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Mushroom Nutritional and Medicinal Properties: A Review

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Abstract:

With potential uses in functional foods, nutraceuticals, and complementary health products, mushrooms are becoming more widely acknowledged as nutrient-dense foods and sources of biologically active chemicals. Protein, dietary fiber, vitamins, minerals, and comparatively little amounts of fat and energy are often found in edible mushrooms. Depending on the species, growth conditions, maturity, substrate, processing, and storage, their nutritional makeup varies significantly. Bioactive substances such β-glucans, phenolic compounds, ergothioneine, ergosterol, triterpenoids, lectins, peptides, and other polysaccharides are found in mushrooms in addition to traditional nutrients. An intriguing non-animal dietary source of vitamin D is mushrooms, which can also contribute vitamin-D_2 when exposed to UV light. Clinical proof is still scarce for a number of medical claims, despite the fact that many experimental investigations show encouraging biological activities. Therefore, mushrooms should primarily be considered nutrient-rich foods and promising sources of bioactive compounds rather than substitutes for established medical treatments.

Keywords: Mushroom, Food, Nutraceuticals, Antioxidants.

Introduction:

Mushrooms have been consumed by humans for centuries because of their distinctive flavour, texture and nutritional properties. More recently, scientific interest has expanded because mushrooms contain numerous compounds that may influence physiological processes and human health. Edible species such as *Agaricus bisporus, Pleurotus ostreatus, Lentinula edodes, Volvariella volvacea* and *Flammulina velutipes* are important food mushrooms, while species belonging to genera such as *Ganoderma, Trametes, Cordyceps* and *Hericium* have received considerable attention for medicinal applications. Mushrooms are characterized by relatively low energy density, substantial protein and fibre content, and a wide range of minerals and vitamins. Their composition is affected by species, cultivation substrate, environmental conditions, developmental stage and processing. Kalac (2013) reported that mushroom fruiting bodies generally contain considerable amounts of protein and minerals while having relatively low lipid concentrations, supporting their value

as nutrient-dense foods. The health-promoting properties of mushrooms are associated not only with nutrients but also with secondary metabolites and structural components. Important compounds include β-glucans, phenolics, sterols, triterpenoids, lectins, peptides, ergothioneine and other polysaccharides. These compounds have been associated experimentally with antioxidant, immunomodulatory, anti-inflammatory, antimicrobial and metabolic effects (Rathore *et al*., 2017; Sharma *et al.,* 2018).

Nutritional Composition of Mushrooms:

Proteins and Amino Acids: Mushrooms provide valuable dietary protein, although the amount varies considerably among species. Mushroom proteins contain several essential amino acids, making them useful as part of diversified diets. The protein content is particularly important from a food-security perspective because mushrooms can convert agricultural and lignocellulosic residues into edible biomass. Rathore *et al*. (2017) reported that mushrooms can contain approximately 19-35% protein on a dry-matter basis, although substantial species-dependent variation occurs. The presence of essential amino acids, combined with low fat content, makes edible mushrooms attractive ingredients in vegetarian and plant-forward diets. Mushroom proteins can also contribute to the development of meat alternatives and other functional food products.

Carbohydrates and Dietary Fibre: Carbohydrates constitute a major portion of mushroom dry matter. However, a significant proportion occurs as structural polysaccharides and dietary fibre rather than readily digestible sugars. Important mushroom polysaccharides include β-glucans, chitin, mannans, hemicellulose and other complex carbohydrates. These compounds contribute to the characteristic texture of mushrooms and may also influence gastrointestinal function.

Mushroom β-glucans have received particular scientific attention because their structures allow interaction with biological receptors involved in immune regulation. Novak et al. (2015) reported that β-(1→3),(1→6)-glucans have been associated with immunomodulatory, antioxidant, anti-inflammatory, antimicrobial, prebiotic and antidiabetic activities.

Lipids and Fatty Acids: Mushrooms are generally low-fat foods. The lipids present contain a relatively high proportion of unsaturated fatty acids compared with saturated fatty acids. The major fatty acids include linoleic, oleic and palmitic acids, with composition varying among species. The relatively low total fat content contributes to the suitability of mushrooms for low-energy diets.

Vitamins: Mushrooms contain several vitamins, including riboflavin, niacin,

thiamine, folates and vitamin C in varying quantities. One of their most interesting nutritional characteristics is their potential to provide vitamin D_2. Ergosterol present in mushroom tissues can be converted into vitamin D_2 following exposure to ultraviolet radiation. Cardwell *et al.* (2018) reported that UV-exposed mushrooms can contain nutritionally relevant concentrations of vitamin D_2 and may therefore represent an important non-animal source of vitamin D. This characteristic has practical importance for vegetarian and vegan diets, where naturally occurring dietary sources of vitamin D can be limited.

Minerals: Mushrooms can provide potassium, phosphorus, iron, zinc, copper, selenium and other minerals. Mineral concentrations depend strongly on species, substrate and growing conditions. Because mushrooms can accumulate minerals from their growing substrate, controlled cultivation is important for ensuring nutritional quality and minimizing undesirable accumulation of heavy metals.

Major Bioactive Compounds:

β-Glucans: β-glucans are among the most extensively investigated mushroom bioactive compounds. They are polysaccharides located predominantly within fungal cell walls.Their biological effects are related partly to molecular structure, molecular weight, branching pattern and solubility. Vetvicka *et al.* (2015) described β-(1→3), (1→6)-glucans as important contributors to the biological activities attributed to medicinal mushrooms. β-glucans can interact with receptors such as Dectin-1, complement receptor 3 and Toll-like receptors. These interactions can influence macrophages, neutrophils, dendritic cells and other immune components.

Phenolic Compounds: Mushrooms contain phenolic compounds capable of scavenging reactive oxygen species and contributing to antioxidant activity. Their concentration depends on species and processing. Phenolic compounds can help protect food and biological tissues against oxidative processes. However, antioxidant activity measured in laboratory assays does not automatically translate into equivalent clinical effects in humans.

Ergothioneine: Ergothioneine is a sulfur-containing amino-acid derivative that occurs in relatively high concentrations in many mushrooms. It has attracted interest because of its antioxidant and cytoprotective properties. The compound can participate in cellular protection against oxidative stress, although the physiological significance of dietary ergothioneine continues to be investigated.

Ergosterol and Triterpenoids: Ergosterol is the principal sterol in fungal membranes and acts as the precursor of vitamin D_2 following UV exposure. Mushrooms also contain various triterpenoids, particularly species of medicinal interest such as

Ganoderma. Cirlincione *et al*. (2022) reviewed mushroom mycochemicals including phenolics, triterpenoids, sterols, fatty acids, polysaccharides, proteins, peptides and lectins, emphasizing their importance in nutrition and functional-food development.

Various Medicinal Properties:

Antioxidant Properties: Oxidative stress occurs when production of reactive oxygen species exceeds the body's antioxidant capacity. Long-term oxidative stress has been associated with cellular damage and several chronic diseases. Mushrooms contain phenolics, flavonoid-like compounds, ergothioneine, selenium and other antioxidant constituents. These compounds can contribute to free-radical scavenging and protection against oxidative processes. Kumar *et al*. (2021) emphasized that mushrooms are important sources of natural antioxidants and reported broad nutraceutical potential associated with their bioactive constituents. Nevertheless, antioxidant capacity measured using chemical assays should not be interpreted as direct evidence that mushroom consumption prevents a specific human disease. Human intervention studies are necessary to establish clinical significance.

Immunomodulatory Properties: One of the most extensively studied medicinal characteristics of mushrooms is their potential to modulate immune responses. Mushroom β-glucans and polysaccharide-protein complexes may interact with immune cells and receptors, stimulating or regulating immune responses. Such effects have generated interest in mushrooms as functional ingredients and complementary immunomodulatory agents. Valverde *et al.* (2015) described multiple biological activities of mushroom β-glucans, including immunomodulatory and antitumor effects. Mushroom-derived preparations such as lentinan and PSK have historically attracted attention in cancer-supportive research. However, the effects depend on mushroom species, extraction methods, molecular structure and preparation quality.

Anticancer Potential: The anticancer potential of mushrooms is one of the most widely investigated medicinal properties. Experimental studies have suggested that mushroom polysaccharides may influence immune surveillance, apoptosis, cell proliferation and inflammatory pathways. Ren *et al*. (2012) reviewed mushroom polysaccharides and highlighted antitumor and immunostimulatory activities associated with compounds such as β-glucans. Sharma *et al*. (2018) similarly reported that medicinal mushrooms contain compounds with potential antitumor and immunomodulatory activities. Epidemiological research has also investigated mushroom consumption and cancer risk. Li *et al.* (2014), for example, conducted a meta-analysis examining dietary mushroom consumption

and breast-cancer risk. However, it is important to distinguish between laboratory evidence, animal studies, observational studies and clinical trials. Current evidence does not justify describing ordinary mushroom consumption as a treatment for cancer.

Anti-Inflammatory Activity: Chronic inflammation is associated with numerous metabolic and degenerative conditions. Mushroom β-glucans and other metabolites have been investigated for their capacity to regulate inflammatory pathways. Murphy *et al.* (2015) reviewed the anti-inflammatory effects of fungal β-glucans and described effects involving inflammatory mediators including nitric oxide, interleukins and tumour-necrosis-factor-related pathways. These findings suggest that mushrooms may have potential as components of dietary strategies aimed at supporting healthy inflammatory regulation. Nevertheless, the magnitude of effects in humans varies considerably between preparations.

Antidiabetic and Metabolic Effects: Mushrooms have also attracted attention for potential effects on glucose and lipid metabolism. Their low energy density, dietary fibre and bioactive polysaccharides may make them useful components of balanced diets. Some mushroom extracts and polysaccharides have demonstrated glucose-lowering effects in experimental models. In addition, certain compounds may influence lipid metabolism and oxidative stress. Tung *et al.* (2020) reviewed medicinal properties of edible mushrooms in relation to metabolic syndrome and associated disorders, including potential anti-obesity, antidiabetic and cardioprotective effects. However, these properties should not be interpreted as evidence that mushrooms alone can prevent or treat diabetes. Dietary pattern, physical activity and clinically appropriate treatment remain fundamental.

Cardiovascular Health: Mushrooms may contribute to cardiovascular health through several nutritional and bioactive characteristics. Their low-fat nature, dietary fibre, potassium content and potential effects on lipid metabolism are particularly relevant. Some mushroom polysaccharides have demonstrated hypocholesterolemic activity in experimental studies. Kumar *et al.* (2021) reported potential cardiovascular benefits associated with the combination of low fat, fibre and bioactive compounds in edible mushrooms. The potential effects on cholesterol, oxidative stress, blood pressure and inflammation make mushrooms attractive candidates for incorporation into heart-healthy dietary patterns.

Antimicrobial and Antiviral Properties: Mushrooms produce numerous secondary metabolites that may protect them against microorganisms in their natural environments. Some of these compounds have demonstrated antimicrobial activity against bacteria, fungi and viruses. Sharma *et al*. (2018) described antibacterial, antiviral, antifungal and antiparasitic activities among several medicinal mushroom species and their metabolites. Mushroom-derived antimicrobial compounds are therefore being investigated as possible sources for future pharmaceutical development. However,

antimicrobial activity observed in laboratory assays does not necessarily indicate clinical effectiveness.

Gut Health and Prebiotic Potential: The indigestible polysaccharides of mushrooms can reach the large intestine and interact with intestinal microorganisms. This has generated interest in mushrooms as potential prebiotic foods. Singdevsachan *et al*. (2016) described mushroom polysaccharides including β-glucans, chitin, mannans and related carbohydrates as potential prebiotic substrates and discussed their possible immunomodulatory and antitumor significance. The relationship between mushroom consumption, gut microbiota and human health is an emerging research field. Future studies using microbiome sequencing and controlled dietary interventions may provide clearer evidence. The ability of mushrooms to generate vitamin D_2 following UV exposure is a particularly promising nutritional application. Cardwell *et al*. (2018) reported that UV-exposed mushrooms can provide nutritionally meaningful quantities of vitamin D_2. The process occurs because UV radiation converts ergosterol into vitamin D_2. This property has led to the development of vitamin-D-enhanced mushroom products. Such products may be useful for populations with limited intake of animal-derived vitamin D sources.

Processing and Bioavailability:

Processing can substantially influence the nutritional and bioactive characteristics of mushrooms. Drying, boiling, frying, roasting, fermentation and extraction may change the concentration and availability of nutrients and bioactive compounds. Yadav and Negi (2021) emphasized that processing conditions can influence the retention of nutritional and nutraceutical components in mushrooms. Consequently, future research should examine not only the concentration of compounds in raw mushrooms but also their stability during realistic food-processing and cooking conditions.

Safety Considerations:

Edible mushrooms are generally regarded as nutritious foods, but not all mushrooms are edible. Wild mushroom consumption can involve substantial risks because poisonous species may resemble edible species. Furthermore, mushroom extracts and concentrated supplements are chemically different from ordinary dietary consumption. Panda *et al.* (2021) emphasized that clinical use of mushroom extracts requires greater attention to efficacy and safety. Potential issues include species misidentification, contamination, heavy-metal accumulation, allergic reactions and interactions involving concentrated supplements. Proper species identification and quality control are therefore essential.

Future Prospects:

The future potential of mushrooms extends beyond their conventional role as vegetables or culinary ingredients. Several emerging areas deserve attention:

- Functional foods: incorporation of mushroom powders and extracts into breads, beverages, snacks and meat alternatives.
- Nutraceutical development: standardized β-glucan, ergothioneine and polysaccharide preparations.
- Vitamin D enrichment: UV-treated mushrooms as non-animal sources of vitamin D_2.
- Pharmaceutical research: development of purified mushroom-derived compounds.
- Gut-health research: investigation of mushroom polysaccharides and microbiome interactions.
- Precision cultivation: manipulation of substrate and environmental conditions to enhance desirable nutrients.
- Sustainable food production: conversion of agricultural residues into protein-rich mushroom biomass.
- Personalized nutrition: evaluation of mushroom consumption according to individual dietary and metabolic requirements.

Conclusion:

Mushrooms represent an important intersection between nutrition, food science and medicinal research. Their nutritional value is associated with protein, dietary fibre, minerals, vitamins and relatively low-fat content, while their medicinal potential arises largely from β-glucans, polysaccharides, phenolic compounds, ergothioneine, ergosterol, triterpenoids and other bioactive molecules. Available evidence indicates promising antioxidant, immunomodulatory, anti-inflammatory, antimicrobial, metabolic and anticancer properties. Mushrooms also have unique nutritional potential as sources of vitamin D_2 following UV exposure. Overall, mushrooms can be considered nutrient-rich functional foods with considerable potential as sources of bioactive compounds. Their integration into balanced diets, functional-food development and evidence-based nutraceutical research could contribute significantly to future nutritional and health-oriented innovations.

References:

1. Cardwell, G., Bornman, J. F., James, A. P., & Black, L. J. (2018). A review of mushrooms as a potential source of dietary vitamin D. *Nutrients*, *10*(10), 1498.
2. Du, B., Lin, C., Bian, Z., & Xu, B. (2015). An insight into anti-inflammatory effects of fungal beta-glucans. *Trends in Food Science & Technology*, *41*(1), 49-59.

3. Kalač, P. (2013). A review of chemical composition and nutritional value of wild-growing and cultivated mushrooms. *Journal of the Science of Food and Agriculture*, *93*(2), 209-218.
4. Kumar, K., Mehra, R., Guiné, R. P., Lima, M. J., Kumar, N., Kaushik, R., ... & Kumar, H. (2021). Edible mushrooms: A comprehensive review on bioactive compounds with health benefits and processing aspects. *Foods*, *10*(12), 2996.
5. Panda, S. K., & Luyten, W. (2022). Medicinal mushrooms: Clinical perspective and challenges. *Drug Discovery Today*, *27*(2), 636-651.
6. Rathore, H., Prasad, S., & Sharma, S. (2017). Mushroom nutraceuticals for improved nutrition and better human health: A review. *PharmaNutrition*, *5*(2), 35-46.
7. Ren, L., Perera, C., & Hemar, Y. (2012). Antitumor activity of mushroom polysaccharides: a review. *Food & function*, *3*(11), 1118-1130.
8. Sharma, D., Singh, V. P., & Singh, N. K. (2018). A review on phytochemistry and pharmacology of medicinal as well as poisonous mushrooms. *Mini reviews in medicinal chemistry*, *18*(13), 1095-1109.
9. Singdevsachan, S. K., Auroshree, P., Mishra, J., Baliyarsingh, B., Tayung, K., & Thatoi, H. (2016). Mushroom polysaccharides as potential prebiotics with their antitumor and immunomodulating properties: A review. *Bioactive carbohydrates and dietary fibre*, *7*(1), 1-14.
10. Tung, Y. T., Pan, C. H., Chien, Y. W., & Huang, H. Y. (2020). Edible mushrooms: Novel medicinal agents to combat metabolic syndrome and associated diseases. *Current Pharmaceutical Design*, *26*(39), 4970-4981.
11. Valverde, M. E., Hernández-Pérez, T., & Paredes-López, O. (2015). Edible mushrooms: improving human health and promoting quality life. *International journal of microbiology*, *2015*(1), 376387.
12. Yadav, D., & Negi, P. S. (2021). Bioactive components of mushrooms: Processing effects and health benefits. *Food Research International*, *148*, 110599.