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Nutritional Value of Mushrooms: A Review

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Abstract: *The present studies have reviewed the nutritional values and properties of different species of mushrooms all over the world considering it to be appropriate healthy diet for proper functioning & growth of the body. Extensive studies have shown that overall protein and carbohydrate content in mushrooms is good along with fiber content but content of lipids and fats is usually low. Mushrooms are imminently suitable for human diet due to its good nutritional composition. Some of mushrooms show special beneficial properties along with good nutritional content for example Lentinnum tuberrosium has very high carbohydrates. Essential amino acids are high in Agaricus abruptibulbus and Termitomyces globules. Some mushrooms like Russula vesca, Russula delica and Termitomyce seurrhizus have shown antibacterial properties as well. Ten species of wild edible mushrooms (WEMs) from Nagaland have high phenolic content, flavonoids and antioxidant properties. Apioperdon pyriforme, Helvella elastica, Morchella conica and Rhizopogon luteolus have good bioaccumulation potential. It was also found that there are some mushrooms which can execute difference in their properties if cooked. Surprisingly Grey Oyster mushroom from Malaysia has minerals as highest nutrient components. Boletus edulis has shown different concentrations of elements in its caps and stripes respectively. Conclusively, mushrooms have incredible nutritive values and can be used as food as well as medicine in a precise manner and can aid in enhancing human health.*

Keywords: Edible Mushrooms, Mushroom production, Nutritional requirements, Healthy food, Non-Green Revolution, Dietary fiber

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1. Introduction

Mushroom is a kind of species which serves purpose of both, food and medicine. In earlier days it was affordable only by rich people of society but now-a-days; it is accessible to vast majority section of society. Mushroom farming is considered as a business with low investment and more profit; as it requires few input materials to grow with lesser space requirements. Nutritionally, mushroom is a good source of protein. Though this is simple growing but along with proteins it has many other nutritional benefits. Edible mushroom is considered as '*meat of vegetarians'*. It is member of Kingdom Fungi. It is also called as fungi with gills. Mushrooms are type of fungi which are visible with naked eyes and can be hand-picked [1]. Mushrooms are found with good as well as bad properties. Many species and varieties of mushrooms are poisonous in nature whereas edible mushrooms are full of good qualities which are beneficial for human health. Mushrooms are cultivated all over the world. Different varieties have varying qualities and levels of nutritional components according to the geographical location. This non-green vegetable is considered as 'non green revolution' by K. Manikandan, can meet the demand of increasing population from limited resources. This review article aims at catering information regarding the nutritional value of Indian and International mushrooms.

2. Literature review

2.1 Indian Mushrooms

A study on *Schizophyllum commune* and *Lentinus edodes*, two species of North-East India for their nutritive values concluded that protein content of *L. edodes* was high than *S. commune*. But fat content was low in both, around 2% and out of that total fat content, Oleic and Linoleic acids were 72-77%. Amount of essential amino acids in *S. commune* was 34% and *L. edodes* was 39%. True digestibility of proteins of *L.edodes* diet was higher than that of *S. commune* [2]. A research was conducted on seven wild edible mushrooms of Khasi hills Meghalaya and found that mushrooms were rich in high amount of protein, minerals and trace elements, and low amount of fat. Approximately 6.12 g of protein, 287 mg of Calcium, 9.3 mg of Iron and 3.72 mg of Zinc were found in around 250g of mushrooms which is considered to be a good amount of nutrition [3].

A work on antioxidant potential of water and methanolic extract of fruiting bodies of 23

species of mushroom discovered that out of the studied mushrooms *Termitomyces heimii*was found to best in terms of antioxidant index (AI) followed by *T. mummiformis* with 86% of AI. Also potent inhibition of lipid peroxidation in *T. heimii* and *T. mummiformis* was 100% and 69% respectively. Water extracts (2−37 mg/g) of fruting bodies were having more total phenolic content than in methanolic extracts (0.7−11.2 mg/g) [4]. A paper about aimed at *Agaricus bisporus* and *Pleurotus sajor caju* and nutritional attributes in them. The esults were that fat and ash content were more in *A. bisporus* than *P. sajor caju* whereas true protein content was more in *Pleutrotus* species than *A. bisporus* [5]. A work on specifically fat and fatty acids of mushrooms from geographically different locations of India produced results estimating that around 0.6% to 4.7% total fat is present in the studied mushrooms. Among the fatty acids, unsaturated fats were more than saturated fats; and oleic acid was most common in all the mushrooms [6].

Research found that if *Pleurotus oestrous*is grown on different lignocellulosic wastes, then its chemical and nutritional values will vary according to the type of waste in which it was grown. The substrate content varies from mushrooms grown on wheat stalk, millet stalk, soyabean stalk, cotton stalk was 17.9g, 14.3g, 22.7g and 31.5g out of 100g respectively [7].

Edible mushrooms of Western Ghats of Kanyakumari have more content of moisture so they are very prone to microbial growth and enzymatic activity. The content of moisture is ~87-95%. Edible mushrooms have good quantity of carbohydrates ranging from 40.6% to 53.3% of dry weight. The highest amount of sugar content was recorded 34.8g on dry basis in *Pleurotus tuberegium*. The mushrooms of Kanyakumari has low amount of lipids and fat in comparison to other mushrooms. Good amount of protein was found in these mushrooms [8].

Nutrient composition of wild and cultivated edible species from Tamil Nadu, named *Lentinus tuberregium is* special as *L. tuberregium* is having abundant percentage of carbohydrate as compared to protein. The quantity of protein found is just 25% to that of carbohydrate being 58.05% in the cultivated species whereas in wild species the carbohydrate is 55.58%. Other nutrients also varied in values in cultivated and wild species [9]. Also a study mentioned that carbohydrate content in mushrooms can be 26-82% on dry weight basis. Likely crude protein of different species of mushrooms varies from 12-35%. It

also mentioned that mushrooms are made up of 80-90% of water and 8-10% of fiber [10].

A study aiming the culinary medicinal potential was done on seven species of *Termitomyces* from the different locations of the North India. They were examined on their nutritional aspects which varied in all the species of *Termitomyces*. Among all the studied species *T. medius*is having maximum amount of protein than in *T. badius* (44%), on the other hand carbohydrate was maximum in *T. striatus* (60.3%), followed by *T. mammiformis* (47.65%). All of these were studied on dry weight basis [11]. Two mushrooms of Western Ghats of India named *Agaricus abruptibulbus* and *Termitomyces globules* were studied and it was found that quantity of Essential Amino Acid (EAA) Isoleucine in cooked *A. abruptibulbus* was high whereas cooked *T. globules* was having high quantity of Threonine, Isoleucine, Phenylalanine, Histidine and Sulphur amino acids. Also in both the mushrooms the contents of Potassium and Selenium were found high than other elements. It was also speculated that cooking has various drastic effects on both the mushrooms [12].

A variety of edible mushrooms of Similipal Biosphere Reserve (SBR), named *Russula vesca*, *Russula delica* and *Termitomyces eurrhizus* were used as ethnomedicines by the indigenous tribals as these are rich source of nutrients, micronutrients, minerals with promising bioactive properties. The speculated amounts of various nutrients after the analysis on these were as follows: protein (~23-35g/100g) and carbohydrate (~46-63g/100g) and fat being the least (~2-5g/100g). These mushrooms also showed moderate levels of anti-bacterial properties against six human pathogenic bacteria [13]. Two main mushrooms of North India i.e. *Agaricus bisporus* and *Pleurotus sajor caju* have high amounts of polyunsaturated fatty acids (>75%) containing Linoleic acid predominantly. Dietary fiber content in *A. bisporus* and *P. sajor caju* mushrooms are aound 40.52% and 43.73%, respectively [14]. Three species of *Pleurotus* from the plains of India were studied and it was found that *P. florida* has 22–25% of dry weight of protein, being the maximum among three of them followed by *P. citrinopileatus* (20–22% of dry weight) and *P. pulmonarius* (15–18% of dry weight). Cholesterol content is low in all of three making the food more protein rich. Antioxidase enzyme, peroxidae and superoxide dimutase were maximum in *Pleurotus florida,* hence mostly used for neutraceutical purposes [15].

A work on seven edible *Russalaceous* mushrooms of North-West Himalayas, namely

R. brevipes Peck, *R. cyanoxantha* (Schaeff.) Fr., *R. heterophylla* (Fr.) Fr., *R. virescens* (Schaeff.) Fr., *Lactarius sanguifluus* (Paulet) Fr., *L. deliciosus* (L.) Gray and *Lactifluuspiperatus* (L.) Kuntze found that protein was in good quantity 19.84-37.77 %, carbohydrates were in higher percentage 40.81-63.24%, fat content was low around 1.7-5.44%. Around 6.89-8.34% of moisture content was present. Ash content was also good, ranging from 6.17%-16.43% [16]. Nutritional and chemical composition of two wild mushrooms of Western Ghat forests of Karnataka i.e. *Amanita hemibapha* (Berk.&Br.) Sacc. and *Trogia cantharelloides* (Mont.) Pat. Were analysed and they were found to have high carbohydrate and protein low fat content. It was also found that edible 100g of mushroom has 420.083 calories. *A. hemibapha* contains 17 amino acids and *T. cantharelloides* contains 18 amino acids. Most abundant elements found in both species were Potassium, Phosphorous and Magnesium [17]. Ten species of wild edible mushrooms (WEM) of Nagaland were put to nutritional analysis on the basis of their total phenolic amount, flavonoids and antioxidant activity. Total protein content was found to be quite high which ranged from 62.27 g/100g (*Lentinus sajor-caju*) to 18.77g/100g (*Lentinus squarrosulus var. squarrosulus*); total carbohydrate content ranged from 38.44 g/100 g (*Lentinula edodes*) to 5.31g/100g (*Schizophyllum commune*); whereas reducing sugar content ranged from 7.81g/100g (*Termitomyces heimii*) to 2.33g/100g (*S. commune*). In the study it was found that Crude fiber ranged from 11.1% (*A. auricula-judae*) to 1.71% (*L. squarrosulus*) and ash content ranged from 10.66% (*L. squarrosulus*) to 3.12% (*L. squarrosulus var. squarrosulus*). Also, highest phenolic content was observed in *L. squarrosulus* (18.7 g/100 g) and highest flavonoid content was observed in *L. sulphurous* (9.3 g/100 g). All the mushroom species studied exhibited antioxidant activity against DPPH free radical, but highest activity was recorded in *L. tigrinus* (47.5 µg/ml, IC_{50}) [18].

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Table 1.: Nutritional analysis of 10 WEM as studied by [18]

Total protein content	62.27g/100g (*Lentinus sajor-caju*)	18.77g/100g (*Lentinus squarrosulus var. squarrosulus*)
Total carbohydrate content	38.44g/100g (*Lentinula edodes*)	5.31g/100g (*Schizophyllum commune*)
Reducing sugar content	7.81g/100g (*Termitomyces heimii*)	2.33g/100g (*S. commune*)
Crude fiber	11.1% (*A. auricula-judae*)	1.71% (*L. squarrosulus*)
Ash content	10.66% (*L. squarrosulus*)	3.12% (*L. squarrosulus var. squarrosulus*)
Highest phenolic content	*L. squarrosulus* 18.7g/100g)	
Highest flavonoid content	*L. sulphurous* (9.3g/100g).	
Highest antioxidant activity	*L. tigrinus* (47.5 µg/ml, IC_{50})	

Four different WEMs namely *Apioperdon pyriforme, Helvellae lastica, Morchella conica* and *Rhizopogon luteolus* from different locations of Jammu and Kashmir were studied for nutritional compinents and it was found that *M. conica*is having maximum amounts of protein and crude fiber that is 24.5g/100g and 4.8% respectively. *R. luteolus* possesses maximum total phenolic content (12.30 mg/g) in its dried sporocarp form. Total ascorbic acid

content (1.71 mg/g) and total flavonoid content (0.78 mg/g) were present in maximum proportions in fruit bodies of *R. luteolus* and *H. elastica*, respectively. Also it was found that these wild mushrooms have good bioaccumulation potential [19]. Mushrooms are becoming important for daily diet due to their unexceptionally high amount of proteins and low content of fat. Generally, staple diet of majority population has low Lysine and Leucine contents but mushrooms have good amount of these amino acids. Adenosine and Cordycepin are two important components found in mushrooms and amount of amino acids found in mushrooms varies from 35-37% [20].

Paddy Straw Milky Mushroom (*Calocybe indica)* was studied for moisture content, crude protein, lipid, ash, crude fiber, and minerals. The estimated amounts were as: protein 14.11%, fiber 8.3%, and carbohydrate 5.62%. Lipid, ash, ether extract and pH were 4.06%, 7.04%, 3.15% and 5.4 respectively. The carbon and nitrogen contents were 33.6% and 3.56% respectively [21].

2.2 Non Indian Mushrooms

In some studies based on out of India mushrooms, one study on consumed edible mushrooms in North-East Portugal including *Agaricus arvensis*, *Lactarius deliciosus*, *Leucopaxillus giganteus, Sarcodon imbricatus*, *Tricholoma portentosum also* revealed that these mushrooms are rich in proteins, carbohydrates but low in fats, which was in coherence with the studies based on Indian mushrooms. On an average 100g of these mushrooms were having approximate amount of 28 kcal [22]. In Grey Oyster mushroom which is cultivated in Malaysia, maximum nutrient was mineral content approximated around >90% followed by crude fiber which was ~17%. Protein and carbohydrate contents were like 4% and 3.54% respectively. Fat and ash content were low 1.18% and 1.16% respectively. So it was concluded that due to high fiber and high antioxidant activity Grey Oyster mushrooms are very good source of food [23].

In a study on seven edible mushrooms of Bangladesh concluded that protein content was found quite high (20-45g/100g) and on the other hand lipid content was low 1- 4%. Carbohydrate was found to be around 11-61g/100g in dry state. Ash and fiber contents were 6-10g and 5-40g on 100g respectively. Antioxidant capacity of extracts was found 0.08-0.21 mg/ml. It was found that Bangladeshi mushrooms are good source of

nutrition and antioxidant activity [24]. Recently studied raw King Bolete Mushrooms, *Boletus edulis,* which is more prevalent in North-East China has high content of element Selenium. The concentration of different elements was different in caps and stipes of the mushroom; like Ag, Cd, Cu, Cs, Ga, Ge, Hg, Mo, Ni, Rb, Sb, Ti and Zn were at higher concentration in caps than stipes. On the other hand elements like Ba, Co, Hf, Sr, Tl, Zr were higher in concentration in stipes than caps [25].

3. Conclusion

Mushrooms are like a coin with two aspects, good as well as bad; good side serves as a food source and medicine, and bad side being a natural poison. After this literature review, it can be concluded that with a few exceptions, edible mushrooms are a good source of proteins and carbohydrates and are low in lipid content. They also have good amount of trace elements and dietary fibers. Some mushrooms have also been shown to have antibacterial properties. It is also established that different parts and stages of life cycle of a mushroom can have different concentration of various nutrients. Hence these nutritional attributes make mushroom a very good source of food, which can be part of a staple diet in upcoming times. This review paper has tried to extract the beneficial contents from renowned articles by various scientists from India as well as outside India. Yet this is not sufficient in terms of scientific knowledge to reach to an exclusive conclusion. A lot is yet to be researched in this area to find successfully the complete profile of this cheap yet beneficial source of food.

References

[1] S. T. Chang, and P. G. Miles, (1992), New Discip., *Mycologist*, *6*(2), pp.64-65.

[2] T. Longvah, and Y. Deosthale, (1998), Compositional and nutritional studies on edible wild mushroom from northeast India, *Food Chemistry*, 63(3), pp.331-334.

[3] D. Agrahar-Murugkar, and G. Subbulakshmi, (2005), Nutritional value of edible wild mushrooms collected from the Khasi hills of Meghalaya, *Food*

Chemistry, 89(4), pp:599-603.

[4] Puttaraju, N.G., Venkateshaiah, S.U., Dharmesh, S.M., Urs, S.M.N. and Somasundaram, R., 2006. Antioxidant activity of indigenous edible mushrooms. Journal of agricultural and food chemistry, 54(26), pp.9764.9772.

[5] R. Goyal, R. B. Grewal, and R. K. Goyal, (2006), Nutritional attributes of *Agaricus bisporus* and *Pleurotus* sajor caju mushrooms. *Nutrition and Health*, *18*(2), pp.179-184.

[6] S. Kavishree, J. Hemavathy, B. R. Lokesh, M. N. Shashirekha, and S. Rajarathnam, (2008), Fat and fatty acids of Indian edible mushrooms, *Food Chemistry*, *106*(2), pp.597- 602.

[7] A. Dundar, H. Acay, and A. Yildiz, (2009), Effect of using different lignocellulosic wastes for cultivation of Pleurotusostreatus (Jacq.) P. Kumm. on mushroom yield, chemical composition and nutritional value. African Journal of Biotechnology, 8(4).

[8] G. Johnsy, S. D. Sargunam, M. G. Dinesh, and V. Kaviyarasan, (2011), Nutritive value of edible wild mushrooms collected from the Western Ghats of Kanyakumari District. *Botany Research Int.*, *4*(4), pp.69-74.

[9] J. Manjunathan, and V. Kaviyarasan, (2011), Nutrient composition in wild and cultivated edible mushroom, Lentinus tuberregium (Fr.) Tamil Nadu., India. *Int. Food Res. J.*, *18*(2), pp.809-811.

[10] K. Manikandan, (2011). Nutritional and medicinal values of mushrooms. *Mushrooms cultivation, marketing and consumption*, pp.11-14.

[11] N. S. Atri, B. Kumari, R. C. Upadhyay, and S. K. Sharma, (2012), Nutritional and sociobiological aspects of culinary-medicinal termitophilous mushrooms from North India, *Int. J. Med. Mushrooms*, *14*(5).

[12] N. Sudheep, and K. Sridhar, (2014), Nutritional composition of two wild mushrooms consumed by the tribals of the Western Ghats of India. *Mycology*, 5(2), pp.64-72.

[13] S. K. Singdevsachan, J. K. Patra, K. Tayung, *et al.*, (2014), Evaluation of nutritional and nutraceutical potentials of three wild edible mushrooms from Similipal Biosphere Reserve, Odisha, India. *J. Verbr. Lebensm*, 9, pp:111–120.

[14] R. Goyal, R. Grewal, and R. Goyal, (2015), Fatty acid composition and dietary fibre constituents of mushrooms of north india. *Emirates J. Food and Agri.*, 27(12), p.927.

[15] S. Khatun, A. Islam, U. Cakilcioglu, P. Guler, and N. C. Chatterjee, (2015), Nutritional qualities and antioxidant activity of three edible oyster mushrooms (Pleurotus spp.). *NJAS-Wageningen Journal of Life Sciences*, *72*, pp.1-5.

[16] S. Sharma, N. S. Atri, M. Kaur, and B. Verma, (2017), Nutritional and neutraceutical potential of some wild edible Russulaceous mushrooms from North West Himalayas, India, *Kavaka*, *48*, pp.41-46.

[17] V. Ravikrishnan, S. Ganesh, and M. Rajashekhar, (2017), Compositional and nutritional studies on two wild mushrooms from Western Ghat forests of Karnataka, India, *Int. Food Res. J.*, *24*(2), pp.679.

[18] T. Ao, and C. Deb, (2019), Nutritional and antioxidant potential of some wild edible mushrooms of Nagaland, India. *J. Food Sc. and Tech., 56(2)*, pp.1084-1089.

[19] U. Altaf, P. Lalotra, and Y. P. Sharma, (2020), Nutritional and mineral composition of four wild edible mushrooms from Jammu and Kashmir, India, *Indian Phytopathology, 73*, 313–320.

[20] M. M. Nagulwar, D. R. More, and L. L. Mandhare, (2020), Nutritional properties and value addition of mushroom: A Review, *The Pharma Innovation J.*, *9*(10), pp.395- 398.

[21] G. Chelladurai, T. K. Yadav, and R. K. Pathak, (2021), Chemical Composition and Nutritional Value of Paddy Straw Milky Mushroom (*Calocybe indica*). *Nature Environment and Pollution Technology*, *20*(3), pp.1157-1164.

[22] L. Barros, P. Baptista, D. Correia, S. Casal, B. Oliveira, and I. Ferreira, (2007), Fatty acid and sugar compositions, and nutritional value of five wild edible mushrooms from Northeast Portugal, *Food Chemistry*, 105(1), PP.140-145.

[23] A. M. Rashidi, and T. A. Yang, (2016), Nutritional and antioxidant values of oyster mushroom (P. sajor-caju) cultivated on rubber sawdust. *International Journal on Advanced Science, Engineering and Information Technology*, *6*(2), pp.161-164.

[24] N. Sifat, F. Lovely, S. M. Zihad, M. Hossain, J. A. Shilpi, I. D. Grice, M. S. Mubarak, and S. J. Uddin, (2020), Investigation of the nutritional value and antioxidant activities of common Bangladeshi edible mushrooms, *Clinical*

Phytoscience, *6*(1), pp.1-10.

[25] J. Falandysz, (2021), Nutritional and Other Trace Elements and Their Associations in Raw King Bolete Mushrooms, *Boletus edulis*, *Int. J. Environmental Res. and Public Health*, 19(1), p.417.