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A Critical Assessment on Importance of MushroomNutraceuticals in Human Health

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Abstract - Mushrooms had beenutilised for clinicaland culinary functionsfor over 1000 years, however the health- sellingcharacteristics of mushrooms viaintestinemicro biota lawhave not begunto be absolutelyexport material.Mushrooms provide an enormous. mainly unexplored reservoir of potent novel medicinal compounds. Mushrooms have long been utilized inmedicationto deal witha number of ailments, together withpores and skinsituations and pandemic infections like AIDS.Thepurposeof this look atis to bringtogetherthefitnesssellingblessings of fit for humanconsumption mushrooms throughintestine micro biota. Anti-allergic, anti- cholesterol, anti-tumour, and anti-most cancerssportswerevalidated in mushrooms. Mushrooms are excessive in carbohydrates which include chitin, hemicellulose, and glucans, in addition to mannans, xylans, and galactans, making themperfect prebiotics. Mushrooms as prebiotics, selling the formation of the intestine micro biota and so offeringfitnessblessings to the host.In this review, we described the favourable effects of different mushrooms on gut micro biota via exogenous pathogen suppression and, as a result, improved host health.

Keywords – Micro biota, Prebiotics, Therapeutic, Neutraceuticals, Food quality, Health benefits

I. INTRODUCTION

Mushrooms have long been regarded as a gourmet item, particularly for their distinct flavour, and have been regarded as a culinary marvel by mankind. There are about 2,000 varieties of mushrooms in nature, but only around 25 are extensively consumed as food, and only a few are professionally grown. Mushrooms are regarded as a delicacy with high nutritional and functional value, as well as nutraceutical foods; they are of great interest due to their organoleptic worth, medical characteristics, and economic importance. [1, 2]. However, distinguishing between edible and medicinal mushrooms is difficult since many common edible species have therapeutic characteristics, and numerous medicinal mushrooms are also edible [3].

Agaricus bisporus is the most widely farmed fungus, followed by *Lentinus edodes, Pleurotus spp*., and *Flammulinavelutipes*. Mushroom output is steadily increasing, with China being the world's largest producer. [1, 4, 5]. Wild mushrooms, on the other hand, are becoming increasingly essential due to their nutritional, sensory, and, most importantly, psychoactive properties.[2].

Mushrooms may be a new source of antimicrobial chemicals, primarily secondary metabolites like terpenes, steroids, anthraquinones, benzoic acid derivatives, and quinolones, but also primary metabolites like oxalic acid, peptides, and proteins. The most researched species, *Lentinus edodes*, appears to exhibit antibacterial properties against both gram-positive and gram-negative bacteria. [6].

They have a high nutritional value because they are high in protein, contain a high quantity of vital amino acids and fibre, and are low in fat but high in critical fatty acids. Furthermore, edible mushrooms contain a substantial amount of vitamins (B1, B2, B12, C, D, and E)[7, 8]. Because of the synergistic effects of all the bioactive components present, they could be a wonderful source of many different nutraceuticals and could be utilised directly in human diet and to promote health.[9–13].

Many different cultures have traditionally used a wide variety of mushrooms for health maintenance, as well as illness prevention and treatment, due to their immunomodulatory and antineoplastic qualities. Of the recent decade, there has been a surge in interest in mushrooms' pharmacological potential, with some even suggesting that many mushrooms function as mini-pharmaceutical factories, generating substances with amazing biological capabilities[5, 14]. Furthermore, increased understanding of the molecular basis of carcinogenesis and metastasis has allowed for the development of novel medications to combat aberrant molecular and biochemical signals that lead to cancer[15].

Mushrooms and fungi have over 100 medicinal properties, including antioxidant, anticancer, antidiabetic, antiallergic, immunomodulating, cardiovascular protector, anticholesterolemic, antiviral, antibacterial, antiparasitic, antifungal, detoxification, and hepatoprotective properties, as well as protection against tumour development and inflammatory processes[16–19]. Polysaccharides, proteins, lipids, minerals, glycosides, alkaloids, volatile oils, terpenoids, tocopherols, phenolics, flavonoids, carotenoids, folates, lectins, enzymes, ascorbic, and organic acids are among the bioactive substances present in fruit bodies, cultured mycelium, and cultured broth.The most important polysaccharide in modern medicine is -glucan, which is the best-known and most versatile metabolite with a wide range of biological activities[5, 16, 17, 20].

A well-balanced diet is an important component of disease prevention, particularly when it comes to oxidative stress. Mushrooms have a long history of usage in oriental medicine to prevent and treat a variety of ailments. Mushroom extracts are being sold as dietary supplements due to their qualities, which include improved immune function and anticancer activity [3, 9, 11, 17, 21–26].The goal of this study was to examine the nutritional value, chemical and nutraceutical composition, and commercial potentialities of the most widely farmed edible mushrooms on the planet.

II. MUSHROOM

Mushrooms, rusts, smuts, puffballs, truffles, morels, and yeasts, are all member of fungal lineage, as many more or less are well known organisms .

Mushrooms are macro fungi that contain distinctive fruiting bodies either epigenous or hypogenous and visible enough to be picked by hand [27]. Because mushrooms lack chlorophyll, they are unable to produce their own nourishment and must rely on dead and decay as saprophytes. The mushroom's fruiting body is visible, while the majority of the mushroom remains underground as mycelium.

The most widely farmed mushroom in the world is *A. bisporus*, which belongs to the *Agaricus* genus. The pharmacological and therapeutic qualities of this group of edible mushrooms are now widely used and studied[28-30].

A. blazei is a common basidiomycete known as "sun mushroom" that is native to Brazil and grown primarily in Japan [31].

A. subrufescens is known as the "almond mushroom" because of its almond flavour. It is farmed in the United States and has been mistakenly identified as *A. blazei*. It generates a variety of bioactive chemicals with the potential to treat a variety of ailments [32]. *L. edodes*, sometimes known as the "shiitake mushroom," is another edible fungus whose aqueous extracts are used as potential sources of antioxidant and anticancer compounds [33].

Pleurotus species, generally known as oyster mushrooms, are made up of about 40 different species, all of which are edible and widely available [34]. They have therapeutic characteristics, as well as various positive and health-promoting benefits, in addition to their nutritional worth. Because they contain numerous chemicals with essential pharmacological/nutraceutical properties, these species have been utilised as therapeutic mushrooms for a long time [35-37].

For thousands of years, the *Ganoderma* species, also known as Lingzhi or Reishi, has been utilised in traditional Chinese medicine to increase health and lifespan. Ganoderma's principal physiologically active polysaccharides are -glucans, and its polysaccharides and triterpenoid components are responsible for its anticancer and antimetastatic properties[38-40].

Huitlacoche, another edible fungus, was shown to have high quantities of selected nutrients and chemicals with nutraceutical potential, which varied depending on maize genotype, stage of development, and cooking procedure. Huitlacoche grown under various settings contained high levels of specific minerals and chemicals with nutraceutical potential which showed variations due to maize genotype, stage of development, and cooking process. [41].

Some other species of mushrooms are also edible and possess health benefits including *Trametes versicolor, Grifola frondosa, Cordyceps militaris, Antrodia cinnanomea* , *Panellus serotinus* (Mukitake), *Flammulina velutipes etc.*

III. NUTRACEUTICALS PROPERTIES OF MUSHROOM

Mushrooms contain significant amount of bioactive components. The type of biologically active substances may vary substantially in edible mushrooms; the concentrations of these biologically active substances may affected due to the differences in strain, cultivation, substrate, age and developmental stage and postharvest conditions like storage, processing, and different cooking practices [42-44].

The bioactive substances that are majorly found in edible mushrooms can be classified into secondary metabolites (like acids, polyphenols, terpenoids, lactones, sesquiterpenes, sterols, alkaloids, nucleotide analogs, metal chelating agents, and vitamins), polysaccharides and glycoprotein, mainly *β*-glucans [45]. These new class of compounds, termed as mushroom nutraceuticals, refers to those compounds which can be appreciably used as dietary supplements, for the betterment of humankind and prevention of various health threatening diseases. These can be often extracted from either the mushroom fruiting body or mycelium and constitutes an crucial component of the expanding edible mushrooms in biotechnology and pharmaceutical industry. It has been shown that regular intake of either edible mushrooms or mushroom nutraceuticals (as dietary supplements) can make people active and healthier [46].

A. POLYSACCHARIDES

Polysaccharides were referred as one of the most significant components derived from mushrooms, and exhibited numerous health benefits with antitumor and immunomodulating properties. Some of the mushrooms polysaccharide have been developed and utilized as functional food substances, including the schizophyllan from Schizophyllum commune, lentinan from Lentinus edodes, pleuran from Pleurotus species, ganoderan from Ganoderma and lucidium calocy ban from Calocybe indica , most of which were considered as the outstanding representatives of D-glucans with the common (1→3) or(1→6) linked glucose backbones and recognized by different degrees and pattern of branches [47-48]. The most common monosaccharides detected in mushrooms polysaccharides were galactose, glucose, xylose, fructose, fucose, mannose, rhamnose, trehalose ,arabinose and mannitol [49] .

β-glucans are the most impotant polysaccharides generally found in mushrooms and this *β*-glucans constitutes around half of the fungal cell wall mass . This is important for the industry because many of them are excreted into the cell growth medium, making their recovery, purification and chemical characterization very simple [50-52]. *β*-glucans are liable for anticancer, anticholesterolemic, immunomodulating, neuroprotective and antioxidant activities of many edible mushrooms.

B. PROTEINS

Bioactive proteins are the principal functional components in mushrooms and also possess great value for their pharmaceutical potential. The crude protein content of edible mushroom is usually somewhat higher, but varies considerably and influenced by factors such as species and stage of development.

Studies have revealed that the dry mushrooms have protein content in an around 228 and 249 g/kg dry matter (Dry Weight), which was significantly higher than other protein sources [53]. Peptides are significant bioactive nutraceuticals in mushrooms with various health benefits such as the enhancement of the digestion and absorption of exogenous nutritional components for the modulation of the immune function to help the host ,defending the invasion of the pathogens, and the activities inhibition of some enzymes[54]. Mushrooms fabricate a huge number of proteins and peptides with fascinating biological activities such as fungal immunomodulatory proteins, lectins, , antimicrobial proteins, ribosome inactivating proteins, laccases and ribonucleases [55].

C. LIPIDS

Edible mushrooms are rich in polyunsaturated fatty acids; thus, the major attributes of polyunsaturated fatty acids including the reduction of serum cholesterol. Ergosterol is the major sterol produced by edible mushrooms, which exhibits antioxidant properties of mushrooms[56] . It has been observed that regular intake of sterol's rich diet may prevent and or reduce cardiovascular diseases in human[57].

Tocopherols, found within the lipid fraction, are natural antioxidants, produced from different reactions and they act as free radical scavenging peroxyl components.

Linoleic acid, also considered as an important fatty acid fraction to humans, can also be isolated from mushrooms and participating in multiple physiological functions in

human body and reduces cardiovascular diseases, blood pressure, triglyceride levels and arthritis [58-61].

D. PHENOLIC COMPOUNDS

Overall, the phenolic compounds of mushroom, mainly including the phenolic acids, hydroxybenzoic Acids, flavonoids, ignans, hydroxycinnamic acids, stilbenes, ltannins, and oxidized polyphenols [62], were considered as aromatic hydroxylated compounds with one or more one or more hydroxyl groups and aromatic rings . Literatures have revealed that the most important bioactivity of phenolic compounds include antioxidant activity in biological systems, acting as free radical inhibitors, , metal inactivators or oxygen scavengers, peroxide decomposers [63,64].

Mushroom	Carbohydrate	Fibre	Protein	Fat	Ash	Energy k cal
Agaricusbisporous	46.17	20.90	33.48	3.10	5.70	499
Pleurotussajor-caju	63.40	48.60	19.23	2.70	6.32	412
Lentinula edodes	47.60	28.80	32.93	3.73	5.20	387
Pleurotusostreatus	57.60	8.70	30.40	2.20	9.80	265
Vovarellavolvaceae	54.80	5.50	37.50	2.60	1.10	305
Calocybe indica	64.26	3.40	17.69	4.10	7.43	391
Flammulinavelutipes	73.10	3.70	17.60	1.90	7.40	378
Auricularia auricula	82.80	19.80	4.20	8.30	4.70	351

Phenolic compounds provide shielding against various degenerative disorders, including, cancer, brain dysfunction and cardiovascular diseases. This property is associated with their capacity to act as antioxidants; they will scavenge free radicals and reactive oxygen species. The process of oxidation is essential for living organisms; it is important for the generation of energy. However, the production of free radicals has been implicated in several human diseases. The phenolic compounds in mushroom shows an excellent antioxidant capacity [65-68].

E. VITAMINS AND MINERALS

Mushrooms are essential sources of vitamins especially of group B particularly thiamine, pantothenic acid ,riboflavin, nicotinic acid, pyridoxine, folic acid, nicotinamide and cobalamine, other vitamins, such as biotin ,ergosterol and tocopherols are also present in mushrooms[69].

Vegetarians are aware of the fact that mushrooms are one of the best plant-based sources of niacin all over the world and it is shown that 100 g of fresh mushrooms supply more than a quarter of the adult's daily requirement of this vitamin. Among the plant based sources mushrooms are considered as unique in that they contain vitamin B12, something that cannot be obtained from vegetables. Since B12 is mainly obtained from animal origin, deficiency is commonly associated with people consumed vegetarian diets. Mushrooms may contain around 0.32-0.65 mg of B12 per gm, therefore only 3 g of fresh mushrooms can provide the RDA of this vitamin. Hence for vegetarians, mushrooms can be considered as a reliable source of getting this important nutrient. Vitamin A is unconventional although several mushrooms contain considerable amounts of pro-vitamin-A, measured as the β-carotene equivalent. Most cultivated mushrooms are assumed to contain little amount of the fat soluble vitamins, E and K, and only a small amount of vitamin C[28]. Mushroom fruiting bodies have a high concentration of well-assimilated mineral components. Major mineral constituents in mushrooms are mainly K, Na, P, Ca, Mg and elements like Cu,Cd , Fe, Zn, Mo form minor constituents [70].

IV. NUTRITIONAL CONTENT OF MUSHROOM

Proteins and many types of mushroom are edible, and most provide about an equivalent quantities of an equivalent nutrients per serving, no matter their shape or size.

The table below shows what proportion of every nutrient raw mushroom provides.

TABLE

Courtesy: Stamets, 2005 *(A.bisporous, P. sajor-caju, Lentinula edodes),* FAO, 1972 (*Pleurotusostreatus , V. volvaceae*), Doshi and Sharma, 1995 (*Calocybe indica*), Crison and Sand, 1978 (*Flammulinavelutipes* and *Auricularia spp*). [68]

Mushrooms include protein, vitamins, minerals, and antioxidants. These can have various health benefits. For example, antioxidants are chemicals that help the body to eliminate free radicals. Free radicals are toxic by-products of metabolism and other bodily processes. They can accumulate within the body, and if too many collect, oxidative stress may result. This can harm the body's cells and may lead to various health conditions. Among the antioxidant agents in mushrooms are:

1.selenium
2.vitaminC
3. Choline

a. CANCER

The antioxidant content in mushrooms may help prevent lung, prostate, breast, and other sorts of cancer, consistent with the National Cancer Institute. Some sources have suggested that selenium may help prevent cancer. Mushrooms also contain a little amount of vitamin D. There is some evidence that vitamin D supplementation may help prevent or treat some sorts of cancer, though consistent with a 2018 report, the effect may vary from person to person. Choline is another antioxidant in mushrooms. Some Sources have suggested that consuming choline can reduce the risk of some types of cancer, but one other study, has indicated that it may increase the risk of prostate cancer. It is worth noting that consuming a nutrient as a supplement isn't an equivalent as consuming it within the diet.

b. DIABETES

Dietary fiber may help manage variety of health conditions, including type 2 diabetes. A 2018 review of meta-analyses concluded that folks who eat tons of fiber may have a lower risk of developing type 2 diabetes. For those, that have already got it, fiber may help reduce blood sugar levels.

A cup of sliced, raw mushrooms, weighing 70 grams (g), provides almost 1 g of fiber. The Dietary Guidelines for Americans recommend that adults consume 22.4–33.6 g of dietary fiber every day, counting on sex and age. Mushrooms, beans, some vegetables, rice, and whole-grain foods can all contribute to a person's daily requirement of fiber.

c. HEART HEALTH

The fiber, potassium, and vitamin C in mushrooms may contribute to cardiovascular health. Potassium can help regulate vital sign, and this might decrease the danger of hypertension and disorder. The American Heart Association (AHA) recommend reducing the intake of added salt within the diet and eating more foods that contain potassium. According to current guidelines, people should consume around 4,700 milligrams (mg) of potassium every day. Mushrooms appear on the AHA's list of foods that provide potassium. A 2016 study concluded that folks with a vitamin C deficiency were more likely to experience disorder and suggested that consuming vitamin C may help prevent this illness. They didn't find evidence that vitamin C supplements can reduce the danger of this sort of disease. There is some evidence that consuming a kind of fiber called beta-glucans may lower blood cholesterol levels. Beta-glucans occur within the cell walls of the many sorts of mushrooms. The stem of the shiitake mushrooms may be a good source of beta-glucans.The Mediterranean diet includes a variety of plant foods, like mushrooms.

d. IN PREGNANCY

Many women take Folic acid, or folate, supplements during pregnancy to spice up fetal health, but mushrooms also can provide folate. A cup of whole, raw mushrooms contains 16.3 micrograms (mcg) of folate. Current guidelines recommend that adults consume 400 mcg of folate every day.

e. OTHER BENEFITS

Mushrooms are rich in B vitamins, such as:

1. riboflavin, or B-2
2. folate, or B-9
3. thiamine, or B-1
4. pantothenic acid, or B-5
5. niacin, or B-3

B vitamins help the body get energy from food and form red blood cells. A number of B vitamins also appear to be important for a healthy brain.The choline in mushrooms can help with muscle movement, learning, and memory. Choline assists in maintaining the structure of cellular membranes and plays aimportant role within the transmission of nerve impulses. Mushrooms also are the sole vegan, nonfortified dietary source of vitamin D. Several other minerals which will be difficult to get from a vegan diet — like selenium, potassium, copper, iron, and phosphorus — are available in mushrooms.

V. THERAPEUTIC VALUE OF MUSHROOM

The main feature of mushrooms is their medical properties, which have drawn the attention of scientists all around the world. Immune boosting, homeostasis and biorhythm modulation, cure and prevention of many diseases, and improvement from life-threatening disorders such as cancer, stroke, and heart disease are some of the significant pharmacological and physiological features of mushrooms. The hypotensive and renal effects of mushrooms, immuno-modulatory and antitumor activities of polysaccharide–protein complex (PSPC) from mycelial cultures, immuno-modulatory and antitumor activities of lectins from edible mushrooms, and various other medicinal effects of the most commonly studied G. lucidum have all been investigated.[43]Under some situations, every drug can be hazardous. According to a separate study, magic mushrooms had the lowest percentage of emergency room visits after usage, even lower than alcohol and marijuana. [69]

A list of potential hazards or adverse effects

- Anxiety
- Psychotic reaction, from transient to persistent
- Impaired reasoning that leads to risky actions (e.g. driving a car)

Excluding people with prior or current psychotic disorders, or such diseases in first-degree relatives, such as a biological parent or sibling, can help avoid or lessen the likelihood of temporary or permanent psychosis. If someone or any of its first or second-degree relatives have a current or prior history of psychotic disorders such as schizophrenia or Bipolar I or II disorder, it is not a good idea to use any psychedelics, including mushrooms. Extreme fear, panic, and a transient (within the 6-hour period) lack of ability to perceive reality appear to be the most prominent, albeit still very unusual, risks. Treatment includes supportive care and, if necessary, medications such as Valium.

A list of common effects

- Altered perception of time and space
- Feeling as if the world is fake
- Having the sensation of being in a dream
- Rapid mood changes, sometimes from very positive to very negative
- Very sensitive mood
- Dizziness
- Fatigue (When taking mushrooms, many people find themselves wanting to lie down or not move much. In comparison to shrooms, this impact appears to be less evident with LSD.)
- Large pupils
- Hard to concentrate
- "Sporadic, transient increases in blood pressure or heart rate"
- Nausea
- Nervousness/anxiety
- Unusual or odd thoughts
- Yawning[71]

A mushroom is a fleshy plant with the fungus's spore-bearing fruiting body. It grows wildly above ground, or some of it is farmed for a variety of purposes. There are numerous mushroom species, including fairy-ring mushroom, enoki, shiitake, oyster mushroom, and magic mushrooms such as Psilocybe, paddy straw mushroom, and others. . Mushrooms have a low calorie count and are commonly used in cooking. Some mushrooms, on the other hand, can be used as a traditional medicine.Mushrooms are high in carbohydrate, vitamins, and minerals, among other nutrients. Those can be found in Agaricus sp., such as crimini or Portobello. Because it is grown in a controlled, sterile setting, this mushroom is safe to eat. Shiitake, maitake, oyster, and enoki are some of the other mushrooms you can eat. There are, however, some mushroom species that are poisonous. Hydrazines are a type of carcinogen found in Agaricus bosporus. Cooking at a normal temperature will remove this carcinogen, but eating it raw will result in mushroom negative effects, such as –

1. *Allergic reaction*

Some people experience allergic reactions such as urticaria as a result of the chemicals in the Agaricus mushroom (dermatologic reaction in allergy).

2. *Asthma condition*

This mushroom's allergic reaction can trigger an asthma attack. It causes hypersensitivity in the bronchus, causing secretion and edoema, resulting in breathing difficulties.

3. *Anaphylactic shock*

Anaphylactic shock will occur as a result of the extreme allergic reaction caused by the mushroom adverse effect. People who have this illness will experience severe hypotension and require immediate medical attention.

4. *Influence the growth of cancer cells.*

Raw mushroom contains a carcinogen that can impact cancer cell proliferation. This is mutagenic and can spread throughout the body.

Psilocybin mushrooms are another mushroom that has a lot of negative side effects. These mushrooms are known as "magic mushrooms" because of their hallucinogenic qualities, which can alter your life perspective. Psilocybin is found in more than 200 different types of mushrooms. They are dark-spored fungi that thrive in tropical and sub-tropical climates. These mushrooms have been studied for their ability to treat psychiatric and psychological issues.

5. *Hallucinogenic effect*

Ingesting the magic mushroom's psychedelic compounds produces a strong hallucinatory impact that lasts 20-30 minutes.

6. *Mild anxiety*

Once consumed, the mushroom's psilocybin properties are broken down into psilocin. It causes a slight anxiety reaction.

7. *Mild electricity sensation through the body*.

The physical sensations of mild electricity and energy that go through the body are also brought on by the psilocybin mushroom.

8. *Emotional and mental changes*.

The psilocybin mushroom can cause emotional and mental alterations that manifest as shifts in perception, feeling, and insight.

9. *Euphoric sensation.*

Psilocybin mushroom has a comparable effect to LSD. It gives the consumer a euphoric experience.

10. *Makes stay awake.*

The psilocybin mushroom has the ability to keep people awake. It's frequently employed to keep people alert as they work.

11. *Change in focus attention.*

Psilocybin mushroom's psychedelic effects can shift the focus of attention. It has a comparable impact to that of other psychoactive substances.

12. *Dilation of pupils.*

Psilocybin mushroom, like psychoactive substances, causes pupil dilatation as a side

effect. This is due to the substance's ability to activate the sympathetic nervous system.

13. *Increase heart rate.*
    The Psilocybin characteristics in mushrooms cause an increase in heart rate by affecting the sympathetic nervous system, which is responsible for heart rate regulation.
14. *Increase the blood pressure.*
    This mushroom side effect occurs as a result of the sympathetic nervous system's reaction. The mushroom's Psilocybin characteristics stimulate it.
15. *Over fear reaction or paranoid.*
    The mushroom's hallucinogenic effect can cause an exaggerated fear response, even paranoia. It has something to do with the hallucinogenic properties of the Psilocybin mushroom.
16. *Bring the nausea feeling.*
    Some mushrooms might be difficult to digest. It will make you feel sick if you consume these mushrooms, especially if they are uncooked.
17. *Attention disruption.*
    The serotonin neurotransmission in the brain is disrupted by the Psilocybin mushroom. This mechanism has the ability to interrupt attention and shift the focus of thought.
18. *Bring the dizziness and confusion.*
    Dizziness and disorientation are also caused by the breakdown of the serotonin transmitter. It also causes a shift in mood.
19. *Panic attack.*
    Because of the mushroom's stimulation of the sympathetic nervous system and psychedelic impact, panic attacks can occur as a side effect. When this effect reaches a saturation point, it triggers a panic attack.
20. *Being fatigue*
    When the mushroom's euphoric side effects reach their peak, fatigue sets in. It causes your body to become exhausted later.
21. *An experience of stomach discomfort.*
    Mushrooms have a lot of gas, which might upset your stomach. It could result in indigestion, nausea, and vomiting.[72]

VI. FUNCTIONAL FOODS FROM EDIBLE MUSHROOM

Mushrooms as natural immunotherapy resources in recent years, mushrooms have been recognised as valuable natural immunotherapy resources that can be employed as immunomodulators and immunostimulators in the treatment of immunodeficiency disorders such as cancer, tumours, HIV, tuberculosis, and other diseases. Pleurotus mushrooms contain a variety of bioactive compounds that can help to enhance or complement a desired immunological response. Polysaccharidepeptides, polysaccharideproteins, and functional proteins (ubiquinone-9, nebrodeolysin, ubiquitin-like peptide and glycoprotein), glucans, proteoglycans and many others are examples of bioactive substances.[73] In China, Coriolus versicolor (CV) is a medicinal mushroom that is used in the prevention and treatment of cancer and infection. The majority of these bioactive chemicals stimulate both the innate and adaptive immune systems, following the immunomodulatory route mechanism of polysaccharide (glucan) from mushrooms. Aqueous extracts produced from CV have been shown to have a wide range of biological activities, including stimulatory effects on diverse immune cells and prevention of cancer growth, in both pre-clinical and clinical studies. While little is known about the physical, chemical, and pharmacodynamic properties of the active principles found in these extracts, there is enough scientific data to suggest that at least some of these elements might be developed into an evidence-based immunomodulatory therapeutic. [74]

CONCLUSION

Several mushroom species have been noticed as sources of bioactive materials, additionally to their important nutritional value. The incorporation of whole mushrooms into the diet chart may have efficacy as potential dietary additives.

The production of mushrooms and the extraction of bioactive metabolites is the main feature for the development of efficient biotechnological methods to obtain these metabolites. By a wide range of studies we observe that mushrooms contain components with outstanding features to prevent or treat different type of diseases.

Powder formulations of some species have revealed the presence of essential nutrients. They present a low fat content and can be used in low-calorie diets, just like the mushrooms fruiting bodies. Some formulations could be used as antioxidants to prevent oxidative stress and thus ageing.

Future studies into the mechanisms of action of mushroom extracts will help us to further delineate the interesting roles and properties of various mushroom phytochemicals in the prevention and treatment of some degenerative diseases.

In view of the current scenario, the research of bioactive components in edible wild and cultivated mushrooms is yet deficient. There are a lots of potential characteristics and old

and novel properties, provided by mushrooms with nutraceutical and health benefits, which deserve further more investigations.[46]

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