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Review Article

CLINICAL USEFULNESS OF *AGARICUS BISPORUS* AND *PLEUROTUS OSTREATUS* IN VARIOUS DISEASE STATES: A COMPARATIVE STUDY

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ABSTRACT

Materia Medica testimony before the time shows evidence of using mushrooms to treat various diseases. Though, the therapeutic and biotechnological potential of mushrooms has yet to be completely explored, mushrooms have long been used as conventional remedy in many countries around the world, and they have confirmed to be an important resource for recent scientific and pharmacological research. Mushrooms are well-known for their use as therapeutic foods for the impediment of a variety of derangements like hypertension, hypercholesterolemia and cancer, antioxidant, antitumor, antimicrobial, anti-inflammatory, and immunomodulatory properties and can help boost immune system. This review discusses current advances to explore on the pharmacological prospectives and clinical relevance prediction of two varieties of mushrooms, *Agaricus bisporus* and *Pleurotus ostreatus*.

Keywords: Button mushrooms, Clinical uses of mushrooms, Mushrooms, Oyster.

1. INTRODUCTION

In human body, free radicals are produced either naturally or as a result of pathophysiolgical cell metabolism. The synthesis of energy in living organisms stimulates biological processes. The process of oxidation is crucial in the production of energy. However, the generation of oxygen-derived free radicals, which have been associated to a variety of disorders including malignancy, rheumatoid arthritis, cirrhosis, arteriosclerosis, and the ageing process, has been discontinued [1]. In aerobic organisms, reactive oxygen species (ROS) are continuously formed and perform their role during cell signaling, detoxification, biosynthetic reaction, and mitochondrial process for chemical protection [2]. Mushrooms have a reputation for being a low-calorie, low-fat food with no nutritional value. Reactive oxygen species (ROS) are formed by NADPH oxidase enzyme during oxidative phosphorylation, which is a natural process in healthy cells. ROS are also active in phagocytosis, apoptosis, and detoxification and are mediators of the body's first protective activities of cells [3]. *Agaricus bisporus, chanterelles, Gomphus, Agaricomycetes, Pleurotus, Femullina velutipes, Lentinula*, and other mushrooms are available in the market. In the past, research on the importance of mushrooms as a safe dietary component and in the avoidance or management of chronic condition was focused [4]. This review highlights comparison of the *Agaricus* and *Pleurotus* mushroom species. *Agaricus bisporus* (Button mushrooms) is widely cultivated and the most common source of food. It has a comestible carbohydrate, less fats and high protein content, vitamins A, B, C, D and K. *Pleurotus* (Oyster mushrooms) are common edible mushrooms. Mushrooms are renowned for their use as remedial foods for the hindrance of a variety of diseases such as cancer, hypertension, hypercholesterolemia with antitumor, immunomodulatory properties anti-inflammatory and antimicrobial, antioxidant [5].

2. *AGARICUS BISPORUS*

2.1. Chemical Constituents and Nutritional Importance

Many palatable mushroom species are widely grown in jungles, whereas approximately 35 varieties are grown on large scale for commercial purpose with 20 of them being grown on a company scale. *A. bisporus* being the greatest cultured and consumed mushroom species in the world, current study has focused on the nutritious value and shelf-life extension of this variety [6].

Mushrooms are high in protein, important amino acids, vitamins (B2, niacin, and folate), polyphenols, and minerals (potassium, phosphorus, selenium, zinc, cobalt, and copper) [7].

Table 1: Constituents present in *Agaricus bisporus* (Value: Unit/100 g) (8)

Constituents	Value (Unit/100 g)
Proximates water	92.45 g
Energy	22 kcal
	93 kJ
Protein	3.09 g
Adjusted protein	2.18 g
Total lipid (fat)	0.34 g
Ash	0.85 g
Carbohydrate, by difference	3.26 g Fiber
Total dietary	1 g
Sugars, total	1.98 g
Glucose (dextrose)	1.48 g
Fructose	0.17 g

Table 2: Vitamins present in *Agaricus bisporus* (9)

Vitamins	Value (Unit/100 g)
Vitamin C, total ascorbic acid	02.1 mg
Thiamin	0.081 mg
Riboflavin	0.402 mg

2.2. Therapeutic effects of *Agaricus bisporus*

2.2.1. Antibacterial and antifungal activity

It subdued the growth of Gram-positive bacteria in a concentration-dependent manner [10]. This investigation was supported a sway of refined tyrosinase from *A. bisporus* on B16F10 melanocytes for the animal pigment synthesis through obstruction of the pigment cell technology. Using B16F10 melanocytes showed that the stimulation of melanin synthesis by refined tyrosinase enzyme is because of exaggerated tyrosinase enzyme absorption. Cellular tyrosinase activity and animal pigment content in B16F10 melanocytes were exaggerated by refined tyrosinase in a dose-dependent manner. The results indicated that refined tyrosinase is treated as a contestant for the healing of vitiligous skin conditions [11].

2.2.2. Cancer-fighting ability

A. bisporus is useful in the treatment of breast cancer as it reduces aromatase enzyme activity and oestrogen biosynthesis. The mushroom extract's action was studied on oestrogen receptor constructive or aromatase constructive cells. They reduced testosterone-induced cell proliferation in MCF7aro cells but ineffective on MCF10A, a non tumorigenic cell line [12].

2.2.3. Antioxidant properties

Natural products' antioxidant and free radical-scavenging properties are well known for their ability to combat the harmful and carcinogenic effects of free radicals. Chemical reactions involving the presence of various chemicals and enzymes provide these features. Antioxidant characteristics' principal role is to guard cells from injury triggered by reactive oxygen species (ROS). Free radical-processing enzymes, such as those involved in the ascorbate/glutathione cycle, may have a role in antioxidant activity [13]. The antioxidant action of a molecule rises with the number of hydroxyl radical groups attached to its aromatic ring by studying eight phenolic compounds and analogues. Other factors that influence antioxidant and anti-radical action include the quantity and position of the hydroxyl group, the existence of additional functional groups, and their site in relation to the hydroxyl groups [14].

2.2.4. Anti-aging activity

Previous research has shown that chronically injected mice exhibit the successful aging properties based on the metabolic and free radical theories of aging by interrupting carbohydrate uptake and persuading aging-related programmed cell death of organs by stimulating the excessive production of ROS and causing oxidative injury *in vivo*, which has been used as an ageing model [15].

2.2.5. Neuroprotective properties

Ergosterol is abundant in mushrooms and can transformed into vitamin D2 through ultraviolet light action [16]. *A. bisporus* is a mushroom high in vitamin D. In Alzheimer's disease vitamin D-enriched *A. bisporus* (160.2 mg/kg, correspondent to approximately 54 IU/kg vitamin D2) was exposed to prevent cerebral and pathological abnormalities. According to the study, a vitamin D augmented the mushroom which could provide a dietary source of vitamin D2 to helps fend off memory impairment in dementia patients [17].

2.2.6. Antihypertensive activity

The renin-angiotensin system's primary component, the enzyme angiotensin-converting enzyme (ACE) is responsible for blood vessels contraction, which

indirectly responsible for hypertension. ACE inhibitors are commonly utilised in the treatment of cardio-vascular disorders as pharmaceutical medications [18]. Mushrooms are high in antihypertensive proteins. This suggests that protein structures and the types of amino acid residues in the protein sequence may play a role in ACE inhibition [19].

2.2.7. Anti-hypercholesteremic Activity

Jeong et al., proved that the reduction of plasma cholesterol in hypercholesterolemic rats fed ABP is linked to the increase and decrease of plasma HDL and LDL levels, correspondingly. The mushroom also reduced liver cholesterol and TG levels significantly. *Agaricus bisporus* shows hypocholesterolemic properties were also linked to a lower atherogenic index and cardiac risk factor [20].

2.2.8. Antiviral Activity

High amount of dietary fibers and antioxidants, such as vitamin C, D, and B12, as well as folates and polyphenols, are found in *Agaricus bisporus* (white button mushroom), which may help to prevent cardiovascular and diabetic diseases [20].

2.2.9. Anti-inflammatory Activity

Secondary metabolites found in mushrooms have anti-inflammatory properties. Mushrooms have anti-inflammatory properties by inhibiting NF-B signaling. Mushroom compounds influence lymphocyte development and properties [20,21]. Secondary metabolites found in mushrooms possess the anti-inflammatory properties. Phenolic, indolic compounds, polysaccharides, vitamins, carotenoids, fatty acids, mycosteroids and bimetals are all anti-inflammatory components found in mushrooms. Mushroom activity is mediated by NF-B signaling inhibition. Mushroom compounds influence lymphocyte development and properties [21].

2.2.10. Immunomodulatory Activity

Mushroom polysaccharides have long stayed used to prevent and indulge a broad range of ailments, including infectious diseases, cancer, and autoimmune diseases. Membrane receptors in leukocytes and macrophages recognize bioactive polysaccharides, causing immune cells to proliferate and differentiate. These activities are responsible for the induction of antitumor and bactericidal effects by enhancing innate and cell-mediated immune responses [22].

2.2.11. Antiarthritic Activity

Glucosamine hydrochloride (GAH) obtained from hydroxyl of chitin in concentrated hydrochloric acid. It is taken out from the cell wall of *A. bisporus* which advance the skeletal development and injury repair through bone morphogenic protein (BMP) signal communication showing antiarthritic activity [23].

3. PLEUROTUS OSTREATUS

3.1. Therapeutic effects

Among the numerous species of this species, *P. ostreatus* is well known and consumed by people all over the ecosphere because of its taste, flavor, high nutritious values and medicinal properties. The existence of abundant dietary compositions as well as active ingredients in *P. ostreatus* resulted in its prominent potentialities such as being immune booster, rich in protein, fiber, vitamin and minerals. It was also added that owing to its high nutritive values, *P. ostreatus* can offer noteworthy support to humans in contrary to malnourishment and diseases [23].

3.2. Antibacterial and Antifungal Activity

The antimicrobial strength of the macrofungus oil extracted with petroleum ether and acetone inhibited gram-positive and gram-negative bacteria, as well as fungi in vitro, indicating that *P. ostreatus* has broad-spectrum antiseptic and antifungal action [24].

3.3. Cancer-fighting properties

When injected intraperitoneally in female Swiss albino mice, all of the substances tested inhibited the growth of the Ehrlich ascitic tumour at stages close to 70% (mean inhibition values). The treatment with the extract from *P. ostreatus* culture broth resulted in the greatest tumour inhibition (76%). Independent of the test substance, the intragastric treatment had no effect on tumor cell development [25].

3.4. Antioxidant activity

Oxidative stress can be triggered by the presence of oxidation agents, a reduction in antioxidant levels, or a combination of the two. As a result of the oxidation process, reactive oxygen species (ROS) and free radicals are created as damaging by the consequences. Many studies from around the world have found that the Pleurotus mushroom contains a variety of bioactive compounds such as terpenoids, phenols, alkaloids, steroids, nucleotides and lectins which have been isolated and recognized from the fruit body, mycelium,

and culture broth of mushrooms and have been shown to have hopeful biological properties [26].

3.5. Anti-aging activity

In aged rats, extracts of *Pleurotus ostreatus* increased vitamin C and E levels, as well as the actions of catalase, superoxide dismutase, and glutathione peroxidase [27]. They are highly effective antioxidant enzymes. Malonaldehyde, a polyunsaturated lipid and an electrophilic mutagen, was reduced in aged rats after a mushroom extract reacted with deoxyadenosine and deoxyguanosine in DNA, establishing a DNA adduct. Pleurotus extracts (methanol, ethanol, acetone, or water extract) can improve antioxidant status during ageing, reducing the occurrence of age-related disorders such as stroke, diabetes, cancer, Parkinson's disease, atherosclerosis and cirrhosis [28].

3.6. Neuroprotective activity

Locals have used the neuroprotective activity Pleurotus ostreatus (*P. ostreatus*) and Lentinus subnudus (*L. subnudus*) for managing of the Alzheimer's disease (AD). The neuroprotective property of *P. ostreatus* and *L. subnudus* in transgenic Drosophila melanogaster fly (TDMF) was studied. The antioxidant status of TDMF raised on nourishment supplemented with *P. ostreatus* as well as the activity of acetylcholinesterase (AChE), butyrylcholinesterase (BChE) [29].

3.7. Antihypertensive Activity

There is influence of several drying procedures on the physical properties and rehydration capacity of mushrooms. The secondary metabolite content, peptide profile, antioxidant effect, and ACE repressive action of dry mushrooms were studied in vitro, simulating the gastrointestinal digestion procedure. X-ray micro tomography has established that the structure of lyophilic and sun-dried mushrooms is conquered by open pores, whereas closed pores dominate in mushrooms dried by hot air and microwave [30].

3.8. Antidiabetic Activity

Hypertriglyceridemia is a common complication in diabetes and causes vascular complications. In diabetes, a lack of lipoprotein lipase activity may play a significant role in triglyceride elevation. As insulin obstructs the activity of hormone-sensitive lipases in adipose tissue and conquers triglyceride release, it is a potent inhibitory activity of lipolysis. Furthermore, insulin treatment for diabetes reduced the plasma triglycerides by restoring lipoprotein lipase levels to standard value. Diabetes-induced hyperlipidemia could be caused by an additional mobilisation of fat from adipose tissue due to glucose underutilization. *P. ostreatus* normalised all lipid profile constraints, suggesting that it may have antihypertensive properties [31].

3.9. Antihypercholesterolic Activity

In vitro models in rodents, as well as human subjects, have been used to study *P. ostreatus*. Aminotransferases, total cholesterol, VLDL, LDL, lactate dehydrogenase, and glucose levels all decreased significantly, while HDL levels increased. The decrease in lipid absorption from the gastrointestinal tract and their increased excretion through faeces is one possible mechanism. Another mechanism is linked to lovastatin's inhibition of HMG-CoA reductase [32].

3.10. Antiviral Activity

Due to the anti-infective, antiviral, antitumor, and immunomodulatory activities and wound healing properties, glucans have got a lot of attention. β-glucans have antiherpetic activity in vitro, inhibiting viral adsorption, diffusion, and cell-to-cell supper while also increasing the proinflammatory cytokine response in macrophages [33]. The trigger of cytokine synthesis, activation of NK cells and T lymphocytes, and increased synthesis of nitric oxide are among the most significant methods of action. Alternative significant mechanism could be the stimulation of DCs, which would allow for more efficient antigen processing and presentation during infection [20, 33].

3.11. Antiarthritic Activity

Fresh mushrooms exhibit presence of significant levels of l-ergothioneine, having an antioxidant activity. Mushroom possesses the Beta-glucan type of carbohydrate which has potential anti-inflammatory action, which can help to protect our body against various disease condition [34]. *P. ostreatus* produces antioxidant action due to its free radical scavenging and showed effective anti-arthritic activity. While blood cells are chief components of the host defense system. The increased WBC can be attributed to systematic response of the rats to paw inflammation induced by the formaldehyde [35].

4. CONCLUSION

Mushrooms can help boost immune system. Palatable mushrooms have been consumed and valued for their flavour, economic and biological value, and therapeutic

properties. They can grow in a variety of climates and on economical, easily available unused materials. These mushrooms are a prime specimen of how low-value waste, principally generated by the cultivation, forestry and food-processing company, can be converted into a higher-value product useful to mankind. Mushroom culture has recently diversified, and the culture of added mushrooms has been proved. The fungus Pleurotus genus has been intensively considered and cultivated in many diverse parts of the world for a variety of reasons. These mushrooms require few ecological controls for agriculturally grown and its fruiting bodies are not frequently infected by diseases and pests. It can also be grown in a modest and inexpensive manner. One more benefit of growing oyster mushrooms is that a high proportion of the matter is converted to fruiting bodies, which increases productivity when compared to other mushrooms, making *P. ostreatus* an exceptional choice for mushroom farming.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

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