**Some numbers**

about 0.5% of all poisonings due to mushrooms reported to the Poison Control Center; 90% of mushrooms are not identified; 80% are asymptomatic (people report it as a poisoning, but not adverse effects seen);

About 70 cases per year with symptoms recorded in North American Mycological Society (NAMA) directory, mostly children under 6, most not fatal - but these only account for about 10% of the poisonings reported at the Poison Control Center. So the real number may be more like 700/year.

Roughly 2% of mushrooms are known to be poisonous, but some of these are very common mushrooms

**Cyclopeptides**  Made with NPRS (non-protein amino acid synthetases; no ribosomes involved!)

**Amanitins**, alpha-amanitin - a specific inhibitor of RNA polymerase II. target organ liver and kidneys. Toxin is not eliminated or metabolized effectively and so continues to circulate in the system.

**Species that contain it in quantity:** *Amanita verna*, *A. phalloides* (the Death Cap), *A. virosa*, *A. bisporigera*, *A ocreata*, *G. autumnalis*, *G. marginata*, *G. venenata* *Lepiota helveola* *L. josserandii*

**Symptoms** - none for first 6 to 24 hrs, then vomiting, diarrhea start and continue for 3 to 8 days accompanied by jaundice, apparent lessening of symptoms, followed by liver or kidney failure and death. About 30% of the reported poisoning is fatal.

**Treatments** - dialysis, hemoperfusion, intravenous liquids, intravenous corticosteroids, Penicillin G, and thioctic acid, emergency liver transplants.

Death rate often quoted as 50%, but appears to be much lower according to Bueg et al (<10%).

**Phalloidins** - a toxin cyclopeptide that binds actin - highly toxic, but apparently unavailable and not part of the toxic effect of *Amanita* species.

**Orellanine** (*Cortinarin A and B*).

Over 60 species in the genus *Cortinarius* contain Cortinarin A, the deadliest species (*C. orelanoides, C. speciosissimus*) contain Cotinarin B

Symptoms - long latent period 3 to 14 days. Followed by burning thirst, gastrointestinal disturbance, headache, pain in limbs, spasms, loss of consciousness, About 15% of reported cases are fatal primarily due to kidney failure.  **No therapy is known.**
the good news is there are no reports of Orellanine poisoning in the US and only 3 reports of poisoning from Cortinarius species.

Monomethyl hydrazines

Gryomitrins - derivatives of N-methyl-N-formylhydrazine (MFN) - oxidizes to form N-nitroso-N-methyl-formamide which is extremely toxic, and carcinogenic. Accounts for about 2-4% of mushroom poisonings in Europe.

Species that contain it: Gyromitra ambigua, G. brunnea, G. californica, G. caroliniana, G. esculenta, G. fastigiata, G. gigas, G. infula

Symptoms: about 2-8 hrs after eating feeling of fullness, violent vomiting, watery diarrhea for 2 days, Headache, lassitude, cramps, intense pain in abdomen, irregular breathing, delirium, convulsions, death due to liver failure with 7 days in 15 to 35% of reported cases.

Treatments - none

Parboiling and discarding the water, or long drying eliminates 99% of toxin. European species seem to have higher reported levels of toxin.

Muscarine interferes with neurotransmitters

Found in: Clitocybe, C. dealbata, C. cerussata, C. rivulosa, C. truncicola and Inocybe spp (at least 30), also Amanita muscaria, and A. pantherina in small amounts

Symptoms in 15 to 30 minutes after ingestion: increased salivation, sweat, tears followed by severe vomiting and diarrhea; constriction of pupils, irregular or slowed pulse, decreased blood pressure, asthmatic breathing. In severe cases patients die from heart or respiratory failure. But mental processes are not directly affected. Fatalities are reported in 6 to 12% of cases - usually children

Atropine sulfate is a specific antidote.

Ibotenic acid and muscimol - GABA neurotransmitter analogs - not metabolized and pass out of the body unchanged.

Symptoms in 20 minutes to 2 hrs. Vomiting in some cases, followed by intoxication, hallucinations and visual disturbances, passing into deep sleep. Death is rare (but not unknown), recovery occurs within 24 hrs.

Found in Amanita patherina and A. muscaria

Used by Siberian tribes in Shamanic rituals. "Soma"

Psilocybin-Psilocyin - neurotransmitter analogues

Symptoms: much like LSD, hallucinations and visual disturbances, odd thought patterns and perceptions
Found in: *Psilocybe baeocystis*, *P. caerulescens*, *P. caerulipes*, *P. cyanescens*, *P. cubensis*, *P. pelliculosa*, *P. semilanceata*, *P. strictipes*, *P. stuntzii*  
*Panaeolus castaneifolius*, *P. cyanescens*, *P. fimicola*, *P. foeniseeci*, *P. sphinctrinus*, *P. subbalteatus*  
*Conocybe cyanopus*, *C. smithii*  
*Gymnopilus aeruginosus*, *G. validipes*  
*Pluteus salicinus*

Used by native americans in Mexico

**Coprine**

Amino acid derivative that causes a toxic interactions with alcohol; Without alcohol there is no effect at all.

**Species that contain it:** *Coprinopsis* (*Coprinus* in Aora) *atramentaria*

Symptoms: 30 minutes after ingestion of alcohol or mushroom (which ever is second) hot sweaty feeling, flushed face, headache, nausea, difficulty breathing, rapid pulse, intoxicated behavior, followed by drowsiness.

To avoid problems avoid drinking alcohol for 5 days after ingestion of this mushroom. Other mushroom poisoning related to alcohol (table.)

**Gastrointestinal poisons** -"wish you would die, symptoms" large catch-all group of poorly known toxins found in a large variety of mushrooms. Most are not killers, but occasionally deaths have been reported. Some are idiosyncratic (i.e., effect some people and not others).

An incomplete list of some of the species:
*Agaricus albolutescens*, *A. hondensis*, *A. placomyces*, *A. silvicola*  
*Agaricus xanthodermus*  
*Amanita brunnescen*, *A. chlorinosma*, *A. flavoconia*, *A. flavorubescen*, *A. frostiana*, *A. parvicolvata*  
*Boletus luridus*, *B. pulcherrimus*, *B. satanas*, *B. sensibilis*  
*Chlorophyllum molybdites*  
*Entoloma lividum*, *E. mammosum*, *E. nidorosum*, *E. pascuum*, *E. rhodopolium* *E.* *salmoniueum* *E. strictius*, *E. vernum*  
*Gomphus bonari*  
*Gomphus floccosus*, *G. kauffmanii*  
*Hebeloma crustuliniforme*, *H. fastibile*, *H. mesophaeum*, *H. sinapizans*  
*Lactarius chrysorheus*, *L. glaucescens*, *L. helvus*, *L. representatus*, *L. rufus*, *L. scrobiculatus*, *L. torminosus*, *L. uvidus*  
*Leptota clypeolaria*, *L. cristata*  
*Leucocoprinus lutea*, *L. naucina*  
*Lycoperdon marginatum*, *L. subincarnatum*  
*Hyphyloma fasciculare*  
*Paxillus involutus*  
*Pholiota aurea*, *P. squarrosa*
Bondarzewia berkeleyi
Phaeolus schweinitzii
Laetiporus species
Ramaria formosa, R. gelatinosa
Russula emetica gr.
Scleroderma spp.
Tricholoma album, T. muscarium, T. nudum, T. pardinum, T. pessundatum, T. saponaceum, T. sejunctum, T. sulphureum, T. venenata
Verpa bohemica

**Basic rules to avoid mushroom poisonings**

If you are not positive of the identification don't each it.

Stick with mushrooms you know well and expand your repertoire slowly.

When trying a new mushroom always eat a small amount and wait 24 hrs before eating more. Save some of the mushrooms so they can be identified if trouble develops.

If you die from mushroom poisoning I will retroactively give you a failing grade for the course.

**References:**


Beug, M. W., Shaw W. and Cochran, K.W. Thirty plus years of Mushroom Poisoning: Summary of approximately 2,000 reports in the NAMA Case Registry. (I received this as an unpublished manuscript, and I'm not sure where it ended up, but its posted on line in case you are interested).

**These are the sources of the two attached readings.**


Boiled to remove its toxins, Amanita muscaria can usually be eaten with impunity. David Arora serves it on his forays; Russians call it mushkum and delight in its nutty flavor; and the Japanese reputedly prefer it to Boletus edulis. Recently, in Santa Cruz, California, Larry Millman and Tonya Haff had an experience of A. muscaria somewhat different from the purely culinary experience they intended to have.

Tonya cut two large (18 x 8 cm) muscaria buttons into 1/4" strips and placed them in two quarts of boiling water. The mushrooms were cooked for 3 1/2 minutes (they were actually in the boiling water for 5 minutes), and after they were drained, both of us sampled a few pieces. We found the taste pleasant, indeed agreeably nutty, although Larry thought they also had a slightly metallic aftertaste. We browned several more slices in olive oil and found them quite pleasant, too. The remaining slices were breaded, then browned. Altogether we ate almost all of the two buttons.

Twenty minutes later both of us started to feel distinctly "off." Larry found himself staring vacantly at some LBMIs we were trying to identify. Tonya noticed that he was holding his stomach and looking uncomfortable. Once we agreed that muscaria was the culprit, we called David Arora and asked him what we should do. "Take notes!" David said. So what follows are the notes we took during the experience:

18:56. We ate A. muscaria at 6:00 PM. Tonya was initially feeling hot, but now she's feeling cold. Her sense of smell is heightened. Larry can't seem to concentrate on identifying our mushrooms.

19:09. Tonya is slurring her words. Her pupils are dilated, and there's a lump in her throat. She finds the cedarlike odor of Camarophyllus rуссо- кориаеs quite cloying. Her upper lip is sweaty. Her stomach is mildly queasy, while Larry's stomach is very queasy.

19:15. Tonya's fingers are clammy. She says her arms are unusually goose bumpy. The cedarlike odor of the waxy cap is really bothering her now. Music is bothering her, too ("Bob Dylan driving me up a wall."). Larry retreats to the bathroom.

19:23. Having vomited some of the muscaria, Larry says he feels a bit better. Or at least his stomach feels a bit better. The rest of him feels buzzed and more or less out of it. He also feels quite hot.

19:27. Tonya is experiencing a heightened sense of touch. Larry's fingers on her forehead seem to be burning a cold hole in her. There's an acute pain in her eye, but it soon goes away. Larry still has a slight buzz, very different, he says, from the experience of being drunk. He remarks that he's glad he's not a Siberian shaman. (Note: Siberian shamans eat muscaria for ritualistic purposes.)

19:38. Our "highs" seem to have stabilized. Larry is again trying to identify some of our mushrooms. Tonya says she feels almost normal, whereas Larry says he can't feel normal because he isn't.

19:53. Tonya is starting to feel a bit hungry. Larry's head feels like foam.

20:00. Tonya feels dizzy when she rolls her eyes. Also sort of sleepy. Larry succeeds in identifying a Mycena.

20:30. Tonya's feeling clumsy and poorly coordinated, but otherwise okay. Larry can't seem to dial a friend's phone number, and likewise can't close the sliding door without getting his hand stuck in it. Also, he says the mushrooms we're trying to I.D. are talking to him.

21:15. Larry's been silent for a while, listening to the mushrooms. All of a sudden he's very talkative, although he's not making much sense. "Smooth circus" — neither of us knows what that means. "Mushrooms are people, too," he says.

21:29. Both of us feel euphoric, Larry especially so — he says he hasn't felt this good in years. We decide to go out to dinner, but first we call David Arora to tell him that we're all right. "Whatever you do," David says, "don't drive." So we appoint Tonya's roommate Mikey the designated driver.

21:54. At a Chinese restaurant. Tonya thinks our food has a consciousness of its own as well as a texture that's "very real." She also thinks everyone in the restaurant is high, and that Larry likes Republicans, although he's earlier made it clear that he doesn't.

22:10. Larry is drinking a beer and says he can relate to the bottle, that the bottle can relate to him, and that the two of them are actually enjoying each other's company.

22:15. Our food feels very textured, and we seem able to commune with each grain of rice. We also feel that we're moving fast, but that our thoughts are moving slowly. Larry keeps dropping his chopsticks. Coordination difficult for both of us.

22:10. Both of us seem to be suffering from short term memory loss. Larry feels that his critical sense, usually very much in evidence, has gone on vacation. The word "euphoria" keeps popping up in our conversation.

At 23:00 we leave the restaurant. Larry says that objects have no meaning, but simply exist. We see a dead deer on the road, and he says the difference between a dead deer and a living one is negligible. Tonya still feels elated, exuberant but at the same time relaxed. She falls asleep around midnight without any difficulty. For the next three days her right ring finger tingles when she hits it with her thumb, but otherwise she notices no symptoms relating to the muscaria ingestion. Larry has a deep sleep and wakes up the next morning feeling refreshed.

Later we asked David Arora why we experienced the ups and downs of an A. muscaria trip when all we'd wanted to do was experience the culinary delights of a muscaria hors d'oeuvre. His explanation: that the mushrooms were far too big for the pot in which they were boiled, with the result that only as much of the toxins were dissolved in the water as the water itself could hold. Thus our trips included a certain disarray of the senses, but not the full disarray experienced by Siberian shamans; and thus, too, our trips did not require a different sort of trip — i.e., to the hospital.
It seems that there once was a wicked sorcerer (jossakeed) who lived in our area. He could throw his voice and make lodges tremble, and do magic tricks, and he fooled many people into paying him good blankets for worthless charms. Among other expensive tastes, this jossakeed—a shaman who is believed by the community to possess magical powers—had a fondness for women. He never applied to the council to make them his wives, for he never intended to support them, he just took whomsoever he wanted whenever he wanted, sometimes he had as many as seven at a time!

However did he get the women to agree to such an arrangement? I marveled.

'That was the most wicked thing of all,' said Nodjimahkwe. 'He would get them to come to him for some charm or other, and then have them drink this decoction he made from the Oshtimisk. Whatever was in it, it made them leave everything and everyone else and want to be with him. They said they saw colored lights and heard beautiful music and had at last found true happiness. They washed that salamander's slimy clothes, and mended his lodge, and cleaned up his filth, and didn't half know what they were doing—they lived in a half-world where nothing was real, but they stayed with him because only he could keep them that way.' Her voice was bitter.

'Once a young girl, even younger than you, Zhatay, came to me and asked me to make her a love charm. She had fallen in love with the chief's son, a man much older than she, who already had two wives. I told Sunflower, my dearest daughter, that in truth there is no charm that summons real love. It is real love given that calls it. But she would not listen, and she went to this jossakeed who said he would give her the charm. He gave her to drink of the Oshtimiskwabo and took her in his arms, and behold, he was more handsome than the chief's son, and there was singing joy in his hands. Handsome! That rat had yellow teeth, a twisted body, and the eyes of a snake!' There was a long silence, and then Nodjimahkwe said, 'When the sorcerer left here, there were seven women dead, and he took with him as many more. Sunflower—my Sunflower—lay dead in a Spirit House on the hill. Our men, our big, brave men, they would do nothing, they were all afraid. I could do nothing about the jossakeed, but I can destroy his evil Wajashkwedo.'

Three drops of water fell on top of the hot slabs and sizzled. I stared in amazement. Ahnishinaubeg women never cry—not unless they are peeling wild onions. It must have been the smoke.

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My Reverend Grandfather Challenges Coprinus

The tale of the evil jossakeed that Nodjimahkwe had related both horrified and fascinated me. I could scarcely credit it as being true. My usual procedure, when in doubt about anything, had been to try it out, but I was unwilling to subject even the woodland creatures to an experiment with A. muscaria. Yet the curiosity to know for sure gnawed away inside my brain almost constantly. I thought that if I should repeat this tale at home my parents might break off my relationship with the Herb Mother, or, at the very least, my father would go to remonstrate with her, and then Nodjimahkwe would know I had questioned her veracity. It was then that I thought of my mother's mother: for thirty years she had lived with the cultures of both races, and surely, out of the wisdom of both, she could tell me the truth.

The next time we visited at Grandfather Sauganash's I sat in the immaculate little kitchen with its shiny pots and pans and nibbled slowly at a stack of cookies until everyone but Grandmother Mistiquay and me had left the room. Then I asked her.

'Ah-ee, so someone has told you about that? Well, I am glad; it is not a pretty thing to think of, but it is dangerous not to know.' She laid down the wooden mallet with which she had been pounding dried rosemary into a great slabe of beefsteak.

'Zhatay, many of the stories you will hear among the backwoods Ahnishinaubeg are nothing but superstitions, like the tales of the Windigo and the Bear Walkers, but this one is true. Of course I have never eaten any of the death-dreamers myself—' she chuckled at the ridiculousness of such a thing, 'but I know for a fact that to some they bring strange dreams and wild, strange behavior, while to others they bring death. Why, even the crispies of the Change-Over Mushroom (French fried Coprinus atramentarius), which your grandfather loves so much, would, if taken along with spirits, cause strange hallucinations and for a time—' At this point, my reverend grandfather stormed into the kitchen. He was purple with rage and the ends of his mustache quivered with anger.

'I'll NOT have you poisoning this child's mind with that devilish nonsense!' he shouted. 'I thought I had trained those heathen superstitions out of your silly head, but I see the shadows have not all given way to the light. Very well. There is one way to prove the situation. Tonight we shall have crispies and elderberry wine with dinner.'

Grandmother gasped, 'but this is Sunday...'

'What better Day to learn truth?' roared grandfather, 'go, woman ---'
Grandmother had surely been trained to one thing, and that was obedience; she scuttled away like a drenched hen. I wasn't so easily intimidated.

'Granda,' I began. He landed a big wallop on my bottom.

'Impertinent upstart,' I didn't know what that meant, but I got the general idea.

Late that afternoon, as was the Sunday custom at Grandfather Sauganash's, we sat down to a splendid repast, the dinner grandmother had planned, plus the huge platter of cropinus crispies that grandfather had ordered. Grandfather intoned a blessing and made the sign of the cross.

'And now to the feast,' he announced gayly as he dug the serving fork into the platter of crispies. In a second, he was roaring again.

'Margaret, you have forgotten the elderberry wine!' The cut-glass decanter from grandfather's ancestral home in Yorkshire came to the table in grandmother's shaking hand. Spirits of elderberry wine, as Grandfather Sauganash made it, was potent stuff. Only a tiny gobletful was allowed at christenings, two of the tiny glasses were permitted at weddings. WaubOshigewan never took any. He told my grandfather that he had taken a religious vow never to drink spirits, and grandfather gave him a blessing for it, but I think what he said later was closer to the truth: 'No Sauganash with firewater is going to make a damn fool out of me.'

Grandfather poured himself half a waterglass of elderberry wine!

'The truth will out,' he said, and lifted the glass toward his womenfolk.

Dinner was a long affair at the rectory, and it usually was fun, but that day it was an unhappy meal. By the time grandmother stood up to bring in the dessert, Grandfather Sauganash began to turn red, blue, purple, and white, and made strange growling noises deep in his throat. My mother whisked me upstairs to the bedroom and locked me in. Of course I didn't stay there.

It took me a little while to figure out how to unlock the door. I crept down to the stair landing in my bare feet, and an utterly weird sight met my eyes. Dignified Grandfather Sauganash was dancing on the dinner table, shouting some strange song in a foreign tongue, throwing dinner knives through the window and door panes, and laughing uproariously as they shattered. Glass panes were terribly expensive in those days. Grandmother Mistiquay cowered behind the sideboard, but she wasn't so cowed that she hadn't thought first to obtain the carving knife and slip it under the rug.

Mother did what she usually did when there was trouble — ran for father.

'Oh, do something, do something,' Grandmother Mistiquay pleaded with my father, 'he must not be seen outside the house like this. CHEMUK — neighbors — would never understand; they might even send us away.'

Father hesitated, and while he did so, a gravy boat caught him on the jaw and splattered brown ooz down the front of his only white linen shirt. Once father decided, it was all over in a split second. Grandfather Sauganash lay on the floor smiling like a baby in his sleep. It was something he had learned how to do in the marine corps, WaubOshigewan told us. There was no Evening Prayer at Saint Ipswich's that night.

When Grandfather awoke early the next morning, the house was all in order and grandmother, clean and starched, and smelling of lavender, stood by his bedside. Grandfather looked around at us all, and he chuckled. Then he laughed.
‘Ho, ho, ho . . . out like a light, eh? Margaret — he always called grandmother by the Christian name with which he had baptized her — I ask your forgiveness for doubting your word. I should have known better by this time.’ He reached for grandmother’s hand.

‘Son,’ he looked straight at my father, ‘I suppose you brought me here. I thank you.’ My father nodded gravely, apprehensive about just how much my grandfather did remember.

‘And you, young lady,’ he looked in the direction where I had been peeking through the portieres, ‘come here and get a big kiss to make up for an undeserved swatting.’ I suffered the wet kiss for my mother’s sake, but it was worse than the wallop, I thought.

‘Ho, ho, ho —’ he continued in such good humor that the great brass bed shook with it, ‘those spirits of elderberry wine of mine are mighty powerful stuff. Just like a young sprat with his first bottle — out like a light. Ho, ho. What year was that bottle, Margaret?’ In surprise, I thought to myself that the old nut didn’t even remember what had happened!

A very quiet little family started home in the buckboard that afternoon. I was deeply ashamed for my Grandfather Sauganash, and I supposed my parents were too.

It was with much amazement, then, that I heard my father say, ‘Your Grandfather Sauganash is a great man, a very great man. Few are the chiefs of any race who can admit they have made mistakes. Hardly any of them are able to laugh at themselves. But your grandfather could. Yes, a great man.’ Then he began to tell me about a chief of the CheMunks over the GitchiGitchiGumeenong whose whole life was one long mistake. This chief, he said, was called by the ridiculous name of Nap-a-long Honey-Paw. . . . Soon I was shrieking with laughter over the silly chief who split his satin pants and put stilts on his shoes. The tension lines about my mother’s mouth began to relax.

My grandparents and my parents were gone and my own papoose was becoming a man before I realized that WaubOshtigwan had truly meant what he said, and that Grandfather Sauganash was indeed a great man. Just the same, I have never really been able to enjoy eating _Coprinus Atromentarius._

The End