



Cautions Regarding Ingestion of *Inonotus obliquus* (Chaga)

Michael W. Beug, Paul Kroeger, and Raymond Li

There is a steadily growing demand for chaga, also known as cinder conk, birch conk, and clinker polypore. Google entries describe chaga as both a medicinal mushroom (that is, a mushroom that when consumed helps treat or prevent a disease) and a superfood. A quick internet search will yield a huge number of sites advertising chaga. However, if you are a chaga user, some significant cautions apply. In this article, we explore the natural history of chaga, the evidence we have for its medical efficacy and the health problems that have arisen in some individuals who use chaga.

Inonotus obliquus is circumboreal where it mainly grows on long-lived species of birch, notably in North America paper birch, *Betula papyrifera*, and yellow birch, *Betula alleghaniensis*. It causes a white heart rot to develop and the tree produces a black (melanized) canker. A tree infected with chaga can live from 10 to over 80 years post-infection before the tree or some portion of the tree dies from the infection. While the tree (or the portion of the tree with the black chaga canker) is alive, the fungus does not form spores and the infection does not spread to other trees. While chaga is not rare, it can be hard to find and in some places is threatened with over-exploitation (Spinosa, 2012). Rick Van de Poll did two studies where he quantitatively estimated the amount of chaga in the forests of New Hampshire, a good place to find birch. In 2006, he found an average of 1.2 cankers per acre in optimal habitat in the Ossipee Mountains. In 2016, he repeated the study in another optimal habitat and found 1.36 individuals per acre on Kezar Ridge in Dixville, NH. Both sites were similar in that they were yellow birch-red spruce habitats on montane slopes. In NH at least, chaga appears to occur once per roughly 1,300 to 2,000 trees.

The canker itself is composed of sterile mycelium and birch wood. It ideally should be harvested when the canker is about 25 years old. Only after death of the tree or the death of the portion of the tree with the canker does the sexual stage of the fungus begin. The actual fruiting bodies are produced under the bark and are rarely seen. Interestingly, only the living canker has medicinal uses. Cankers from dead limbs and dead trees are inactive.

Traditionally chaga was ground into a fine powder and brewed into a tea. The hot water extract has β D-glucans (about 35%). After the hot water extraction (which breaks down the chitin), extraction with ethanol isolates the water-insoluble components including betulinic acid (produced from betulin by the sterile mycelium), betulin (produced by the birch tree), and phytosterols. Sometimes methanol is used in the second extraction (instead of ethanol) but this is not

recommended since methanol is highly toxic and methanol residues can cause blindness. Consuming the powder directly (without making a tea or tincture) is ineffective since the potentially desirable β D-glucans, betulinic acid, betulin, and phytosterols will all be largely unavailable, bound inside cells made of chitin.

Chaga is prized for both anticancer and immunostimulating effects. However, human studies are lacking. Dr. Andrew Weil has a good page on chaga on his website (<https://www.drweil.com/diet-nutrition/nutrition/choose-chaga-mushrooms/>) and he ends the chaga entry with a link to a list of medicinal mushrooms where there is some evidence for efficacy in humans. Chaga is not on his list because there is too little evidence for its efficacy. The Memorial Sloan Kettering Cancer Center also has a web entry with a well-referenced section on chaga (<https://www.mskcc.org/cancer-care/integrative-medicine/herbs/chaga-mushroom>). They also cite the need for human clinical studies. In a summary of the purported uses of chaga, they cite laboratory and animal studies that show that chaga can inhibit cancer production but note an absence of human studies. Since there is little correlation between in vitro (e.g., Petri dish studies), successful animal studies, and successful human studies, it cannot be concluded that these mushrooms are truly medicinal without human clinical studies. The Memorial Sloan Kettering Cancer Center page also mentions the use of chaga to stimulate the immune system, to reduce inflammation, and to protect the liver. Laboratory and animal studies show that chaga can activate certain types of immune cells but human in vivo studies are lacking. One small human study has suggested a reduction in markers for inflammation. An ability to protect the liver remains anecdotal.

The Memorial Sloan Kettering Cancer Center web pages on chaga warn individuals interested in chaga not to use it if they are taking either blood-thinning medications or diabetes medications. An anonymous NAMA member adds:

I would like to respond to your report on chaga with a personal anecdote about my use of chaga. I have been a regular chaga user for over 10 years. I have been taking a cup of simmered chaga water decoction daily, using a heaping teaspoon of ground chaga or small chunks. Over the years, I have had very few colds (much less than before chaga), which I thought could be due to an immune enhancing property.

About a year ago, I had prostate surgery (a TURP). I stopped taking chaga two weeks before the surgery. By a week after the surgery, I was feeling fine. I was told that it was normal to pass some blood clots during the subsequent

weeks after surgery. I started taking chaga again at three weeks post surgery. A few days later I passed some clots, but then had quite heavy hematuria, followed by excruciatingly painful bladder spasms. I ended up in the ER and was hospitalized for two days, receiving irrigation via catheter until the bleeding stopped.

I knew about the “blood thinning” effects of chaga, which is why I went off it before and after the surgery. I have a suspicion that using chaga, even three weeks post-surgery, could have been responsible for my bleeding episode. I think that people with surgery scheduled should be warned about chaga’s potential for causing excessive bleeding associated with surgery. If chaga was involved in my case, apparently a three week’s abstinence is not enough time to wait before resuming intake.

Rick Van de Poll, another NAMA toxicology identifier, pointed out a case where an individual made productive use of the blood thinning properties of chaga:

I teach a lot about mushrooms and am getting more and more people who use fungi medicinally in all types of ways. Two autumns ago, a man came to a workshop who basically said chaga saved his life. Both his grandfather and father died in their 50s from heart disease. Genetically they were prone to high cholesterol and heart attacks. At 57, he decided he would consult his physician and see if he could do anything about it. The physician said no, perhaps some blood thinners could help. His LDL levels were in the 250–260 range and they said he was a “walking time bomb.” Not wanting to (and not being able to afford medication), he took the advice of local herbalist and started drinking two cups of chaga tea every day. He did no other therapies and took no other drugs. In six months his LDL levels went down to 110. In another two months they were at 95. His doctor was amazed and asked him how he did it. He had already undertaken dietary changes (at age 40) so he said that all he simply did was to drink chaga tea every day.

WebMD (<https://www.webmd.com/vitamins/ai/ingredientmono-1474/chaga>) warns against taking chaga if you have an autoimmune disease (e.g. multiple sclerosis, lupus, rheumatoid arthritis, etc.), are having surgery soon (bleeding issues), or breast-feeding.

In addition, reports of extremely high levels of oxalates in chaga are of concern. Susan Goldhor’s 2017 article, “Chaga Revisited” in *Mushroom the Journal*, cited a 2014 Japanese case of chaga mushroom-induced oxalate nephropathy (Goldhor, 2017). In that case, a 72 year old woman who had been diagnosed with cancer a year earlier had been taking 4–5 teaspoons of powdered chaga daily for six months. She suffered liver damage and complete, irreversible kidney failure attributed to the oxalates in the chaga (Kikuchi et al., 2014).

The second report came in January 2019 in an email to Michael Beug and to Leon Shernoff from a geologist in Yellowknife, Northwest Territories. She consumes 1 cup of chaga tea and 2 mL of chaga tincture nearly every day. She harvests her own chaga and makes her own tinctures. She also eats lots of spinach, beet greens, almonds, and other foods high in oxalates. She has discovered that when she consumes too many oxalates, the first sign of trouble is weak fingernails.

Her doctor eventually traced the problem to depletion of zinc in her body. The zinc (and calcium) in her body was being chelated and removed by the oxalates from chaga and her other high oxalate foods. The loss of calcium also puts her at much higher risk from osteoporosis.

After reading a first draft of this article, Dr. Denis Benjamin noted that there are undoubtedly many additional unreported cases. The next day an email from Paul Kroeger, past-president of the Vancouver Mycological Society, contained descriptions of five cases from British Columbia alone. Soon Paul Kroeger and Raymond Li identified four additional recent BC cases bringing the total to nine:

2011. One of the organizers of Sicamous Fungi Festival harvested chaga from her property on Shuswap Lake in 2010 and stored it in a sealed canister. After drinking tea regularly for a while, she developed GI distress. When I examined the material in September 2011 it was moldy with a musty actinomycete-like soil odor and looked faintly grey-fuzzy. Extracts made from it showed greatly reduced inotodiol, botulin, and betulinic acid (supposed therapeutic compounds) levels in HPLC analysis.

2014. An older male taking chaga mushroom suffered hepatitis and renal failure.

2015. An adult female presented with a three-day history of vomiting and some confusion. The patient had significantly elevated liver enzymes (AST and ALT approximately 2,000) serum creatinine, and coagulopathy (INR 2). N-acetylcysteine was given initially for presumed acetaminophen toxicity, but acetaminophen was not detected and the patient denied taking acetaminophen. After disclosure of chaga tea consumption from a health food store, N-acetylcysteine was resumed. Liver enzymes and neurological status improved over three days.

2016. An adult female took 1 cup of chaga tea from health food store. One hour later, she became lightheaded and tingly.

2017. A healthy adult male came to hospital due to feeling faint and in hospital developed a brief episode of bradycardia. Initial work up did not reveal any obvious cause. The patient had obtained chaga capsules several months prior at a health fair and for the three or four days before coming to the hospital, he had been drinking chaga tea from his naturopathic doctor.

2018. A healthy adult male was drinking chaga tea (simmered for four hours in water) intermittently for three weeks. Had been experiencing fatigue, light-headedness, body aches and plugged ears since starting to consume the tea. He was referred to hospital for assessment after vomiting once (but no other GI symptoms). Liver and kidney function tests were normal.

2018. An older female had been normally consuming 1 to 2 cups of a tea from the root of a flowering plant called “hush-hush” that she harvests for her arthritis. Presumably she wasn’t having problems with the tea at this dosage. On the day she came to hospital with bradycardia and hypotension she had consumed 3 to 4 cups of tea and had vomited once. She was kept overnight for monitoring. When we followed up the next day, the patient had been discharged, and the tea was now identified as chaga.

2018. An adult female took four capsules of a proprietary chaga preparation all at once (normal recommended dose for the product is one capsule, four times daily), felt tremulous several hours later, and went to hospital. The physician felt the patient might just be anxious.

2019. An older male went to hospital after several days of altered level of consciousness, confusion, and paranoia. He had been drinking several cups of chaga tea (from a "root") daily for the past four or five days. He improved spontaneously and was discharged, but came back to hospital the next day with similar symptoms as well as elevated heart rate and blood pressure. Whether the patient had resumed drinking the tea is not documented. The treating MD did not think the symptoms were related, but no information on what other explanations being considered was available.

Out of nine reported adverse reactions attributed to chaga products, or where chaga is suspected or implied by the subjects or recorders:

- 7 mentioned chaga tea
- 2 mentioned proprietary preparations in capsule form
- 1 did not specify the form of chaga
- 2 involved symptoms and treatment outcomes suggestive of oxalate toxicity
- 4 involved bradycardia and/or hypotension, light-headedness, dizziness or faintness

4 involved GI symptoms, vomiting

Tracing the cause of the symptoms for the cases listed above is challenging because people may have been taking chaga tea in response to existing disease and thus have complicated history of therapies and symptoms. However, both the 2014 case and the 2015 case make us suspect the involvement of oxalates.

We had never thought of looking at oxalate concentrations in any fungi and proceeded to do Google searches plus academic library searches using a variety of different academic search engines (EBSCO Host, JSTOR, Science Direct, etc.). Most sources report either that chaga has high oxalate levels or say that it has extremely high levels, but give no values. We found a paper by Savage et al. (2001) where they examined the soluble and insoluble oxalate content of six different commercially grown mushrooms in Uppsala, Sweden as well as three forest-harvested species (*Cantharellus cibarius*, *Boletus edulis*, and *Hydnum repandum*). All of the species examined contained oxalates. Wild mushrooms contained 250–440 mg/kg DM and cultivated mushrooms contained 600–1,000 mg/kg DM total oxalates. A Polish group, studying cadmium, lead, and oxalic acid levels in four wild bolete species observed oxalate levels ranging from 480–1,540 mg/kg from places with differing pollution levels (Sembratowicz and Rusinek-Prystupa, 2012). Nile and Park (2014) examined oxalate and mineral content of 20 species of wild edible mushrooms from India and found total oxalate content in the range of 450–1,000 mg/kg DM. These levels are low compared to most foods. Leon Shernoff, editor of *Mushroom the Journal*,

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emailed Swiss chemist Tjakko Stijve to ask if he had references to oxalates in mushrooms. Tjakko replied that he did not find any information on oxalates in *Inonotus obliquus*. His email to Leon had the following observation:

According to Swiss author and mycotoxicologist René Flammer in his manual GIFTPIILZE, AT Verlag, Aaru and München 2014, pages 78 and 79: (translated from the German): “Oxalates are widely present in mushrooms from several genera. *Laetiporus sulphureus*, *Ramaria flava*, and *Ramaria botrytis* are very rich in oxalates. The latter mushroom contains as much as 2,075 mg/kg DM. This is 10–100 times more than was measured in edibles as *Agaricus bisporus*, *Macrolepiota procera*, *Pleurotus ostreatus*, *Rozites caperatus*, *Lentinula edodes*, and *Flammulina velutipes*.”

We found only one reference to oxalate levels in *Inonotus obliquus* (Glamočlija et al., 2015). In chaga from Russia and Finland, oxalic acid was the main organic acid, with only traces of other acids (and interestingly, no betulinic acid). The oxalate levels were 4,870 mg/kg DM in Russian material and 6,250 mg/kg DM in material from Finland, by far the highest oxalate levels we have seen reported for any mushroom and are six to 100 times more than in typical edible mushrooms. Glamočlija et al. (2015) also reported results for “chaga” from Thailand, a source of chaga well outside its known range. We noted that the Thailand samples had only 2,000 mg/kg DM oxalic acid and the main organic acid was p-hydroxybenzoic acid (4,700 mg/kg), a phenolic acid present in only trace amounts in the Russian (130 mg/kg) and Finnish samples (490 mg/kg). The popular preparation methods recommended for making chaga tea, with extended simmering times of 2.5–4 hours, seem well suited to maximize extraction of water soluble oxalates into the resulting beverage. Likewise, the use of alcohol solutions for a secondary extraction of chaga components could even further increase oxalate content in the final product since alcohol will also dissolve the water insoluble oxalates. Glamočlija et al. (2015) found that roughly half of the oxalates were extracted by hot water and about 50% more was obtained with their secondary ethanol extraction.

The popularity and reputation of chaga has resulted in naïve enthusiasts collecting and consuming materials resembling chaga but of unknown identity or properties, a situation with obvious potential for harmful results. In 2010, NAMA received a poisoning report from an individual who had consumed a tea made from *Apiosporina morbosa* (black knot fungus) and *Daldinia concentrica* (carbon balls). He suffered stomach issues for three days. In 2018 in British Columbia, an adult male went to the hospital with dizziness, nausea, and slow heart rate. He said he had consumed a “tree mushroom growing on bark.” The submitted sample was an undifferentiated outgrowth from bark of a conifer tree, which yielded no fungal DNA except a *Psathyrella* trace that was most likely from contaminating spores.

Since chaga is highly valued, some harvesters might include other melanized conks that are not chaga, use dead conks, or stretch their chaga with other material(s). Thus when purchasing chaga, you may never know for sure what you are getting. Certain suppliers have tried provenance-tracking and quality control measures to address such concerns. We believe Velma Sterenberg from Northwest Territories has worked on certification programs for chaga harvest there. Jeff Chilton from British Columbia has also initiated quality control testing of samples and provenance-tracking for his chaga and reishi products.

An obvious solution is to cultivate chaga. That would help preserve wild chaga as well as provide a more consistent product. However, cultivated *Inonotus obliquus* produces different metabolites than wild material. Hence, we can expect different effects from cultivated material, but have no data on whether or not cultivated material has an improved medical potential or a lessened potential. Furthermore, the artificial cultivation of chaga may not be a replacement for wild-gathered material because the phytosterol and inotodiol, is apparently biosynthesized from betulin and betulinic acid in the living birch host. “Chaga” found on trees other than birch, such as aspen, alder, oak, or trees other than birch apparently lack all three of these presumed therapeutic constituents and are unlikely to truly be chaga (Spinosa and Bunyard, 2012).



Oxalates and oxalic acid play vital roles in many plant-disease and wood-decay fungi by weakening and penetrating host cells through growth of calcium oxalate crystals from hyphal exudates into plant tissues. Apparently, many tree-conk fungi produce oxalates in their mycelium and substrate as part of disease infection and wood decay processes, and continue to do this in artificial culture (Guggiari et al., 2011). This means that artificial culturing of *Inonotus obliquus* could make products that still have high oxalate content. Chaga is unusual among “medicinal mushrooms” in consisting of mycelium and substrate but not a fruiting body and this could explain high oxalate content.

In summary, we do not have good human clinical data on the efficacy of chaga in treating or preventing cancer, stimulating the immune system, reducing inflammation or protecting the liver. We do have in vitro studies that are tantalizing. We do know that unlike other medicinal mushrooms, chaga is very high in toxic oxalates and so consumption of chaga teas presents an osteoporosis risk plus health risks from loss of zinc, a critical micronutrient. These potential problems are in addition to the better-known risks to people with diabetes and to people on blood thinning medication. People, especially those already at risk from high oxalate intake, are recommended to limit their consumption of chaga products until more is known about oxalates in chaga. When they do consume chaga, they should consider doing so in conjunction with a meal also high in calcium (e.g., with milk products) or with supplemental calcium citrate. The supplemental calcium

will combine with soluble oxalates. Calcium oxalate in the GI tract winds up being safely excreted with the feces. Without the added dietary calcium, free oxalate would be absorbed and then calcium oxalate forming in the kidneys could lead to kidney stones as well a direct damage to the kidneys, possibly resulting in kidney failure.

Acknowledgements

We want to thank Velma Sterenberg for her questions about chaga that have led to this inquiry. Leon Shernoff, Ron Spinosa, Rick Van de Poll, Denis Benjamin, Greg Marley, Else Vellinga, Lawrence Leonard, Tim Geho, and Andrus Voitk all provided comments and editorial advice that helped us shape this paper.

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