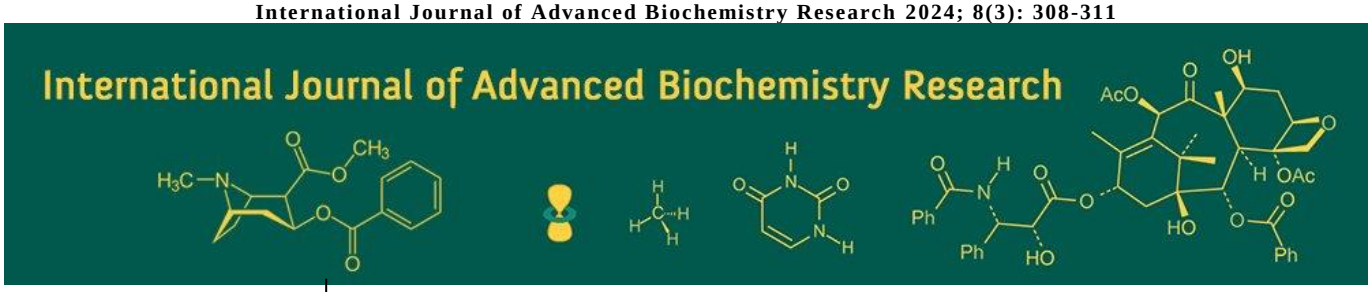


**ISSN Print:** 2617-4693
**ISSN Online:** 2617-4707
IJABR 2024; 8(3): 308-311
www.biochemjournal.com
Received: 19-12-2023
Accepted: 23-01-2024

**Chauhan RS**
KVK, CCS Haryana Agricultural University, Hisar, Haryana, India

**Yadav NS**
KVK, CCS Haryana Agricultural University, Hisar, Haryana, India

**Bochalya MS**
RRS, CCS Haryana Agricultural University, Hisar, Haryana, India

**Yadav H**
RRS, CCS Haryana Agricultural University, Hisar, Haryana, India

**Chauhan P**
KVK, CCS Haryana Agricultural University, Hisar, Haryana, India

**Gandhi V**
RRS, CCS Haryana Agricultural University, Hisar, Haryana, India

**Corresponding Author:**
**Chauhan RS**
KVK, CCS Haryana Agricultural University, Hisar, Haryana, India

# Nutritional and medicinal attributes of edible mushrooms in human health

**Chauhan RS, Yadav NS, Bochalya MS, Yadav H, Chauhan P and Gandhi V**

**DOI:** https://doi.org/10.33545/26174693.2024.v8.i3d.733

**Abstract**
Global food production faces many challenges, including climate change, a water crisis, land degradation, and desertification. These challenges require research into non-traditional sources of human foods. Edible mushrooms as a component of farming system as well as an independent venture to address the issues of diversification in agriculture, quality food, health and environment by collaborative and coordinated efforts of farmers, entrepreneurs, marketers, agro-industry. Hence, there is a need to shift towards controlled agriculture and secondary agriculture. Mushroom cultivation is one such vocation, in which agro wastes utilized for production of quality food having nutritional and medicinal values. Mushroom is considered as health food that has quality protein, low sodium, high amount of fibre, medicinal benefits as described in the next section. Mushroom is efficient means for conversion of agricultural wastes into valuable protein and presents huge potential for generating additional income and employment. Creating awareness among the farmers about the benefits of mushroom production and nutritional and health benefits among the consumers and imparting training to the farmers may go a long way in promoting mushroom production. Considering the above mentioned facts, the present study was undertaken to determine the role of mushroom in human life.

**Keywords:** Mushroom, health, nutrition, medicine, agricultural

## Introduction
Mushrooms are the source of proteins, minerals, polysaccharides, unsaturated fatty acids, and secondary metabolites. Various chronic diseases have been controlled by the consumption of edible mushrooms. In this article, the compositions and nutritional values of edible mushrooms were discussed. Furthermore, bioactive compounds such as poly-phenolic compounds and antioxidant capacity of edible mushrooms, as well as the application of these edible mushrooms as potential therapeutic agents, were covered. It is endeavored to review the modern progress on the potential consumption of edible mushrooms in the growth of functional food products and its effects on the nutritional, physical, and organoleptic properties of the developed food products. This information could be beneficial for the development of food products with health functionalities, which are of great interest to medical & nutrition industry.

The practice of eating mushrooms can be dated back to ancient times, whereby wild edible mushrooms were collected and consumed. Mushrooms have been identified as a useful food and as a source for the advancement of drugs and nutraceuticals (Lakhanpal and Rana, 2005; Khatun *et al*., 2012) [16, 14]. Mushrooms are an excellent source of vitamins, e.g. B vitamins and vitamin D, and minerals, e.g. phosphorus, magnesium, selenium, copper, and potassium and are also rich in dietary fiber, chitin and β-glucans. Numerous studies have shown that mushrooms are a rich source of bioactive compounds, e.g. phenolic and flavonoid compounds that exert antioxidant properties and these could be beneficial to human health. Mushrooms could help in reducing the risk of diseases, such as Parkinson's, Alzheimer's, hypertension, stroke, and cancer, as well as act as an antibacterial, immune system enhancer, and cholesterol-lowering agents. The non-food based portion of crops such as the stalks, straw and husk are categorized under lignocellulose biomass (Jordan *et al*., 2008; Phan and Sabaratnam, 2012) [12, 23]. The utilization of organic rich items *viz*. mycelium based is regarded as bio-degradable, maintainable and contributes to the change of feasible economy,

which is one of challenges in society at present (Zhu *et al*., 2013; Picornell-Buendia *et al*., 2016; Apples *et al*., 2018, Bhatia *et al.*, 2011, 2012) [30, 24, 3, 7].

**Why Eat Mushrooms**

Edible mushrooms are important sources of food. They are consumed not only for their innate flavour and taste, but also for their important nutritional value. On fresh weight basis mushrooms are superior in protein content (Aremu *et al*., 2009) [4] to all vegetables and fruits, but are inferior to meat and dairy products, which are the conventional protein sources. Mushrooms are widely known for their great taste and amazing health benefits. Packed with a ton of essential vitamins and minerals, they make for an excellent addition to human diet, adding flavour to many different recipes. Crimini mushrooms are one of the most widely used mushroom varieties, popular in kitchens around the world. Many don't realize that mushrooms, including crimini mushrooms, are actually a kind of fungus. They're native to North America and Europe and are known for their delicate flavour and meaty texture.

**Health Benefits**

Mushrooms are a low-calorie food that packs a nutritional punch. Loaded with many health-boosting vitamins, minerals, and antioxidants, they have long been recognized as an important part of any diet. For instance, mushrooms raised with exposure to ultraviolet light are a good source of vitamin D, an important component in bone and immune health. Mushrooms are an excellent source of zinc, an essential trace element. Zinc is a vital nutrient for boosting the immune system and is also needed for ensuring optimal growth in infants and children. Moreover, researchers have found a number of other excellent reasons for incorporating mushrooms into diet.

**Lower Blood Pressure**

Mushrooms are rich sources of potassium, a nutrient known for reducing the negative impact that sodium can have in our body. Potassium also reduce the tension in blood vessels, potentially helping to lower blood pressure.

**Boost Immune System**

The anti-inflammatory effect of mushrooms has been shown to greatly improve the efficiency of the immune system. Research has found that mushrooms help stimulate microphages in the immune system, enhancing its ability to defeat foreign bodies and making you less susceptible to serious illnesses.

**Weight Loss**

The low carbohydrate content of mushrooms makes it an ideal food for diabetics and people who intend to control their body weight. Long and short-term studies alike have found that mushrooms, in combination with exercise and other life style changes, can have an important impact on weight loss. For example, after being asked to substitute 20 percent of their beef consumption with mushrooms, research participants showed improvements in their BMI and belly circumference. The antioxidants in mushrooms are also thought to reduce the risk of hypertension and other metabolic disorders.

**Quality protein and health benefits:** Mushrooms are a health food and from the nutritional point of view are placed between meat and vegetables. Mushrooms are reported to be an excellent source of riboflavin and nicotinic acid; a good source of pantothenic acid and ascorbic acid (Ukpebor *et al*., 2007) [29]. These are rich in quality protein, low sodium, and high amount of fiber, carbohydrate and vitamins. Mushrooms are low in caloric value and hence are recommended for heart and diabetic patients. They are rich in proteins as compared to cereals, fruits and vegetables. In addition to proteins (3.7%), they also contain carbohydrate (2.4%), fat (0.4%), minerals (0.6%) and water (91%) on fresh weight basis. Mushrooms contain all the essential nine amino acids required for human growth. Mushrooms are excellent source of thiamine (vitamin-B1), riboflavin (B2), niacin, pantothenic acid, biotin, folic acid, vitamin C, D, A and K which are retained even after cooking. They are also reported to possess anticancer activities. Some people use mushrooms as a substitute for meat in their brews (Abulude, 2005) [1]. Hence, edible mushrooms are known as the vegetable meat of the world and can be prepared into a variety of delicious dishes and as flavours for other dishes (Haas and James, 2009) [11].

**Global population vs. quality food, health and environment**

The three problems faced by the human race are quality food, health and environment. The magnitude of these problems is set to increase as the world's population continues to grow. The 20$^{th}$ century began with a world population of 1.6 billion, and ended with 6.0 billion inhabitants. By 2050 the total world population could reach 10.5 billion, with most of the growth occurring in the less developed countries. The dwindling natural resources are constraining the production systems and these constraints are going to increase with increasing population, changing lifestyles and various degradative processes already affecting the globe. The increasing global population growth may turn out to be a bigger threat to the world's food production and water supplies, health quality, than climate change. In fact, climate change is a function of the increase in population and growing needs of this population.

**Health crisis and choice of food**

We live in an era of human health crises, especially when considering the leading killer diseases of our time. We have the HIV/AIDS pandemic; various types of cancer, upsurge of hypertension, diabetes, and cardiovascular disorders worldwide. Bovine spongiform encephalopathy (BSE) commonly called Mad-cow disease (a viral disorder affecting the nervous system), foot-and-mouth disease (a highly infectious viral problem afflicting cattle, pigs, sheep, and goats, that caused havoc in Europe), Bird flu (especially H5N1 strain), swine flu and various other zoonotic infections and many other disorders (many of which are linked with what we eat) are sending out shock waves that are forcing the world's inhabitants to drastically change their choices of food menus and are shifting from meat towards mushrooms and other vegetarian diets. Human beings are the only species in the world that has figured out how to be in complete control of its food supply. The challenge now is to make sure the food doesn't take control of us.

**Mushrooms as health food:** Mushrooms, which is called the vegetable meat of the future and accepted as an ideal health food and an efficient tool for recycling of organic wastes as well as a source of subsidiary income, are becoming very popular amongst rural masses (Chauhan, *et al.*, 2021) [9]. Mushrooms are a rich protein source having essential amino-acids and high digestibility. Mushrooms have all the nine essential amino acids required for human being. Mushrooms have approximately two times more protein than in vegetables and 4-12 times protein than in fruits. Considering that number of people suffer from malnutrition, mushrooms can be an important way to combat this problem. Mushrooms are also good for heart as they have got low fat, no cholesterol, has more of unsaturated fatty acids and some of the mushrooms have compounds like lovastatin that is known to lower the cholesterol in the blood. Moreover, mushrooms have low-sodium and high potassium content making it a suitable food for persons suffering from high blood pressure. These are also rich in minerals which also include copper (heart-protective) and selenium (anti-cancer). The mushrooms are also considered delight of diabetics as it is a low calorie food with no starch and has also number of anti-oxidants. These are rich in fiber and also a very good source of vitamins especially vitamin B complex including vitamin B12. Mushrooms are the only vegetarian source of vitamin D. Many of the mushrooms are known to have anti-viral properties and their consumption activates the immune system of the human body. Compounds from number of mushrooms have found applications in cancer research and numbers of them have been found to reduce the side effects of radio-therapy and chemotherapy. Hence, there is a need to popularize health benefits of mushrooms.

**Mushrooms as dietary supplements/medicine**

There is evidence that consumption of plant foods such as fruits and vegetables provide protection against various diseases, especially chronic degenerative diseases (Selvi *et al.*, 2007) [28]. This protection can be explained by the free-radical scavenging capacity of antioxidants in plant foods. Plant foods are a good source of polyphenols, which have been reported to be effective radical scavenger and inhibitors of liquid peroxidation (Makam and Konig, 2001) [18]. Kettawan *et al*., 2011 [13] and Selvi, *et al.*, 2007 [28], have demonstrated that mushrooms contain antioxidants. Apart from their nutritive values, mushrooms also have potential medicinal benefits especially as antitumor. Abulude, (2005) [1]; Kuforiji and Fasidi, (2008) [5] and Kettawan *et al*., (2011) [13] elaborated on the medicinal uses of *Pleurotus* in Nigeria. They stated that these mushrooms can be used in combination with other herbs as ingredients to care ailments such as chest pain, cold, dropsy, fever, headache, smallpox and stomach pains. Mushroom extracts, that are used or studied as possible treatments for diseases. *Lentinula edodes* (shiitake), *Grifola frondosa* (maitake), and *Ganoderma lucidum* (reishi), have a history of medicinal use spanning millennia in parts of Asia. Medicinal mushroom research has indicated possible cardiovascular, anti-cancer, anti-viral, anti-bacterial, anti-parasitic, anti-inflammatory, hepatoprotective, and anti-diabetic activities (Lentinan, 2009) [31].

Dietary supplements have been described as ingredients obtained from food, plants and mushrooms that are taken, without further modification, separately from food for their presumed health-enhancing benefits. These preparations have variety of names like dietary supplements, tonics, functional foods, nutraceuticals, phytochemicals, food supplements, nutritional supplements, mycochemicals, biochemic preventives and designer foods. There has been rapid increase in trade of mushrooms as supplement and for other medicinal benefits. Any good product requires a uniform quality from batch to batch that is possible only when a uniform material is produced and is processed by following standard practices. The Newton's third law, that for every action there is equal and opposite reaction, applies everywhere - also when we tend to claim too many benefits of mushrooms. This leads to criticism, especially in the light of variable quality of products labeled identically. Thus, there is need for quality standards for mushroom products to have better market. Many mushrooms that are used as food also have medicinal value. For example, oyster mushroom is a source of the drug class of statins (Lovastatin) used for lowering cholesterol and so preventing cardiovascular disease. Similarly, shiitake has lentinan that is considered to have anti-tumor, anti-thrombosis, anti-asthma, antivirus and anti-cholesterol activity. Many of these compounds considered to have medicinal value are polysaccharides and their chemical synthesis is not easy. Modern medical practice relies on highly purified pharmaceutical compounds whose activity and toxicity show clear structure-function relationships. Hence there is need for further validation and research on these mushrooms.

**Conclusion**

Mushrooms are considered to be one of the super foods due to its high nutrient content, especially protein, dietary fibre, vitamins and minerals. In addition, mushrooms are also well-known to contain bioactive compounds, such as ergosterol, β-glucans, lentinan, and peroxidase, which possess health functionalities. This claim is confirmed by various studies showing that mushrooms possessed anti-hyper-cholesterolaemic, anti-viral, anti-cancer, and anti-hypertensive activities. Studies have been conducted to investigate the potential of mushrooms in food applications. The findings from various studies showed promising results whereby the incorporation of mushroom into food products enhances the nutritional values as well as the physical properties of the food product and income generation. Hence, it is not a surprise to know that the food and pharmaceutical industries are using mushrooms or bioactive compounds from mushrooms to develop functional foods. Creating awareness among the farmers about the benefits of mushroom production, creating awareness among the consumers about the nutritional and health benefits of mushroom and imparting training to the farmers may go a long way in promoting mushroom production.

**References**

1. Abulude FO. Proximate and phytate compositions of mushrooms consumed in south western Nigeria. Adv Food Sci. 2005;27(4):185-188.
2. Akinyele BJ, Akinyosoye FA. Effect of Volvariella volvacea Cultivation on the Chemical Composition of Agrowastes. Afr J Biotechnol. 2005;4(9):979-983.
3. Appels FVW, Camere S, Montalti M, Karana E, Jansen KMB. Fabrication factors influencing mechanical, moisture- and water-related properties of mycelium-based composites. Mater Des. 2018;161:64-71.

4. Aremu MO, Basuk Gyan SD, Goyal A, Bhowmik PK, DattaBanik S. Proximate composition and functional properties of mushroom flours from Ganoderma spp, *Omphalotus olearius* (DC) sing and *Hebeloma mesophaeum* (Pers) Quels used in Nassarawa State, I. Mal of Journal Nutrition. 2009;15(2):233-241.
5. Belewu MA, Banjo NO. Pre-treatment of Sawdust and Cotton waste by White rot fungi (*Pleurotus sajor-caju*). Proc 26th Annu Conf NSAP; c2000. p. 159-160.
6. Bhatia JN, Chahal D, Chauhan RS. Technological gap in adoption of improved mushroom cultivation practices in Haryana. Agri Update. 2011;6(3,4):206-209.
7. Bhatia JN, Chauhan RS, Chahal D. Transfer of mushroom technology as one of the livelihoods generating activity identified in rural Haryana. Agri Update. 2012;7(1, & 2):80-84.
8. Chang ST. World production of cultivated and medicinal mushrooms in 1997 with emphasis on Lentinus edodes. Int J Med Mushrooms. 1999;1:291-300.
9. Chauhan RS, Yadav NK, Saini AK, Tallapragada S, Yadav NS. Economic empowerment, energy production and bioremediation through mushroom cultivation. Adv Res Agric Vet Sci. 2021;8(4):13-19.
10. Chiu SW, Law SC, Ching ML. Themes for mushroom exploitation in the 21st century: Sustainability, waste management, and conservation. J Gen Appl Microbiol. 2000;46:269-282.
11. Haas EM, James P. More vegetables, please!! Delicious recipes for eating healthy food each and every day. Oakland, California: New Harbinger Publications. 2009;41:130-134.
12. Jordan SN, Mullen GJ, Murphy MC. Composition variability of spent mushroom compost in Ireland. Bioresour Technol. 2008;99:411-418.
13. Kattawan A, Chanlekha K, Kongkachuichai R, Chaaroensiri R. Effects of cooking on antioxidant activities and polyphenol content of edible mushrooms commonly consumed in Thailand. Pak J Nutr. 2011;10(11):1094-1103.
14. Khatun S, Islam A, Cakilcioglu U, Chatterjee NC. Research on Mushroom as a Potential Source of Nutraceuticals: A Review on Indian Perspective. Amer J Experimental Agril. 2012;2(1):47-73.
15. Kuforiji O, Fasidi I. Compositional studies on Pleurotus tuber-regium sclerotia. Adv Food Sci. 2008;30(1):2-5.
16. Lakhanpal TN, Rana M. Medicinal and nutraceutical genetic resources of mushrooms. Plant Genet Resour: Characterization and Utilization. 2005;3:288-303.
17. Antil R. Global and national climate change concerns in India. Int. J Geogr Geol. Environ. 2022;4(2):187-190. DOI: 10.22271/27067483.2022.v4.i2b.161
18. Makem SM, Konig WA. Chemical study of the essential oil of Cyperus rotundus. Phytochemistry. 2001;47:577.
19. Martinez-Carrera D. Simple technology to cultivate Pleurotus on coffee pulp in the tropics. Mushroom Sci. 1989;12(Part 2):169-178.
20. Okhuoya JA, Akpaja EO, Osemwegie OO, Ogherekano AO, Ihayere CA. Nigerian mushrooms: underutilized non-wood forest resource. J Appl Sci Environ Manage. 2010;14(1):43-54.
21. Panjabrao MV, Sopanrao PS, Ahmed SA, Vaseem BM. Bioconversion of low quality lignocellulosic agricultural waste into edible protein by *Pleurotus sajor-caju* (Fr.) Singer. J Zhejiang Univ Sci A. 2007;8:745-751.
22. Peng JT. The cultivation of edible mushrooms in Taiwan. Mushroom Sci. 1989;12(Part I):769-788.
23. Phan CW, Sabaratnam V. Potential uses of spent mushroom substrate and its associated lignocellulosic enzymes. Appl Microbiol Biotechnol. 2012;96:863-873.
24. Picornell-Buendía MR, Pardo-Giménez A, de Juan-Valero JA. Qualitative parameters of *Pleurotus ostreatus* (Jacq.) P. Kumm mushrooms grown on supplemented spent substrate. J Soil Sci Plant Nut. 2016;16(1):101-117.
25. Ragunathan R, Gurusamy R, Palaniswamy M, Swaminathan K. Cultivation of *Pleurotus* spp. on various agro-residues. Food Chem. 1996;55:139-144.
26. Rajkumar M, Dharmara JK. Reuse of agro-wastes for culture of oyster mushroom *Pleurotus citrinopileatus* (Fr.) Singer. Indian J Environ Health. 1999;41:130-134.
27. Rambelli A. Manual on mushroom cultivation. FAO Plant Production and Protection Paper (FAO). 1983;5:43:73.
28. Selvi S, Uma Devi P, Suja S, Murugan S, Chinnarswamy P. Comparison of non-enzymic antioxidant status of fresh and dried form of Pleurotus florida and *Calocybe indica*. Pak J Nutr. 2007;6(5):468-471.
29. Ukpebor JE, Akpaja EO, Ukpebon EE, Egharevba O, Efedue E. Effect of the edible mushroom, Pleurotus tuber-regium on the cyanide level and nutritional contents of rubber seed cake. Pak J Nutr. 2007;6(6):534-537.
30. Zhu HJ, Liu JH, Su LF, Hu ZF, Qiao JJ. Combined alkali and acid pre-treatment of spent mushroom substrate for reducing sugar and bio-fertilizer production. Bioresour Technol. 2013;136:257-266.
31. Lentinan. In: Handbook of Natural Colorants. New York: Wiley; c2009. p. 183-200. ISBN 0-470-511 99-0.