Edible Mushrooms: Nature's superfood for health and wellbeing

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ABSTRACT

Several varieties of mushrooms are consumed and cultivated throughout the world for their important nutritional benefits and medicinal properties. Mushrooms are indeed wonder foods that are not only nutritionally rich but also pack several bioactive compounds of medicinal importance. Nutritionally, mushrooms are perfect foods for a healthy diet and weight management, rich in protein, fiber, minerals and vitamins and at the same time offer the benefit of being low on calories, fats, cholesterol, gluten and sodium. The review outlines the nutritional composition of mushrooms as well as the recent research that highlights the therapeutic potential of various mushrooms. The review describes the array of health benefits offered by mushrooms including their antioxidant, antitumor, hypoglycemic, hypocholesterolemic, and immunomodulating effects. Mushrooms also have potential as foods for weight management, boosting the immune system, lowering blood pressure, strengthening bones and prevention of neurodegenerative diseases. The review also discusses various edible mushroom varieties cultivated worldwide. Mushrooms can hence serve as a healthy nutritionally packed addition to our daily diet.

Keywords: *Mushrooms, Antioxidants, Anti-inflammatory, Weight loss, Anti-cancer*

1. Introduction

Mushrooms are fungi with distinct structures called fruiting bodies which are visible to the naked eye and can be plucked by hand (Chang and Miles, 1992). About 12,000 species of mushrooms have been discovered so far, which accounts for only 10% of the total number of mushrooms that are thought to exist (Jayachandran *et al.*, 2017). Out of the discovered ones, only 2000 species are known to be edible (Cerletti *et al.*, 2021). The most commonly cultivated mushrooms are *Agaricus bisporus, Pleurotus spp.*, *Lentinus edodes,* and *Flammulina velutipes* (Aida *et al.*, 2009).

Mushrooms have been considered as a culinary delicacy and consumed for a very long period in history. Their health benefits were recognized very early by the Greek, Roman and Chinese civilizations. They described mushrooms as 'providing strength to the warriors in the battlefield', 'Food of the Gods', and 'Elixir of life' respectively (Valverde *et al.*, 2015). They continue to be valued for their nutritional benefits and bioactive properties till date.

From a nutritional point of view, mushrooms positively benefit humans as they are low in fat, high in dietary fibers and proteins, and also are a source of vitamins, minerals and other nutraceuticals (Das *et al.*, 2021). Owing to the high levels of quality proteins, vitamins, minerals, dietary fibers and phenolic compounds, mushrooms are regarded as healthy food

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ingredients. Also, they are suitable for improving the nutritional profile of foods as they contain a relatively low concentration of fat and digestible carbohydrates (Cerletti *et al.*, 2021; Das *et al.,* 2021).

Mushrooms are also regarded as mini pharmaceutical factories that possess miraculous biological properties including antidiabetic, anti-inflammatory, antioxidant, immunomodulatory, antiviral, antitumor and immunoregulatory effects (Zhang *et al.*, 2016; Roncero-Ramos and Delgado-Andrade, 2017).

2. Mushrooms help fight malnutrition

Edible mushrooms have a rich nutritional value. They have a good amount of protein and fiber, and are low in fat content (Mattila *et al.,* 2001). Fats constitute only 20-30 g/ kg of mushrooms making them a low-calorie food. The main fatty acids present are linoleic, oleic and palmitic. Mushrooms are also a source of carbohydrates with presence of glycogen, mannitol, chitin and trehalose in large proportions. Fibers, β-glucans, hemicelluloses, and pectic substances are also present (Kalač *et al.*, 2013). Mushrooms provide all the essential amino acids as per adult requirements, as well as have higher protein content than most of the vegetables which makes them an ideal choice for vegetarian diets. The most abundant amino acids are leucine, valine, glutamine, glutamic acid and aspartic acid (Valverde *et al.*, 2015). Mushrooms are rich in essential vitamins and minerals as well. Riboflavin (vitamin B2), niacin, folates, and trace quantities of vitamin B1, B12, C, D and E are present, along with minerals like copper, potassium, magnesium, phosphorus, iron, calcium and zinc (Wang *et al.*, 2014). Further, edible mushrooms are rich dietary sources of antioxidants such as glutathione and ergothioneine and micronutrients such as selenium and vitamin D2 ,that have been known to decrease in humans as they age. (Beelman *et al.*, 2019). Table 1 enlists nutrient composition of various edible mushrooms. Some of the nutrient contents of edible mushrooms have also been discussed below.

2.1 Polysaccharides

The main polysaccharide found in mushrooms is beta-glucans which constitute about half of the cell wall mass of fungi. Beta-glucans confer antioxidant, anticancer, anticholesterolemic, neuroprotective and immunomodulating properties to many edible mushrooms (Ferreira et al., 2009). Data collected from various different species of higher basidiomycetes revealed immunomodulating and anti-tumor properties quantified by some specific carbohydrates-trehalose, fructose, glucose, mannose, rhamnose, xylose, fucose, arabinose, sucrose, mannitol, and maltose-present in them (Valverde *et al.*, 2015).

2.2 Bioactive proteins

They are an important functional component of mushrooms and also have a great pharmaceutical potential. For instance, mushrooms are the producers of a variety of proteins and peptides with miraculous biological activities like fungal immunomodulatory proteins, lectins, antimicrobial proteins, ribonucleases, ribosome inactivating proteins, and laccases (Xu *et al.*, 2011).

2.3 Polyunsaturated fatty acids

They are often present in the edible mushrooms and are responsible for the reduction of serum cholesterol. No trans isomer of unsaturated fatty acids have been detected in mushrooms. Ergosterol, responsible for antioxidant properties, is one of the major sterols produced by edible mushrooms. Sterols are important to be included in diet for the prevention of cardiovascular diseases (Guillamón *et al.*, 2010)

2.4 Phenolic compounds

They are secondary metabolites with antimicrobial, anti-inflammatory, cardio-protective, antiallergenic, antiatherogenic, antithrombotic, and vasodilating properties. They also have antioxidant effects, which prevent the occurrence of diseases such as cancer and brain dysfunction (Balasundram *et al.*, 2006).

Table 1: Nutrient composition of some common edible mushrooms

Species (Scientific Name)	Common Name	Value of Constituents (Unit/100g)				References
		Water	Proteins	Total Lipid (Fat)	Carbohydrates	
Agaricus bisporus	Button Mushroom	92.45g	3.09g	0.34g	3.26g	Bhushan *et al.*, 2018
Agaricus campestris	Field Mushroom	92g	4.2g	0.4g	1g	Redzic *et al.*, 2010
Pleurotus ostreatus	Oyster Mushroom	88.5g	32g	3.1g	50.9g	Raman *et al.*, 2020
Lactarius piperatus	Peppery milk cap	90g	2.5g	1g	4.4g	Redzic *et al.*, 2010
Cantharellus cibarius	Chanterelle Mushroom	85.56g	3.10g	0.72g	8.86g	Caglarlrmak *et al.*, 2002
Boletus edulis	Penny Bun	80.53g	7.39g	1.70g	9.23g	Caglarlrmak *et al.*, 2002
Pleurotus eryngii	King Oyster Mushroom	91g	11.95g	7.50 g	39.85g	Raman *et al.*, 2020

The table demonstrates a comparative account of the nutritional constituents of seven different edible mushroom species. The data collected from various research resources indicates that, in general, mushrooms contain approximately 80-90% water and about 10% dry matter. The dry matter is composed of carbohydrates, proteins, fibers, vitamins, minerals, lipids and ash content. High moisture content is responsible for the freshness of mushrooms. Per 100g of the weight, the moisture content for *Pleurotus* species ranges between 85-90g and is comparatively high in *Agaricus* species (>90g). Other species have moderate moisture. The *Pleurotus* species is considered a good source of protein. This contributes to the highest amount of protein content in *Pleurotus ostreatus* (32g), as compared to other species such as *Agaricus, Lactarius, Boletus* having 3, 2.5 and 7g of protein respectively. Similarly, carbohydrate content in *Pleurotus* is higher than other species primarily because of non-fiber carbohydrates such as sugars. It can be observed that lipid content does not have a significant difference from one species of mushroom to another. Low levels of lipid results in low energy value of these mushrooms. As a result, we may conclude that mushrooms are low-calorie, high-protein foods, with the *Pleurotus* species being an exceptionally rich source of protein.

3. Mushrooms provide multitude of health benefits

Mushrooms are consumed worldwide for its culinary delicacies and excellent therapeutic potential. The therapeutic properties of the macrofungi are a result of the numerous bioactive molecules synthesized by them (Fig. 1). We can classify the bioactive substances found in mushrooms into three categories viz Secondary metabolites, Glycoproteins and Polysaccharides (beta-glucans). The secondary metabolites include alkaloids, terpenoids, metal chelating agents, acids, polyphenols, nucleotide analogs, sterols, lactones, sesquiterpenes and vitamins. Some of the health benefits of mushrooms are discussed below (Chang *et al.*, 2012).

3.1 Antioxidant Activity

The antioxidative properties of mushrooms, including reduction of human LDL (Low-

Density Lipoproteins), suppression of lipid peroxidation, and scavenging of free radicals, have been thoroughly studied, among its other health benefits. Increased production of free radicals can damage DNA, lipids, and proteins, leading to several chronic disorders including neurological damage, cardiovascular diseases and cancer (Zhou *et al.*, 2011). Antioxidants are naturally found in vegetables, fruits, cereal grains, edible flowers, and medicinal plants (Zhang *et al.,* 2016). Edible mushrooms are the storehouse for a wide range of antioxidant compounds such as ergothioneine, carotenoids, phenolics, poly-saccharides, tocopherols, and ascorbic acid. As a result, mushroom consumption may boost a person's antioxidative capacity, lowering the level of oxidative stress on the body (Roncero-Ramos and Delgado-Andrade, 2017).

3.2 Cholesterol lowering effect

Cardiovascular diseases are generally linked to elevated levels of cholesterol and triacylglycerol in the body. Several studies performed on animals show that body lipid profile is positively influenced by consumption of oyster mushrooms, specifically *Pleurotus ostreatus* (Schneider *et al.,* 2011). Scientists have proven mushrooms to be safe, effective, and natural anti-hypercholesterolemia therapeutic agents. A plethora of medical research and studies on edible mushrooms give valuable insights about their clinical effectiveness besides the culinary demand (Wasser, 2011). They have discovered that medicinal mushrooms are rich in dietary fibers and certain β-glucans. Together, they are capable of inhibiting cholesterol absorption by increasing fecal excretion of bile acids and lowering serum LDL cholesterol levels (Chen *et al.,* 2008).

3.3 Hypoglycemic effect

Mushrooms, which have traditionally been used as an adjunct with diabetes treatments, represent an interesting new frontier in the development of novel forms of therapies to manage diabetes and

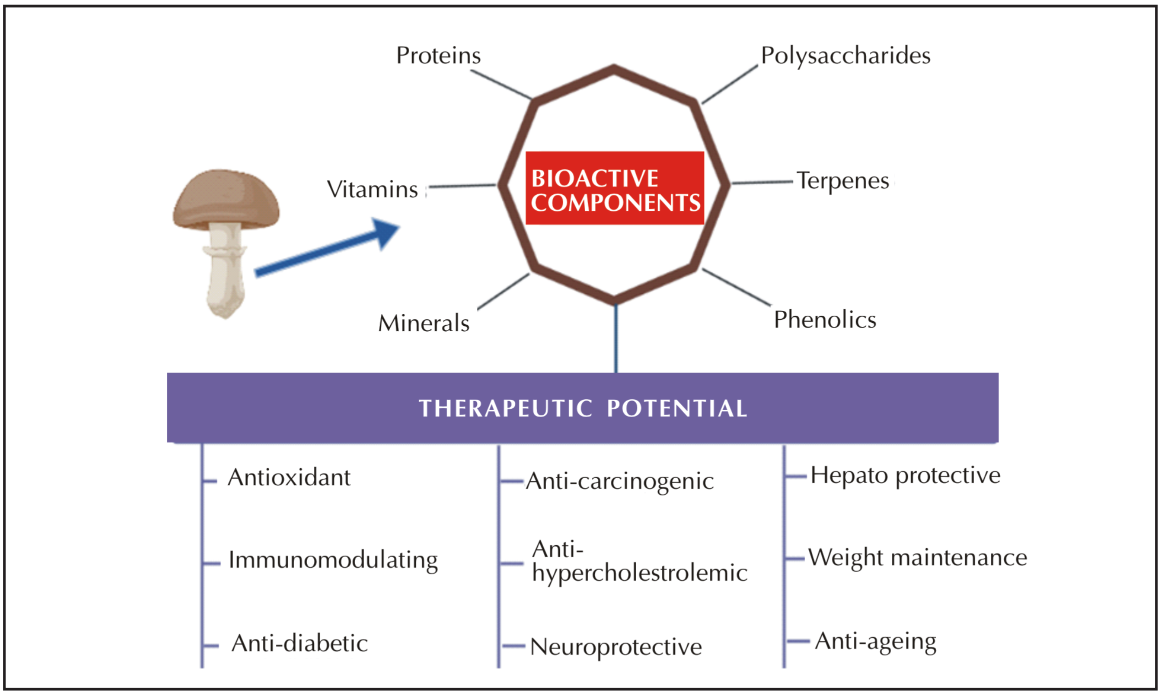

Figure 1: Bioactive components present in mushrooms and potential health benefits.

its consequences. Certain mushroom species have been shown to regulate blood glucose levels and influence the severity of diabetes complications with no adverse effects (Lo *et al.,* 2011; Jovanović *et al.,*2017). Studies have shown that basidiomycetous mushrooms have good amounts of biologically active polysaccharides and majority of them belong to the group of beta-D-glucans. A type of dietary fiber β-glucan is a chief component of mushrooms, cereal grains, and prebiotic bacteria. Obesity, cardiovascular disease, diabetes, and cancer can all be prevented and controlled by including it in diet (Ahmad *et al.,* 2012; Chen *et al.,* 2007). In addition to improving hyperglycemia, β-glucan administration under diabetic conditions has been demonstrated to produce a systemic improvement that potentially increases the organism's resistance to onset of diabetic complications (Mihailović*et al.,* 2013; Uskokovic*et al.,* 2013). Lactones, sterols, terpenes, lectins, alkaloids, and phenolics are some of the low molecular weight active substances found in mushrooms. These compounds have exhibited medicinal potential, as well as hypoglycemic properties (Prabhakar, 2020)

3.4 Anti-Cancer effects

Some of the mushrooms that are known to have cancer-fighting properties belong to the genus *Agaricus, Pleurotus, Cordyceps,Calvatia, Lactarius,Phellinus, Ganoderma, Antrodia Clitocybe, Xerocomus, Trametes, Schizophyllum, Suillus, Flammulina, Inonotus, Inocybe, Funlia, Russula, Albatrellus,* and *Fomes.* Mushrooms are known to help patients cope with the negative effects of chemotherapy and radiation therapy, such as lowered immunity, nausea, anemia and bone marrow suppression. A large number of bioactive compounds have been discovered in mushrooms, including anti-tumor agents (Patel and Goyal, 2012). Japanese people have been traditionally consuming oyster mushrooms for their properties such as preventing cancer and hypertension. Observational studies have found that eating mushrooms can help prevent cancer, highlighting the significance of including mushrooms in a regular diet as recommended by the World Health Organization (Figueiredo and Régis, 2017).

3.5 Weight Loss

Mushrooms have been proven to possess antioxidant properties, which boosts the antioxidative mechanism of cells. This further enhances the anti-inflammatory function, reducing the risk of obesity-related hypertension and dyslipidemia.

Edible mushrooms have minimal calories and low energy density. Their nutrient profile resembles several products that are advised in weight-loss and maintenance regimens. Many "diet" foods, on the other hand, have a low palatability, which may lead to non-adherence to such foods. However, adults find edible mushrooms to be extremely palatable, making them a viable substitute for high-energy-density foods. Mushrooms are thus a suitable candidate to be used in the prevention and treatment of obesity (Poddar *et al.*, 2012).

In the past, anti-diabetic effects were identified in *Ganoderma lucidum*, a medicinal mushroom used in traditional Chinese medicine. It has now been shown that this mushroom also possesses anti-obesity properties. The findings offer the possibility of using this mushroom as a prebiotic in the future to treat obesity and obesity-related metabolic diseases (Holmes, 2015).

3.6 Immune system booster

Mushrooms are well-known for their ability to modulate the immune system, affecting lymphocytes, macrophages, hematopoietic stem cells, T cells, dendritic cells (DCs), and natural killer (NK) cells (Moradali *et al.,* 2007). In recent years, many studies have investigated the possibility that mushroom extracts and isolated metabolites can stimulate or repress various immune system components. Immunomodulators could be useful for the prevention and treatment of illnesses caused by immunodeficiency or other abnormalities of the immune system (Lull *et al.*, 2005). Certain metabolites that seem to enhance the human immune response are being studied that can further be utilized for the treatment of immunodeficiency diseases, cancer, or as an adjunct with antibiotic therapy (Jong and Birmingham, 1992)

Immune-suppressing metabolites may be effective in the treatment of autoimmune and gastrointestinal disorders (e.g., Crohn's disease) (Jain *et al.*, 2010). In comparison to other mushrooms, those that are rich in polysaccharides, especially β glucans, possess therapeutic properties and can boost the immune system (Mhanda *et al*, 2015). Reishi, commonly known as the "King of Mushrooms, is an edible medicinal mushroom with potent anti-inflammatory effect. It is associated with longevity of life, improved immunological function, and clarity of mind. *Ganoderma* is the most common genus of this mushroom, with *Ganoderma lucidum*, *G. tsugae*, and *G. lingzhi* being closely related species (Nahata, 2013).

3.7 Lowers blood pressure

As stated earlier, mushrooms are a low-fat food with unsaturated fatty acids as their major composition of fats, they are a healthy choice for our heart (Manikandan, 2011).Moreover, they are a rich source of potassium that helps in reducing the negative impact of sodium on our body and also maintains circulation of blood, lowering the tension in blood vessels and thus helping to lower blood pressure (Wasser, 2014).

3.8 Mushrooms for strengthening bones

Mushrooms are believed to have the potential for being the only unfortified, non-animal dietary source of vitamin D that can yield a significant amount of vitamin D2 in a single serving. Mushroom cell walls are a source of ergosterol, having functions that are similar to cholesterol in animals, i.e. facilitating intracellular transport, strengthening cell membranes, and controlling membrane fluidity (Weete *et al.*, 2010)

Edible mushroom species that are exposed to UV radiation such as sunlight or a UV lamp, can produce nutritionally essential levels of vitamin D (Taofiq *et al.*, 2017). In mushrooms, the most prevalent form of vitamin D is D2, with minor levels of vitamins D3 and D4, whereas in animal diets, vitamin D3 is the most common form.In both rats and humans, the bioavailability of vitamin D2 from mushrooms has been proven, and animal models have shown that vitamin D2 from mushrooms improves bone strength (Cardwell *et al.*, 2018).

3.9 Mushroom intake and depression

Antioxidants, anti-inflammatory agents, vitamin B12 and nerve growth factors are a few of the bioactive substances found in mushrooms that may help with anxiety and depression. Depression is a common and severe neuropsychological condition that has been impacting more than 300 million individuals of all ages worldwide and is one of the primary causes of global disease burden (Kanter *et al.*, 2008). Despite the fact that a variety of antidepressants are currently accessible, their efficacy is barely adequate, and most of them have adverse effects.

Mushrooms are the richest dietary resource of the amino acid ergothioneine – an anti-inflammatory compound that humans cannot synthesize. Reasonable amount of this amino acid can reduce the likelihood of oxidative stress, which may also help relieve symptoms of depression. Potassium is abundant in white button mushrooms, and it is believed to help with anxiety (Ba *et al.*, 2021). Furthermore, *Hericium erinaceus,* popularly known as Lion's mane mushroom, is believed to have potential antimicrobial, anticancer, antioxidative, anti-inflammatory, antidiabetic, antihyperglycemic, and hypolipidemic effects. Parkinson's disease, Alzheimer's disease and Cognitive impairment have been treated with this mushroom. Bioactive components isolated from H. erinaceus' mycelia and fruiting bodies have been shown to enhance the expression of neurotrophic factors, such as nerve growth factors that are connected to cell proliferation (Chong *et al.*, 2019)

3.10 Mushrooms improve gut health

The gut microbiota plays an important role in supporting our wellbeing. Any imbalance in gut microbiota composition has been linked to a variety of chronic diseases including obesity, atherosclerosis, kidney disease, type 2 diabetes, cardiovascular disease, and hypertension (Sánchez *et al.*, 2017). Various bioactive components present in mushrooms have been demonstrated to influence gut microbiota and promote health. Non-digestible mushroom polysaccharides play the role of prebiotics, reducing pathogenic development in the intestine by promoting the growth of probiotic bacteria (Kumari, 2020). The most commonly reported edible mushrooms that can modify gut microbiota include *Ganoderma lucidum, Hericium erinaceus, Lentinula edodes, and Grifola frondosa* (Li *et al.*, 2021)

3.11 Mushrooms as anti-microbial agents

Till now, numerous antimicrobial agents have been discovered and developed. However, a major drawback that limits their use is the development of resistance to the drugs by the microbes (Zhang *et al.,* 2016). Mushrooms provide a safe, herbal and reliable resource in this context as it contains many antibacterial, antifungal and antiviral properties. Some examples are as follows:

- *Agaricus bisporus* - antimicrobial activity against *Neurospora sitophila* and phytopathogenic fungi (Liu *et al.*, 2015).
- *Lenzites betulina* - antimicrobial activity against *Staphylococcus aureus, Escherichia coli, Bacillus subtilis, Fusarium graminearum, Gibberellazeae*and *Cercosporella albo-maculans* (Liu *et al.*, 2014).
- *Tricholoma giganteum* - antimicrobial activity against *Fusarium oxysporum, Mycosphaerellaarachidicola*and*Physalospo rapiricola* (Guo *et al.*, 2005).
- *Hericium erinaceus* - antimicrobial activity against *Helicobacter pylori* (Shang *et al.*, 2013).
- *Pleurotus ostreatus* - antimicrobial activity against *Fusarium oxysporum, Mycosphaerellaarachidicola*and*Physalospo rapiricola* (Chu *et al.*, 2005).

3.12 Hepatoprotective effects of mushrooms

The use of mushrooms in traditional medicine is supported by scientific research. Mushrooms represent a novel choice to the limited therapeutic alternatives currently available for the treatment of liver problems or associated symptoms, and future research should take this into account. Many mushroom extracts provide hepatoprotective effects against harmful chemical-induced liver injury. Phenolics, triterpenes, polysaccharides, and peptides are the primary classes of compounds that could be responsible for such effects. (Soares *et al.,* 2013 "a") A study was recently conducted to investigate the hepatoprotective properties of an *Agaricus blazei* extract against paracetamol-induced damage. The extract was found to be highly successful in healing several of the typical symptoms of liver injury, such as lipid peroxidation levels, and enzyme release into the bloodstream. (Soares *et al.,* 2013 "b")

4. Diversity of Edible Mushrooms

4.1 *Agaricus*

Most of the edible mushrooms worldwide are represented by the genera- A*garicus*. A representing species- *A. bisporus*- the common button mushroom is the most cultivated among edible mushrooms. It contains various phytochemicals that help in cancer prevention (Adams *et al.*, 2008). Another species, *A. blazie* (sun mushroom), is native to Brazil that is being consumed worldwide for its medicinal benefits like- anticarcinogenic, antimutagenic, and immunostimulatory activities (Firenzouli*et al.*, 2008). *A. brasiliensis* is grown worldwide owing to a wide range of medicinal properties demonstrated by this species- anti-inflammatory, anti-aromatase, antitumor, antioxidant, immunomodulatory, and antimicrobial. (Soković*et al.*, 2018). The other edible species include- *A. polytricha* and *A. subrufescens*

4.2 *Lentinus*

Attributing to its nutritional value and having a possible potential for therapeutic applications, *Lentinus edodes* or "shiitake mushroom", are the second most popular edible mushroom in the global market. The medical applications of *L. edodes* include the treatment of following diseases-heart disease, cancer, environmental allergies, fungal infection, frequent flu and colds, diseases involving depressed immune function (including AIDS), bronchial inflammation, hypertension, infectious disease, hepatitis, diabetes, hyperlipidemia (including high blood cholesterol), and regulating urinary inconsistencies (Bisen*et al.*, 2010). The other edible species include- *L. polychrous*- It is also used as a medicine for the treatment of diseases like- envenomation caused by snake or dyspepsia. Moreover, they also show antioxidative activity and have inhibitory effect on cell proliferations of breast cancer (Thetsrimuang*et al.*, 2011)

4.3 *Pleurotus*

The mushrooms belonging to this genus, popularly known as the oyster mushrooms, include about 40 species, out of which almost all are commonly available and edible. Approximately 25% of the total cultivation of mushrooms globally is accounted for by the commercial production of *Pleurotus* species. The *Pleurotus* species are regarded as 'speciality mushrooms' in America and Europe. Moreover, their cultivation is economically profitable in Korea as they are one of the most consumed species there. Their commercial importance is due to the array of nutritional benefits they provide such as-carbohydrates, essential amino acids, dietary fibre, proteins, minerals and water-soluble vitamins. Besides, they also have various functional bioactive molecules that positively influence health (Raman *et al.*, 2020). Some of the bioactive molecules are - lectins that confer antitumor, immunomodulatory and antiproliferative properties; polysaccharides that enhance the immunity and also exhibit anticancer activities; and phenolic compounds that perform antioxidant functions (Finimund *et al.*, 2013).

4.4 *Ganoderma*

It is said to be the 'mushroom of immortality' that has been used for thousands of years traditionally in Chinese medicine for improvement of health and longevity (Zeng *et al.*, 2019). Commonly known as Lingzhi (in China) or Reishi (in Japan), they are used in the treatment of hepatopathy, hypertension, neurasthenia, and carcinomas. Some other health benefits include- modulation of the immune system, hepatoprotection, control of blood glucose levels, bacteriostasis, and more. The most cultivated species is *G. lucidum* owing to its paramount pharmaceutical importance (Wachtel-Galor*et al.*, 2004).

4.5 *Trametes versicolor*

It is a mushroom with chemopreventive potential as it inhibits the growth of various human cancer cell lines (Standish *et al.*, 2008).

4.6 *Grifolafrondosa*

By inducing cell apoptosis, it has a significant anticancer activity, especially on human gastric carcinoma (Valverde *et al.*, 2015).

4.7 *Cordyceps militaris*

Cordyceps militaris- a parasitic fungi- has been used traditionally in China and Korea for enhancing longevity and vitality (Siu *et al.*, 2004). It is one of the most beneficial mushrooms with significant positive influences on human health. There are more than 21 clinically proven benefits of the mushroom- owing to some of the active components like cordycepic acid, cordycepin, nucleosides, sterols (ergosterol), and polysaccharides (Jo *et al.*, 2020). Some of the health benefits are- antidiabetic, antioxidant, anti-hypertension, anti-osteoporotic, antiviral, anti-aging, immunomodulatory, antitumor, insecticidal, antimetastatic, antiproliferative and antibacterial properties (Ashraf *et al.*, 2020). It can also be used as a preventive material for cancer and against various infections such as influenza A, chronic bronchitis and other viral infections (Valverde *et al.*, 2015).

4.8 *Cordyceps sinensis*

Cordyceps sinensis is a parasitic fungus belonging to the Ascomycetes family. It has an insect larval host-*Hepialis armoricanus*. It is found in the high altitude regions like the central Himalayan mountains in India (Zhou *et al.*, 2009). The fungus has been used traditionally in China and Tibet for its various medicinal benefits (Singh *et al.*, 2014). The fungus has been used for a very long time by the local people as *Yarsha Gamboo* for the enhancement of respiratory efficiency, stamina, immuno-modulation, and the treatment of cerebrovascular, renal, liver, and respiratory diseases (Paterson, 2008). Some other therapeutic applications of *Cordyceps sinensis* are- increased ATP production, stabilization of blood sugar metabolism, increased oxygen utilization, antibacterial activity, reduction of blood pressure and protection of vital organs like heart, liver and kidney (Valverde *et al.*, 2015).

4.9 *Antrodia cinnanomea*

Another medicinal mushroom that is native to Taiwan. It has been used commercially for the treatment of cancer, hypertension, food and drug intoxication, abdominal pain, diarrhoea and skin itching (Chen *et al.*, 2013).

4.10 *Panellus serotinus (Mukitake)*

It is a popular edible mushroom in Japan. It is also used for preventing the development of non-alcoholic fatty liver disease (Inoue *et al.*, 2013).

4.11 *Auricularia*

China grows various edible species of *Auricularia* commercially. A medically remarkable species- *A. polytricha*- is cultivated for its health benefits such as- antitumor, anticoagulant properties, reduction of aortic atherosclerotic plaque and LDL cholesterol. Besides, another species - *A. auricula-judae*- is widely used as a component in Chinese dishes. It also has positive impacts on health such as- used as a blood tonic, and used for its antitumor, anticoagulant, hypoglycemic, and cholesterol-lowering properties (Yu *et al.*, 2014).

4.12 *Flammulina velutipes*

Owing to the presence of biologically active compounds such as antioxidants, poly-saccharides, and dietary fibre, it positively impacts human health by lowering blood pressure, blood sugar and cholesterol (Yeh *et al.*, 2014).

5. Conclusion

Edible mushrooms must be utilized in the production of low-calorie and high-protein diets due to their reduced fat and higher protein content. Moreover, their use as remedial foods may prevent the occurrence of lifestyle - associated problems like hypertension, diabetes, hypercholesterolemia, and cardiovascular diseases. There are budding prospects for mushrooms to be included in the diet in order to fully utilize the benefits of the bioactive compounds present in them.

As stated in this review, mushrooms have considerable health benefits that should be explored in an attempt to improve the quality of our lives. Finally, more studies and data is required to acquire a better understanding of the antioxidant properties of various mushroom species, as well as how to incorporate active metabolites into food supplements and medications.

Mushrooms and their bioactive ingredients could be a potential raw material for the pharma-ceutical industry in the near future, helping it to cure a variety of diseases with minimal toxicity, as opposed to currently existing medications, which have severe side effects. Mushrooms can be utilized as food supplements and functional foods and their inclusion in diet should be increased as a preventive measure from life-threatening diseases. Majority of the studies conducted till now have been carried upon cell culture models or on animals, with relatively few human experimental studies. Human experimental research needs to be increased since the results of in-vitro studies are not always supportive. As a result, more research with credible experimental and clinical data from human trials are needed to determine whether the reports related to health are completely valid and meaningful.

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