

*Hericium Erinaceus*: Erinacine A

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## Introduction

### Mushroom Basics

Mushrooms are commonly known in the Chinese cultural for their natural medicinal properties while in places like the United States mushrooms are known for their culinary purposes. Mushrooms continue to be a growing topic in the research community especially for varieties of mushrooms that can achieve similar benefits and results that today's medicine brings. Most mushrooms have a similar life cycle which begins with the inoculation of two spawns which leads to spore germination then the creation of the mycelial expansion until reaching the different sizes of the fruitbody. The mushroom cycle can be found in Figure 1. Now many companies have genetically engineered the spawn to not reproduce itself from the mature fruitbody.

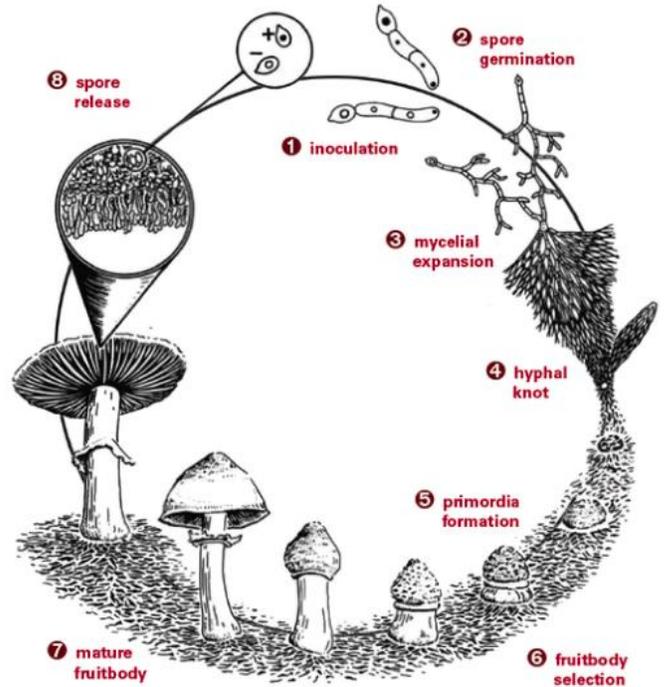


Figure 1: Shows the fungal cycle from start to finish (*Host Defense, 2017*).

## *Hericium erinaceus* (Lion's Mane)

Erinacines- component found in Lion's Mane

A variety of mushroom that has been grabbing the attention of different pharmaceutical companies is the *Hericium Erinaceus* commonly known as Lion's Mane. Lion's Mane also known as, "Sheep's head, Bear's head, Bearded tooth carpophore, and Yamabushitmnake" (*Lion's Mane (Hericium erinaceus)*). Lion's Mane in nature is found growing off the dry bark of trees (Kuo, 2016). Now a days there are many products in the market that sell Lion's Mane mushroom powder as a superfood. Lion's Mane mushroom is known to have the component erinacines. Erinacines as of now are only found in the mycelia of the *H. erinaceus* there is no evidence of this component being present at the fruiting body stage (Li, 2014). Erinacines have been found to have powerful antioxidant components, may have the potential to slow down degenerative diseases of the brain, and help prolong life.

Erinacines like many other substances have been found to have different strands. As of now erinacines A-K and P-S have been identified (Kuo, 2017). Researchers have been focusing on erinacine A due to its potential for aiding in neurodegenerative disorders and for its antioxidant capacity.

What Lion's Mane products are found in the market?

Companies that are selling Lion's Mane mushroom products sell them as powder or capsules. What many companies have in common is that their products offer memory boost and antioxidants (7 Best Lion's Mane Mushroom Supplements to Get Rid Of Brain Fog). Many of

these companies consider Lion's Mane mushroom powder a superfood. A superfood is one high in fiber or antioxidants that is beneficial for the human health according to *MedicineNet*.

### Antioxidant Components

As defined by the NIH and the National Cancer Institute reactive oxygen species are, "A type of unstable molecule that contains oxygen and that easily reacts with other molecules in a cell. A buildup of reactive oxygen species in cells may cause damage to DNA, RNA, and proteins, and may cause cell death. Reactive oxygen species are free radicals. Also called oxygen radical." To fight of these harmful effects of oxygen radicals the body needs antioxidants. By definition antioxidants protect cells from free radicals (*National Cancer Institute, NIH*). According to the article published in the *Biological Macromolecules Journal* many companies have tried to create antioxidants to help preserve the cells in our body. But many of these human-made antioxidants have led patients to liver failure (Zhang, 2012).

Antioxidants have the capacity of scavenging for free radicals throughout the body. In scavenging for free radicals' antioxidants are protecting the body from oxidative damage. Oxidative damage leads to cell aging and eventually cell death. If the body is able to prolong cell death with the help of antioxidants in the long run living organisms could live a longer life (Zhang, 2012). The article "*Hericium erinaceus* mycelium and its isolated erinacine A protection from MPTP-induced neurotoxicity through the ER stress, triggering an apoptosis," found that ER stress is correlated with neuronal death. Oxidation is also linked to dopaminergic cell loss which is correlated with Parkinson's disease.

### Nerve Growth Factors (NGF)

There are many illnesses that are caused by neurodegenerative disorders which include but are not limited to dementia, Alzheimer's Disease, and Parkinson's Disease. These diseases are caused by the death of neurons throughout the nervous system (Kuo, 2016). The death of neurons in different areas of the brain cause different symptoms. Unlike other cells neuros are unable to regenerate themselves using proteins. According to an article the nerve growth factors are protein which are too big to fit through the blood-brain barrier that would allow for nerve development (Bing-Ji, 2010). As explained by the article, "Blood-brain barrier permeability and physical exercise" the blood-brain barrier separates the central nervous system from the rest of the tissues. Homeostasis is maintained by controlling the nutrients and materials found in the blood from entering the brain and vis versa. Regeneration of neurons could be achieved using nerve growth factors which are proteins that support the growth and maintenance of neurons (Shimbo, 2005).

In a study published in 2010 by the journal *Mycology* it found erinacines to be successful in animal trials at regenerating damaged nerves (Bing-Ji, 2010). Erinacines has proven to be successful because the particles are small enough to penetrate the blood-brain barrier *in vivo*. Meaning that the components found in erinacines that helps with the regeneration of neurons could potential aid in slowing down or reversing the effects of degenerative diseases of the brain. In another study published by the *Journal of Natural Products* it identifies erinacine A as a potential neurotransmitter that acts as a synthesis stimulator similar to adrenaline and dopamine (Chen, 2016). Upon further research in 2018 in the article, "Neurohealth properties of *Hericium*

*erinaceus* mycelia enriched with erinacines” it was determined that only erinacine A showed positive neuron regeneration in the central nervous system of rats.

An article found that erinacine A not only contains nerve growth factors, but it also prevents ischemic injuries to neurons. In doing this it protects the brain from oxidation stress. In animals that have suffered a stroke erinacine A helped prevent inflammation of the brain. In the future scientist hope to be able to prevent stroke-induced brain injuries (Lee, 2014).

### Prolonging Life

In a single study published in 2019, “Erinacine A-enriched *Hericium erinaceus* mycelia promotes longevity in *Drosophila melanogaster* and aged mice” it suggests the potential for erinacines A to prolong the life of mice and flies. In this study erinacine A is classified as an, “active cyathin diterpenoida component” which has antioxidant components that slow down aging. In mice and flies there was a significant increase in the life span. Later on, through further evaluation of the mice and flies it was determined that there was a decrease in oxidation factors in the liver and an increase in antioxidant components. The increase in life span for flies was from 30 days to 38 days and for mice from 13 to 14 months to 15 and 16 months. The study states that it is very difficult to measure the effects of erinacines A in humans because an individual’s life span can be affected by many internal and external factors. Aging is a very complex topic that can’t be easily evaluated.

### Possible Complications

An article published in the Science Direct stated their process for cultivating *Hericium erinaceus* mycelia as, “It was preserved at 4C and subcultured every three months. The seed culture was grown in a 250ml flask containing 100 ml of the medium containing (g/l): glucose 20, yeast extract 5, peptone 3, KH<sub>2</sub>PO<sub>4</sub> 1, and MgSO<sub>4</sub> 1 in distilled water at 25C without shaking for 12 h, and then at 140 rpm for four days.” Out of all this only 5ml of product were retrieved (Zhang, 2012). The process of enriching mycelia with erinacine A is very complex and delicate.

An article published by the *Atlantis Press* authors Jinzhe He and Qiang Shen explored the different factors that affect the extraction of erinacine from Lion’s Mane mycelia. In this study they determined that not only did ethanol play a huge role in the quantity of erinacine extracted but also the temperature at which it was extracted and the pretreatment of the mycelia. As illustrated by Figure 2 there is an ideal combination of timing, temperature and amount of ethanol for an optimal extraction.

Besides achieving extraction at an optimal level many sources reports the

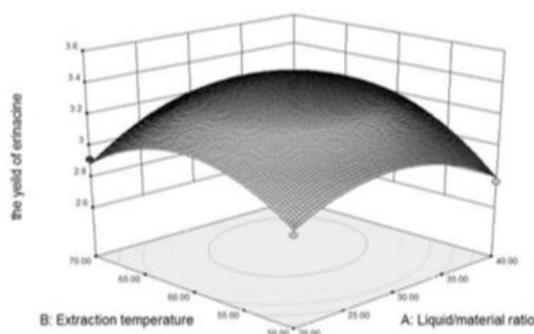


Figure 2 a graph taken from the article *Optimization of Extraction key Process for Erinacine from Hericium erinaceus* demonstrating the optimal point for erinacine extraction.

process being expensive and very low yielding (He, 2015). Not many companies can afford to go through this process and devote their resources. Extracting erinacine from mycelia is not only expensive but time consuming and delicate. Prior to extraction mycelia must be fermented for four weeks and constantly be shaken at 30 degrees Celsius (Kawagishi et al., 1996 and Bing-Ji et al., 2010).

#### Closing Statement/Moving Forward

Erinacine A found in *Hericium erinaceus* has been investigated in the past 20 years for many of its benefits but more specifically for its capacity as an antioxidant, for its potential as a nerve growth factor and the hope of prolonging life. There are many complications when it comes to actually enriching *Hericium erinaceus* mycelia with erinacine A, but many researchers see the benefit.

Erinacine A has the capacity of doing so much more. An article was looking at the benefits at how erinacine A could affect people who take anti-depressants (Chiu, 2018). There are many antidepressants out there in the market, but many come with side effects. There is hope that erinacine A could act as a natural antidepressant. Another article was seeing erinacine A as a possible treatment for creating new pathways to help with the recovering of gastric cancer (Kuo, 2017). Moving forward erinacine A could have the possibility of not only fighting neurodegenerative disorders like Alzheimer's disease and Parkinson disease but also preventing the illness in the first place (Lion's Mane (*Hericium erinaceus*)).

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