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Mushroom *(Hericium erinaceus)* as therapeutic potential for human health

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Abstract

Monkey head mushroom or the lion mane mushroom is an edible mushroom for human health and is known for culinary and medicinal uses. This mushroom contains biochemical compounds that stimulate the growth of brain cells and is also useful for protection against Alzheimer's disease besides reducing symptoms of anxiety and depression. Monkey head mushroom or the lion mane mushroom is also useful in diabetes management. It has also cancer fighting abilities. This manuscript endeavors the beneficial effect of monkey head mushroom for human health by its therapeutic potential.

Keywords: Lion's Mane mushroom; Human diseases; Medicinal valued mushroom; Disease control

1. Introduction

The monkey head mushroom or Lion's Mane mushroom, botanically known as *Hericium erinaceus*, stands out as a unique and esteemed member of the fungal kingdom. It is edible mushroom native to North America, Europe, and Asia. Lion's mane is an edible mushroom found most abundantly in East Asia that has been used widely as a food and as an herbal medication in traditional medicine. It acts as a tonic to relief stress, anxiety and depression. , However, mild gastrointestinal complains of abdominal discomfort, nausea, or diarrhea have been reported . Lion's mane mushroom typically grows on the trunks of dead hardwood trees and has distinctive long, white dangling spines that resemble as lion's mane. The fruit bodies can be harvested for culinary use. It has antioxidant, antidiabetic, antilipidemic, antihypertensive, antineoplastic, an immunomodulatory activities as well as hepatoprotective, neuroprotective and cardiovascular protective properties. The fungus generally feeds on dead trees but is also a tree parasite. *H. erinaceus* has been used in traditional Chinese medicine for centuries. Its production is widespread within Asia mostly production practices on wood logs. It is able to withstand cold temperatures and frost conditions. Lion's mane mushrooms are large, white, shaggy mushrooms that resemble a lion's mane as they grow. Li et al., (2020) reported prevention of early Alzheimer's disease by Erinacine biochemical,

2. Taxonomy

Hericium erinaceus (lion's mane) is an edible mushroom, that belongs to the Hericiaceae family, order Russulales, class Agaricomycete and phylum Basidiomycota. This mushroom is also called as lion's mane mushroom or bearded tooth fungus. The basidiocarp of *H. erinaceus* is a large having irregular bulbous tubercules which are up to 35 centimeters in diameter and are dominated by crowded, hanging, spore-producing spines which are 2-4 cm.

The hyphal system is monomitic, amyloid, and composed of thin- to thick-walled hyphae that are approximately 3–15 µm (microns) wide. The hyphae are 3-15 µm and contain clamped septa and filled with oily resinous substances.

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The basidia are 30–45 µm long and 5–10 µm wide containing four spores. The white amyloid spores measure approximately 5–7 µm in length and 4–5 µm in width which are subglobose to short ellipsoid and spore surface is smooth to finely roughened McCracken (1970).

The monokaryotic mycelium growth of *H. erinaceus* is slower than dikaryotic growth while monokaryotic fruitbodies are also smaller than dikaryotic fruitbodies. The monokaryotic mycelium was found to produce fusoid to subglobose chlamydospores. The basidiocarp of *H. erinaceus* are mainly produced annually from August to November in Europe. Spore production was found highest at mid day depending on temperature increase and a decrease of relative humidity.

2.1. Mushroom Biochemicals

There are multiple constituents in *Hericium erinaceus* including unique hericenones, erinacine terpenoids, beta-polysaccharides, and phenolic acids as well as lectins, proteins, fatty acids, sterols, and multiple minerals and vitamins as are found in multiple mushroom species. *H. erinaceus* is found to contain diverse phytochemicals like β-glucan. Essential oil produced include hexadecanoic and other oils such as 2-methyl-3-furanthiol, 2-ethylpyrazine and 2,6-diethylpacid, linoleic acid, phenylacetaldehyde and benzaldehyde , yrazine.

2.2. Mushroom Culivation

In the UK, H. erinaceus picking and sale is illegal and there it is included to the Wildlife and Countryside Act 1981. This fungus has not been commercially exploited while some reports do exist wherein the yield varies from 165 g per 1 kg of medium. The solid substrate for cultivation is most commonly a mixture of sawdust of hardwood or conifer containing different components like wheat bran, wheat straw, soybean meal, corn meal, rice bran, and rice straw while a liquid substrate includes glucose for the carbon source, soybean powder, corn powder, and wheat bran powder as a complex nitrogen source with pH 6.0 as optimal.

Hericium erinaceus requires 85 to 90% of relative humidity. The incubation temperature most suitable for the mycelial growth of *H. erinaceus* is found to be 25°C, and the optimum temperature for vegetative growth is 26°C. The artificial cultivation of *H. erinaceus* was first reported in China in 1988.[] It is cultivated using artificial logs, bottles, and polypropylene bags. Haricium Lion mane contain bioactive substances that have many beneficial effects on the body, especially the brain, heart, and gut. Growth regulators, such as 2,4-Dichlorophenoxyacetic acid and gibberellin, were observed to have an advantageous effect on spore germination. Other technologies, such as red and green laser light of low intensity, stimulated spore germination as well as the vegetative growth of mycelium. Argon and helium lasers also contributed to the acceleration of fruit body development by 36–51%, Hassan (2007); Nguyen et al., (2018).

2.3. Human health Values

It is useful for both culinary and medicinal purposes in Asian countries like China, India, Japan, and Korea. This mushroom contains two special compounds that stimulate the growth of brain cells viz., hericenones and erinacines. It also helps to protect against Alzheimer's disease, a degenerative brain disease that causes progressive memory loss. Besides, it has anti-inflammatory effects that can reduce symptoms of anxiety and depression. Lion's mane extract may protect against the development of stomach ulcers by inhibiting the growth of *Helicobacter pylori* and protecting the stomach lining from damage. Lion's mane mushrooms are large, white, shaggy mushrooms that resemble a lion's mane as they grow. Research shows that lion's mane extract can reduce the risk of heart disease. Studies of rats and mice have found that lion's mane mushroom extract improves fat metabolism and lowers triglyceride levels. Chronically high blood sugar levels eventually cause complications like kidney disease, nerve damage in the hands and feet, and vision loss. Cancer occurs when DNA of human beings becomes damaged, causing cells to divide and replicate out of control. Some research suggests that lion's mane mushroom has cancer-fighting abilities. Research also shows that lion's mane mushrooms contain powerful anti-inflammatory and antioxidant compounds that may help to reduce the impact of these illnesses. A strong immune system protects the body from bacteria, viruses, and other disease-causing pathogens. On the other hand, a weak immune system puts the body at a higher risk of developing infectious diseases. Animal research shows that lion's mane mushroom can boost immunity by increasing the activity of the intestinal immune system, which protects the body from pathogens that enter the gut through the mouth or nose Li et al., (2020); Gonkhom et al., (2022).

This extraordinary mushroom not only possesses an alluring appearance but also holds a significant historical presence in diverse cultures, especially within the context of ancient herbal medicine practices. This fungus holds promising prospects in several domains. Its potential as a natural remedy for cognitive health is gaining attention. This mushroom

has neuroprotective properties and could play a role in supporting brain function, which is particularly relevant in the present aging population where neurodegenerative conditions like Alzheimer's disease are a growing concern. Furthermore, Lion's Mane has been explored for its potential in addressing mood disorders. It is a rich source of bioactive compounds, including β-glucans, that can positively affect the immune system. The fungus produces bioactive compounds that can be used to treat various chronic diseases like obesity, high blood pressure, hepatic disorders, and cancer. It also has other benefits like wound healing and improving the immune system. This manuscript endeavours to elucidate the multifaceted potential of Lion's Mane mushroom within the domains of nutrition, health, and wellness. Through a comprehensive examination of its properties and benefits, Lion's Mane mushrooms can be harnessed to enhance human well-being. By unlocking the secrets hidden within this remarkable fungus, the study provides insights that can empower individuals to incorporate Lion's Mane into their daily lives, fostering a healthier and more balanced lifestyle.

Submerged culture is a type of artificial cultivation of *H. erinaceus* whereby the fungus is grown in a liquid medium. Using this method, a large number of mycelia can be obtained quickly. Bioactive compounds can be sourced from the fruiting bodies, submerged-cultivated mycelial biomass, or liquid-cultivated broth. Growers optimize the culture medium composition to obtain simultaneously high yields of *H. erinaceus* mycelial biomass, exopolysaccharides, and polysaccharides. Submerged fermentation is preferable for the production of mycelial biomass and biologically active metabolites in order to produce a more uniform biomass Sokoi et al. (2016); Li et al., (2020).

3. Conclusion

Hericium erinaceus is an edible medicinal mushroom with a long history of its use as medicine in in Asia and other countries. A number of studies suggest that *H. erinaceus* exhibits a diverse array of biological effects, including improvement in cognitive impairment, nerve repair, and certain forms of cancer prevention and their treatment. More specifically, compounds isolated from *H. erinaceus*, such as polysaccharides, erinacines, and hericenones, have been reported to exert preventive effects against Alzheimer's disease, Parkinson's disease, and other neurodegenerative diseases as well as neurological injury via several neuroprotective mechanisms. However, many of the behavioral studies have utilized an intragastric administration or an injection route, which is not recommended for *H. erinaceus* preparation in clinics. More studies are needed to comprehensively clarify the safety and clinical application of *H. erinaceus* preparations that could elicit significant and reproducible preventive effects by daily consumption. The use of *H. erinaceus* has also been reported in combination with clinical therapeutic regimens to enhance the quality of life of patients with certain types of cancer. Thus, it appears that H. erinaceus has a broad therapeutic potential in human health. The bioactive components of *H. erinaceus* are natural antioxidant and anti-inflammatory compounds, and can exert a diverse range of functions such as neuroprotection, anti-inflammatory, modulation of gut microbiota, and anticancer effects. Such promising applications of this mushroom for therapies have contributed to the public interest and its bioactive components for clinical success. Nevertheless, further studies are still needed to unveil the potential effects of *H. erinaceus* and underlying mechanisms to pave the way from the laboratory to clinical use in future.

References

[1] Ballotin VR, Bigarella LG, Brandão ABM, Balbinot RA, Balbinot SS, Soldera J. 2021. Herb-induced liver injury: systematic review and meta-analysis. World J Clin Cases. 5490-5513.

[2] Bessone F, García-Cortés M, Medina-Caliz I, Hernandez N, Parana R, Mendizabal M, Schinoni MI, et al. 2022. Herbal and dietary supplements-induced liver injury in Latin America: experience from the LATINDILI Network. Clin Gastroenterol Hepatol. 20:e548-e563.

[3] Boddy, Lynne; Crockatt, Martha E.; Ainsworth, A. Martyn. 2011 "Ecology of Hericium cirrhatum, H. coralloides and H. erinaceus in the UK". Fungal Ecology. Conservation underground: Fungi in a changing world. 4 (2): 163–173. .

[4] Brown AC. 2017. Liver toxicity related to herbs and dietary supplements: Online table of case reports. Part 2 of 5 series. Food Chem Toxicol. 107: 472-501.

[5] Bunchorntavakul C, Reddy KR. 2013. Review article: herbal and dietary supplement hepatotoxicity. Aliment Pharmacol Ther. 37: 3-17.

[6] Cheng J.-H., Tsai C.-L., Lien Y.-Y., Lee M.-S., Sheu S.-C. 2016. High molecular weight of polysaccharides from Hericium erinaceus against amyloid beta-induced neurotoxicity. BMC Complement. Altern. Med. 16:1–9.

[7] Chong P.S., Fung M.-L., Wong K.H., Lim L.W. 2020. Therapeutic potential of Hericium erinaceus for depressive disorder. Int. J. Mol. Sci. 21:163.

[8] Davis, R. Michael; Sommer, Robert; Menge, John A. 2012. Field Guide to Mushrooms of Western North America. Berkeley: University of California Press. pp. 280–281.

[9] Docherty S, Doughty FL, Smith EF. 2023. The acute and chronic effects of lion's mane mushroom supplementation on cognitive function, stress and mood in young adults: a double-blind, parallel groups, pilot study. Nutrients. 15:4842.

[10] Friedman M. 2015. Chemistry, nutrition, and health-promoting properties of Hericium erinaceus (Lion's Mane) mushroom fruiting bodies and mycelia and their bioactive compounds. J. Agric. Food Chem. 63:7108–7123.

[11] Ghosh S., Nandi S., Banerjee A., Sarkar S., Chakraborty N., Acharya K. 2021. Prospecting medicinal properties of Lion's mane mushroom. J. Food Biochem. 45:e13833.

[12] Ginns, J. 1985. "Hericium in North America: cultural characteristics and mating behavior". Canadian Journal of Botany. 63 (9): 1551–1563.

[13] Gonkhom, Didsanutda; Luangharn, Thatsanee; Hyde, Kevin D.; Stadler, Marc; Thongklang, Naritsada. 2022. "Optimal conditions for mycelial growth of medicinal mushrooms belonging to the genus Hericium". Mycological Progress. 21 (9). 11557.

[14] Grace, Jeanne; Mudge, Kenneth W. 2015. "Production of Hericium sp. (Lion's Mane) mushrooms on totem logs in a forest farming system". Agroforestry Systems. 89 (3): 549–556.

[15] Grozier CD, Alves VA, Killen LG, Simpson JD, O'Neal EK, Waldman HS. 2022. Four weeks of Hericium erinaceus supplementation does not impact markers of metabolic flexibility or cognition. Int J Exerc Sci. 15:1366-1380.

[16] Hassan, F.R.H 2007. "Cultivation of the Monkey Head Mushroom (Hericium erinaceus) in Egypt" (PDF). Journal of Applied Sciences Research. 3 (10): 1229–1233.

[17] He, Xirui; Wang, Xiaoxiao; Fang, Jiacheng; Chang, Yu; Ning, Ning; Guo, Hao; Huang, Linhong; Huang, Xiaoqiang; Zhao, Zefeng. 2017. "Structures, biological activities, and industrial applications of the polysaccharides from Hericium erinaceus (Lion's Mane) mushroom: A review". International Journal of Biological Macromolecules. 97: 228–237.

[18] He, Xirui; Wang, Xiaoxiao; Fang, Jiacheng; Chang, Yu; Ning, Ning; Guo, Hao; Huang, Linhong; Huang, Xiaoqiang; Zhao, Zefeng. 2017. "Structures, biological activities, and industrial applications of the polysaccharides from Hericium erinaceus (Lion's Mane) mushroom: A review". International Journal of Biological Macromolecules. 97: 228–237.

[19] Hersant H, He S, Maliha P, Grossberg G. 2023. Over the counter supplements for memory: a review of available evidence. CNS Drugs. 37:797-817.

[20] Hu J.-H., Li I.-C., Lin T.-W., Chen W.-P., Lee L.-Y., Chen C.-C., Kuo C.-F. 2019. Absolute bioavailability, tissue distribution, and excretion of erinacine S in Hericium erinaceus mycelia. Molecules. 24:1624.

[21] Huang C.-J., Webb H.E., Zourdos M.C., Acevedo E.O. 2013. Cardiovascular reactivity, stress, and physical activity. Front. Physiol. 4:314.

[22] Jackson P.A., Wightman E.L., Veasey R., Forster J., Khan J., Saunders C., Mitchell S., Haskell-Ramsay C.F., Kennedy D.O. 2020. A randomized, crossover study of the acute cognitive and cerebral blood flow effects of phenolic, nitrate and botanical beverages in young, healthy humans. Nutrients. 12:2254.

[23] Jacobsson I, Jönsson AK, Gerdén B, Hägg S. 2009. Spontaneously reported adverse reactions in association with complementary and alternative medicine substances in Sweden. Pharmacoepidemiol Drug Saf. 18: 1039-1047.

[24] Kennedy D.O., Jackson P.A., Forster J., Khan J., Grothe T., Perrinjaquet-Moccetti T., Haskell-Ramsay C.F. 2017. Acute effects of a wild green-oat (Avena sativa) extract on cognitive function in middle-aged adults: A double-blind, placebo-controlled, within-subjects trial. Nutr. Neurosci. 20:135–151.

[25] Khan M.A., Tania M., Liu R., Rahman M.M. 2013. Hericium erinaceus: An edible mushroom with medicinal values. J. Complement. Integr. Med. 10:253–258.

[26] Khan MA, Tania M, Liu R, Rahman MM. 2013. Hericium erinaceus: an edible mushroom with medicinal values. J Complement Integr Med. 10 (1): 253-258.

[27] La Monica MB, Raub B, Ziegenfuss EJ, Hartshorn S, Grdic J, Gustat A, Sandrock J, et al. 2023. Acute effects of naturally occurring guayusa tea and Nordic lion's mane extracts on cognitive performance. Nutrients. 15:5018.

[28] Li I., Chang H.-H., Lin C.-H., Chen W.-P., Lu T.-H., Lee L.-Y., Chen Y.-W., Chen Y.-P., Chen C.-C., Lin D.P.-C. 2020. Prevention of Early Alzheimer's Disease by Erinacine A-Enriched Hericium erinaceus Mycelia Pilot Double-Blind Placebo-Controlled Study. Front. Aging Neurosci. 12:155.

[29] Li IC, Chang HH, Lin CH, Chen WP, Lu TH, Lee LY, Chen YW, et al. 2020. Prevention of early Alzheimer's disease by erinacine A-enriched Hericium erinaceus mycelia pilot double-blind placebo-controlled study. Front Aging Neurosci. 12:155.

[30] Li W., Zhou W., Kim E.-J., Shim S.H., Kang H.K., Kim Y.H. 2014. Isolation and identification of aromatic compounds in Lion's Mane Mushroom and their anticancer activities. Food Chem. 170:336–342.

[31] Ma B.-J., Shen J.-W., Yu H.-Y., Ruan Y., Wu T.-T., Zhao X. 2010. Hericenones and erinacines: Stimulators of nerve growth factor (NGF) biosynthesis in Hericium erinaceus. Mycology. 1:92–98.

[32] Martínez-Mármol R., Chai Y., Khan Z., Kim S.B., Hong S.M., Gormal R.S., Lee D.H., Lee J.K., Lee M.K., Kim S.Y. 2020. Hericerin derivatives from Hericium erinaceus exert bdnf-like neurotrophic activity in central hippocampal neurons and enhance memory. bioRxiv. 271676.

[33] McCracken, F. I. 1970. Spore Production of Hericium erinaceus". Phytopathology. 60 (11): 1639.

[34] Medina-Caliz I, Garcia-Cortes M, Gonzalez-Jimenez A, Cabello MR, Robles-Diaz M, Sanabria-Cabrera J, Sanjuan-Jimenez R, et al. 2018. Spanish DILI Registry. Herbal and dietary supplement-induced liver injuries in the Spanish DILI Registry. Clin Gastroenterol Hepatol. 16:1495-1502.

[35] Mori K, Inatomi S, Ouchi K, Azumi Y, Tuchida T. 2009. Improving effects of the mushroom Yamabushitake (Hericium erinaceus) on mild cognitive impairment: a double-blind placebo-controlled clinical trial. Phytother Res. 23:367-72.

[36] Mori K., Inatomi S., Ouchi K., Azumi Y., Tuchida T. 2009. Improving effects of the mushroom Yamabushitake (Hericium erinaceus) on mild cognitive impairment: A double-blind placebo-controlled clinical trial. Phytother. Res. 23:367–372.

[37] Muhanna M, Lund I, Bromberg M, Wicks P, Benatar M, Barnes B, Pierce K, et al. 2023. Lion's mane. Amyotroph Lateral Scler Frontotemporal Degener. 23:1-4.

[38] Nagano M, Shimizu K, Kondo R, Hayashi C, Sato D, Kitagawa K, Ohnuki K. 2010. Reduction of depression and anxiety by 4 weeks Hericium erinaceum intake. Biomed Res. 31:231-237.

[39] Nagano M., Shimizu K., Kondo R., Hayashi C., Sato D., Kitagawa K., Ohnuki K. 2010. Reduction of depression and anxiety by 4 weeks Hericium erinaceus intake. Biomed. Res. 31:231–237.

[40] Navarro VJ, Barnhart H, Bonkovsky HL, Davern T, Fontana RJ, Grant L, Rleddy KR, et al. 2014. Liver injury from herbals and dietary supplements in the U.S. Drug-Induced Liver Injury Network. Hepatology. 60: 1399-1408.

[41] Navarro VJ, Seeff LB. 2013. Liver injury induced by herbal complementary and alternative medicine. Clin Liver Dis. 17: 715-35.

[42] Nguyen, Bich Thuy Thi; Ngo, Nghien Xuan; Le, Ve Van; Nguyen, Luyen Thi; Tran, Anh Dong; Nguyen, Lam Hai Thi. 2018. "Identification of Optimal Culture Conditions for Mycelial Growth and Cultivation of Monkey Head Mushrooms (Hericium erinaceus (Bull.: fr.) Pers)". Vietnam Journal of Agricultural Sciences. 1 (2): 117–126.

[43] Nieman KM, Zhu Y, Tucker M, Koecher K. 2023. The role of dietary ingredients in mental energy - a scoping review of randomized controlled trials. J Am Nutr Assoc. :1-16.

[44] Notaras M., van den Buuse M. 2020. Neurobiology of BDNF in fear memory, sensitivity to stress, and stress-related disorders. Mol. Psychiatry. 25:2251–2274.

[45] Royse, Daniel J. 2010. "Speciality Mushrooms and Their Cultivation". Horticultural Reviews: 59–97.

[46] Ryu S., Kim H.G., Kim J.Y., Kim S.Y., Cho K.-O. 2018. Hericium erinaceus extract reduces anxiety and depressive behaviors by promoting hippocampal neurogenesis in the adult mouse brain. J. Med. Food. 21:174–180.

[47] Saitsu Y, Nishide A, Kikushima K, Shimizu K, Ohnuki K. 2019. Improvement of cognitive functions by oral intake of Hericium erinaceus. Biomed Res. 40:125-131.

[48] Saitsu Y., Nishide A., Kikushima K., Shimizu K., Ohnuki K. 2019. Improvement of cognitive functions by oral intake of Hericium erinaceus. Biomed. Res. 40:125–131.

[49] Sokół, Sławomir; Golak-Siwulska, Iwona; Sobieralski, Krzysztof; Siwulski, Marek; Górka, Katarzyna. 2016. "Biology, cultivation, and medicinal functions of the mushroom Hericium erinaceum". Acta Mycologica. 50 (2). 1069.

[50] Spelman K., Sutherland E., Bagade A. 2017. Neurological activity of Lion's mane (Hericium erinaceus) J. Restor. Med. 6:19–26.

[51] Teschke R, Wolff A, Frenzel C, Schulze J, Eickhoff A. 2012. Herbal hepatotoxicity: a tabular compilation of reported cases. Liver Int. 32: 1543-56.

[52] Thongbai B., Rapior S., Hyde K.D., Wittstein K., Stadler M. 2015. Hericium erinaceus, an amazing medicinal mushroom. Mycol. Prog. 14:1–235.

[53] Tsai Y.-C., Lin Y.-C., Huang C.-C., Villaflores O.B., Wu T.-Y., Huang S.-M., Chin T.-Y. 2019. Hericium erinaceus mycelium and its isolated compound, erinacine A, ameliorate high-fat high-sucrose diet-induced metabolic dysfunction and spatial learning deficits in aging mice. J. Med. Food. 22:469–478.

[54] Tsai-Teng T., Chin-Chu C., Li-Ya L., Wan-Ping C., Chung-Kuang L., Chien-Chang S., Chi-Ying H.F., Chien-Chih C., Shiao Y.-J. 2016. Erinacine A-enriched Hericium erinaceus mycelium ameliorates Alzheimer's disease-related pathologies in APPswe/PS1dE9 transgenic mice. J. Biomed. Sci. 23:1–12.

[55] Uffelman CN, Doenges KA, Armstrong ML, Quinn K, Reisdorph RM, Tang M, Krebs NF, et al. 2023. Metabolomics profiling of white button, crimini, portabella, lion's mane, maitake, oyster, and shiitake mushrooms using untargeted metabolomics and targeted amino acid analysis. Foods. 12:2985.

[56] Vigna L., Morelli F., Agnelli G.M., Napolitano F., Ratto D., Occhinegro A., Di Iorio C., Savino E., Girometta C., Brandalise F. 2019. Hericium erinaceus improves mood and sleep disorders in patients affected by overweight or obesity: Could circulating pro-BDNF and BDNF be potential biomarkers? Evid. Based Complement. Altern. Med. 7861297.

[57] Wang L.-Y., Huang C.-S., Chen Y.-H., Chen C.-C., Chen C.-C., Chuang C.-H. 2019. Anti-inflammatory effect of erinacine C on NO production through down-regulation of NF-κB and activation of Nrf2-mediated HO-1 in BV2 microglial cells treated with LPS. Molecules. 24:3317.

[58] Webb H.E., Weldy M.L., Fabianke-Kadue E.C., Orndorff G., Kamimori G.H., Acevedo E.O. 2008. Psychological stress during exercise: Cardiorespiratory and hormonal responses. Eur. J. Appl. Physiol. 104:973–981.

[59] Zimmerman HJ. Unconventional drugs. Miscellaneous drugs and diagnostic chemicals. In, Zimmerman, HJ. 1999. Hepatotoxicity: the adverse effects of drugs and other chemicals on the liver. 2nd ed. Philadelphia: Lippincott, pp. 731-734.