

# Spores Illustrated

## ATTACK OF THE FLY ZOMBIES

The below titled article appeared, not surprisingly, on Halloween in the NY Times Science Section

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*Spores Illustrated* is the newsletter of COMA, the Connecticut-Westchester Mycological Association.

## This Fungus Fires Artillery From the Backs of Zombie Flies

“After *Entomophthora muscae* fatally infects house flies, it makes microscopic stalks for hurtling spores at other insects that come nearby.”

by Knavul Sheikh

- Oct. 31, 2019  
“The living dead may buzz among us. Attacked by a fungus that takes over their bodies, flies start acting erratically in the moments before they die, playing an unwitting role in spreading the fungus even further. Scientists call them “zombie flies,” and they are found across North America and Europe.”

Curiosity being piqued it was imperative to know why our community was heretofore ignorant of this fungal phenomenon. It turns out we weren't. Two decades earlier the great Tom Volk put the word out. His article appears below.

### Tom Volk's Fungus of the Month for March 2000

This month's fungus is *Entomophthora muscae*, a fungus that infects houseflies.



This month's fungus (and its host) is actually still stuck to the back window of my house. I found it there a couple of months ago when I spotted this large housefly with a halo of spores surrounding it. Fortunately I knew what it was and took pictures to use for the fungus of the month during the winter, when there aren't too many fungi out in nature to look at. This particular fungus is called *Entomophthora*

*muscae* (ent-uh-MOF-thor-uh MUSK-eye). *Entomo-* means insect, *-phthora* means destroyer, so this is the "insect destroyer." *Muscae* means "of the fly." The fungus belongs to the Zygomycota, but rarely forms zygospores. It is a member of an order of mostly entomoparasitic fungi called the Entomophthorales. I'll have more to say about these other insect destroyers later. I've also seen this called *Entomophthora coronata*, which means "insect destroyer with a corona," referring to the corona (like during a solar or lunar eclipse) of spores that is formed when the fungus sporulates around the fly. Apparently this is an incorrect name. (Thanks to Kathie Hodge of Cornell University for this clarification).

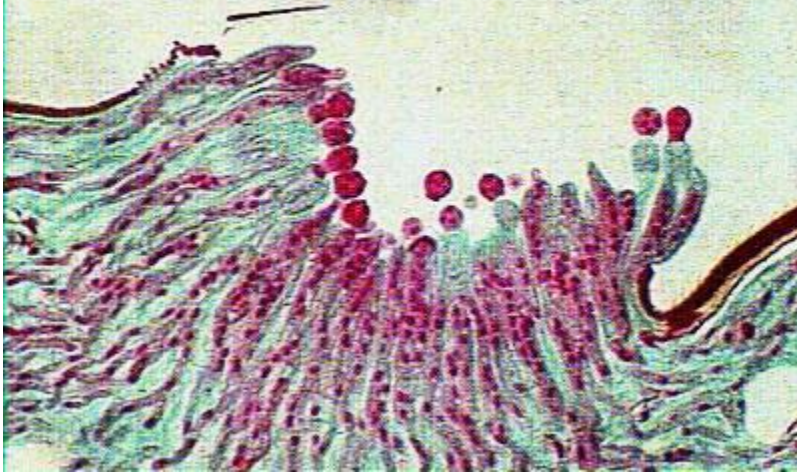
So how did the fly get stuck to my window? This particular fungus produces abundant spores, and the fly must have had the misfortune of having one of the spores land on it a few days previous to its untimely demise. The spore germinated and penetrated the exoskeleton of the fly, or grew in through one of many cracks in the fly's "armor." The first thing the fungus does, according to some reports, is grow up into the



brain of the fly, in order to control its activities. The mycelium of the fungus grows into a particular area of the brain that controls the crawling behavior of the fly, forcing the fly to land on a nearby surface and crawl up as high as possible. Eventually the hyphae of the fungus grow throughout the body of the fly, digesting its guts, and the fly dies. Small cracks open in the body of the fly and the *Entomophthora* produces sporangia, each with a single spore, in pads. Remember that most fungi want to get their spore bearing structures as high as possible, so that the spores will get caught in air currents more easily. Other fungi produce

fruiting bodies to accomplish this but *Entomophthora* takes advantage of its relationship with the fly to get its spores as high as possible.

To the right and up you can see a longitudinal section of the abdomen of the fly filled with fungal hyphae and with three pads of sporangia bearing spores on the upper surface.



To the left is a close-up of one of these pads of sporangia with their spores. The circular spores are forcibly shot off by the sporangia and are what you can see on the glass of my window in the first picture.

Enormous numbers of spores are produced in the "hope" that a few of them will actually land on flies and continue the life cycle. This fungus is a fascinating find for any mycologist or student.

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So what good could this be for us humans? Well if you're thinking, you're already ahead of me, and you're wondering whether *Entomophthora* could be used for biological control of these annoying insects. The answer is apparently yes, although there are some technical problems, such as the short lifespan of the spores. These biological controls would be far better to use than conventional insecticides, which are most broad spectrum, killing a wide variety of insects as well as being toxic to animals, including humans. Most of the bioinsecticides are specific to one species or at least a genus or family of insects, so they can target only the group the scientist want to eliminate. There are also species in the Entomophthorales that target species of other insects such as moths, aphids and grasshoppers. This is an area of active research, blending Entomology and Mycology very well.

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I hope you enjoyed this month's fungus. Be on the lookout for flies and other insects stuck to your walls and windows with a halo of spores around them. They're actually quite common--but not as common as we would like. Don't forget to shut the screen door on your way out --- you're letting flies in....

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## Through The Looking Glass; A Microscopy Workshop

Dateline: Wednesday, October 30th, 2019: Friends Meetinghouse



Those of us who were willing to brave the rain and cooler temperatures were in for a real treat, as Paul Sadowski from the NYMS conducted a beginner's workshop on microscopy— in this case, the use of a compound microscope to observe features of mushrooms and slime molds that are only visible under high magnification.

The objective of the class was to introduce the attendees the microscope as a tool in mushroom identification and was a collaborative under the guidance of the group leader. Some of the various aspects covered were an initial introduction to the compound microscope (we had 5 on hand), calibration of the eyepiece reticle, illuminating the specimen, care of slides, cover slips, mounting fluid, reagents, dyes, and handling minute quantities of various specimens— which were all supplied by Paul.

The 90-minute session flew by so fast, it seemed as if we had only been there for a short time when Paul announced that it was almost 9:00! I feel that I can speak for everyone who was there when I say that we would have liked to suspend time, so we could have continued until midnight. We learned so much, and had such a good time, that I can honestly say that I'm glad more people *didn't* show up!

Setting up the space for a workshop of this type (which included a slide presentation in addition to hands-on work with microscopes) proved to be more complicated than it is for one of our usual evening programs, and we were lucky enough to have COMA's brilliant A/V expert (and Webmaster) *Boris Martinov* in attendance, without who's help things would most certainly not have gone as smoothly as they did.

I can only hope that we will be able to coerce Paul into doing another workshop next year!

—Joe Brandt





## PUFFBALL LASAGNA

An experiment in cuisine was a genuine success at the COMA banquet. The concept was simple. Replace the noodles in a lasagna with sliced puffballs and you get a gluten free, keto friendly Lasagna.

Those of us who have tried to find some culinary use for the giant puffball have discovered that the Styrofoam like texture of the puffball (dry and crumbly) becomes more cohesive and noodle-like once sautéed in a thin slice. After being lightly fried in a little olive oil or butter those slices can be placed on parchment paper or wax paper and frozen for later use.

For best results a long ham knife will cut a soccer ball sized puffball into dinner plate sized 1” slices for sautee. They can then be used just like Lasagna noodles. First a layer of “gravy” in the pan, then a layer of puffball, then Ricotta and more “gravy” with sliced meatballs and sausage. After three layers, top with sauce and lots of Mozzarella and its ready to bake.

This couldn't be done Vegan so I went closer to the traditional Bronx Italian Lasagna. Canned Sicilian plum tomatoes. Meatballs (veal, pork, beef) with gluten free bread crumbs. Sweet Italian sausage, Boneless pork ribs, of course mushrooms (dried Hens, Oysters, Porcini, Fresh Agaricus) Garlic, Onions, Vegetable stock, Beef stock, Whole Milk Ricotta, Mozzarella, grated Romano and Parmesan Cheeses, Fresh Oregano, Thyme and Basil, Dried Herbs Du Provence, Paprika, Adobo, Red Pepper Flakes, fresh ground black pepper.

When the big white blobs come back next year we'll try to create a Vegan White Lasagna with Vegan Ricotta. Until then Mangia!



## POLITICS STRIKES AT COMA

The mysterious workings of the COMA Board are generally placid and harmonious – but once you introduce the root of all evil (money), things heat up. COMA has a money problem few understand or sympathize with. We have too much. Thanks to the steady hands of past and present presidents on the tiller and the even steadier hand of Don on the till, COMA has built up a respectable surplus.

A spirited debate has gone forward online amongst the distinguished members of the COMA Board about how best to address our windfall. Lower dues? We’re already dirt cheap. Offer more scholarships? We often can’t find takers for the ones we have.

Perhaps it should have been predictable from past experience, that your humble Spores Illustrated editorial board (of one) would take a different slant. It was proposed (if slightly tongue in cheek) that we consider an investment in a party balloon to promote our passion. First it was “Go big or go home”



When that proposal seemed unlikely to pass muster we dropped back to a compromise smaller balloon. The Board was still unmoved.



Alas the time for a COMA balloon is not yet here but there’s always next year.

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**The Mad Mycologist**

Like Death he stalked the ravished land,  
His cutting implement in hand,  
Pale Oyster Mushrooms cried in fear:  
"The Mad Mycologist draws near!  
His bloodlust will not be abated  
Until we're all decapitated!"

He stripped barren fields and woods  
of Chanterelles and Scarlet Hoods.  
No Parasol was safe from him—  
The Fungus Fiend, the Reaper Grim.  
Smug Deathcaps smirked: "He won't hurt us  
For we are much too poisonous!"

Plump Puffballs pleaded as he past,  
And Weeping Widows wept their last.  
The Horns of Plenty blew no more,  
As Ceps lay slaughtered by the score.  
A small voice cried out: "Please don't eat us!"  
The last words of a Bay Boletus.

One day he slew two Agarics  
(Defying bylaw twenty-six)  
They gloated "Ha! We've got him now!"  
And hauled him off to court in Slough.  
"Off with his head!" the jury cried.  
"He's guilty of Mass Fungicide!"

The moral of this tragic tale  
is "Wickedness must not prevail",  
That he who harms a helpless fungus  
Is not fit to dwell among us,  
But shall go to Hell and boil!  
(Or lightly fry in olive oil.)

—P. Versehoyle

## Soup's On!

Whatever the weather, whatever the mushroom, there is always room for soup - from cold weather "remedies" to a cool summer soup, if you have a few 'shrooms and a little time, you can make enough for a crowd, or just for yourself. Not only is soup easy to make, it's a great vehicle for thrilling your culinary senses, while pleasantly transporting some of your favorite fungi to your stomach in high style. Soup is near the top of the list of "comfort foods", striking a cord that is not easily duplicated by other means, and it's versatility allows you to tailor almost any recipe to suit your palate.

Another great thing about soup is that not only can it be prepared in larger or smaller quantities with equal ease, it can allow you to "stretch" a relatively small quantity of mushrooms, while still featuring them "front and center"—instead of just adding them to a dish as one of the ingredients, or as a garnish.

We can explain the differences between soup, chowder, consommé, bisque, bouillon and potage. On second thought, *never mind*. The differences are irrelevant— and besides, our job here isn't to bore you to tears, it's to enlighten you— and entice you into trying to make something wonderful and impressive. *Oh, yes you can*. Got mushrooms? If so, this isn't rocket science. The trick is to start with good ingredients. A great feature of mushroom soup is that it may be done with a wide variety of mushrooms, and can include the use of fresh, frozen, or even dehydrated mushrooms.

You do need a good stock. Does it have to be homemade? No, but that would be great! Say, for instance, you have a beautiful *Meripilus sumstinei* (Black-staining polypore), that is too tough for the fry pan - boil it with some onions, garlic, celery, & salt, strain it out, and you have a super stock! But you don't find one of those every day and soup, on the other hand, can very realistically be made frequently, so find a great instant stock, and use it if you don't have the time or inclination to make your own.

Starting with onions, fried up in olive oil with some minced garlic thrown in, you can build a great soup out of anything in your refrigerator, topped off with the mushrooms of the day— you really cannot go wrong. And, if



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improvisation isn't your thing, we have a few recipes that you can follow.

### **Chicken Mushroom Congee**

3 quarts vegetable stock with 1 tsp. ground ginger  
3/4 c. short grain sushi rice  
2 C. sliced chicken mushrooms (or 1 cup pre-cooked)  
12 Shiitake mushrooms  
1-2 Tbsp. olive oil  
1 Tbsp. peanut oil  
1 Tbsp. soy sauce  
2 ounces fresh ginger, peeled and julienned  
1 cup sliced vegetarian “chic” patty or (cooked) chicken patty  
sesame oil, toasted sesame seeds (optional)  
6 scallions, trimmed, sliced thin diagonally  
1 large bunch cilantro leaves  
salt & freshly ground pepper

- Bring stock to boil in a large pot over high heat. Reduce heat to low, add rice, and gently simmer, stirring occasionally, until grains break down. About 2 hours.
- Meanwhile, cook chicken mushrooms in olive oil till done, 5 - 10 minutes. (Skip if using pre-cooked.) Set aside.
- Slice shiitakes, sprinkle with soy sauce, and cook in peanut oil until liquid evaporates and mushrooms are browned, about 8-10 minutes. Set aside.
- When rice/stock is ready, add chicken mushrooms & shiitakes, simmer about 15 minutes. Add ginger & sliced “chick” or chicken patty, cook for five minutes.

Season to taste with salt & pepper. Place in bowls and garnish with sesame oil, sesame seeds (if using), scallions and cilantro.

### **OYSTAH CHOWDAH\*\***

2 Tbsp butter substitute: Earth Balance or similar (You *can* use unsalted butter, but the recipe is intended to be *vegan*.)  
1/4 lb oyster mushrooms\* cut into 1/2 inch pieces. (See note below)  
1/2 cup raw cashews  
2 cups vegetable broth, divided  
2 cups water  
1/2 cup onion, diced

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1-1/2 cups cauliflower, cut into pieces  
1/4 tsp. minced garlic (or a bit more to taste)  
3 bay leaves  
1/2 tsp thyme, dried  
1/4 tsp white pepper  
1 tsp salt (or less, if the veggie broth is salty)  
1-1/2 cups diced peeled potatoes  
1/4 tsp. natural smoke flavor, optional (but recommended)  
1/4 tsp. fresh ground black pepper  
1 Tbsp. parsley, minced  
Oyster crackers (optional)

In a skillet, sauté 1 Tbsp. butter substitute (or butter) and oysters (7 minutes), then set aside. (\*If using pre-cooked mushrooms, skip this step entirely.)

Grind cashews to a fine powder, then add 1 cup broth. Blend until smooth. In a stock pot, over medium high heat, add 1 TBSP butter substitute, onion, cauliflower & garlic. Sauté 5 minutes, then add bay leaves, thyme, white pepper, remaining broth, water, cashew mixture & salt. Bring to a boil, reduce heat to low, cook 15 minutes. Remove bay leaves. Transfer to a blender, blend completely until smooth. Return to pot, add potatoes, cook over low heat for 40 minutes. Add mushrooms (and the smoke flavor, if using), stir & cook another 5 minutes. Serve hot, garnished with a sprinkle of fresh parsley and a few oyster crackers, if you've got 'em. (Serves 4— but you'll probably want to at least *double* the recipe!)

\*\*Reprinted courtesy of VegNews Magazine. Recipe by Allison Rivers Samson, owner of [AllisonsGourmet.com](http://AllisonsGourmet.com), a vegan, organic, artisan bakery & gift shop.

### **Mushroom & Bean Soup**

3 whole garlic cloves, peeled  
3 Tbsp. olive oil  
1 can (16 oz. or more) crushed tomatoes, or 10 fresh peeled plum tomatoes, diced  
10 fresh Agaricus bitorquis mushrooms\*, sliced  
1 pound canned cannellini beans (white) beans  
1½ cups long-grain rice or 2-3 cups cooked rice of your choice  
2 tsp. salt  
4 cups warm water  
3 heaping Tbsp. chopped parsley  
freshly ground pepper

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3-4 Tbsp. grated Parmesan cheese or ground nut/seed mixture

Sauté the mushrooms in 1 Tbsp. oil. Set mushrooms aside. Sauté garlic in the 2 Tbsp. oil in a big soup pot, turning until golden brown. Discard cloves. Add tomatoes & mushrooms, cook 5 minutes. Add the beans, liquid & all. Add rice, salt & water. Bring to a boil, cover, reduce heat, cook 15 minutes until rice is tender. (Shorten cooking time if using cooked rice.) Stir once or twice while cooking. Uncover pot, stir in parsley, add pepper. Serve how with a sprinkling of Parmesan cheese.

\*If you do not have *Agaricus bitorquis*, any nice *Agaricus* will do the trick, but *bitorquis* can really shine in this recipe!

### **Chicken Matzo-Miso Soup**

Here's one of the easiest recipes to use plain baked (or pan-fried, or boiled) chicken mushrooms, and it works well even if they're a bit older & a little tough:

- Buy a box of *Manishewitz Matzo Ball Mix* at the supermarket.
- Go to your local Asian restaurant, and buy a large container of *miso soup*.
- Bake/pan-fry/boil some pieces of *chicken mushroom*. (OK to use cooked frozen) Take one cup of these, put them in a food processor, and grind them up well.
- Follow the directions on the package of matzo ball mix, but put the ground chicken mushrooms into the bowl when you add the packet contents.
- Continue to follow the directions on the box. (We recommend that after you've formed the matzo balls, refrigerate them for another 30 minutes.)
- Boil matzo balls as per instructions on the box. (Trick: get them into the boiling water quickly, and cover the pot immediately.)
- Remove matzo balls with a slotted spoon when done. Place a serving of matzo balls (3-4) in a bowl, ladle a cup or two of (hot) miso soup over them.

**Hen Bisque**

1 - 2 cups baked hens OR sauté 3 cups fresh cleaned hens as below\*, reserving liquid  
3 TBS butter or butter substitute, divided  
3/4 cup raw cashews  
2 cups vegetable broth  
1 cup hen broth from baked hens, or as sautéed, below  
1 cup water  
2 cups chopped cauliflower  
3 bay leaves  
1/2 tsp. dried thyme  
1/4 tsp. fresh ground white pepper  
1 tsp. sea salt  
4 TBS good quality Italian tomato sauce  
4 TBS merlot or other dry red wine  
Fresh parsley for garnish

**Soup:**

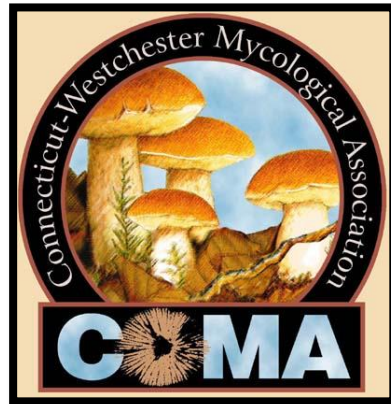
-Grind cashews to a fine powder, then add 1 cup vegetable broth and puree till smooth.  
-Sauté cauliflower in 2 TBS butter/butter substitute for 5 minutes, add hen broth, bay leaves, thyme, pepper, salt, remaining vegetable broth, water, and cashew mixture. Cook for 15 minutes. Remove bay leaves, and puree remainder in blender till smooth.  
-Return to pot. Add tomato sauce & red wine, stir, taste for seasoning, adding more sauce or wine if desired.  
-Add hens. Warm for about 5 minutes, till evenly heated.  
Serve garnished with chopped parsley.

**\*Hens:**

Clean 3 cups fresh hens, (cutting hens into 1 - 2 inch pieces)  
Heat 1.5 TBS butter or butter substitute, and 1.5 TBS olive oil  
Add 1 chopped shallot to oil, cook till shallot begins to clarify, then add garlic,  
Add 1/2 tsp. thyme, 3/4 tsp. sea salt, stir  
Add hens, cook until hens begin to release their juice, then, carefully drain off some of the juice, reserving 1 cup for above recipe. (If hens are particularly dry and you don't have a full cup, just use what you have and add water.)  
Cook about 15 minutes until hens are browned and add to above soup.

— **Joe & Kathy Brandt**

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committee members are:**



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