Elevating Mushroom Extract Quality

A Science-Driven Approach to Transparency and Efficacy

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MUSHEEZ®
MUSHROOMS MADE EASY

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Contents

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Executive Summary

This report outlines MUSHEEZ®'s transition from using/relying on legacy quality metrics (when measuring the purity and potency of mushroom extracts) to advanced, compound-level analysis for functional mushroom extracts. Traditional indicators such as extraction ratios and total beta-glucan percentages are widely used in the industry but fail to reflect the presence or concentration of the bioactive compounds (metabolites) that drive potentially therapeutic effects.

To address this, MUSHEEZ® now employs advanced testing methodologies including Nuclear Magnetic Resonance (NMR) and Liquid Chromatography–Mass Spectrometry (LC-MS) to verify extract identity, purity, and compound integrity. These tools enable precise quantification of common, and species-specific, metabolites such as ganoderic acids, betulinic acid, hericenones, erinacines and so on.

Our study and comparative analysis of commercially available extracts reveals significant inconsistencies across brands, with some containing only trace levels of key compounds. In contrast, our PureMushroom™ extracts demonstrate strong bioactive profiles and full traceability, supported by batch-level Certificates of Analysis (COAs).

This document is intended for formulation experts, regulatory reviewers, and brand decision-makers seeking high-integrity ingredients and deeper transparency in the mushroom supplement supply chain.

Additionally, we hope mushroom extract manufacturers and distributors embrace the challenge to deeply, and independently, test their own products and openly publish their results or use the data to improve the quality of their products and processes.

Introduction

The rapid growth of the functional mushroom sector has brought both opportunity and risk. While consumer demand and product availability have surged, the means by which extract quality is measured have not kept pace with scientific rigour. Labels citing “10:1 extraction ratio” or “30% beta-glucans” remain industry standard — yet these metrics are often vague, misleading, and disconnected from the actual bioactive compounds profiles of the products concerned.

At MUSHEEZ®, we recognised the need to move beyond traditional metrics and toward analytical methods that directly measure the compounds responsible for potential functional benefits. This report presents our ongoing shift toward validated, compound-level testing using technologies such as NMR and LC-MS.

We detail the rationale behind this change, introduce key bioactive compounds of interest, and share comparative data from a variety of well-known brands and suppliers and examples of MUSHEEZ® PureMushroom™ extracts. Our aim is to provide a discussion point or path for clearer standards for evaluating mushroom extracts — standards rooted in measurable data, scientific literature, and transparency.

What prompted us to write this report?

A few several factors but in particular there was a conversation with a potential client about 9 months ago that went something like this…

> *Can you supply organic lions mane and reishi extract powders about 15:1 extraction ratio and 20/30% beta glucans?*
>
> ***Yes, we can.***
>
> *What’s the difference between them? I mean if both the lion’s mane and reishi are both 20% beta glucans then what is the difference?*
>
> ***Well, they contain different compounds of interest. For example, lion’s mane contains hericenones and reishi contains ganoderic acid.***
>
> *I see. How much of these are present in your specific extracts? Are they present in high or optimal amounts? How do you measure them? What percentages of these compounds should we expect to see?*
>
> *(This was the point where I started squirming in my seat)*
>
> ***Err no, we don’t measure those amounts. We can’t. Tests are either not available or too expensive.***
>
> *So how do we know if your extracts contain these compounds?*
>
> *(Another squirm)*
>
> ***Well, you don’t but (we believe) the source material is premium quality and extraction processes are advanced so the levels should be good…*** *(ashamed I couldn’t give a decent professional answer).*

The potential client was not impressed but bought from us anyway because they liked our honesty and “trusted us.”

You get the point, I hope. These are (some of the) questions that mushroom extract suppliers and brand owners in China, Europe, USA do not want you to ask. The uncomfortable truth is that we did not know the answers, and it seems no one else in the supplement industry really did either (Scientists, I don’t include you, I am sure some who are reading this are thinking: Well of course you can measure with XYZ but it’s expensive and time consuming etc.).

A lot of brands and manufacturers are hyping the wonderful bioactive mushroom compounds of interest and cite published research as evidence, but no one was actually offering hard data about their products. It played on my mind and gave me sleepless nights, seriously. What is in our extracts? Are they really any good? How can we find out for sure? So, we started down the rabbit hole with a modest research and testing budget. Nine months later, here we are. Round one complete.

Acknowledgements and Disclosures

This paper is designed primarily to draw your attention to the need for better quality control in the mushroom extract industry. We also are a business and hope you check out the first products from our new range of PureMushroom™ extracts. You can read about them at www.musheez.eu/pure

One other transparency acknowledgement. Yes, we used ChatGPT to help identify some research references for deeper analysis. We have checked all content manually and we are also grateful for a peer-review and contributions from renowned mycologist Attila Fodi. (Note: ChatGPT gave a lot of poor or inaccurate results actually – which we discovered after checking everything manually. It was useful but we learned it cannot be trusted so the value was limited.)

A special note of thanks is also due to Nammex. They are market leader in the USA/Canada because not only of the quality of their mushroom extract products but also their commitment to research, sharing and transparency advocacy. Their work and approach in recent years have definitely inspired us to walk the good path too. We have no commercial relationship with Nammex, they did not contribute to this report. We just want to give credit where it is due.

Why Testing for Purity and Active Compounds Matters

Economically motivated adulteration is a recognised problem in many botanical ingredient categories and mushroom extracts are no exception. Even when a mushroom extract is not intentionally adulterated, it can still be ineffective due to poor-quality inputs or substandard processing. Many extracts on the market are made from immature fruiting bodies, low-grade biomass, or material that has been poorly stored or have oxidised. These factors can drastically reduce the concentration of available beneficial compounds.

Extraction techniques also vary widely in effectiveness. Insufficient heat, incorrect solvent use, or rushed processing times can result in powders that contain little more than fibre and colour — with minimal levels of active ingredients.

A branded extract product might look and taste the part and have an impressive looking Certificate of Analysis (COA) but without rigorous testing, there is actually no way for you to know, for sure, what is in the bag and if it has the potential to deliver real physiological benefits.

Not all mushroom extracts are created equal.

The global boom in functional fungi has predictably led to a surge of low-cost, low-integrity products — many of which do not contain the compounds they claim (or at least what end consumers expect them to contain based on the marketing hype).

For business buyers, brand owners and formulation specialists, this has potentially profound consequences:

Rampant Adulteration Goes Undetected

Many mushroom products are, sadly, diluted with:

- Grain-based mycelium, which adds starch and may also affect the proportion or type of bioactive compounds available. Small reminder here: A mushroom is the fruiting body, not the mycelium. A further note is that some extract powders are called “full spectrum.” This is NOT a sign of purity or quality. Full spectrum usually means a blend of fruiting body and mycelium and in our experience, it means primarily mycelium-on-grain mixed with a little fruiting body to claim the full spectrum tag. Full spectrum is a red flag. Caveat emptor. Test, test, test.
- Spent or reused biomass with negligible bioactivity. (If you squeeze a teabag many times the tea is weaker, right?)
- Maltodextrin or other fillers to bulk up powders or increase solubility. Note: Actually, maltodextrin gets a very bad press. If transparently disclosed at the point of sale, then there are good cases for its usage:
    - solubility increases when used as a binder,
    - mouthfeel,
    - powder consistency (avoiding clumping).

Without rigorous testing with methods like LC-ESI-QTOF-MS and NMR (read more on them later), these adulterants can go undetected.

Why B2B Buyers Should Care

- Product efficacy matters. If the bioactive compounds are not there, neither are the potential benefits. Consumers will eventually drop products that “don’t work.”
- Consumer trust is at stake. Brands that do not validate their extract ingredients risk erosion of reputation.
- Regulatory compliance. EU/UK markets are moving toward higher standards. Testing now protects against future liability.
- Differentiation = Value. Transparent, verified ingredients justify a premium price and set your brand apart in an increasingly crowded market.

Investing in scientifically backed extracts is not a cost. It is a value multiplier. A profit generator.

Your customers — and your formulators — deserve better than marketing myths.

It is not the time or place to go into pricing here but combining research, purity validation and batch level quantification of compound of interest levels are not the cheapest of processes. Verified extracts probably will cost you more than low quality untested options (but not as much as you think!). Obvious really. As the old saying goes: You pays your money, you takes your choice.

Problems with Traditional Metrics (Extraction ratios, Beta-glucans)

Extraction Ratios and Generic Beta-Glucan Claims Aren't Enough

Historically, extract powders have been labelled with extraction ratios (e.g., 10:1, 15:1) and total polysaccharide or beta-glucan content. This naming convention is likely to continue for some time.

However:

- **Extraction Ratios are often misleading**. A high ratio does not confirm higher potency. It may result from degraded input material or inefficient processing. Conversely, a lower-ratio extract may deliver significantly more bioactive compounds if grown and extracted with precision.
- **Beta-Glucan Tests often report total glucans, including inactive α-glucans.** Only specific fractions, especially β-glucans with 1,3/1,6 linkages, are linked to immune modulation in peer-reviewed studies. Many legacy tests do not isolate or report these accurately. There are discrepancies in results done using the same assay (e.g. Megazyme) depending on who has run the test. Step 5 is the issue for cognoscenti. My point is that the beta-glucans results you get from one reputable lab can be different from the results from another. Frustrating but true. We continue investigating this area.

We have analysed many of our own legacy extracts and dozens of samples from other suppliers and well-known brands. To be kind, we will say the results were incredibly varied (some figures are published later in the report).

The bottom line is that just because an extract claims high beta-glucans and a high extraction ratio, this does not always correlate with significant levels of bioactive compounds of interest.

Why Don't Extraction Ratios Reflect Quality in Mushroom Extracts?

Extraction ratios like "10:1" or "20:1" are commonly used in marketing mushroom extracts — but they are often misleading and do not reliably indicate quality. Here is why:

1. Extraction Ratios Tell You Nothing About Bioactive Compounds

A "10:1" extract means 10 kg of raw material was used to make 1 kg of extract. But it says nothing about what was actually extracted — whether it's rich in bioactive compounds like ganoderic acids, beta-glucans, or hericenones, or if it's mostly starch, fibre, or degraded biomass.

Without chemical analysis, you cannot know the value of the extract no matter what the ratio claims to be.

2. Poor Starting Material = Poor Extract

High extraction ratios can come from:

- Low-quality mushroom material
- Substrate-grown mycelium with little fruiting body content
- Reused or "spent" mushroom biomass.

Even a 20:1 extract is weak if the source material was poor to begin with. Obvious really.

3. Weak or Inappropriate Extraction Methods

A high ratio does not mean the extraction process was effective. Little or no useful compounds will be extracted if:

- The temperature was too low.
- The time was too short.
- The wrong solvent was used (e.g., only water when key compounds are poorly water-soluble).

That said, and contrary to popular opinion, water extraction can still yield substantial bioactive compounds (e.g. triterpenoids like ganoderic acids from reishi, if the method is optimised) as proven through LC-MS (liquid chromatography–mass spectrometry) testing. Really. We have the data. We show you later in this report.

While many brands claim that alcohol is required for extracting triterpenes, this is not always true. LC-MS testing can detect meaningful levels of ganoderic acids in water extracts, especially under high-temperature or extended-time conditions. Claims that water extracts would only contain "zero" triterpenes are outdated and inaccurate.

There are many recycled myths in the mushroom extract world. ***Chaga mushroom extract made from the fruiting body*** *is one of our favourites (someone please tell them that chaga is not a mushroom and the fruiting body is rarely seen and NEVER used in food supplements).*

These myths (and downright misinformation) occur because someone says something and suddenly "social media experts" and reputable brands start to parrot the same lines without any validation. We did the same. We admit it. What else could we do without the time and money to test? We believed and trusted the words of others. But no longer. We will still consider any opinion of course but now we want the data independently verified before we sing the song.

4. Extraction Ratios Can Be Manipulated

I do not want to get into the processing tricks that are used by unethical manufacturers because it is really depressing and actually a distraction from our goal (measure data, find or make the best extracts).

The point though is that you could have:

- A 5:1 extract, e.g. reishi, with high triterpene and beta-glucan content, or
- A 20:1 extract that's mostly fibre and tastes bitter but has little to no beneficial compounds

RECAP- What Actually Matters:

- **LC-MS quantified bioactive compounds** (like ganoderic acids, betulinic acid, hericenones etc.)
- **Purity validation:** Is it NMR-tested to identify the species? Is it made with the fruiting body, mycelium, or grain-grown biomass? Are any adulterants present?
- **Is it certified organic?** Organic is good for you. Good for the planet. Pesticides are bad.
- **Transparency:** Real data beats marketing claims

If you are making, researching, or buying mushroom extracts, always look for analytical data — ideally (in our opinion) verified through **Nuclear Magnetic Resonance (NMR) and liquid chromatography–mass spectrometry (LC-MS)** — instead of relying on extraction ratios alone. If your budgets are more limited then look at HPLC and HPTLC testing – these both have their merits and should be considered.

We admit that we have not been able to evaluate all our legacy extracts with every test at our disposal (yet), which is why we are in transition. We ask our clients and partners for patience. The first testing rounds are done, more will follow. It is a money issue; it is really quite expensive to run some of these tests and secure expert analyses of the data etc. Plus, we are a fast-growing small company, time is also a precious resource, and you know what they say: Clients come first, and we have orders to process.

Any investors out there reading this – take note, we aim to be the number one trusted supplier of verifiably premium organic mushroom extracts (ingredients and finished products) in Europe to herbal practitioners, D2C supplement brands, and food/supplement manufacturers. We know how to get there (more or less). Speedy execution requires investment, or we have to simply continue to move forward like the tortoise in the race 🙂. *Interested? If you are not going to time-distract us too much from helping our clients, can add value and have the right attitude we would love to speak with you*

Our Testing Strategy: Small Molecules, Big Impact

At the start of the year, we launched an ongoing program to evaluate more and more of the key compounds cited in the scientific literature, associated with real physiological effects, including immune regulation, neuroprotection, anti-inflammatory action, antioxidant activity and so on.

We conduct lab testing to identify and quantify specific bioactive compounds in each mushroom species. These include:

- Triterpenes (e.g., ganoderic acids, betulinic acid)
- Small molecule metabolites (e.g., adenosine, ergothioneine)
- Cognitive-supporting compounds (e.g., hericenones, erinacines)

NMR (Nuclear Magnetic Resonance) for Identity Testing

NMR uses magnetic fields and radio waves to determine the molecular structure of a sample. It provides a detailed profile of the chemical components in the extract.

Why did we choose NMR?

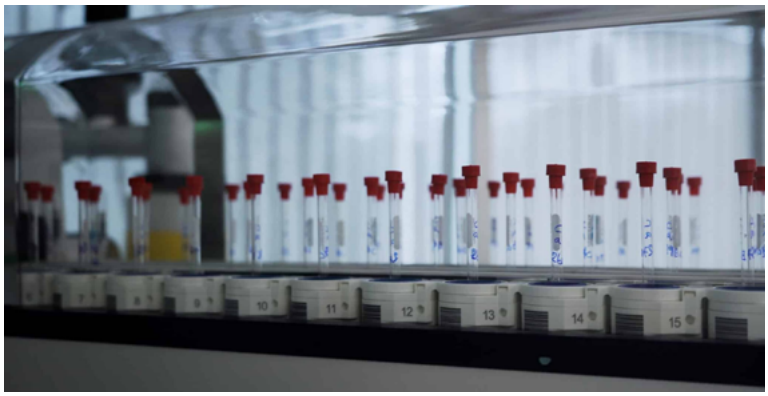
Comprehensive Profiling: It's useful for identifying active compounds like polysaccharides, triterpenoids, or other bioactive compounds.

Quantitative Analysis: It can precisely quantify components, ensuring batch-to-batch consistency, and measure ratios of key compounds, helping verify authenticity.

Non-Destructive: For us a decisive factor is that the sample is not destroyed during analysis, allowing for further, or repeat, testing if needed.

Standardisation Potential: I don't want to go into our strategic direction here but suffice to say it would be clearly useful to work towards standardisation and the data could be ideal for creating standardised profiles of authentic mushroom extracts for comparison.

Molecular Diagnostic Test Method (PIQ-MTD-003)



Identity is assessed using Purity-IQ Nuclear Magnetic Resonance (NMR) technology. Molecular diagnostics in this test use non-targeted metabolomic analysis to determine species authenticity and targeted analysis to evaluate product related attributes.

The spectra collected are analysed using an orthogonal approach wherein they are visually assessed and analysed against the Purity-IQ Global Registry using several statistical methods such as principal component analysis (PCA), linear discriminant analysis (LDA), and hierarchical cluster analysis (HCA).

Samples are scientifically analysed and fingerprinted according to Purity-IQ metabolomic standard operating procedures. Metabolomic fingerprint data is added to the registry, benchmarking a criterion for future batch/ lot identity and consistency verification.

"While traditional methods have long been relied upon in the industry, NMR stands out as a powerful and robust tool for addressing authenticity in today's rapidly evolving product landscape. Its advanced capabilities offer deep insights that support product verification with a high level of confidence. Understandably, it is natural for people to resist change and be hesitant around technologies that are less familiar or require specialized expertise. That is why we continue to focus on education and awareness—because as the industry grows, so must the tools we use to ensure quality and trust."

Amber Thelen, Purity-IQ Inc.

LC-MS (Liquid Chromatography–Mass Spectrometry) for Bioactive Compound Identification and Chemical Profiling

We use a high-precision analytical technique called **LC-ESI-QTOF-MS:**

- **Liquid Chromatography (LC)** separates each compound in the mixture.
- **Electrospray Ionization (ESI)** gently converts those compounds into ions.
- **Time-of-Flight Mass Spectrometry (TOF-MS)** accurately measures their mass.

Unlike standard triple quadrupole instruments, we use a Quadrupole Time-of-Flight (QTOF) mass spectrometer which gives us greater sensitivity, higher resolution, and more accurate mass identification. This allows us to:

- Detect a broader range of natural compounds — even in exceedingly small amounts.
- Confidently confirm their identity based on exact molecular weight.
- Deliver consistent and scientifically reliable results.

Accuracy & Quality Control

- We use internal standards to ensure consistency and reduce variability.
- Calibration curves help us quantify each compound with precision.
- Quality control samples are included in every batch to monitor accuracy.
- Blanks are tested to confirm there is no cross-contamination.

How We Extract the Good Stuff (if you want to go down the rabbit hole a bit further)

To analyse these compounds, we use a method called **"**Dilute and Shoot":

1. A small sample is mixed with a special liquid made of water, acetonitrile, and a mild acid.
2. It is shaken, cooled, spun in a centrifuge, and filtered.
3. The resulting liquid contains the compounds we want to measure.

This method helps us get accurate results from both powdered and liquid mushroom extracts.

What Exactly Do We Look For?

We identify and measure key natural/bioactive compounds of interest (also called metabolites) found in medicinal/functional mushrooms. These include:

- **Adenosine** – known for their potential energy and immune support/anti-inflammatory effects.
- **Betulinic Acid & Ganoderic Acids** – triterpenes studied for anti-inflammatory and antioxidant properties.
- **Ergosterol & Ergothioneine** – associated with cellular health and antioxidant activity.
- **Hericenones & Erinacines** – found in lion's mane, linked to brain and nerve health.
- **D-Mannitol** – natural sugar alcohols and acids commonly present in mushrooms.

Bioactive Compounds of Interest in Reishi, Chaga, and Lion's Mane

What are the bioactive compounds of interest (in Reishi, Chaga, and Lion's Mane)? And how much could you expect to see in their extract powders?

Please note our research in the table is a work in progress and some of the ranges below may not be entirely accurate. It is a really interesting area and of course once we know the yield ranges it begs the next question: What needs to change in cultivation, extraction, and other factors to increase yields? The rabbit hole never ends!

Compound	Mushroom Source	Typical Concentration Range (%)	Notes	Sources / Evidence
Inotodiol	Chaga	Minimum 0.1% - 0.7% average 0.19%	Lower solubility in water; found only in Chaga; concentration largely depends on the host tree.	Based on our own analysis of range of samples and • Comparative Study of Chaga (*Inonotus obliquus*) Dietary Supplements Using Complementary Analytical Techniques • Isolation, Physicochemical Characterization, and Biological Properties of Inotodiol, the Potent Pharmaceutical Oxysterol from Chaga Mushroom • Comparative Analyses of Bioactive Compounds in *Inonotus obliquus* Conks Growing on *Alnus* and *Betula*
Ganoderic acids (A, B, C1, D, etc.)	Reishi	0.5-30+% (typical 2-5%)	Highly dependent on the extraction method; alcohol extracts generally yield more.	Based on our own analysis of range of samples and In situ effervescence reaction-assisted mechanochemical extraction of ganoderic acids from *Ganoderma lucidum*
Betulinic acid	Chaga	0.003-0.7%	More concentrated in bark-adjacent conk; low solubility in water.	Based on our own analysis of range of samples.
Adenosine	Reishi, Chaga, Lion's Mane	0.01-0.25%	Water-soluble nucleoside; found in many fungi.	Based on our own analysis of range of samples.
Ergosterol	All (universal fungal sterol)	0.01-0.1%	Fat-soluble; typically higher amounts found in alcohol extracts.	Based on our own analysis of range of samples. One paper does suggest 2-6% although we have never seen these levels: A comparative study of conventional and supercritical carbon dioxide extraction methods for the recovery of bioactive compounds from Lion's Mane mushroom (*Hericium erinaceus*)
D-Mannitol	All (highest in Lion's Mane and Reishi)	0.1-3.7%	Water-soluble sugar alcohol; abundant in fruiting bodies.	Based on our own analysis of range of samples.
Ergothioneine	All (especially Lion's Mane)	0.01-0.15%	Antioxidant; varies with species and cultivation conditions.	Based on our own analysis of range of samples. Trace amounts in some samples.
Hericenones (C, D, E, J, etc.)	Lion's Mane	0.05-0.5% although using Supercritical CO2 it could rise to a massive 4.335%	Found mainly in the fruiting body; fat-soluble.	Based on our own analysis of range of samples and A comparative study of conventional and supercritical carbon dioxide extraction methods for the recovery of bioactive compounds from Lion's Mane mushroom (*Hericium erinaceus*)
Erinacine A	Lion's Mane (mycelium)	Traces amount in fruiting bodies. We have not tested mycelium products	Primarily in cultured mycelium; low levels in fruiting body extracts.	Based on our own analysis of range of samples.

Shared Species Compounds of Interest

Across our PureMushroom™ product range - Initially PureChaga™, PureReishi™, and PureLionsMane™ several important compounds are consistently found. These include **Adenosine**, **D-Mannitol**, **Ergosterol**, and **Ergothioneine** (in Reishi and Lion's mane, not Chaga).

The presence and quantification of these compounds can help confirm the authenticity of the mushroom material and serve as supporting indicators of extraction quality, when interpreted with species-specific data.

Adenosine Potential Benefits: Adenosine plays a vital role in cellular energy transfer and has potential anti-inflammatory effects, which may support cardiovascular health and reduce anxiety.

References:

1. Extracellular adenosine signaling in molecular medicine. **Eltzschig, H.K.** *J Mol Med, 2013;91(2):141–146.*
   - **Summary:** This review discusses the role of extracellular adenosine signaling through its four G-protein coupled receptors (Adora1, Adora2a, Adora2b, and Adora3) in various physiological and pathological processes, including cardiovascular function, inflammation, and cancer.
2. Adenosine and Inflammation: Here, There and Everywhere. **Pasquini, S., Contri, C., Borea, P.A. et al.** *Int J Mol Sci, 2021;22(14):7685.*
   - **Summary**: This article explores adenosine's potent modulatory effects on inflammation and its potential as a pharmacological target in various diseases where inflammation is a key factor.
3. Targeting Adenosine in Cancer Immunotherapy to Enhance T-Cell Function**. Vigano, S., Alatzoglou, D., Irving, M. et al.** *Front Immunol, 2019;10:925.*
   - **Summary**: This review focuses on how elevated adenosine levels in the tumor microenvironment suppress protective immunity, particularly T-cell function, and discusses therapeutic strategies to block the adenosine pathway to enhance cancer immunotherapy.

D-Mannitol Potential Benefits: D-Mannitol acts as a diuretic and may offer protective effects on renal function while exhibiting antioxidant properties.

References:

1. D-mannitol modulates glucose uptake ex vivo; suppresses intestinal glucose absorption in normal and type 2 diabetic rats**. Chukwuma, C.I., Matsabisa, M.G., Erukainure, O.L. et al.** *Food Biosci, 2019;29:30–36.*
   - **Summary**: This study suggests that D-mannitol may be used as a dietary supplement to control postprandial blood glucose levels by reducing intestinal glucose absorption and increasing muscle glucose uptakes.

Ergosterol Potential Benefits: Ergosterol is known for its role as a precursor to vitamin D2 and is associated with antimicrobial effects and immune support.

References:

1. Potential Beneficial Effects and Pharmacological Properties of Ergosterol, a Common Bioactive Compound in Edible Mushrooms. **Rangsinth, P., Sharika, R., Pattarachotanant, N. et al.** *Foods, 2023;12(13):2529.*
    - **Summary**: This review discusses the pharmacological effects of ergosterol, including its antimicrobial, antioxidant, anticancer, antidiabetic, and anti-neurodegenerative activities. The article aims to provide an overview of the available evidence regarding the pharmacological effects of ergosterol and its underlying mechanisms of action.
2. Ergosterol and Lanosterol Derivatives: Synthesis and Possible Pharmacological Applications. **Stefaniak-Skorupa, J., Milewska, M.J.** *ChemMedChem, 2025:e202400948*
    - **Summary**: This study explores the synthesis of ergosterol and lanosterol derivatives and their potential pharmacological applications, including antimicrobial, antioxidant, anticancer, antidiabetic, and anti-neurodegenerative effects.

Ergothioneine Potential Benefits: Ergothioneine is a powerful antioxidant that may protect cells from oxidative stress, enhance immune support, and provide neuroprotective effects.

References:

1. Ergothioneine: A Stress Vitamin with Antiaging, Vascular, and Neuroprotective Roles? **Paul, Bindu D.** *Antioxid Redox Signal, 2022;36(16-18):1306–1317.*
    - **Summary**: This review discusses the role of ergothioneine (ET) in promoting neuronal differentiation, increasing neurotrophin levels in the brain, and preventing neurotoxicity induced by excitotoxins and chemotherapeutic agents. It also highlights ET's potential in ameliorating learning and memory deficits and its involvement in the gut-brain axis via microbiota interactions.
2. Ergothioneine as a Natural Antioxidant Against Oxidative Stress-Related Diseases. **Fu, T.T., Shen, L.** *Front Pharmacol, 2022;13:850813.*
    - **Summary**: This paper discusses the antioxidant properties of ergothioneine (EGT) in animals and its close relationship with oxidative stress diseases. It summarizes the possible therapeutic or protective mechanisms of EGT, including its role in improving endothelial cell senescence and vascular relaxation damage caused by hyperglycemia in diabetes.
3. Ergothioneine: an under recognised dietary micronutrient required for healthy ageing?**. Tian, X.J., Thorne, J.L., Moore, J.B.** *Br J Nutr, 2023;129(1):104–114.*
    - **Summary**: This article reviews the potential role of ergothioneine in healthy ageing, highlighting its accumulation in tissues exposed to oxidative stress and its protective effects against ischemia-induced myocardial damage and reperfusion injury in various organs.

Species-Specific Compounds of Interest

However, what truly defines the functional potential of each mushroom are its **species-specific compounds**. For the purposes of this report these include:

- **Ganoderic acids** in Reishi *(Ganoderma lucidum)* — these triterpenes are among the most studied compounds for their potential immune-supporting and anti-inflammatory effects.
- **Inotodiol** and **Betulinic acid** in Chaga *(Inonotus obliquus)* compounds studied for their antioxidant and antitumor activity.
- **Hericenones** and **Erinacines** in Lion's Mane (*Hericium erinaceus*) linked to nerve growth factor (NGF) stimulation and cognitive support.

Our analytical testing approach quantifies both the shared metabolic markers and these mushroom-specific bioactive compounds, ensuring that each PureMushroom™ extract not only meets our purity benchmarks but delivers acceptable levels. In the future (in collaboration with other researchers) we hope to find evidence that shows the levels found in our extracts have the potential to deliver on their targeted health functions.

MUSHEEZ®

Potential Health Benefits of Common Compounds Found in Reishi

Ganoderic Acids A, B, C1, C2, C6, D Potential Benefits: Ganoderic acids have demonstrated anti-inflammatory, hepatoprotective, and antiproliferative effects on cancer cells. It has also been shown to enhance the cytotoxic effects of cisplatin against various human gallbladder cancer cell lines in vitro.

References:

1. Ganoderic acid A from *Ganoderma lucidum* ameliorates lipid metabolism and alters gut microbiota composition in hyperlipidemic mice fed a high-fat diet**. Guo, W.L., Guo, J.B., Liu, B.Y. et al.** *Food Funct, 2020;11(8):6818–6833.*
   - **Summary**: This study investigates the effects of Ganoderic acid A (GA-A) on lipid metabolism in obese mice. The results indicate that GA-A significantly improves lipid profiles and modulates lipid metabolism-related gene expression.
2. Metabolomic Insights into the Mechanisms of Ganoderic Acid: Protection against α-Amanitin-Induced Liver Injury. **Zheng, C., Lv, S.F., Ye, J.F. et al.** *Metabolites, 2023;13(11):1164.*
   - **Summary**: In this in vitro animal study Ganoderic Acid A demonstrates a potential ability to act as a hepatoprotective agent in case of Alpha-Amanitin induced liver injury..
3. Ganoderic acid A potentiates cisplatin's cytotoxicity on gallbladder cancer cells by promoting DNA damage and inhibiting cell stemness**. Zhang, G., Lan, H.M., Wu, J. et al.** *World J Surg Oncol, 2025;23(1):148.*
   - **Summary:** This recent study gives us more insight about the mechanic of action of Ganoderic Acid A and the way it synergistically works together with cisplati.
4. Triterpenes from the Spores of *Ganoderma lucidum* and their inhibitory activity against HIV-1 protease. **Min, B.S., Nakamura, N., Miyashiro, H. et al.** *Chem Pharm Bull, 1998;46(10):1607–1612.*
   - **Summary**: Ganoderic acid B was shown to inhibit HIV-1 protease, suggesting antiviral potential among Ganoderma triterpenes.
5. Ganoderic acid C1 isolated from the anti-asthma formula, ASHMI™ suppresses TNF-α production by mouse macrophages and peripheral blood mononuclear cells from asthma patients. **Liu, C.D., Yang, N., Song, Y. et al.** *Int Immunopharmacol, 2015;27(2):224–231.*
   - **Summary**: This study identifies Ganoderic acid C1 (GAC1) as a compound that significantly reduces TNF-α production in immune cells, suggesting its potential in treating inflammatory conditions like asthma.
6. Ganoderic acid D prevents oxidative stress-induced senescence by targeting 14-3-3ε to activate CaM/CaMKII/NRF2 signaling pathway in mesenchymal stem cells. **Yuan, H., Xu, Y., Luo, Y. et al.** *Aging Cell, 2022;21(9):e13686.*
   - **Summary:** The study demonstrates that Ganoderic acid D (GA-D) can delay cellular senescence and aging in mice by enhancing antioxidant defenses and modulating specific signaling pathways.
7. Ganoderic acid D attenuates gemcitabine resistance of triple-negative breast cancer by promoting HIF-1α destabilization. **Luo, B., Song, L., Chen, L. et al.** *Phytomedicine, 2024;129:155675.*
   - **Summary:** This research indicates that Ganoderic acid D (GA-D) can enhance the efficacy of chemotherapy in triple-negative breast cancer by targeting hypoxia-inducible factors.

Lucidenic Acids Potential Benefits: Lucidenic acids demonstrate anti-inflammatory, neuroprotective, and antidiabetic properties.

References:

1. A Review on the Sources, Structures, and Pharmacological Activities of Lucidenic Acids. **Zheng, C., Rangsinth, P., Shiu, P.H.T. et al.** *Molecules, 2023;28(4):1756.*
   - **Summary:** This comprehensive review summarizes the sources, chemical structures, and pharmacological activities of various lucidenic acids, including Lucidenic acid D. The authors discuss the potential neuroprotective effects of lucidenic acids, highlighting their antioxidant and anti-inflammatory properties, which are crucial in neuroprotection.
2. Influence of cultivation substrate on antioxidant activities and triterpenoid profiles of the fruiting body of *Ganoderma lucidum*. **Luo, G., Pan, Z., Liu, Z. et al.** *Front Nutr, 2024;11:1329579.*
   - **Summary:** This study investigates how different cultivation substrates affect the antioxidant activities and triterpenoid profiles of *G. lucidum*. The researchers identified various lucidenic acids, including Lucidenic acid D1, and noted their significant antioxidant activities, suggesting potential neuroprotective benefits.

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Potential Health Benefits of Common Compounds Found in Chaga

Betulinic Acid Potential Benefits: Has shown anticancer, anti-inflammatory, and neuroprotective properties.

References:

1. Anti-Inflammatory Activities of Betulinic Acid: A Review. **Oliveira-Costa, J.F., Meira, C.S., Neves, M.V.G.d. et al.** *Front. Pharmacol, 2022;13:883857.*
   - **Summary:** This comprehensive review discusses the broad-spectrum anti-inflammatory activity of betulinic acid, highlighting its effects on various inflammatory mediators and pathways.
2. Betulinic Acid for Cancer Treatment and Prevention. **Fulda, S.** *Int J Mol Sci, 2008;9(6):1096–1107.*
   - **Summary:** This article explores the potent antitumor activities of betulinic acid, focusing on its ability to trigger the mitochondrial pathway to apoptosis in cancer cells.
3. Betulinic acid impairs metastasis and reduces immunosuppressive cells in breast cancer models. **Zeng, A.Q., Yu, Y., Yao, Y.Q. et al.** *Oncotarget, 2018;9(3):3794–3804.*
   - **Summary:** This study demonstrates that betulinic acid can suppress tumorigenesis in breast cancer by inhibiting metastasis and reducing immunosuppressive cells.
4. Discovery of betulinic acid as a selective inhibitor of human melanoma that functions by induction of apoptosis. **Pisha, E., Chai, H.B., Lee, I.S. et al.** *Nat Med, 1995;1(10):1046–1051.*
   - **Summary:** Identified betulinic acid as a selective compound with cytotoxic activity against human melanoma cells, marking it as a potential anticancer agent.

Inotodiol Potential Benefits: Inotodiol has been studied for its antiviral, anti-inflammatory, and immune-boosting properties, contributing to overall health and well-being.

References:

1. Inotodiol protects PC12 cells against injury induced by oxygen and glucose deprivation/restoration through inhibiting oxidative stress and apoptosis. **Li, Y., Zhang, W.T., Chen, C. et al.** *J Appl Biomed, 2018;16(2):126–132.*
   - **Summary:** This study investigated the neuroprotective effects of Inotodiol on PC12 cells subjected to oxygen and glucose deprivation/restoration (OGD/R), a model for ischemic injury. The results demonstrated that Inotodiol significantly reduced oxidative stress and apoptosis in PC12 cells by modulating the expression of apoptosis-related proteins, including Caspase-3, Bcl-2, and Bax.
2. Neuroprotective effects of a new triterpenoid from edible mushroom on oxidative stress and apoptosis through the BDNF/TrkB/ERK/CREB and Nrf2 signaling pathway in vitro and in vivo. **Kou, R.W., Xia, B., Han, R. et al.** *Food Funct, 2022;13(23):12121–12134s.*
   - **Summary:** This research explores the neuroprotective properties of 2α-hydroxy-inotodiol (2α-HI), a triterpenoid isolated from *Inonotus obliquus*. The compound was found to effectively protect SH-SY5Y cells against hydrogen peroxide-induced oxidative stress by activating the Nrf2 and BDNF/TrkB/ERK/CREB signaling pathways, suggesting its potential in ameliorating neurodegenerative diseases.

Potential Health Benefits of Common Compounds Found in Lions Mane

Hericenones C, D, E, J Potential Benefits: Hericenones may promote nerve growth factor (NGF) synthesis, which is crucial for neurogenesis and neuroprotection.

References:

1. Hericenones C, D and E, stimulators of nerve growth factor (NGF)-synthesis, from the mushroom *Hericium erinaceum*. **Kawagishi, H., Ando, M., Sakamoto, H., Yoshida, S., Ojima, F., Ishiguro, Y., Ukai, N., Furukawa, S.** *Tetrahedron Lett, 1991;32(35):4561–4564.*
   - **Summary:** This study reports the isolation of hericenones C, D, and E from the fruiting bodies of *Hericium erinaceus*. These compounds were found to stimulate the synthesis of NGF, suggesting potential neurotrophic effects..
2. Hericenone C attenuates the second phase of formalin-induced nociceptive behavior by suppressing the accumulation of CD11c-positive cells in the paw epidermis via phosphorylated P65. **Li J., Hamamura K., Yoshida Y. et al.** *Biochem Biophys Res Commun, 2024;720:150077.*
   - **Summary:** This study investigates the analgesic effects of hericenone C in a mouse model. The results indicate that hericenone C significantly reduces pain behavior in the second phase of the formalin test, suggesting its potential as an analgesic agent.
3. Neuroprotective Metabolites of *Hericium erinaceus* Promote Neuro-Healthy Aging. **Roda, E., Priori, E.C., Ratto, D. et al.** *Int J Mol Sci, 2021;22(12):6379.*
   - **Summary:** This preclinical study in mice evaluated the effects of a two-month oral supplementation with a standardized *Hericium erinaceus* extract containing defined amounts of Erinacine A, Hericenone C, Hericenone D, and L-ergothioneine. The findings demonstrated significant efficacy and highlight the potential of *H. erinaceus* extracts as promising adjuncts for supporting healthy aging and elderly care.
4. An endoplasmic reticulum (ER) stress-suppressive compound and its analogues from the mushroom *Hericium erinaceum.* **Ueda, K., Tsujimori, M., Kodani, S. et al.** *Bioorg Med Chem, 2008;16(21):9467–9470.*
   - **Summary:** This research identifies Hericenone J as a compound isolated from *Hericium erinaceus* that exhibits protective effects against ER stress-induced cell death in Neuro2a cells, indicating its potential neuroprotective properties.

Hericenes Potential Benefits: Hericenes C and D have been linked to neuroprotective effects and may promote neurogenesis.

References:

1. Total syntheses and endoplasmic reticulum stress suppressive activities of hericenes A–C and their derivatives. **Kobayashi, S., Hamada, Y., Yasumoto, T. et al.** *Tetrahedron Lett, 2018;59(18): 1733–1736.*
   - **Summary:** This study reports the neuroprotective effects of Hericenes B and C against endoplasmic reticulum (ER) stress-dependent cell death.
2. Hericerin derivatives activates a pan-neurotrophic pathway in central hippocampal neurons converging to ERK1/2 signaling enhancing spatial memory. **Martínez-Mármol, R., Chai, Y.J., Conroy, J.N. et al.** *J Neurochem, 2023;165(6):791-808.*
   - **Summary:** Hericene A promoted axon outgrow and neurite branching in cultured hippocampal neurons, demonstrated potent neurotrophic activities. Also, in an animal test (performed on ICR male mice) it significantly enhanced hippocampal memory.

Erinacine A Potential Benefits: Erinacine A is known for its ability to stimulate nerve growth factor synthesis, potentially enhancing cognitive and neuroprotective effects.

References:

1. Erinacines A, B and C, strong stimulators of nerve growth factor (NGF)-synthesis, from the mycelia of *Hericium erinaceum.* **Kawagishi, H., Shimada, A., Shirai, R. et al.** *Tetrahedron Lett, 1994;35(10): 1569-1572.*
   - **Summary:** This study reports the isolation and chemical structure of diterpenoids, Erinacines A, B and C from the mycelium of *Hericium erinaceus*, and their potent Nerve Growth Factor (NGF)-synthesis stimulating activity.
2. Neuroprotective Effects of Erinacine A on an Experimental Model of Traumatic Optic Neuropathy. **Hsu, C.L., Wen, Y.T., Hsu, T.C. et al.** *Int J Mol Sci, 2023;24(2):1504.*
   - **Summary:** This study investigated the neuroprotective effects of Erinacine A in a rat model of traumatic optic neuropathy. The results demonstrated that Erinacine A treatment preserved visual function and retinal ganglion cell density by suppressing apoptosis, neuroinflammation, and oxidative stress.
3. Prevention of Early Alzheimer's Disease by Erinacine A-Enriched *Hericium erinaceus* Mycelia: A Pilot Double-Blind Placebo-Controlled Study. **Li, I.C., Chang, H.H., Lin, C.H. et al.** *Front Aging Neurosci, 2020;12:155.*
   - **Summary:** This pilot clinical trial evaluated the efficacy and safety of Erinacine A-enriched *Hericium erinaceus* mycelia in patients with mild Alzheimer's disease. Over 49 weeks, participants receiving the supplement showed significant improvements in cognitive assessments compared to the placebo group, suggesting its potential in preventing cognitive decline.

Hard Data. Charts. Numbers. The Good Stuff.

At MUSHEEZ® we are increasing our level of transparency as this report demonstrates but there are some limits for commercial reasons and protecting our intellectual property etc.

Anyway, we tested a number of extracts from brands on sale in the EU and also samples from Chinese and EU manufacturers. We do not name names obviously, but we can say with almost 100% certainty that some well-known brands either do not know, or do not care, what is in their product.

The spread of results was huge. Shockingly so. There are products being sold that contain mere traces of the target mushroom material and a lot of filler, or substitute material. Others appear authentic but exceptionally low for some key compounds (suggesting inferior quality source material or poor extraction depending on the case).

But there were also some nice surprises. There are some genuine and reasonable/superior quality products out there, thankfully!

For confidentiality reasons, we reserve sharing more in-depth details for our existing clients and select business partners exclusively.

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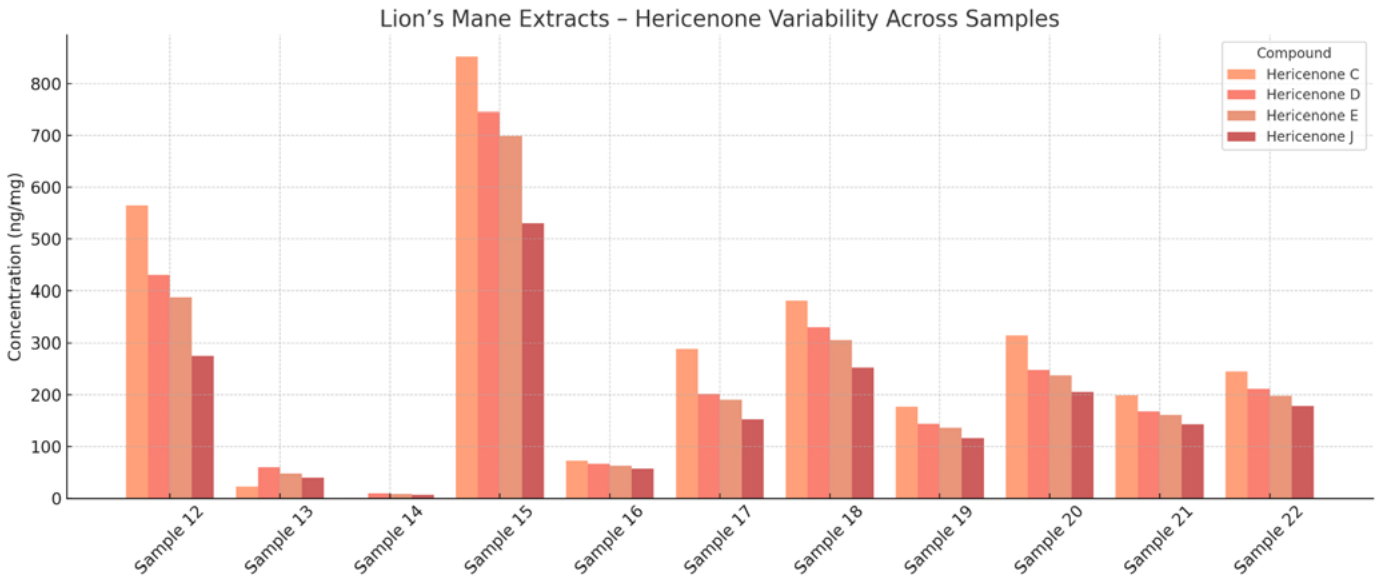
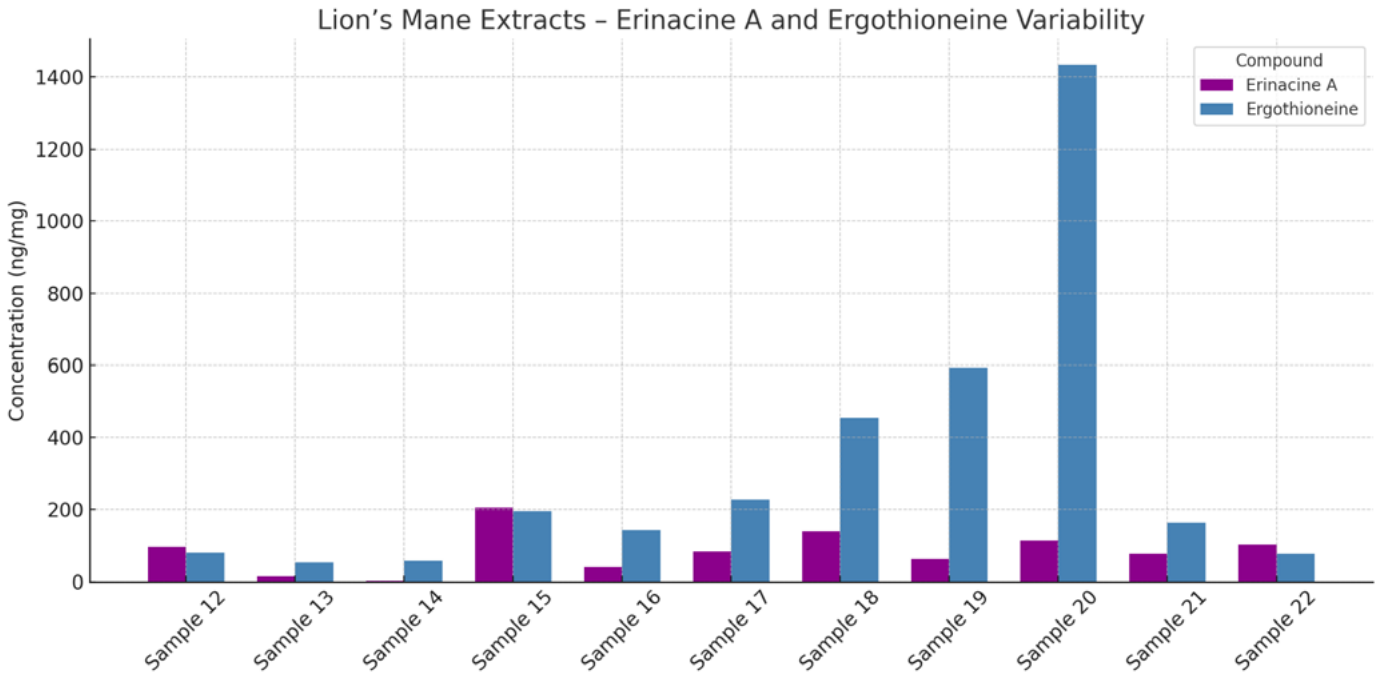
Lion’s Mane Compound Test Data and Analysis

Lion’s mane extracts are the most popular by far (2024/5). The quality range is vast.





Compound	Calculated. Concentration (ng/mg)										
	Sample 12	Sample 13	Sample 14	Sample 15	Sample 16	Sample 17	Sample 18	Sample 19	Sample 20	Sample 21	Sample 22
Adenosine	899.4	2331.1	465.1	215.1	1213.9	674.5	631.2	766.1	257.5	2111.5	148.1
D-Mannitol	14859.6	14570.7	20066.5	56322.1	37044.4	33642.3	24958.2	26077.7	25428.5	17421.0	47869.5
Ergosterol	484.7	1043.5		321.1	490.1	397.6	161.0	1.4	178.2	230.1	160.8
Ergothioneine	79.8	52.8	57.9	194.8	141.6	228.4	454.2	593.7	1434.7	163.7	77.5
Hericenone C	565.2	23.2	0.6	852.3	71.7	287.9	381.4	176.3	313.6	198.7	244.2
Hericenone D	431.1	58.9	9.3	745.1	65.8	201.3	329.7	142.6	247.1	167.3	211.4
Hericenone E	388.0	47.2	8.6	699.0	62.4	190.1	305.8	135.1	236.3	159.9	198.3
Hericenone J	274.5	39.8	6.7	531.2	56.9	151.7	251.4	115.8	205.4	142.5	177.8
Hericenone C isomer	528.1	20.1	0.5	793.4	69.3	271.2	342.1	163.3	299.5	187.5	229.6
Hericenone D isomer	407.7	52.0	7.7	721.0	63.7	213.5	317.2	133.9	241.6	162.1	202.9
Hericenone E isomer	365.2	43.9	7.1	676.6	60.3	184.7	293.9	126.2	230.4	154.9	189.4
Hericenone J isomer	249.0	36.2	5.5	513.0	55.0	146.2	241.0	108.1	200.1	137.9	172.2
Hericene C	194.3	24.7	4.1	361.5	48.9	108.2	172.9	85.3	143.0	102.6	130.1
Hericene D	187.1	22.1	3.9	348.2	46.2	101.3	161.8	80.6	136.1	98.7	123.3
Erinacine A	97.2	14.5	2.2	205.9	39.8	83.6	138.4	62.0	115.2	76.9	102.5

Simplified Interpretation of Lion's Mane Test Data:

Observation	Interpretation
Samples 12, 15, 20	Show strong overall profiles — high across hericenones, hericenone isomers, hericenes, and ergothioneine. Likely high-quality dual extracts with full-spectrum compound preservation.
Sample 14	Exceptionally high D-mannitol (56,322 µg/g) but extremely low hericenones/hericenes and low ergosterol — suggests a water extract only, and possibly poor fruiting body quality or early harvest.
Samples 13 & 14	Weakest nootropic profiles. Very low levels of hericenones (many <10 µg/g) and ergosterol is undetected — possible signs of ineffective extraction or immature/low-density biomass.
Sample 19	High ergothioneine (593.7 µg/g) and solid hericenone isomer levels — but low primary hericenones — possibly an extract focused on antioxidant profile more than nootropics.
Sample 18	Strong across the board: good erinacine A (138.4 µg/g), balanced hericenones and isomers — a model dual extract candidate.
Samples 21 & 22	Moderate in hericenones and ergothioneine, but some of the lowest ergosterol levels — may point to water-only extracts or loss during processing.

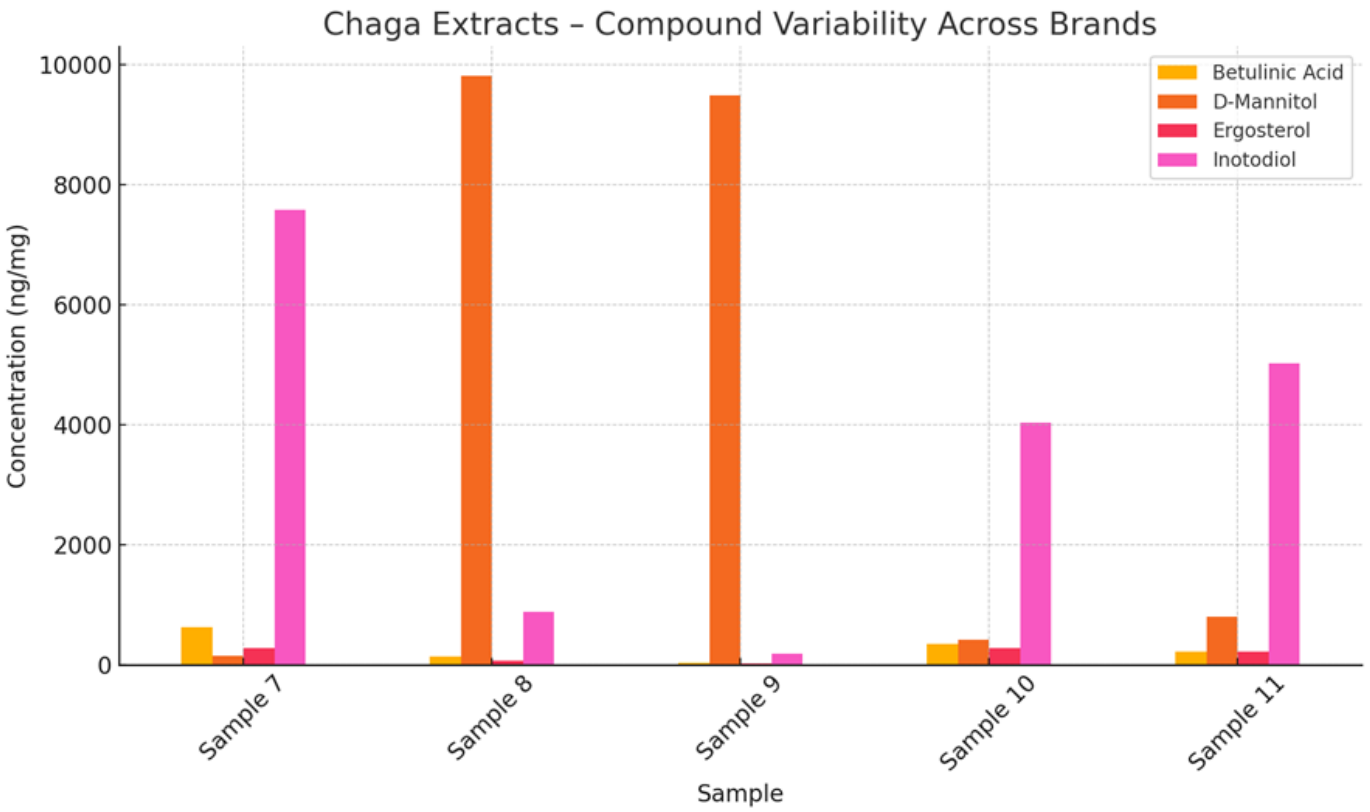
A Few Takeaways

- Hericenone C and D remain the most prominent nootropic markers. Sample 15 shows the highest values for both (>850 µg/g).
- Erinacine A, while primarily a mycelium marker, shows strong levels in Samples 15, 18, and 20, which is notable since the fruiting body usually shows little or none — this may suggest some cross-contamination or advanced fruiting-body expression (rare but possible). Note: While Erinacine A is typically confined to mycelium, rare cases of 'advanced fruiting-body expression' — where the fruiting body biosynthesises minor amounts of mycelium-associated compounds — have been documented. Alternatively, and more likely, elevated erinacine levels suggest the presence of mycelial biomass in the raw material. In other words, it has probably been mixed with some mycelium. Another option although unlikely is that very young fruiting bodies (way earlier than typical 33 days or similar) were harvested. They can also contain Erinacine A in considerable amounts, but it would mean lower weight yield, less money, so, unlikely.
- Ergothioneine peaks in Sample 20 (1,434.7 µg/g), suggesting high antioxidant potential and possibly optimal harvest timing or cultivar.

Red Flags

- **Sample 14:** High sugar content, low actives — possibly a weak or overly diluted extract.
- **Samples 13 & 14:** Low ergosterol and nearly flat nootropic profile — would fail most QC criteria.

Chaga Compound Test Data and Analysis

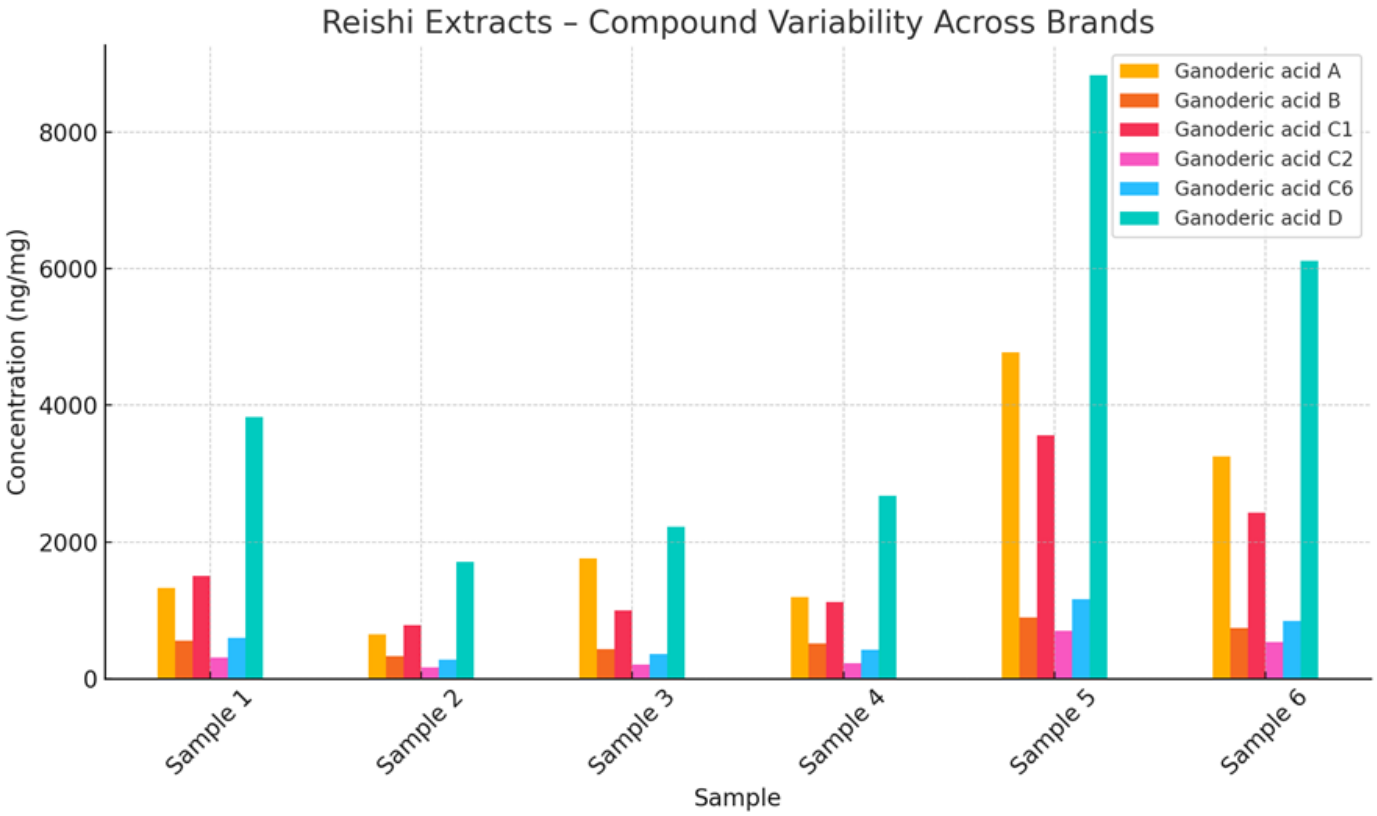


Compound	Calculated. Concentration (ng/mg)				
	Sample 7	Sample 8	Sample 9	Sample 10	Sample 11
Adenosine	-	31.6	87.1	67.7	700.5
Betulinic Acid	627.0	135.3	27.9	344.7	213.4
D-Mannitol	150.6	9810.4	9486.3	418.6	801.7
Ergosterol	276.7	60.5	14.2	273.9	220.3
Inotodiol	7580.0	882.3	183.5	4032.3	5016.7

Simplified Interpretation of Chaga Test Data:

Observation	Interpretation
Sample 7, 10, 11	High inotodiol, moderate to high betulinic acid, consistent with authentic Chaga extract.
Sample 8	Very low inotodiol (882.3 µg/g), high ergosterol (60.5 µg/g), and high D-mannitol → could indicate either immature conk, degraded raw material, or contamination with other fungal matter.
Sample 9	Lowest inotodiol (183.5 µg/g), lowest betulinic acid (27.9 µg/g), and lowest ergosterol (14.2 µg/g) → this is a very poor-quality Chaga extract, possibly oxidized, over-processed, or from spent biomass.
Ergosterol anomaly	Ergosterol is not typically dominant in Chaga, so elevated levels (esp. alongside low inotodiol) may suggest inclusion of non-Chaga fungal biomass or fermentation-derived material.

Reishi Compound Test Data and Analysis



Compound	Calculated. Concentration (ng/mg)					
	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5	Sample 6
Adenosine	31.3	134.1	27.5	1538.3	732.2	
D-Mannitol	2804.3	13489.4	17109.6	1272.5	34519.2	17266.1
Ergosterol	422.8	221.8		329.1	258.6	376.0
Ergothioneine	3.2	7.4	57.0	1.9	57.8	28.0
Ganoderic acid A	1327.2	644.8	1758.8	1196.4	4775.8	3248.0
Ganoderic acid B	549.9	327.6	432.1	507.3	892.1	734.6
Ganoderic acid C1	1498.5	776.1	990.7	1120.4	3564.9	2431.5
Ganoderic acid C2	308.6	162.8	200.4	224.7	698.1	532.7
Ganoderic acid C6	590.8	279.1	354.9	415.2	1163.5	838.1
Ganoderic acid D	3831.0	1701.5	2220.9	2674.3	8840.3	6111.7
Lucidenic acid D	24.8	14.9	19.4	21.0	45.2	33.8

Simplified Interpretation of Reishi Test Data:

Observation	Interpretation
Sample 5 & 6	Strong profiles across all ganoderic acids (esp. A, C1, D), high D-mannitol, and decent ergosterol → likely high-quality dual extracts from mature fruiting body.
Sample 4	Exceptionally high adenosine (1538.3 µg/g) with balanced triterpenes → could suggest water-rich extract or good dual extraction with excellent adenosine preservation.
Sample 1 & 3	Lower triterpene levels overall, moderate ergosterol and mannitol → possibly under-extracted or low-ratio extracts, though still within plausible range for Reishi.
Sample 2	Low ganoderic acids, low ergosterol (221.8 µg/g), and very high D-mannitol (13489.4 µg/g) → may indicate immature fruiting body or water-heavy extract with low alcohol fraction.
Lucidenic acid D	Low across all samples (14.9–45.2 µg/g), which is expected due to its minor role in overall triterpene profile, but still a useful marker for product integrity.

A Deeper Dive into a Reishi Extract

Results Summary for our PureReishi™ water extract (15:1, 20% beta glucans)

NOTE: Bioactive compound levels vary between batches. This is due to natural variation — mushrooms are not synthetic isolates. 100% consistency is elusive. So that is why each batch is independently LG-MS tested to ensure transparency. Once we have enough data, we may be able to guarantee certain average levels for some bioactive compounds. Watch this space. It will take a while.

Did you notice in the data below that over 2.11% triterpenes were detected. This dispels the myth that dual extraction is needed to get the triterpenes (ganoderic and Lucidenic acids) out. Dual extraction would of course increase the amounts (approximately double) .

Analyte Peak Name	Concentration (ng/mg)	Analyte RT
Adenosine	1538.3	3.61
D-Mannitol	34519.2	0.75
Ergosterol	258.6	7.97
Ergothioneine	57.8	0.87
Ganoderic acid A	4775.8	4.45
Ganoderic acid B	2037.6	4.36
Ganoderic acid C1	4628.2	4.51
Ganoderic acid C2	888.5	4.36
Ganoderic acid C6	990.4	4.33
Ganoderic acid D	12182.4	4.39
Lucidenic Acid D	461.6	4.43
Total Measured Triterpenes (others may be present that we cannot measure)	21188.7 (2.11%)	

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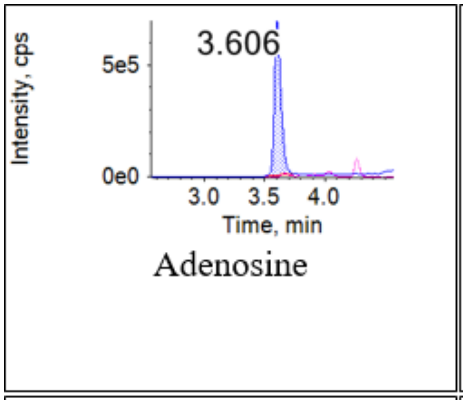
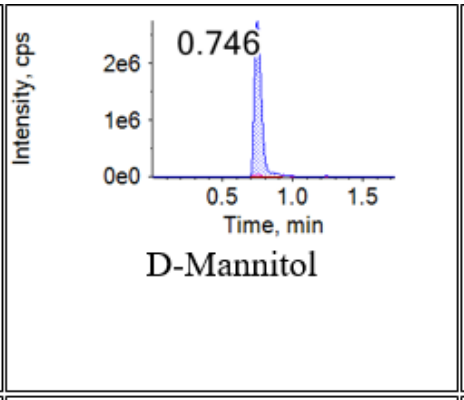
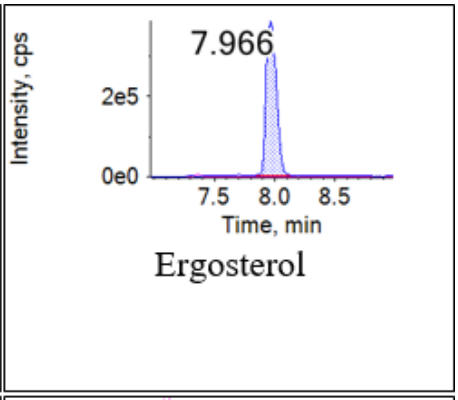
Analyte Peak Reviews



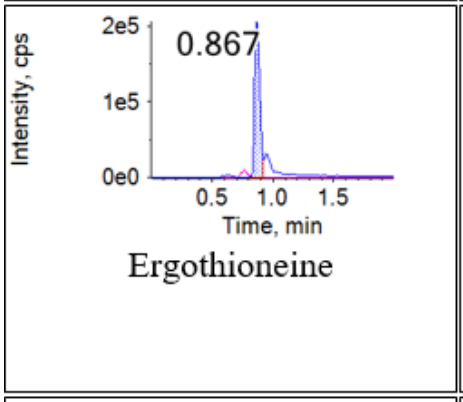
Adenosine



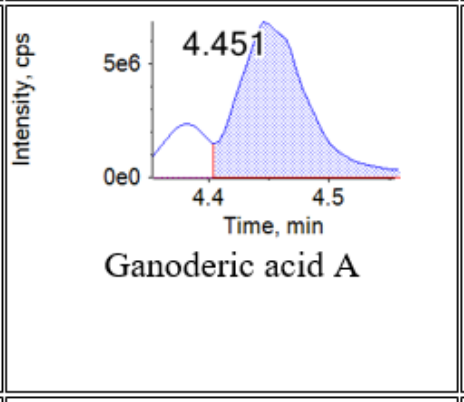
D-Mannitol



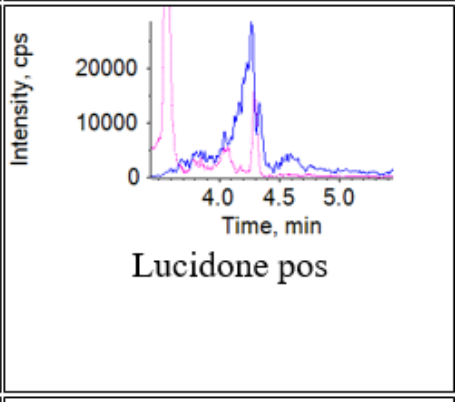
Ergosterol



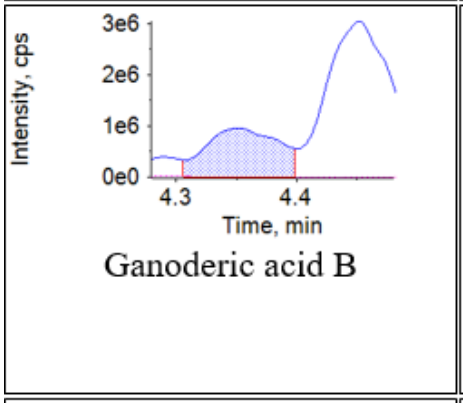
Ergothioneine



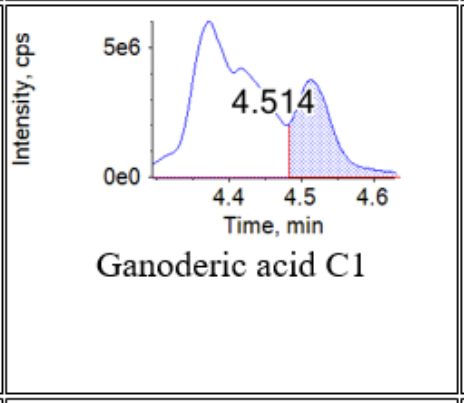
Ganoderic acid A



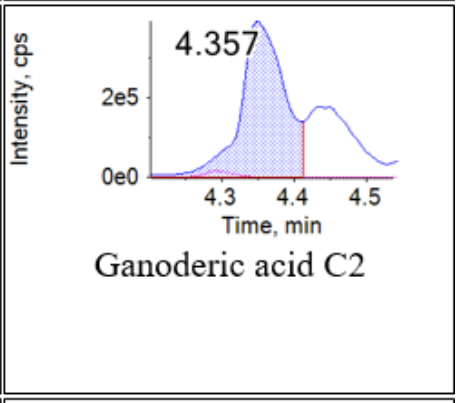
Lucidone pos



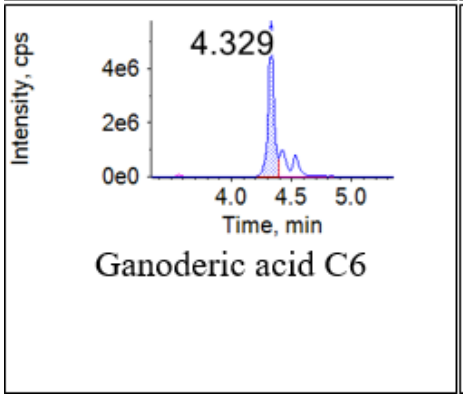
Ganoderic acid B



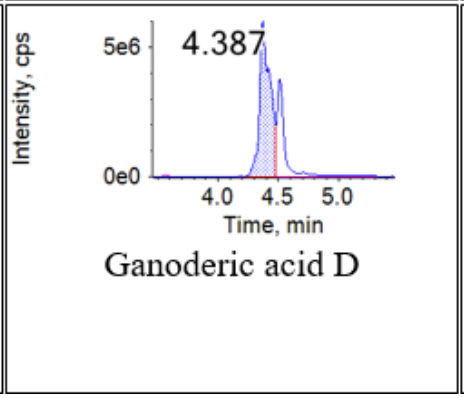
Ganoderic acid C1



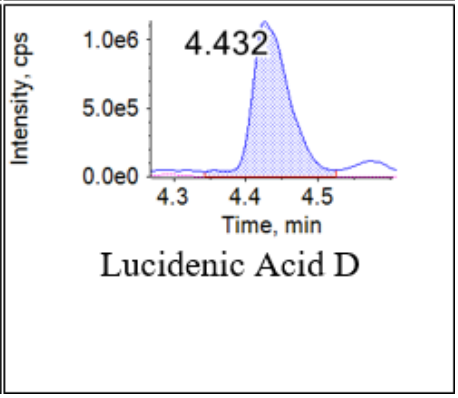
Ganoderic acid C2



Ganoderic acid C6



Ganoderic acid D



Lucidenic Acid D

Certification

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services@purity-iq.com
150 Research Lane, Suite 102
Guelph, ON, N1G 4T2, Canada

Purity-IQ Global Registration No:PIQ04212025-5158

Organic Reishi water extract powder

This product has been scientifically analyzed, and deemed authentic according to Purity-IQ genomic and/or metabolomic standard operating procedures, and is officially registered within the Purity-IQ Global Registry.

Target Species: Ganoderma lingzhi
Product code: PBORWEP
Lot/Batch Number: 20240707
Company Address: **Natural Chaga OU**
Korve
Pillapalu, Harjumaa,
74502, Estonia

Date issued: 05/05/2025

Authorized by: Director, Product Development

The Purity-IQ global registration certificate number correlates to laboratory certificates of analysis and has been verified by Purity-IQ.

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Guelph, ON, N1G 4T2, Canada

Certificate of Analysis - PIQ04212025-5158

Natural Chaga OU
Korve
Pillapalu, Harjumaa,
74502, Estonia

Contact 1: Robin Gurney **Email 1:** business@musheez.eu
Date Received: 05/01/2025
Date Reported: 05/05/2025

Purity-IQ Global Registration No: PIQ04212025-5158

Product Name: Organic PureReishi™ Water Extract Powder
Date Sampled: 04/17/2025
Lot/Batch Number: 20240707
Product Code: PBORWEP
Plant/fungal Part: Fruiting body

Metabolomic Identification Analysis

Non-targeted and targeted Verification Analysis	Result	Parameter
Identity verification	Positive identification	The submitted sample name, and its molecular profile agree with molecular profiles and sample names of the Purity-IQ Global Registry.
Addition	Not Detected	Adding substances to mimic or enhance certain characteristics, such as flavor, colour, or weight.
Substitution	Not Detected	Replacing or partially replacing a product with a lower-cost, inferior, or different substance, including other species, parts of the plant, synthetic alternatives or imitations.
Dilution	Not Detected	Reducing the concentration of a product by adding filler or diluent beyond the concentration claimed.

Analysis	Method	Result
Ganoderma lingzhi	PIQ-MTD-003	Positive identification

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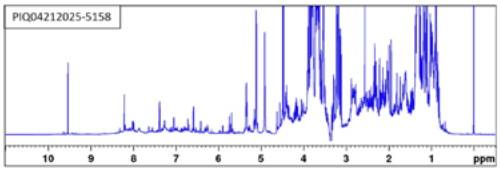
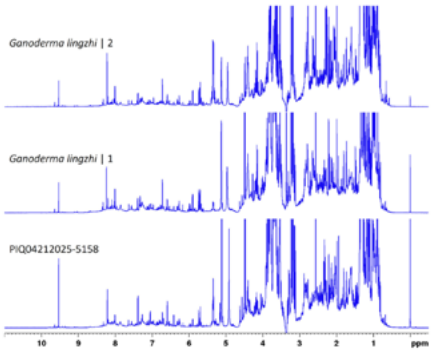
Metabolomic Spectra: PIQ04212025-5158



1H NMR spectral profile of PIQ04212025-5158 and authentic samples of same species in the Purity-IQ Global Registry.



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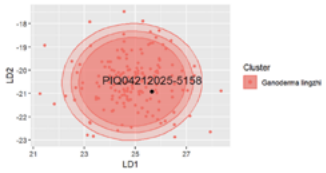
PIQ04212025-5158 aligns at a confidence interval of ≥95% with authentic samples of same species in the Purity-IQ Global Registry.



Definitions:

Positive identification:

The submitted sample name, and its molecular profile agree with molecular profiles and sample names of the Purity-IQ Global Registry.

Negative identification:

The submitted sample name, and its molecular profile do not agree with molecular profiles and sample names of the Purity-IQ Global Registry.

Molecular Diagnostic Test Method (PIQ-MTD-003)

Identity is assessed using Purity-IQ Nuclear Magnetic Resonance (NMR) technology. Molecular diagnostics in this test use non-targeted metabolomic analysis to determine species authenticity and targeted analysis to evaluate product related attributes. The spectra collected are analyzed using an orthogonal approach wherein they are visually assessed and analyzed against the Purity-IQ Global Registry using several statistical methods such as principal component analysis (PCA), linear discriminant analysis (LDA), and hierarchical cluster analysis (HCA).

Samples are scientifically analyzed and fingerprinted according to Purity-IQ metabolomic standard operating procedures. Metabolomic fingerprint data is added to the registry, benchmarking a criterion for future batch/lot identity and consistency verification.

The results and conclusions presented in this report are true and accurate to the best of Purity-IQ's knowledge. However, the advanced molecular diagnostics employed can very rarely give rise to inconclusive, or incongruent results, and in such cases corroboration of this result by repeat testing, or different analytical methods may be warranted. Metabolomic identification does not attest to sample quality, nor do these diagnostic tools preclude the presence of other species or compounds not requested to be analyzed. Sample(s) received in acceptable condition. This Certificate of Analysis pertains only to the above sample(s) analyzed. This report shall not be altered, modified, copied or reproduced, except in its entirety.

Authorized by: Nolan Frame
NMR Spectroscopist
05/05/2025

CONCLUSION AND OUR NEXT STEPS

We are really happy to be on this journey, proud of our progress with our limited resources.

We accept we can do better, and know we will, as fast as we can.

We are reinvesting profits to test more samples of our current range of legacy extracts and also competing brands in the EU/UK marketplace. Any of our existing extracts that do not meet our new exacting standards will be discontinued and at the same time we will build the PureMushroom™ extract range.

We are now investing further into compound-level research, beyond what is mentioned in this report, working with academic partners and testing labs to ensure transparency, traceability, and potentially meaningful health benefits for the final consumer. Sorry we cannot disclose these details publicly. Perhaps in v2.0 of this report at the end of the year.

We invite our clients and partners to engage with us, to co-create better products, and help raise the standards of the mushroom extract category industry wide.

Did you enjoy this report? Yes? Please share it around in your favourite groups and discussion fora. Spread the word that advanced quality testing is possible. There are no excuses - if quality matters more than squeezing profit. It does to us. We are talking about giving people potential health benefits, right? It is not a game.

If you did not enjoy this report, we are sorry but not offended. It is just version 1.0, and we are not experts in report writing lol. Give us some feedback and we will try to do better in v2.0.

The MUSHEEZ® Mission

Our mission is to enhance the health and well-being of people across Europe, the UK, and beyond by providing sustainably produced, premium-quality functional mushroom extracts.

Through advanced technology and responsible practices, we deliver our extracts as private label solutions for supplement brands, high-grade ingredients for manufacturers, and our exclusive MUSHEEZ® branded products via trusted resellers.

About MUSHEEZ®

MUSHEEZ is the main brand of Natural Chaga OU (chaga was our first love, but we have grown to love other functional mushrooms too like reishi, lion's mane and cordyceps too) was founded in 2019 by me, Robin. We are based in Estonia, Europe.

That's me in the pic with a big piece of wild Estonian chaga on my head!

Robin Gurney with a large Conk of Chaga

We live and work in a beautiful, clean forest in Estonia, at the heart of a tiny village called Pillapalu (12 km from the nearest shop). Clients can come and say hello if you are in the area 🙂.

We are a fast-growing family business supplying high-quality, certified organic, easy-to-consume, and competitively priced functional mushroom extract ingredients, finished products and custom formulations to businesses all over Europe.

Most of our products are liquid or powder mushroom extracts classified as food supplements.

We do still manufacture some products inhouse, but we also work with professional cultivators, extractors and specialist manufacturers too in China and other European countries. Our focus nowadays is more on product development, recipe making, quality control and serving over 50 brands across 25 countries in Europe and the UK.

Our focus is on the royal family of functional mushrooms (technically chaga isn't a mushroom by the way).

Chaga – ***"King of the mushrooms"***

Reishi – ***"The divine mushroom"***

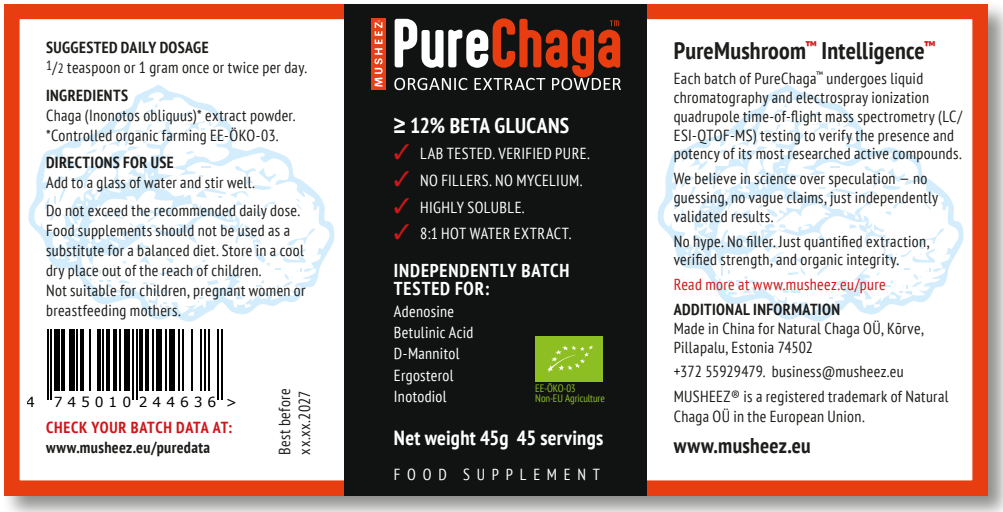
Lion's mane – ***"The smart mushroom"***

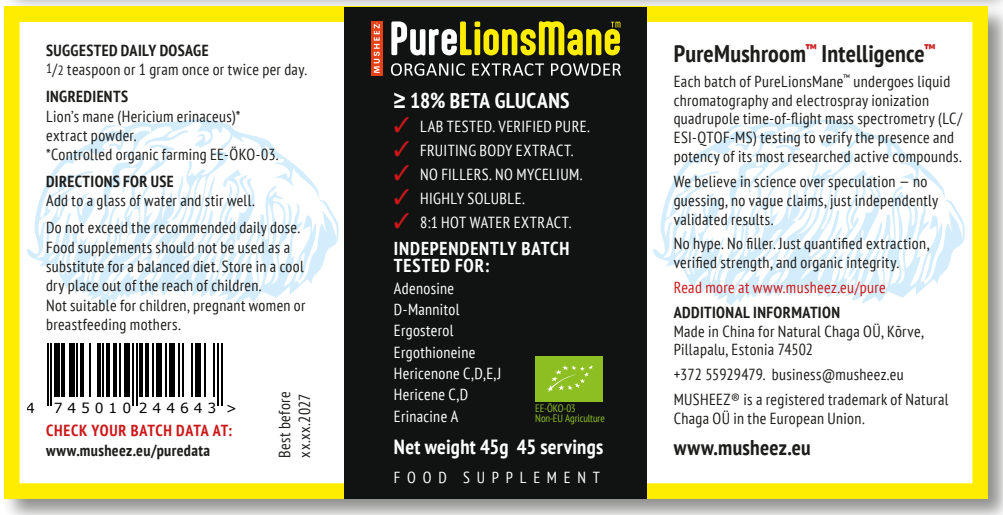
PureMushroom™ Extract Powders

Our PureMushroom™ extract powders are available in bulk MOQ 1kg or in retail Miron VioletGlass jars 45g.

Here are a few example jar labels for your interest.

Contact us for more info business@musheez.eu





Natural Chaga OÜ aka MUSHEEZ®
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www.musheez.eu

Business registry code: 14486621
VAT code: EE102081273
EORI: EE14486621