

Mushrooms Need Food Safety, Too

Presented by Mary Saucier Choate, UNH Food Safety Field Specialist



Mushroom Market is Booming

Value of U.S. sales for commercially grown specialty mushrooms in 2021-2022 totaled \$87.3 million.

Up 32% from the previous season.

Released August 26, 2022, by the National Agricultural Statistics Service (NASS), Agricultural Statistics Board, USDA

Mushroom Producer Quick Scan

Diversified Farms

Growing Mushrooms

RI : 0

MA : 1

CT : 3

NY : 4

ME : 6

NH : 8

VT : 10

Mushroom Only

Operations

CT : 2

MA : 3

RI : 4

VT : 4

NH : 6

ME : 9

NY : 19

Mushroom Farming is Farming

US FDA considers mushrooms to be an agricultural product – the same as other fresh produce.

Specialty Mushrooms

Any mushroom **except** the white button mushroom (*Agaricus bisporus*) commonly found in supermarkets.

Specialty Mushrooms **are not** these familiar: *Agaricus bisporus* mushrooms (shown in different stages of development)

White button

The most popular mushroom, white buttons represent about 90 percent of mushrooms consumed in the United States.



Crimini

Also known as baby 'bellas or browns, criminis are similar in appearance to whites, but have a light-tan to rich-brown cap and a firmer texture.



Portabella

A larger relative of criminis, Portabellas have tan or brown caps and measure up to 6 inches in diameter.



BLUE OYSTER



PHOENIX OYSTER



SHIITAKE



BLACK PEARL OYSTER



BEARS HEAD (LIONS MANE)



CHESTNUTS



KING OYSTER



ELMS



Images from The NH Mushroom Company
(www.nhmushrooms.com)

Many kinds of Mushroom Production

- Indoor Production
- Outdoor Log Grown
- Outdoor Beds
- Foraged/Wild Harvested
- Combination of the Above
- Homestead/Hobby/Beginner

Best Food Safety Practices in Mushroom Production

What are the benefits from paying attention to best farm food safety practices?

Best Food Safety Practices in Mushroom Production

- Prevent and reduce food safety risks
- Increase shelf life
- Buyers may require them
- Customers may ask about them
- Protect the local food system
- Protect the farm

Enoki Mushroom *Listeria* Outbreak

- As of April 17, 2020, 36 people infected with the outbreak strain of *Listeria monocytogenes*.
- Epidemiologic, traceback, and laboratory evidence indicates that enoki mushrooms labeled as “Product of Korea” are the likely source of this outbreak.
- 31 hospitalizations and four deaths have been reported.
- Six cases are pregnancy-associated. Two resulted in fetal loss.

Source: Centers for Disease Control and Prevention, National Center for Emerging and Zoonotic Infectious Diseases (NCEZID), Division of Foodborne, Waterborne, and Environmental Diseases (DFWED)

Dried Wood Ear Mushroom Salmonella Outbreak

- As of November 4, 2020, this outbreak appears to be over.
- A total of 55 people infected with the outbreak strain of *Salmonella Stanley* were reported.
- 6 hospitalizations were reported. No deaths were reported.
- Epidemiologic, laboratory, and traceback information showed that wood ear mushrooms distributed by Wismettac Asian Foods, Inc., of Santa Fe Springs, CA were the likely source of this outbreak.

Source: Centers for Disease Control and Prevention, National Center for Emerging and Zoonotic Infectious Diseases (NCEZID), Division of Foodborne, Waterborne, and Environmental Diseases (DFWED)

Green Day Produce, Inc. Recalls Enoki Mushrooms Because of Possible Health Risk

Recalling its 200g/ 7.05oz packages of ENOKI MUSHROOM (Product of Korea) sold from September 2022 - October 2022 because it has the potential to be contaminated with *Listeria monocytogenes*.

No illnesses have been reported to date

Distribution of the product has been suspended.

Enoki Mushrooms Recalls

The U.S. Food and Drug Administration (FDA) and public health officials from several states have been collecting samples of enoki mushrooms and found *Listeria* in many samples, resulting in more than 20 recalls of enoki mushrooms.

Source: <https://www.cdc.gov/listeria/outbreaks/enoki-11-22/index.html>

Captured 11/30/2022

Enoki Mushrooms from Korea

FDA believes that it is extremely unlikely that the contamination of enoki mushrooms ... is due to an isolated incident.

... “*L. monocytogenes* strains ...in multiple shipments over a period of time are consistent with resident pathogens in mushroom operations in the Republic of Korea.

Evidence suggests that enoki mushrooms may be a high-risk reservoir for *L. monocytogenes* due to the difficulty in maintaining good hygienic practices at medium-sized plants where the mushrooms are typically produced.

Food Safety in Mushroom Production

- Clean hands/gloves
- Clean containers
- Clean surfaces
- Clean tools
- Clean storage areas
- Water Quality



Food Safety in Mushroom Production

- Water
- Worker Personal hygiene/health
- Growing Medium (logs/substrate)
- Animal Intrusion
- Harvesting
- Post-harvest handling
- Packaging
- Storage
- Transportation

Water is Crucial in Mushroom Production

Know the Quality of the Water You Are Using



Water use in Log Grown Mushroom Production

Mushrooms are “forced” aka “shocked” to meet market demands.

The year-old inoculated logs are immersed (shocked), in water for 12 to 24 hours, after which the logs are stacked or leaned against a rail or a tree, for about a week.

After seven to ten days usually, the small mushroom primordials (pins) begin to form; and several days later (temperature/moisture dependent), the mushrooms are ready to harvest.

Water use in Indoor Mushroom Production

Water ruins the texture and shelf life of mushrooms.

They must be carefully handled from harvesting through selling.



Water use in Indoor Mushroom Production

Proper humidity levels are crucial for optimal mushroom production.



Moisture in Grow Rooms can be a *Listeria* Risk

Listeria Monocytogenes (Lm)

- *Listeria* needs moisture to grow
- It can reproduce any place that remains wet for an extended period (~longer than six hours)
- Especially in areas where water is constantly present

Ways to Reduce *Listeria* Risk

Regular cleaning and sanitizing of areas easy for *Lm* to establish harborage in:

- Floors, especially cracks and crevices
- Drains
- Wet insulation in walls or around pipes and cooling units
- Rubber seals around doors
- Regular squeegee of standing water in grow room

Food Safety in Mushroom Production

Worker Personal hygiene/health



Food Safety in Mushroom Production

Worker Personal Hygiene/Health

- Handwashing with soap and water
 - After using the toilet
 - Before harvesting or handling the mushrooms
- Workers staying home if they have symptoms of:
 - vomiting, nausea, diarrhea or jaundice
- Properly bandaging cuts and disposing of mushrooms that may have been contaminated with blood or other bodily fluids

Growing Medium in Mushroom Production



Growing Medium in Mushroom Production

- Logs cut from live hardwood trees
 - Log inoculation ASAP helps the mycelia to outcompete natural fungi and bacteria already present as log decomposes
- Sterilized or pasteurized substrates.
 - Most common substrates used in block production: straw, sawdust, soybean hulls, and wheat bran.
- Many more- beyond the scope of this presentation

Animal Intrusion in Mushroom Production



Food Safety in Mushroom Production

- Harvesting



Harvesting in Mushroom Production

All harvesters should wash their hands with warm water and soap before harvesting.

Proper glove use adds another layer of sanitary handling.



Post-harvest Handling in Mushroom Production

Indoor-grown mushrooms only need the growing substrate trimmed off.

Log grown may need to be wiped off with a clean paper towel or a clean soft brush

Harvesting in Mushroom Production

Mushrooms should be harvested using clean tools, directly into clean containers.



Packaging in Mushroom Production



Storage in Mushroom Production

Harvested mushrooms should be stored at 34-37 °F and will last for about 7 days.



Transportation in Mushroom Production

To minimize spoilage and bacterial growth, mushrooms require a complete cold chain for storage and transport.



Food Safety in Mushroom Production

Standard Operating Procedures/checklists for monitoring and documenting temperatures, quality, cleaning, etc.

Daily Sheet
 Date: 10/11/22
 Employees: Meliah, Devon

Opening Checklist
 Click in 7:57
 Outside Temp 34
 Weather conditions Foggy
 Outside humidity 100%
 Incubation room Temp 57
 Walk in Cooler Temperature 35
 Room Check (Time) 8:07

Room Checks (Time)

	Temp	CO2	rh
4)	10.9	384	87.9
3)	9.9	31	84.0
2)	9.3	542	87.8
1)	12.2	947	86.6
0.5)	5.9		81.3
0)	5.9		83

NOTES: (How does the room feel? Too wet/dry? Too hot/cold? Was a room left off accidentally? Observations? Does a bay of mushrooms look blotchy? Doing better than you've ever seen? Record it here!)

Picking/Yield Data

Species	Formula	Batch	Unit	Bay	Shelf	Date Inoculated	Blocks w/ yield	Blocks w/o	Total Blocks	Yield
B	120	20/50	20/22	59	FR	4	3	0	1.51	.50
B	120	50/50	20/22	57	FL	4	1	0	.5	
B	120	50/50	20/22	57	FL	4	4	0	1.89	
B	120	50/50	20/22	5	ML	4	11	0	4.45	
B	120	20/22	13	BR	4	3/2	5	0	1.52	
B	120	4/22	4	BL	3	3/5	3	0	.58	
B	120	4/22	4	ML	3	3/5	10	0	7.81	.78
LM	105	4/22	2	ML	2	3/5	5	0	3.75	
B	120	4/22	1	ML	1	3/5	4	0	2.31	
B	120	4/22	3	ML	3	3/5	3	3	1.40	
B	120	4/22	1	ML	1	3/5	1	1	.27	.25
B	120	4/22	4	ML	4	3/5	4	0	1.60	
B	120	4/22	17	ML	17	3/5	0	0	7.92	.4

Inoculation Data

Species	Date Inoculated	Good / Bad / Shock	Room / Bay
A5 BP	9/21	94/2/X	4/ML
A8 B	9/19	99/1/X	4/BR
A BP	9/19	101/1/X	3/ML
D2 B	9/21	98/X/X	4/FL
D5 BP	9/16	97/2/X	2/BR

NOTES Any green bags? Did you throw away an entire hundred?
 Write it here! Boom 300
 vBelt, Felt gasket, hydro 5, O hydro,

End of Day Checklist
 (Initial after each task in completed)

Release pins (do this before you mop, keeps things cleaner) _____
 Mop/Vacuum Grow Rooms DK
 Fill Red Bucket (grow room 0.5) DK
 Fill White bucket (grow room 0) DK
 Empty Walk In Bucket DK
 Air Compressor (boiler room) DK
 Walk-in Temperature 35
 Incubation Temperature 59
 Outside Temperature 60 Weather Conditions Sunny
 Room Checks _____
 Turn in Daily Sheet (Leave in Office) _____
 Clock Out _____

	Temperature(C)	CO2	rh
4.)	13.7	480	83.5
3.)	11.9	35	85.0
2.)	12.8	812	84.2
1.)	13.5	945	84.3
5.)	60		78.1
0)	60		83

Seasonal(Winter)
 Get Wood for the night _____
 Fill Wood Boiler (Check with Eric) _____

Mushroom Food Safety Resources

Cornell Small Farms Program Harvest to Market Guide- Post Harvest Handling
<https://smallfarms.cornell.edu/projects/mushrooms/harvest-to-market-guide/>

GAPs, FSMA, and Food Safety in Mushroom Production January 2022 webinar
<https://www.youtube.com/watch?v=yYuHmocGdQQ>

Mushroom Farm Food Safety and Security Assessment from Penn State University
www.afdo.org/wp-content/uploads/2020/09/Mushroom-Farm-Food-Safety-and-Security-Self-Assesment-PSU.pdf

Control of *Listeria monocytogenes* In Mushroom Growing and Packing Environments *(Intended for large commercial growers, but small growers can still gain good information on preventative measures.)*
<https://extension.psu.edu/control-of-listeria-monocytogenes-in-mushroom-growing-and-packing-environments>

Cornell Small Farms Program <https://smallfarms.cornell.edu/projects/mushrooms/methods-of-commercial-mushroom-cultivation-in-the-northeastern-united-states/2-seven-stages-of-cultivation/#inoculation>

Mushroom Thank You's

- Alec Malenfant & Eric Milligan, Meliah Puckett, and Devon Russell, NH Mushroom Company
- William Dunkerley, Dunk's Mushrooms
- Louis Giller & Eliah Thanhauser, North Spore
- Pierre Miron & Luc Lamirande, New Earth Organics
- Tracey Dunne, Breezy Woods Mushroom Farm
- Sue Greene, Slopeside Farm
- Tina Ward, Mountain View Mushroom Farm
- Karen Parker Feld, Crow's Feat Farm
- Luke LaBorde Ph.D., Professor of Food Science Penn State University



Mushroom Thank You's

THANK YOU!

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Presented by Mary Saucier Choate,
UNH Food Safety Field Specialist
mary.choate@unh.edu





Water Used to Sprout Mushrooms

Last updated June 15, 2018

TYPE: TAN Question/Answer

TOPIC: Ag Water (Preharvest), Produce Safety Rule (PSR)

CASE NUMBER: 00154228

Question:

Could you help me determine if the water used to sprout mushrooms is agricultural water? The logs are soaked in spring water, typically a week passes before the mushrooms begin to grow.

Answer:

Thank you for your inquiry. Since finalizing the Produce Safety Rule (80 FR 74353 (Nov. 27, 2015)), FDA has received feedback that some of the standards outlined in Subpart E, "Agricultural water" (21 CFR Part 112, §§ 112.41-112.50), which include numerical criteria for pre-harvest microbial water quality, may be too complex to understand, translate, and implement. These factors can be important to achieving high rates of compliance.

In response to these concerns, the FDA is exploring ways to simplify the microbial quality and testing requirements for agricultural water while still protecting public health. Therefore, we will not be providing a response to your inquiry at this time. For more information, see "FDA Considering Simplifying Agricultural Water Standards" at <https://www.fda.gov/Food/GuidanceRegulation/FSMA/ucm546089.htm>.

Best Handling Practices for Foragers

- Recognize the conditions and practices that could contribute to post-harvest contamination.
- Use storage and transportation methods that would prevent the contamination of mushrooms.
- Understand the relationship between personal hygiene and the contamination that could contribute to foodborne illness.
- Know the picking area/conditions where mushrooms should not be harvested due to conditions that may lead to foodborne illness (ex. Feedlots, mushrooms that appear to be contaminated by birds or other animal species).

HeP 2300 Change: Wild Harvested Mushrooms

Rule updates made due to 2021 passage of law 143RSA
A:28

Law requires license for anyone harvesting, identifying or
distributing Wild Harvested Mushrooms (WHM)

Law requires license fee, proof of fulfilling educational
requirements by applicant

Law states that licensees may only harvest on a property
with documented permission from landowner/manager

HeP 2300 Change: Wild Harvested Mushrooms

- In Progress: A training program for Wild Harvested Mushroom licensees
- DHHS Website updates
- WHM Application
- List of licensees
- Consumer education on wild mushrooms

Slide Title

Video frame

Slide Title

- Slide Bullets/Text