

Medicinal Importance of Pleurotus species (Oyster Mushroom): A review

Haseeb Irfan¹, Amna Saleem², Maham gill³, Ayesha Ali⁴, Momina Akmal⁵

^{1,2,3,4,5} Institute of Plant protection Department of Plant pathology, MNS University of Agriculture Multan, Pakistan.

Email: ^{1*} haseeb.s6630@gmail.com ,² aminasaleem714@gmail.com ³ aishhaider2003@gmail.com
⁴ mahamgill259@gmail.com, ⁵ akmalmomina8@gmail.com

Corresponding Author* : Haseeb Irfan

Abstract Pleurotus ostreatus is a Macro- Fungi. It belongs to the class Basidiomycota and the family Agaricaceae. It is the second-largest cultivated edible mushroom for various purposes like food and medicine. Somehow cardiometabolic parameters and various diseases like cancer can be treated with the intake of mushrooms through diet. In the modern world, oyster mushrooms are known for their high-quality protein, fiber, vitamins and many other healing properties. It is used as a health enhancer, more than any other mushroom. Many biologically active compounds in this mushroom include polysaccharides, lipopolysaccharides, proteins, peptides, glycoproteins, nucleosides, triterpenoids, lectins, lipids and their derivatives.¹ In this review, an extensive database search and analysis was performed to change the status and to predict the biomedical potential of Oyster mushroom (Pleurotus). (Sarma, Saha et al. 2018) .

Keywords: Pleurotus ostreatus, Macro- Fungi, Oyster mushroom

1. INTRODUCTION

Pleurotus Ostreatus is an edible fungus that is rich in various functional ingredients such as Beta-Glucans. They are soluble fibers that come from the cell wall of fungi, some bacteria, and plants. They can lower the risk of heart diseases, functions like lipid and glucose metabolism, heart attack risk, and blood pressure. It can also be used to control body weight used in diet (Food). It has been researched that various bioactive compounds can also be obtained from different solvent extracts of the fruiting body and the mycelium of the oyster mushroom (Pleurotus ostreatus). They can be helpful in many health-beneficial activities like immunomodulatory and probiotic activities. The different solvent extracts and different polysaccharides extracts of Pleurotus. Ostreatus have shown anti-cancer in both animals and in human cells. (Dicks and Ellinger 2020) Among fungi, the mushroom is more prominent due to its distinctive fruiting body which can be hypogeous and epigeous, large enough to be seen with an eye and picked by hand. The mushroom family includes 14,000 to 22,000 species while the actual number is many times higher than it which is undescribed. In this large number, only 2000 species are edible. While hundreds of mushroom species cultivated commercially are poisonous, they can't be eaten. Most of the poisonous mushrooms belong to the genus *Amanita*, *inocybe*, and *panaeus*. The toxic effects of the poisonous mushrooms are due to many secondary metabolic enzyme activities. Many mushrooms are still considered one of the interests of nature and many types of mushrooms are just due to their pleasant aroma and taste. Mushroom nutrients and medicinal value was discovered in early 1500 BC based on much ancient literature. In 1986 first time reported the hypotensive activity of Pleurotus mushroom was, later anti-tumor activity was also discovered. Till now many studies can show the medicinal properties and nutritional properties of mushrooms. Pleurotus mushroom is a mouse model, later anti-tumor activities were shown in Nanba in mushrooms and according to Chang and Buswell called "Mushroom Nutraceuticals" of late they have been included in the category of functional foods. Functional foods are that food that is modified and consumed as a normal diet to provide health benefits. *Rajarathnam et al.* mushrooms mainly belong to the genus *Amanita*, *Inocybe*, and later Cohen et al. thoroughly reviewed and updated bio-potentialities of Pleurotus species that resulted in an upsurge in R and D mushroom Fungus. Commercially button mushroom ranked first followed by shiitake and oyster mushroom occupied the third position. The Oyster mushroom belongs to the phylum Basidiomycota which produces oyster shape mushrooms. Oyster mushrooms are distributed all over the world from temperate to tropical regions, they grow at a temperature range of 12-32 °C. There are various colors of oyster mushroom but white is the most common variety of it. It can be grown on many types of agricultural waste, oyster mushrooms are very rich in protein, vitamins, and minerals. Oyster mushroom also contains a very low amount of carbohydrates, and sugar and very less amount of or no cholesterol. Extensive work on the medical attributes of Pleurotus was done by Wang, Li, and their colleague in the first decade of the new millennium, later Gregori updated and reviewed the nutritional and medicinal value of Pleurotus species. Usage of oyster mushrooms is also considered a functional food because they produce positive effects on human beings in many ways. Functional food comprises products of microbial, plant, and animal origins containing physiologically active compounds beneficial for human health and reducing the risk of severe diseases. It includes supplements, medicinal foods,

vita foods, and so on. Many mushrooms are helpful in human ailments because they possess many pharmacological and biological features. They act as a metabolic activator, control intoxication, and viral infections, and help immune-balancing and immunomodulation's, like antioxidants and energy-boosting properties. (Patel, Naraian et al. 2012) Extracts of many mushrooms are used as a treatment of many harmful diseases extracts of *Ganoderma* species have been helpful in the treatment of various human ailments right from microbial infections to viral infections including HIV due to its immunopotential and immunomodulatory properties, Treatment of malignancies such as lung cancer, cardiac failure, etc.; Fruiting bodies as well as active mycelia of *Pleurotus* species also possess several therapeutic properties like anti-inflammatory, immunostimulatory and immunomodulatory, anticancer activity and much more activity. Chemical analyses have shown that many of the biologically active compounds isolated from mushrooms belong to hemicelluloses, lipopolysaccharides, peptides, proteins, and glycoproteins. Medicinal Plants have high importance as we know that there is no treatment of viral disease (Samad et al., 2022a,b,c,d,e,f,g,h) while these Plants can also be used as immune booster in viral diseases.

BENEFICIAL EFFECTS

Pleurotus Ostreatus (*P.ostreatus*) has many beneficial effects from which some are characterized below:

- ✓ They are low in Fats, Calories, and Essential Fatty acids.
- ✓ They are high in vegetable proteins, minerals, and vitamins.
- ✓ They promote heart and immune system health.
- ✓ They encourage healthy blood sugar control. They provide anti-oxidants and anti-inflammatory effects.
- ✓ They generate green medicine for the treatment of cancer and ailments.

REPORTED THERAPEUTIC VALUES OF PLEUROTUS BENEFICIAL TO BRAIN:

Pleurotus Ostreatus (*P.ostreatus*) are high in vitamin B12, from which it has been observed that it may potentially reduce "Brain Shrinkage", and have plenty of long-chain omega-3 fatty acids, which, when people are deficient, may be linked to depression or suicide. (Solomko and Eliseeva 1988)

ANTIMICROBIAL:

Oyster mushroom has been explored to combat simple and multiple drug-resistant isolated of *E. coli*, species of *Candida*, and some other species of *Streptococcus*. Antimicrobial and antifungal activity of oyster mushrooms dependent upon the nature of the solvent, ether extract was more active against gram-negative bacteria as compared to acetone extract.ⁱⁱ Ether and acetone extracts of *OM* against *B. subtilis*, *E. coli*, and *S. cerevisiae*. Later, Nithya had higher antibacterial activity again with *Pseudomonas* and *E. coli* when compared with gram-positive organisms. (Sharma, Jana et al. 2014)

ANTI-CANCER ACTIVITIES:

"Cancer is a disease in which some of the body's cells grow uncontrollably and spread to other parts of the body". Globally, cancer is one of the main diseases which may result in human death, it is currently estimated 8.2 million and will likely reach to 13 million per year worldwide till 2030. However, if we talk about the treatment of cancer it includes chemotherapy, radiotherapy and chemically derived drugs. These can cure cancer up to a good percentage but treatments such as "chemotherapy" and "radiotherapy" can put patients under a lot of strain and further damage of their health. Cytotoxic bioassay of Ethyl acetate, Hexane and Chloroform extract of *Pleurotus ostreatus* in different concentrations on Brine shrimp lethality bioassay was resulted the LC values of 10 µg/ml, 40 µg/ml and 75 µg/ml for Hexane, Ethyl acetate and Chloroform, respectively. Through some experimentations; it is viewed that Polysaccharides has extracted from *Pleurotus Ostreatus* mycelium component. Due to which it is observed that *Pleurotus Ostreatus* has anti-cancer activities. The different polysaccharide fractions which were extracted from mycelium biomass of *Pleurotus Ostreatus* suppresses the development of Ehrlich Tumor (ET) and Sarcoma 180 (S180). Although, water soluble *P.ostreatus* Polysaccharides extracted on human Caco-2 cells reduces the secretion of MMP-2 (matrix metalloproteinase-2) and MMP-9 (matrix metalloproteinase-9) and also inhibited the invasion of Caco-2 cells (colon cancer cells). (Dicks and Ellinger 2020)

ANTIVIRAL: P.

Mushroom contains substances that exert direct or indirect antiviral effects as a results of immune-stimulatory activity. An antiviral protein was isolated and identified from fruiting body of oyster mushrooms. Water soluble glucans isolated from sclerotia of *P. tuber-regium* and their corresponding water-soluble sulphated derivatives were active against herpes simplex virus type-1 and type-2. Anti-viral activity was due to binding of sulphated β -glucans to viral particles thereby preventing them from infecting the host cells. Not only intracellular proteins of *P. ostreatus* but its extracellular extract also contains polysaccharides that have immuno-modulating effects. (Patel, Naraian et al. 2012)

CHOLESTEROL LEVEL:

By adding oyster mushrooms (*P. ostreatus*) in your recipes/meals you can reduce your total cholesterol level. If you replace half of the meat in a dish with mushrooms, then this will greatly reduce your consumption of cholesterol. And in results an equivalent percentage of your cholesterol will take place.

BLOOD SUGAR-LEVEL:

B vitamins, the main bioactive compounds in mushrooms may have anti-diabetic properties. Improve insulin resistance, and also reduce pancreatic tissue damage. Moreover, several bioactive peptides that are obtained after in-vitro digestion of *Pleurotus Ostreatus* (oyster mushroom) have been shown to inhibit the angiotensin converting enzyme. This might be helpful in reducing blood pressure (BP)

HEART HEALTH:

Oyster mushrooms (*P. ostreatus*) may promote heart health by reducing heart disease risk factors like high cholesterol and high blood pressure. *P. ostreatus* is especially high in several compounds that benefit heart health, which includes fibers called beta-glucans.

URIC-ACID:

Oyster mushrooms (*P. ostreatus*) contains a good amount of purines, a compound that is broken down into uric acid in the body. It greatly controls the uric-acid percentage in our body. High levels of uric acid can aggravate gout symptoms, such as pain, swelling and redness in the joints.

ANTIOXIDANT:

Antioxidant such as phenolic and flavonoid compound are delaying and inhibiting oxidative processes. Oyster mushroom have potent antioxidant activity in both in vitro and in vivo. Rich in vitamin and selenium content which is important antioxidant in biological system. (Dicks and Ellinger 2020)

Anti-Human Immunodeficiency Virus (HIV):

Ribonucleases (RNases: mol . wt . 10.7 kDa) have been isolated and characterized from the *P. ostreatus* that has the potentiality to neutralize HIV through degradation of viral genetic material. On the other hand RNases (mol.wt.14.5kDa) was isolated and characterized from sclerotia of *P. tuber* - ribonucleolytic activity toward Poly-G. Another ribonuclease , pleuuregin , was also isolated from both fresh and dried sclerotia of

P. tuber - regium. Later in the fruiting bodies of OM they observed a novel ubiquitin - like protein having HIV - 1 reverse transcriptase inhibitory activity. Similarly hot water extracts of *P. sajor* - caju and *P. pulmonarius* inhibit HIV - 1 reverse transcriptase activity by SU2 molecule having 4.5 kDa mol . wt. A lectin isolated from fresh fruiting bodies of *P. citrinopileatus* also inhibited HIV - 1 reverse transcriptase. ⁱⁱⁱMost recently it was reported that a hemolysin (mol . wt . 27.0 kDa) , a monomeric protein isolated from *P. nebrudensis* , exhibited anti - HIV - 1 activity in CEM cell culture. (Patel, Naraian et al. 2012)

CARDIO-METABOLIC PARAMETERS:

Cardio-metabolic disease describes a spectrum of conditions beginning with insulin resistance, progressing to the metabolic syndrome, pre-diabetes, and finally to more severe conditions.^{iv} Cardio-metabolic diseases are a group of common but often preventable conditions including heart attack, stroke, diabetes, insulin resistance and non-alcoholic fatty liver disease.^v It has been observed globally that there is increase in the number of people who experience one or more of these conditions during their lifetime. Cardio-metabolic diseases and their parameters are leading global health challenge. There happening as well as progression is severely affected by diet. The rate of cardio-metabolic diseases and its

parameters can be increase inthe upcoming time due to intake of artificial food/diet instead of nutritional food/diet. It canalso become major risk factor of cardiovascular diseases (CVDs). The WorldHealth Organization (**WHO**) as estimated that 17.9 Million people died from cardio-vascular diseases (CVDs) 2016; it was 31% of all deaths.

TREATMENTS:

To treat the cardio-metabolic diseases *P.ostreatus* plays a vital and beneficialregium , exhibited very stable nuclease activityat 100 ° C for 30 min . with a higher (Dicks and Ellinger 2020)role. Being an edible mushroom and a part of usual diet it's aninteresting alternative source of nutrients and also a source to fulfil ecological reasons. To improve the cardio-metabolic health *P.ostreatus* delivers various bioactive compounds such as “**β-Glucans**”. *P.ostreatus* produces “**Twice**” as many β-Glucans as *A- bisporus* produces due to its beneficial role in the prevention of insulin resistance, dyslipidemia, hypertension, and obesity. β- Glucans in *Pleurotus Ostreatus* are the side chained or branched polysaccharides in comparison to linear β-Glucans in oats and barley. However, β-Glucans in variousmushrooms are cross-linked with “chitin”, fungal cell-wall which results to reduce their solubility.

HYPOTENSIVE:

The level of antihypertensive property varies with mushroom species and their combinations while OM possesses bloodpressure lowering activity. Hot aqueous extractand dried fine particles of fruiting bodies of *P. nebrodensis* have been accounted inprevention of hypertension . Hagiwara et al . indicated that *P. cornucopiae* might bring forththe same effect associated partly with D - mannitol which inhibits angiotensin - I converting enzyme . Recently Ching et al . have shown that protein fractions from *P. cystidiosus* possessed the highest ACE(angiotensin - I converting enzyme) inhibitory activity that cause the contraction ofblood vessels thereby raising the blood pressure ; however effect was lower comparedto captopril , an ACE inhibitor used for the treatment of hypertension and some other types of congestive heart failure .^{vi}

HYPERGLYCEMIC :

Guanide , a compoundrelated to the bi - guanide class of oral anti - diabetic drugs was isolated from the *Pleurotus*species that exerted anti - hypoglycemic effect Endo - polymer from submerged mycelial cultures of *P. ostreatus* possesses hypoglycemic effects . High fibre and proteins content and low fat content of edible mushrooms make it ideal food for diabetic patient. Aqueous extracts of *P. pulmonarius* upon oral administration decreased serum glucose level in alloxan - treated diabetic mice. Polysaccharides extracted from fruiting bodyof *P. citrinopileatus* alleviated anti - hyperglycemic effect by the elevation of the activity of glutathion peroxidase .

ANTILIPIDEMIC :

Hyperlipidemia is the leading risk factor for atherosclerosis . Feeding of mushroom powder increases the excretion of total lipids and cholesterol through faecal matter . Mevinolin (a statin : polysaccharide), present in fruiting bodies of *P. ostreatus* and *P. citrinopileatus* exhibited anti - hypocholesterolemic activities. *P. pulmonarius*exhibited potent synergistic antihyperglycemiceffect when used in combination with glyburide. Recent report produced by Alam etal . states that when hypercholesterolemic rat feeding of diet containing 5 % fruiting bodies of *P. ferulae* reduced the total cholesterol in plasma , triglyceride , low - density lipoprotein, total lipid , phospholipids etc. Whereas 5 % mushroom powder of *P. salmoneostramineus* reduced total lipid phospholipids and LDL / HDL ratio by 29.67 , 16.61 and 65.31 % , respectively.(Patel, Naraian et al. 2012)

CONCLUSION:

Oyster mushroom (*P.ostreatus*) is a beneficial mushroom in many aspects. It shows beneficial and medicinal activities with the help of its various bio-active compounds and extracts. It can also be known as “Green Medicine”. It shows various anti-cancer activities and also on the other hand it deals with many cardio-metabolic parameters. Thus, further clinical trials with a well-controlled study design are necessary to get more accurate results. This review show that oyster mushroom have many promising medicinal properties. Due the number of bioactive compounds oyster mushroom help to maintain and prevent the disease. They have also high nutritional value. The abundance of information available in this review suggests that oyster mushrooms have many promising therapeutic properties that require further study with advanced processing aids. Therefore, fruity bodies, mycelium and their liqueur or mushroom extract are considered to be beneficial nutrients due to their ability to cure many human ailments. Although biological activity is better understood in many cases, it is important to recognize the active substance in many cases so that the correct method can be incorporated into the study of the basics. The availability of high-tech methods should allow OM researchers to invest in new metabolic principles, their potential in vitro drug trials, and clinical trials that

meet international standards. In the age of "finance" it will be much easier to study the process by checking the oyster mushroom biomariotype to improve its nutritional value for holistic medicine.

REFERENCES

- Dicks, L. and S. J. N. Ellinger (2020). "Effect of the intake of oyster mushrooms (*Pleurotus ostreatus*) on cardiometabolic parameters—A systematic review of clinical trials." **12**(4): 1134.
- Grace E. Vincent, Sarah M. Jay, Charli Sargent, Corneel Vandelanotte, Nicola D. Ridgers, Sally A. Ferguson. "Improving Cardiometabolic Health with Diet, Physical Activity, and Breaking Up Sitting: What about Sleep?", *Frontiers in Physiology*, 2017
- Nisha, Aesha Chhatbar, Harsiddhi Chhatbar, Arun Arya. "Chapter 25 Biochemical Aspects and Cultivation of Medicinal Mushroom *Pleurotus flfordida* on Cellulosic Waste of Cotton and Paper", Springer Science and BusinessMedia LLC, 2022
- Patel, Y., et al. (2012). "Medicinal properties of *Pleurotus* species (oyster mushroom): a review." **3**(1): 1-12.
- Piraino, F. and C.R. Brandt, 1999. Isolation and partial characterization of an antiviral, RC-183, from theedible mushroom *Rozites caperata*. *Antiviral Res.*, 43(2): 67-78
- Samad A, Abbas A, Mehtab U, Ur Rehman Ali Khera H, Rehman A and Hamza M . Infectious Bronchitis Disease in Poultry its Diagnosis, Prevention and Control Strategies. *Ann Agric Crop Sci.* 2021; 6(7): 1100.
- Samad, A. ., Hamza , M., Muazzam, A. ., Ahmad, H. ., Ahmer, A. ., Tariq, S. ., Khera, H. U. R. A. ., Mehtab, U. ., Shahid, M. J. ., Akram, W. ., Kaleem, M. Z. ., Ahmad, S. ., Abdullah, A. ., & Ahmad, S. . (2022). Policy of control and prevention of infectious bursal disease at poultry farm. *African Journal of Biological, Chemical and Physical Sciences*, 1(1), 1-7.
- Samad, A., Ahmad, H., Hamza, M., Muazzam, A., Ahmer, A., Tariq, S & Muthanna, F. M. (2022). Overview of Avian Corona virus, its prevention and control Measures. *BULLET: Jurnal Multidisiplin Ilmu*, 1(01), 39-45.
- Samad, A., Hamza, M., Muazzam, A., & Harahap, M. K. (2022). Role of Artificial Intelligence in Livestock and Poultry Farming. *Sinkron: jurnal dan penelitian teknik informatika*, 7(4), 2425-2429.
- Samad, A., Hamza, M., Muazzam, A., Ahmer, A., Tariq, S., Ahmad, S., & Mumtaz, M. T. (2022). Current Perspectives on the Strategic Future of the Poultry Industry After the COVID-19 Outbreak. *Brilliance: Research of Artificial Intelligence*, 2(3), 90-96.
- Samad, A., Hamza, M., Muazzam, A., Ahmer, A., Tariq, S., Javaid, A., ... & Ahmad, S. (2022). Newcastle Disease In Poultry, Its Diagnosis, Prevention And Control Strategies. *BULLET: Jurnal Multidisiplin Ilmu*, 1(01), 1-5.
- Samad, A., Hamza, M., Muazzam, A., Ahmer, A., Tariq, S., Shahid, M. J., ... & Din, F. U. (2022). Overview of Bacterial Diseases in Poultry and policies to control disease and antibiotic resistance. *BULLET: Jurnal Multidisiplin Ilmu*, 1(01), 19-25.
- Samad, A., Khera, H. U. R. A., Rehman, A., Hamza, M., Mehtab, U., Hussain, K., ... & Javaid, A. A Brief Overview on Ventilation and its Role in Poultry Production.
- Sarma, D., et al. (2018). "Bioactive compounds with special references to anticancer property of oystermushroom *Pleurotus ostreatus*." **7**(4): 2694-26
- Sharma, A. K., et al. (2014). "Antimicrobial properties of some edible mushrooms: A review." **3**(5): 1009-1023.
- Solomko, E. and G. J. P. b. i. m. Eliseeva (1988). "Biosynthesis of vitamins B by the fungus *Pleurotustosreatus* in a submerged culture." **24**(2): 164-169.
- Talkad, Muralidhar S., Rajat K. Das, Preetham Bhattacharjee, Sagnik Ghosh, and Undre Prasad Shivajirao. "Establishment of Enzyme Inhibitory Activities of Lovastatin, Isolated From *Pleurotus ostreatus*", *InternationalJournal of Applied Sciences and Biotechnology*, 2015.