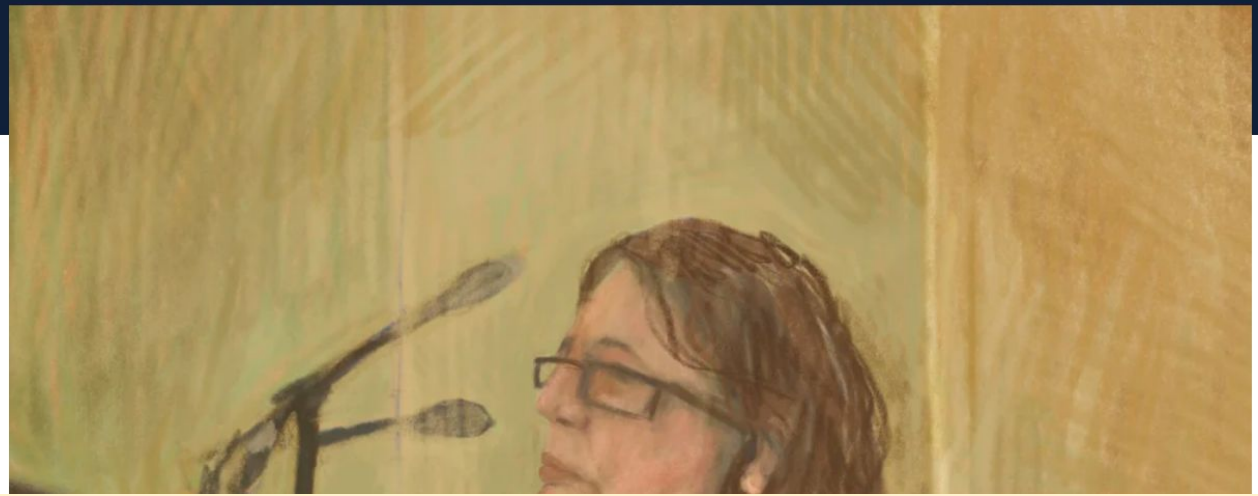
Paddy straw mushroom

Destroying angel

WORLD

Australian woman pleads not guilty ahead of murder trial over mushroom deaths

Erin Patterson denied killing her ex-husband's relatives by serving them poisonous mushrooms in a case that has riveted the country.



CRIME

Woman who ate poisonous mushrooms said meal was "delicious" before dying, doctor testifies at triple murder trial

May 7, 2025 / 9:20 AM EDT / CBS/AFP

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Int J Circumpolar Health. 1998 Jan;57(1):40-55.

Uses of mushrooms by Finns and Karelians

M Härkönen [1]

Affiliations + expand

PMID: 9567575

Abstract

Finns have adopted two traditions of mushroom use: one, the old Roman tradition, came through France and Sweden to the educated, mostly Swedish speaking people of southwest Finland; the other came from the east via Karelia and was adopted by ordinary country folk. This eastern tradition is still maintained among the Karelinas living in Tver government in Russia. Even the use of Amanita muscaria for killing flies is still utilized there. The western tradition favoured chanterelles and Boletus edulis, the eastern acrid milk caps, the Lactarius species. During the famines in the 1860's and after the World War II the government authorities tried to promote the use of wild mushrooms, but the real impulse to a more versatile mushroom use was initiated after the war when 400,000 evacuees from that part of Karelia conquered by the Soviet Union were resettled among farming families all over Finland. In 1969 the National Board of Forestry began to train mushroom advisors, a programme which still continues. In 1981 Finland passed a statute on edible mushrooms and drew up a list of commercial species. Even today the largest percentage of marketed mushrooms comes from Eastern Finland and the Lactarius tivialis species sells best. Gyromitra esculenta, the false morel is considered a delicacy. Today picking mushrooms is a passionate hobby for many Finns.

Let’s take a look at cultural forces driving changes in the way mushrooms are viewed and used.

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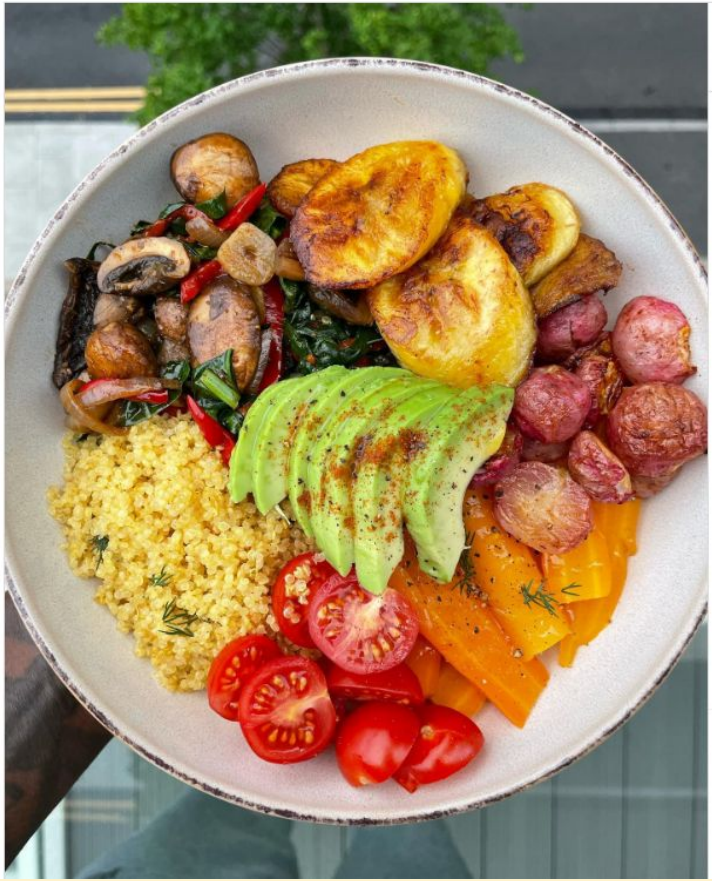

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the_mushroom_forager **Follow** **Message**

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The Mushroom Forager
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Paul Cain
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Lions Mane


Big guy


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Health Benefits of Mushrooms

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Reishi

Boosts immune function and helps manage stress. It also supports heart health and promotes better sleep.

Chaga

Rich in antioxidants, helps fight oxidative stress and enhances immunity. It also supports overall wellness.

Lion's Mane

Improves memory and cognitive function by stimulating nerve growth. It also helps with mood and mental clarity.

Cordyceps

Increases energy and endurance while supporting blood sugar regulation and immune function.

Maitake

Strengthens the immune system and helps regulate blood sugar levels. It also supports heart health.

Shiitake

Help stimulate the body's natural immune response. They are also rich in antioxidants.

Agaricus

Boosts immunity and supports overall health. It also helps regulate blood sugar levels.

Turkey Tail

Enhances immunity and supports gut health. It also promotes liver health and detoxification.

achieveequilife · Follow

achieveequilife Let's talk mushrooms...🍄

When it comes to supporting your immune health, there's one group of superfoods that doesn't get nearly enough attention: medicinal mushrooms. While fruits and veggies are staples in most diets, an entire kingdom of nutrition—fungi—is often left out.

Although we might encounter a stray portabello here and there, most people will not encounter the ~variety~ of medicinal mushrooms found in Daily Mushroom Immune Support.

Eastern traditions have used mushrooms like reishi and lions mane mushroom in both ceremony and medicine for thousands of years. Only recently has science verified the benefits that these powerful mushrooms provide.

Daily Mushroom Immune Support contains a powerful blend of these exact EIGHT beneficial medicinal mushrooms and utilizes only the fruiting body (no roots or stems) for increased potency 💪

Curious about how mushrooms can support your immunity? Comment 🍄 and we'll send you the product link to learn more!

PS: This week only, we're giving away FREE Daily Mushroom Immune Support! Don't miss your chance to experience the difference - Link in bio. 👆

24w

amazane_huzy 🔥🔥👏👏

8w Reply

Liked by **nhmushroomcompany** and **2,256 others**

December 6, 2024

Add a comment... Post

feralucy_ · Follow

feralucy_ 14w
An Ode to Amanita Muscaria (FLY AGARIC). 🍄

I have a very special relationship with this mushroom. Interwoven into many threads of my internal and outer world, my family, my home lands.

Samhain 2024, I carve out some time and journey to the forests where I know she resides with medicine making in mind and my phone to make a film.

Day 1, nothing. I feel a huge loss, am I too late?

Day 2, I feel a strong urge to leave my phone at home in the morning. Head out feeling pessimistic yet drawn to a certain pine woodland and I find more Amanita I have ever seen in my life. I sit with her for

250 likes
February 13

FDA Alerts Industry and Consumers about the Use of Amanita Muscaria or its Constituents in Food

HFP Constituent Updates

Constituent Update

December 18, 2024

Today, the U.S. Food and Drug Administration (FDA) issued a letter to food manufacturers that *Amanita muscaria* (*A. muscaria*), its extracts, and certain of its constituents (muscimol, ibotenic acid, and muscarine) are not authorized for use as ingredients in conventional food. *A. muscaria* and its constituents have been used in foods intended to have hallucinogenic effects, sometimes marketed as “psychedelic edibles”, “legal psychedelics” or “mushroom edibles”. After reviewing the available information about *A. muscaria* and its constituents, the FDA concluded that they do not meet the safety standard for use in food and that their use as food ingredients may be harmful. We also recommend that people avoid eating foods with these ingredients. The FDA’s assessment of chemicals in the food supply is part of our commitment to food safety and public health.

The FDA determined that the use of this ingredient and its constituents do not meet the Generally Recognized As Safe (or GRAS) standard and that they are unapproved food additives. The agency included its assessment in a memorandum added to the Post-

BBC

US hikers reported a death. But they imagined it while high on mushrooms

3 days ago

Share Save

Max Matza
BBC News

The view from the top of Cascade Mountain in New York

Fantastic Fungi

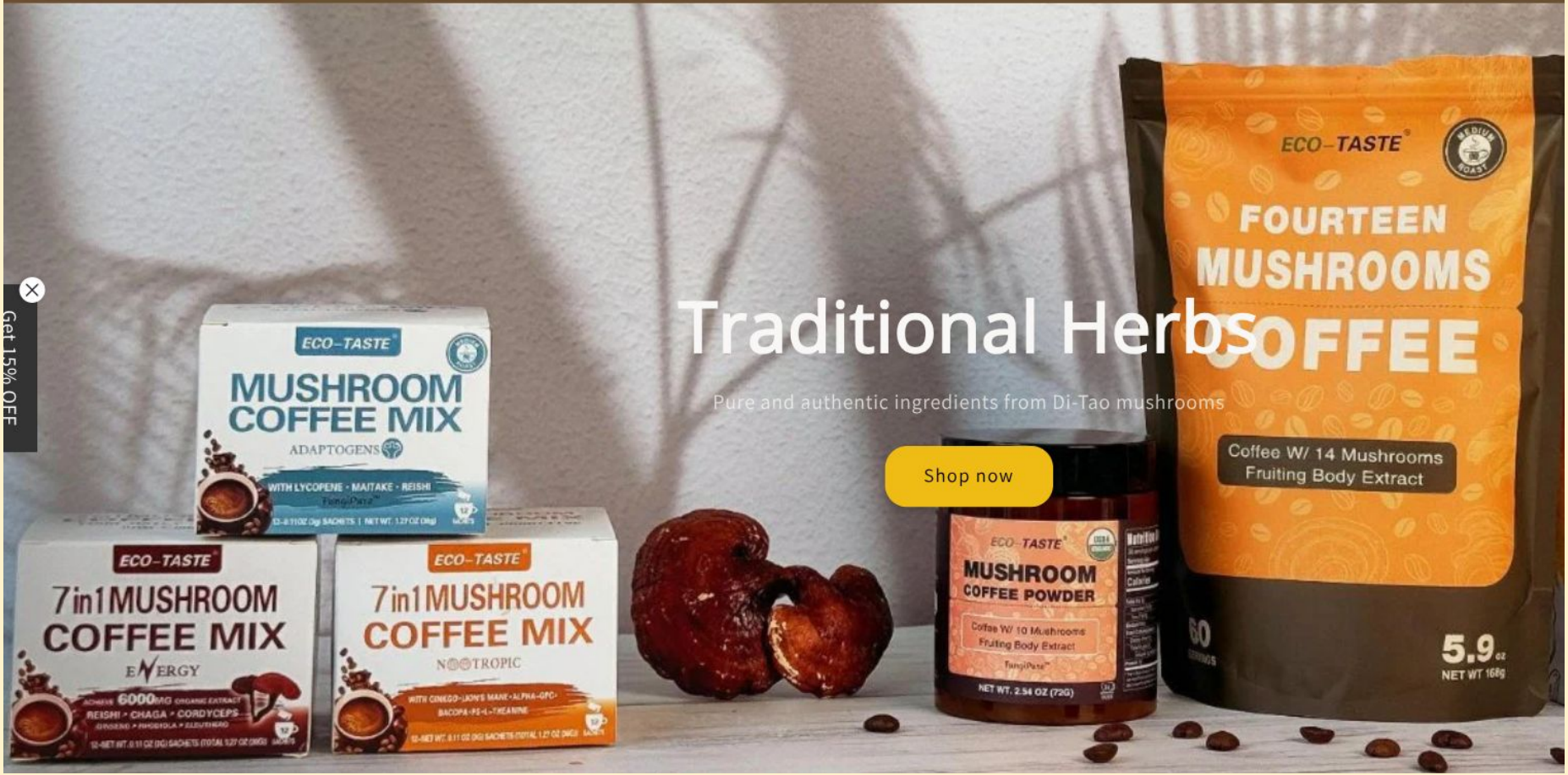
Remind Me

Delve into the magical world of fungi, from mushrooms that clear oil spills to underground fungal networks that help trees communicate.

Genres: Documentary Films, Nature & Ecology Documentaries, Science & Nature Documentaries

About **Fantastic Fungi**

The new wave of wellness: functional mushrooms take over TikTok



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Antioxid Redox Signal. 2022 Jun 3;36(16-18):1306–1317. doi: 10.1089/ars.2021.0043

Ergothioneine: A Stress Vitamin with Antiaging, Vascular, and Neuroprotective Roles?

Bindu D Paul [1,2,3,✉]

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PMCID: PMC9221166 PMID: 34619979

ON THIS PAGE

Fruiting bodies of selected edible mushrooms as a potential source of lovastatin

Original Paper | Open access | Published: 25 January 2020

Volume 246, pages 713–722, (2020) Cite this article

European Food Research and Technology

Aims and scope →

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Katarzyna Kała, Agata Kryczyk-Poprawa, Aleksandra Rzewińska & Bożena Muszyńska

Abstract

Agaricus bisporus, *Cantharellus cibarius*, *Imleria badia*, and *Lentinula edodes* are among the most popular species of edible mushrooms in Poland. These edible mushrooms are an important source of biologically active substances exhibiting beneficial (e.g., antioxidant,

Mushrooms magnify memory by boosting nerve growth

10 February 2023

Researchers from The University of Queensland have discovered the active compound from an edible mushroom that boosts nerve growth and enhances memory.

Professor Frederic Meunier from the Queensland Brain Institute said the team had identified new active compounds from the mushroom, *Hericium erinaceus*.

"Extracts from these so-called 'lion's mane' mushrooms have been used in traditional medicine in Asian countries for centuries, but we wanted to scientifically determine their potential effect on brain cells," Professor Meunier said.

Researchers found lion's mane mushroom improved brain cell growth and memory in pre-clinical trials. Image, UQ

"Pre-clinical testing found the lion's mane mushroom had a significant impact on the growth of brain cells and improving memory.

Article | Open access | Published: 05 April 2024

A randomized controlled clinical trial examining the effects of *Cordyceps militaris* beverage on the immune response in healthy adults

Atcharaporn Ontawong, Sirinat Pengnet, Arthid Thim-Uam, Narongsuk Munkong, Nukrob Narkprasom, Kanjana Narkprasom, Kullanat Kuntakhut, Natakorn Kamkeaw & Doungporn Amornlerdpison

Scientific Reports **14**, Article number: 7994 (2024) | Cite this article

32k Accesses | **31** Altmetric | Metrics

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Sections | Figures | References

Abstract

Introduction

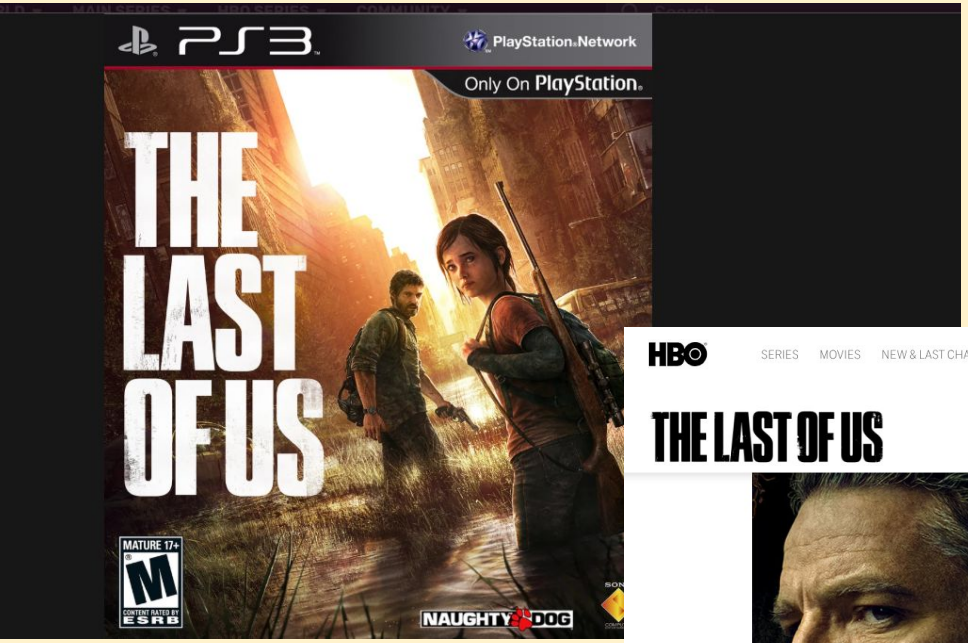
Results

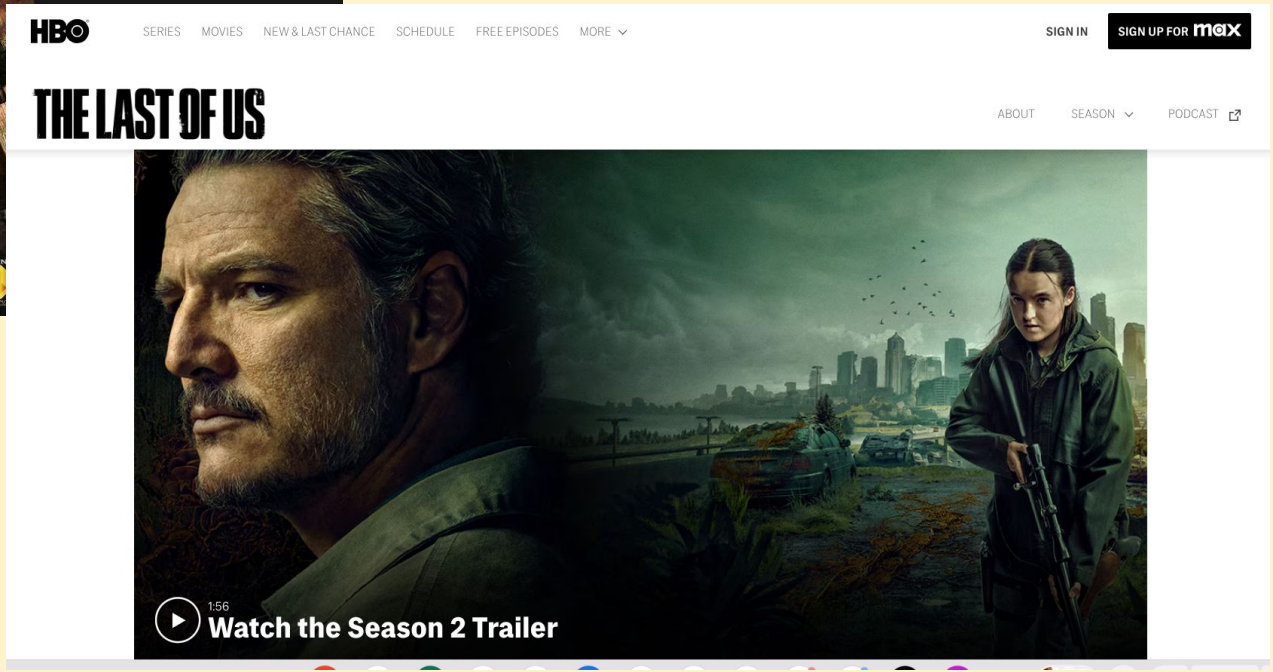
Discussion

Conclusions

Methods

Abstract


PS3
PlayStation.Network
Only On PlayStation
THE LAST OF US
MATURE 17+
M
CONTENT RATED BY ESRB
NAUGHTY DOG


HBO
SERIES
MOVIES
NEW & LAST CHANCE
SCHEDULE
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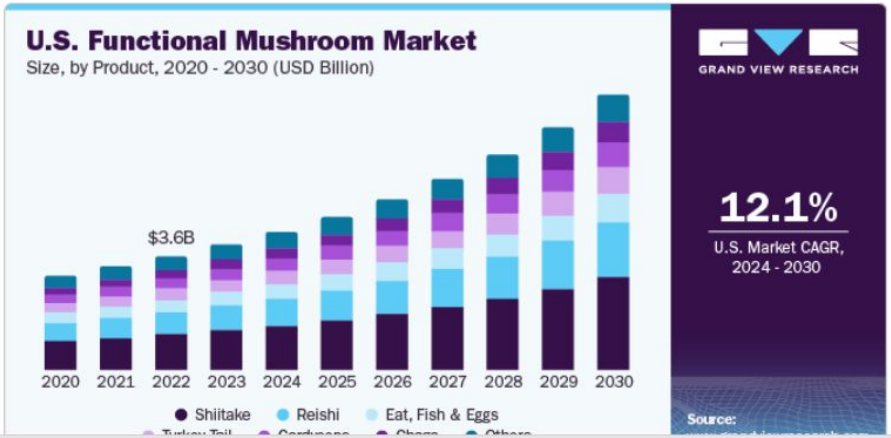
SIGN UP FOR max
THE LAST OF US
ABOUT
SEASON
PODCAST
1:56
Watch the Season 2 Trailer

Functional Mushroom Market Size, Share & Trends Analysis Report By Product Type (Reishi, Shiitake), By Application (Food & Beverage, Pharmaceutical), By Region (EU, APAC, North America), And Segment Forecasts, 2024 - 2030

Report ID: GVR-4-68039-932-0 | Number of Report Pages: 120 | Format: PDF
Historical Range: 2018 - 2023 | Forecast Period: 2024 - 2030 | Industry: Consumer Goods

Functional Mushroom Market Size & Trends

The global functional mushroom market size was valued at USD 31.71 billion in 2023 and is expected to grow at a compound annual growth rate (CAGR) of 11.2% from 2024 to 2030. This can be attributed to the growing popularity of functional mushrooms as superfoods due to their numerous health advantages. Functional mushrooms can be found in a variety of healthcare and pharmaceutical products. As a result, their demand is likely to grow over the forecast period. In addition, increasing product application scope in the pharmaceutical industry as a health supplement is further driving industry growth.



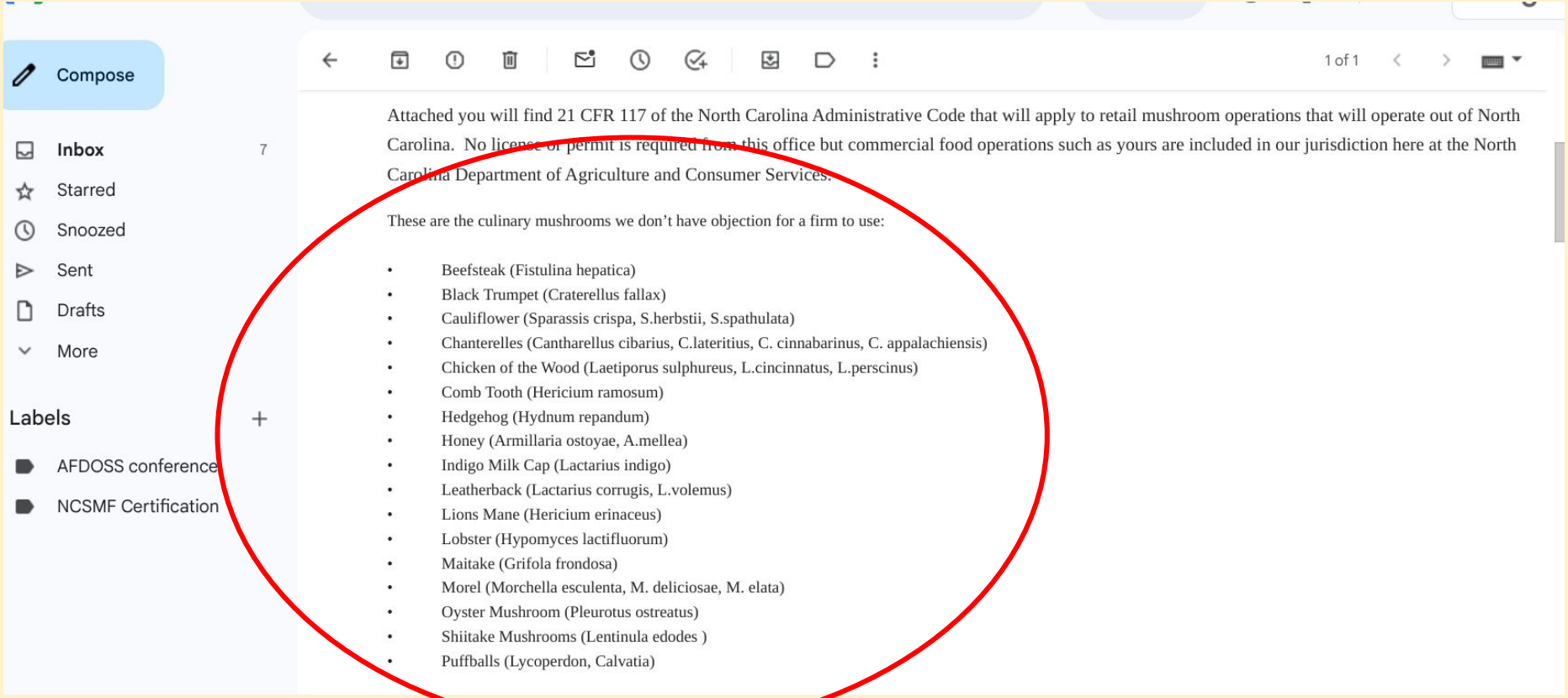
Cultivated chestnut (*Pholiota adiposa*)

Wild golden pholiota (Pholiota aurivella)

includes identification of the mushroom species by the scientific and common name, the name, address and telephone number of the wild mushroom forager and the food establishment, and a statement describing the qualifications and training of the wild mushroom forager. The statement must specify the species of wild mushroom(s) the forager is qualified to identify.

The "North Carolina Wild Mushroom Verification/Sale Tag" should remain attached to the container in which the wild harvested mushrooms are received. It must remain attached until the container is empty. The tag shall be retained for 30 days and shall include the name and address of the wild mushroom forager, forage location, date foraged, date delivered to the food establishment, and the date the container is empty. The species of mushrooms and the quantity by weight must be marked on the tag. The sixteen-species listed below are the only wild mushrooms approved to be foraged and sold to food establishments in North Carolina. The mushroom species are also listed on the tag.

- **Beefsteak (Fistulina hepatica)**
- **Black Trumpet (Craterellus fallax)**
- **Cauliflower (Sparassis crispa, S.herbstii, S.spathulata)**
- **Chanterelles (Cantharellus cibarius, C.lateritius, C. cinnabarinus, C. appalachiensis)**
- **Chicken of the Wood (Laetiporus sulphureus, L.cincinnatus, L.perscinus)**
- **Comb Tooth (Hericium ramosum)**
- **Hedgehog (Hydnum repandum)**
- **Honey (Armillaria ostoyae, A.mellea)**
- **Indigo Milk Cap (Lactarius indigo)**
- **Leatherback (Lactarius corrugis, L.volemus)**
- **Lions Mane (Hericium erinaceus)**
- **Lobster (Hypomyces lactifluorum)**
- **Maitake (Grifola frondosa)**
- **Morel (Morchella esculenta, M. deliciosae, M. elata**
- **Oyster Mushroom (Pleurotus ostreatus)**
- **Puffballs (Lycoperdon, Calvatia)**


Compose
Inbox 7
Starred
Snoozed
Sent
Drafts
More
Labels
AFDOSS conference
NCSMF Certification
1 of 1
Attached you will find 21 CFR 117 of the North Carolina Administrative Code that will apply to retail mushroom operations that will operate out of North Carolina. No license or permit is required from this office but commercial food operations such as yours are included in our jurisdiction here at the North Carolina Department of Agriculture and Consumer Services.
These are the culinary mushrooms we don't have objection for a firm to use:
Beefsteak (Fistulina hepatica)
Black Trumpet (Craterellus fallax)
Cauliflower (Sparassis crispa, S.herbstii, S.spathulata)
Chanterelles (Cantharellus cibarius, C.lateritius, C. cinnabarinus, C. appalachiensis)
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Morel (Morchella esculenta, M. deliciosae, M. elata)
Oyster Mushroom (Pleurotus ostreatus)
Shiitake Mushrooms (Lentinula edodes)
Puffballs (Lycoperdon, Calvatia)

[redacted]@ncagr.gov> May 15, 2024, 3:20 PM

to me

Good afternoon Ernie,

Attached are the 21 CFR 117 of the North Carolina Administrative Code that applies to retail and manufacture of mushrooms. The list in not encoded in the regulations. Here is the search list to search food ingredients that you may use to determine if an ingredient can be used in a food: https://www.cfsanappsexternal.fda.gov/scripts/fdcc/index.cfm?cat=FoodIngredientsPackaging&type=basic&search=

Additional CFR references include: https://www.ecfr.gov/current/title-21/chapter-I/subchapter-B/part-182

If you have any further questions or concerns, please do not hesitate to call upon this office or reply to this email.

Thanks,

[redacted]

How to store and use wild mushrooms

- Keep mushrooms in paper bag in fridge until use – they will never be more fresh and delicious than they are right now, so sooner is better
- All mushrooms should be cooked thoroughly before eating! Eating raw mushrooms may upset your digestive system and even, in the case of morels, poison you.
    - General cooking instructions: chop (except for small mushrooms) and add to hot, DRY pan (no oil), cook on medium heat until they have released water, water has evaporated, and they are starting to stick. Then add oil or butter, garlic, seasonings, etc. and cook as desired.
- If you are eating a mushroom that you've never had before, cook and eat just a couple of bites a day before digging into a full meal. Occasionally folks find that they are sensitive to certain species.

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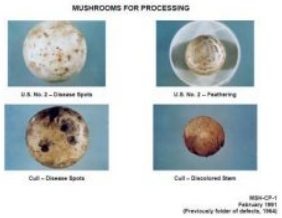
Mushrooms



MSH-CP-1 (February 1991)

Fresh vegetables for Processing:
Disease Spots, Feathering, and Stem Discoloration.

MSH-P-2 (February 1991)

Fresh vegetables for processing:
Disease Spots, Feathering, and Stem Discoloration.

The USDA Guidelines for visual inspection consider exactly one species from the kingdom of fungi


0316BH(1)01

The fundamental challenge of mushrooms in the American food system is lack of familiarity

- Consumers often don’t know much about what they are consuming or how best to consume it.
- Regulators often have very little mushroom-specific training
- We need smart, safe regulations and we need a push for outreach and training on all sides