



Theme: Food Sustainability

Opinion

Mushroom: Reliable Protein Source in the Future

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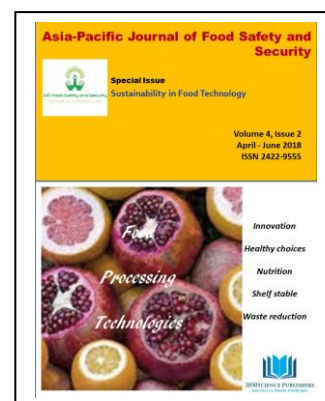
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Highlights

- Mushrooms are important part of human diet.
- Mushrooms are potent source of compounds of pharmaceutical importance.
- Mushroom nutraceuticals can be extracted from both the mushroom mycelium and fruiting body.

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Abstract

Mushrooms have been a part of the human diet and used as both food and medicine for centuries and they form very nourishing meals because of easy digestibility. The carbohydrate and fat contents of edible mushrooms are quite low. The absence of starch in mushrooms makes it an ideal food for diabetic patients and obese people. Mushrooms promote immune function; boost health; lower the risk of cancer; inhibit tumor growth; help balancing blood sugar; reduce inflammation and support the body's detoxification mechanisms because of the specific bioactive compounds in them. The fermentable dietary fibre in mushrooms augments healthy functioning of bowel system as fibre serves as a food for beneficial microbes in human digestion system. Mushrooms represent a vast source of yet undiscovered potent pharmaceutical products. The consumption of mushrooms can make a valuable addition to the often-unbalanced diets of people in developing countries and has the potential of becoming reliable source of nutrition.

Keywords: Mushroom; Nutrition; Protein; Nutraceutical; Functional food

Introduction

Mushrooms are regarded as a macro-fungus with a distinctive fruiting body which can be either epigeous or hypogeous and large enough to be seen with the naked eyes and to be picked by hand (Chang and Miles, 1992). Hundreds of identified species of mushrooms, since time immemorial, have made a significant global contribution to human food and medicine. Many mushroom species including the button mushroom (*Agaricus*), Shiitake (*Lentinus*), Oyster (*Pleurotus*), Paddy straw (*Volvariella*), Lion's Head (*Hericium*), Ear (*Auricularia*), Ganoderma (*Reishi*), Maitake (*Grifola frondosa*), Winter (*Flammulina*) are commonly grown for food or medicinal purposes across tropical and temperate zones (Marshall and Nair, 2009). This article gives a deep insight into the nutritional, therapeutic and potential pharmaceutical properties of mushrooms.

Mushroom as food and ingredient for future food security

Mushrooms have been a part of the human diet and used as both food and medicine for centuries and their importance is well established in many spheres of human life as well as ecosystem functions. They are known to produce enough amount of protein rich quality food which is of high biological value and appropriate for all age groups. Edible mushrooms are recognized not only as delicacy but also as food in human diet. They are consumed not only for their innate flavour and taste but also for their important nutritional value. The nutrient content of different mushrooms varies from species to species and depends on their growth requirement. Cultivated and wild mushrooms contain reasonable amounts of proteins, carbohydrates, minerals, fibres and vitamins (Aida *et al.*, 2009), but are low in

calories, sodium, fats and cholesterol (Barros *et al.*, 2007). Mushrooms possess high percentage of water (93-95%) and are rich sources of various minerals such as potassium, phosphorus, calcium, magnesium, iron and copper (Shu *et al.*, 2007). One third of the iron within the mushrooms is known to be in accessible form. Although many myths are associated with consumption of mushrooms, yet they are useful diet for vegetarians because they contain all the essential amino-acid required by an adult (Koyyalamudi *et al.*, 2009). In comparison to animal sources of protein, mushrooms have high protein conversion efficiency per unit of land and per unit time (Bano and Rajarathnam, 1988). They are good source of vitamin B, C and D, including niacin, riboflavin, thiamine, and folate.

Compounds of pharmaceutical importance with potent and unique health enhancing properties have been isolated from mushrooms (Wasser and Weis, 1999). So many medicinal mushrooms could be considered to be the solution for many of the human health issues. Minimal sodium with rich potassium in mushroom enhances salt balance and facilitates blood circulation in human and are thus found suitable for high blood pressure patients. The fermentable dietary fibre in mushrooms augments healthy functioning of bowel system as fibre serves as a food for beneficial microbes in human digestion system. Compounds such as Kresin which is known to restrict tumor activity is widely used as a leading cancer drug in pharmaceutical industries. A diverse collection of polysaccharides (beta-glucans) and minerals isolated from mushrooms are responsible for regulation and strengthening the human immune system. Their polysaccharide content is used as anticancer drug. Even, they have been used to combat HIV effectively (Nanba, 1993; King, 1993).

Mushrooms as functional foods are used as nutrient supplements to enhance immunity. Mushroom health supplements are marketed in the form of powders, capsules or tablets made of dried fruiting bodies, extracts of mycelium with substrate, biomass or extract from liquid fermentation etc (Wasser, 2005). Besides being functional foods, there are various uses of mushrooms including complementary medicine/dietary supplements for anticancer, antiviral, immunopotentiating, hypocholesterolemic and hepatoprotective agents which are therefore referred to as mushroom nutraceuticals. Mushroom nutraceuticals can be extracted from either directly the mushroom mycelium or fruiting body and represent an important component of the expanding mushroom biotechnology industry. It has been shown that constant intake of either raw mushrooms or mushroom nutraceuticals (dietary supplements) can make people stay fit and healthy. Mushrooms provide a high protein and low-calorie diet and can thus be recommended to the heart patients. Edible mushrooms known as the meat of the vegetable world can be prepared into a variety of delicious dishes and as flavours for other dishes. These soups are

added to a variety of other foods. Some people use mushrooms as a substitute for meat in their stews (Abulude, 2005).

The most common nutrients which are available in general mushrooms are:

Proteins and amino acids

The crude protein content of edible mushrooms is usually high but varies greatly according to factors such as species and stage of development of the mushroom (Longvah and Deosthale, 1998). On fresh weight basis, the protein content in mushrooms is superior to all vegetables and fruits but inferior to the conventional protein sources such as meat and dairy products (Aremu *et al.*, 2009). The digestibility of *Pleurotus* mushrooms proteins is equivalent to that of plants (Bano and Rajarathnam, 1988). However, on dry-weight basis mushrooms are similar with respect to dried-yeast and superior to dried peas and beans. The free amino acid level of mushrooms is usually low ranging from 7.14 to 12.3 mg/g in dry edible mushrooms and contributes to the main flavor properties of mushrooms (Maga, 1981). Edible mushrooms contain proteins that are composed of threonine and valine but deficient in sulphur containing amino acids (methionine and cysteine). Wild mushroom proteins also contain considerable amounts of non-essential amino acids such as: alanine, arginine, glycine, glutamic acid, aspartic acid, proline and serine. They are important in providing structure to cells, tissues and organs and are therefore essential for growth and repair (Beluhan and Ranogajec, 2011).

Vitamins

Cultivated mushrooms are a good source of vitamins such as riboflavin, niacin and folates. In addition, they also contain small amounts of vitamin C and B1 and traces of vitamins B12 and D2. The vitamin B2 content in mushrooms is also higher than that generally found in vegetables (Mattila, 2001). Mushrooms contain moderately high amounts of folates and their bioavailability is as good as that for folic acids (Clifford *et al.*, 1991). The ergosterol present in mushrooms is the precursor for Vitamin D synthesis in human body. 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).

Carbohydrates

Edible mushrooms contain high levels of oligosaccharides and only a low level of total soluble sugars (Bano and Rajarathnam, 1988). The carbohydrate content of edible mushrooms varies from species to species and ranges from 35% to 70% DW (Mau, *et al.*, 2001).

Fatty acids

The fatty acid level in mushrooms is generally low around 2–8%. The level of polyunsaturated fatty acids as compared to saturated fatty acids is quite high, constituting more than 75% of total fatty acids of which oleic and linoleic acids are the most significant, while palmitic acid is the main saturated fatty acid (Ribeiro, *et al.*, 2009).

Antioxidants

Antioxidants present in mushrooms scavenge the free radicals present in human body, reduces cell maturity and thus acts as an anti-aging agent. Ergothioneine is a specific antioxidant found in *Flammulina velutipes* and *Agaricus bisporus*, which is necessary for healthy eyes, kidney, bone marrow, liver and skin and consequently reducing the aging process. Selvi *et al.* (2007) and Kattanwan *et al.* (2011) have demonstrated the antioxidant properties of mushrooms.

Conclusion

It may be concluded that mushrooms have the potential to make an important contribution to the livelihoods of rural and semi urban dwellers through food security and income generation of the burgeoning world population. Mushrooms can make a valuable dietary addition through their protein and micronutrient content as well as their medicinal properties. Its cultivation can make an important contribution to the livelihoods of the unemployed, of women, and of the landless poor who, with appropriate training and access to inputs, can increase their independence and self. The FAO has been actively promoting mushroom cultivation for rural development and food security in developing countries (Marshall and Nair, 2009). Mushrooms are functional food and are a source of biologically valuable components that offer great therapeutic potential for the prevention and control of human diseases. Further research and clinical trials needs to be carried out to validate mushrooms as source of bioactive molecules with medicinal applications. They may be used directly in the diet to promote health, taking advantage of the additive and synergistic effects of the bioactive compounds present in them. Medicinal mushrooms represent a growing segment of today's pharmaceutical industry owing to the plethora of useful bioactive compounds. Dedicated research should be undertaken to isolate, purify, and structurally investigate of novel anticancer and immune-stimulator compounds.

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