World Journal of Dairy & Food Sciences 5 (2): 140-144, 2010
ISSN 1817-308X

Nutritional Analysis of Wild and Cultivated Edible Medicinal Mushrooms

[1]*H. Pushpa and* [2]*K.B. Purushothama*

[1]Department of Microbiology, M.S. Ramaiah College of Arts, Science and Commerce, Bangalore, India
[2]Department of Botany, St. Joseph's College, Bangalore, India

Abstract: Five species of wild and cultivated edible medicinal mushrooms were selected to study their nutritional value. The total protein, total carbohydrate, total lipid, crude fiber and ash content of each mushroom were studied on dry weight basis. They ranged from 18.32-41.06, 28.38-49.2, 1.54-4.96, 13.2-29.02 and 7.01-17.92, respectively. This study suggested that the test mushrooms were protein and fiber rich with low fat content. Hence these nutrients contents made mushroom as a low energy, healthy foodstuff and these mushrooms may also be used as protein supplementary diet.

Key words: *Agaricus bisporous* · *Pleurotus florida* · *Calocybe indica* · *Russula delica* · *Lyophyllum decastes* · Nutritional value

INTRODUCTION

The use of mushrooms as food is probably as old as civilisation and mushrooms currently have greater importance in the diet of mankind. Cultivation and production of edible mushrooms are on the increase, particularly in Europe, America and Asia. The increased nutritional importance is due to the nutritive value of high-grade mushrooms, which almost equals that of milk [1]. Mushrooms have been evaluated for their nutritional status on the basis of their chemical composition. Cultivated and wild mushrooms contain reasonable amounts of proteins, carbohydrates, minerals, fibres and vitamins [2, 3]. Furthermore, mushrooms are low in calories, sodium, fats and cholesterol [4]. Edible mushrooms have long been considered to have medicinal value and to be devoid of undesirable effects [5].

Lillian Barros *et al.* [6] reported that the wild mushrooms were richer sources of protein and had a lower amount of fat than commercial mushrooms. 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 therefore essential for growth and repair [7] More than 140,000species of mushrooms exist in nature, but less than 25 species (*Agaricus bisporus, Pleurotus spp., Lentinus edodes, Volvariella volvacea, Auriculariaspp.* etc.) are widely accepted as food and only a few have attained the level of an item of commerce [8]. Due to their high content of vitamin, protein and mineral, mushrooms are considered as "Poor man's Protein" [9]. The Greeks and Romans described mushrooms as "Food for the Gods" and were served only on celebrations. Reference to mushrooms is found in Vedas [10-12]. Most people eat mushrooms, mostly because of its flavour, meaty taste and medicinal value [13]. Mushrooms can be used for the food to solve the malnutrition problem [14]. Mushrooms have good nutritional value particularly as a source of protein that can enrich human diets, especially in some developing countries where animal protein may not be available and are expensive. The protein content of fresh mushroom is 3.7% stated by Food Agriculture Organization's publication in 1978. The edible and medicinal mushrooms can be used on human welfare in the 21st century [15]. Many genera of mushrooms are edible and are rich in essential nutrients such as carbohydrates, proteins, vitamins, mineral, fat, fibres and various amino acids [16]. Mushrooms generally possess most of the attributes of nutritious food as they contain many essential nutrients in good quantity [17]. It must however be emphasized that some mushrooms are poisonous and may claim lives within few hours after consumption [18].

Pleurotus species are rich in medicinal values. *Pleurotus florida* has antioxidant and antitumor activities in experimental animals [19, 20] *Pleurotus* species are very much effective in reducing harmful plasma lipids and thus reduce the chance of atherosclerosis and other cardiovascular and artery-related disorders. These medicinal properties might be due to the presence of some important components in dietary mushrooms.

Corresponding Author: H. Pushpa, Department of Microbiology, M.S. Ramaiah College of Arts, Science and Commerce, Bangalore, India. E-mail: ramesh.pushpa1@gmail.com.

Alam *et al.* [21] reported the nutritional analysis of P*leurotus florida* and *Calocybe indica* were he reported that these mushrooms were rich in proteins (20-25%) and fibres (13-24%) and lower amount of lipid (4-5%). The pileus and gills were protein and lipid rich and stripe was carbohydrate and fibre rich. Md. Asaduzzaman [22] reported the nutrient contents in *Agaricus bisporous*. Whereas he reported total lipids, carbohydrate, crude fiber and ash content as 37.6, 10.0, 23.6, 21.2 and 7.8g per 100g of dried mushroom, respectively. Chang and miles [23] also reported the similar results. Lillian Barros *et al.* [6] reported 0.92g/100g of total fat, 80.93g/100g of Crude protein, 9.90 g/100g of Ash and 8.25 g/100g of Carbohydrates in *Agaricus bisporous*. Nina Pandey *et al.* [24] determined the protein in 35 species of mushrooms by Bradford's method, they reported that *Russula delica* contains 0.456 mg/ml of protein and Agaricus bisporous contain 0.509 mg/ml of protein. Anantachai Placklumyong *et al.* [25] analysed that *Russula delica* Fr.contains, 90.67% moisture, 0.72%ash, 3.7% protein, 0.43%fat, 3.62%carbohydrate in form of reducing sugar with derived from 3.21% polysaccharide, 0.59% fiber, 41 mg sodium, 150 mg potassium and 10 mg calcium. Goyal *et al.* [26] reported that the fat and ash content were significantly higher in *Agaricus bisporus*, whereas, crude fibre and crude protein contents were significantly higher in *Pleurotus sajor caju*. Total and protein nitrogen was significantly higher in *Pleurotus sajor caju* than *Agaricus bisporus* mushroom as a result its true protein content was also significantly higher. No significant differences were found in the energy, carbohydrates and non-protein nitrogen contents of both the varieties of mushrooms. Braaksma *et al.* [27] investigated that the crude protein content of the common mushroom (*Agaricus bisporous*) contain 19-38% on a dry weight (DW) basis.

In the present study we intend to evaluate the composition of wild, commercial and medicinal mushrooms collected from Banaglore, India. The evaluation of nutrient composition included the determination of proteins, fats, ash, carbohydrates and fibres.

MATERIALS AND METHODS

Mushroom Samples:

- Calocybe indica
- Agaricus bisporous
- Russula delica
- Pluerotus florida
- Lyophyllum decastes

All the collected mushrooms were dried for the estimation of Ash, Proteins, fibres, fat and total carbohydrates.

Determination of Total Ash [29]: About 3 grams of sample is weighed in a crucible and as heated in a muffle furnace at 550 degree Celsius for 30 minutes and cooled in desiccators. The ash content was calculated using following equation.

$$\text{Ash content (g/100 g sample)} = \frac{\text{Weight of ash}}{\text{Weight of sample taken}} \times 100$$

Determination of Total Proteins [29]: To about 0.7 gram of sample in a digestion flask, 1 gram of Copper Sulphate, 10 gram of Potassium sulphate and 20 ml of Sulphuric acid was added. After complete digestion the content is transferred into a vessel. 25 ml of 0.2N Sulphuric acid was pipetted out into beaker and distillation was started. The distillate was allowed to collect in Sulphuric acid for a known volume and time. The collected distillate is titrated against 0.2N Sodium Hydroxide using Methyl red as an indicator. The percentage of Protein was calculated.

$$\% \text{ of Nitrogen} = \frac{\text{(Titre Blank-Titre Sample) X0.014X1000}}{\text{Weight of Sample}}$$

% of Protein = % of Nitrogen x 6.24

Determination of Fat Content [29]: About 10 grams of Mushroom sample was weighed and extracted with Petroleum Ether in an extraction apparatus for 16 hours. The extract was dried, cooled in desiccators and weighed and mass was recorded. The % of fat was determined using a equation

$$\% \text{ of Fat} = \frac{\text{100 (wt. of Soxlhet flask with extracted fat-Wt of empty Soxhlet flask)}}{\text{Weight of Sample}}$$

Determination of Fibre Content [29]: 5 grams of mushroom sample was extracted using Petroleum ether. The fat free material was transferred in a beaker and 200ml of dilute sulphuric acid was added and boiled. Whole boiling acid in a flask is connected to reflux condenser and heated for 30 minutes. The flask was removed and filtered and washed thoroughly with boiling water followed by washing in boiling Sodium Hydroxide and again refluxed for 30 minutes. The contents were filtered and washed with boiling water and finally

washed the ethanol. The residues were dried and incinerated in muffle furnaces at 660 degree Celsius and the crucible along with ash was weighed and percentage of fiber was calculated.

$$\% \text{ of crude fiber} = \frac{100(\text{ Wt of crucible with before ashing-Wt of crucible after ashing})}{\text{Wt of the sample}}$$

Determination of Total Carbohydrates [29]: By difference method (100-total moisture+ total ash + total Moisture + total Protein + total Fat + total fibres) the percentage of carbohydrates was calculated.

RESULT AND DISCUSSION

The results of the nutritive value of wild and commercial edible mushrooms are shown in Table 1. The total carbohydrates, fat, protein, fibre and Ash contents in *Calocybe indica* was found to be 49.2g, 4.96, 21.6, 13.2 and 12.8g, respectively. The mushroom was found to be rich in protein and carbohydrate and contain less amount of fat. This result is nearly similar to the report of Nuhu Alam *et al.* [21]. However, there is a little difference in the fiber content this may be due to compost composition.

In case of *Agaricus bisporous*, the total carbohydrate, total protein, total fat, crude fiber and ash were found to be 28.38g, 2.12g, 41.06g, 18.23 and 7.01g, respectively.

The mushroom was found to be rich in protein than carbohydrate and very less amount of fat. This result was similar to the previous report [6, 24, 28].

The total carbohydrate, fat, protein, fibre and ash in case of Pleurotus florida was found to be 32.08, 1.54, 27.12,and 9.41g, respectively. Mushroom is found to be richer in carbohydrate composition than protein and total fat is found to be very less in its composition. This result was similar to the report of Chang and Miles [1], Nuhu Alam *et al.* [21] and Arun Ingale and Anita Ramtek [27] but, the composition of crude fiber is slightly different might be due to the use of different compost for their growth.

In 100g of dried *Russula delica*, the carbohydrate, fat, protein, fibre and ash was found to be 34.88, 5.38, 26.25, 15.42 and 17.92g, respectively. These results were not much similar to the work of Muhsin Konuk *et al.* [28] where they had reported total fat as 3.15g, ash 8.56 and Protein composition was almost similar. It is known that the chemical composition of mushrooms are affected by a number of factors, namely mushroom strain, composition of growth media, time of harvest, management techniques, handling conditions and preparation of the substrates.

In *Lyophyllum decastes* the total carbohydrate, total protein, total fat, crude fiber and ash were found to be 34.36, 2.14, 18.31, 29.02 and 14.2g, respectively. In order to compare the result obtained very less research has been done to our knowledge.

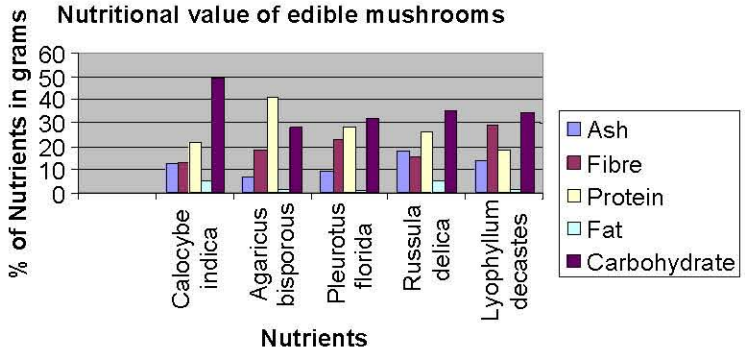

Fig. 1:

Table 1: Nutritional analysis of wild and cultivated edible medicinal mushrooms (% in grams)

Sl No.	Mushroom	Ash	Fibre	Protein	Fat	Carbohydrate
01	*Calocybe indica*	12.80	13.20	21.60	4.96	49.20
02	*Agaricus bisporous*	7.01	18.23	41.06	2.12	28.38
03	*Pleurotus florida*	9.41	23.18	27.83	1.54	32.08
04	*Russula delica*	17.92	15.42	26.25	5.38	34.88
05	*Lyophyllum decastes*	14.20	29.02	18.31	2.14	34.36

Among all the mushroom *Calocybe indica* contain large amount of carbohydrates. *Agaricus bisporous* contain large amount of protein. Very less amount of fat was noted in *Pleurotus Florida*. Fibre content was maximum in *Lyophyllum decastes* and ash was found to be more in *Russula delica* and least in Agaricus bisporous.

In conclusion, the tested mushrooms are protein and fiber rich with low fat content. The ash content and carbohydrate content was less than other food from plant and animal origin. Overall, the rich nutritional composition makes wild mushrooms very special. So, mushrooms are a promising food that may overcome protein-energy malnutrition problem in the third world. The protein, fiber, mineral, carbohydrates and fat content make them ideal vegetable for diabetic, cancer and heart patients. These nutrients contents made mushroom as a low energy, healthy foodstuff and these mushrooms may also be used as protein supplementary diet.

ACKNOWLEDGEMENT

We would like to thank Gokula Education Foundation and St.Joseph's college for their support to carry out this project.

REFERENCES

1. Chang S.T. and P.G.Miles 1989. Edible Mushrooms and Their Cultivation, CRC Press, Boca Raton., pp: 293-302.
2. Alofe, F.V., 1991. Amino acids and trace minerals of three edible wild mushrooms from Nigeria. J. Food Compost. Anal., 4: 147-174.
3. Stamets, P., 2000. Growing Gourmet and Medicinal Mushrooms, Ten Speed Press, California, pp: 207-430.
4. Chang, R.Y., 1996. Potential application of *Ganoderma* polysaccharides in the immune surveillance and chemoprevention of cancer. Mushroom Biology andMushroom Products, Proceedings of the Second International Congress, ed. D.J. Royse, Penn State University Press, Philadelphia, pp: 164-173.
5. Sakagami, H., Y. Kwazoe, N. Komatsu, A. Simpson, M. Nonoyama, K. Konno, T. Yoshida, Y. Kuroiwa and S. Yanuma, 1991. Antitumor, antiviral and immunopotentiating activities of pine cone extracts: potential medicinal efficacy of natural and synthetic lignin-related materials. Anticancer Res., 11: 881-888.
6. Lillian Barros, Telma Cruz, Paula Baptista, M. Leticia, Estevinho and Isabel C.F.R. Ferreira, 2008. Wild and commercial mushrooms as source of nutrients and nutraceuticals, Food and Chemical Toxicol., 46: 2743-2747.
7. Leon-Guzman, M.F., I. Silva and M.G. Lopez, 1997. Proximate chemical composition, free amino acid contents and free fatty acids contents of some wild edible mushrooms from Queretaro, Mexico, J. Agriculture Food Chemistry, 89: 533-539.
8. Lindequist, U., T.H.J. Niedermeyer and W.D. Julich, 2002. The pharmacological potential of mushrooms. eCAM, 2: 285-299.
9. Pandey, N., 2004. Chemical Analysis of Mushroom of Kathmandu Vally. Submitted to University Grant Commision.
10. Chube, H.S., 1995. Nutrational and Medicinal value of Mushrooms. Mushroom Production Technology; University of Agriculture and Technology, India, pp: 1-6.
11. Adhikari, M.K., 2000. Mushrooms of Nepal. Edited by G. Durrieu, P.U. Printers, Battisputali, Kathmandu, Nepal, pp: 236.
12. Adhikari, M.K., 1990. History of Mycological explorations in Nepal. Cryptog. Mycol., 11(2): 111.
13. Moore, D. and S.W. Chiu, 2001. Fungal products as Food, eds. Pointing,S.B. and Hyde, K.D. in Bio-exploitation of filamentous fungi. Fungal Diversity Research Series, 6: 223-251.
14. Manandhar, K.L., 2003. Mushroom cultivation Technology for women's income. Proceedings of International Conference of Women's Science and Technology for Proverty Alleviation.
15. Chang, S.T., 1999. Global impact of edible and medicnal mushrooms of human welfare in the 21st century; nongreen revolution. International Journal of Medicinal Mushrooms, 1: 1-8.
16. Okwulehie, I.C. and E.I. Odunze, 2004. Evaluation of the nutritional value of some tropical edible mushrooms. J. Sustain. Agric. Environ., 6(2): 157-162.
17. Fukushima, M., 2000. LDL receptor mRNA in rats is increased bydietary mushroom (Agarics bisporus) fibre and sugar beef fibre. J. Nutr., 130: 2151-2156.
18. Phillips, R., 1985. Mushrooms and other Fungi of Great Britain and Europe 3rd edition. Pan Books London.
19. Nayana, J. and K.K. Janardhanan, 2000. Antioxidant and antitumour activity of *Pleurotus florida*. Current Sci., 79(7): 941-943.

20. Manpreet, K., S. Giridhar and Khanna, 2004. *In vitro* and *in vivo* antioxidant potential of Pleurotus florida in experimental animals. Mushroom Res., 13(1): 21-26.
21. Nuhu Alam, Asaduzzaman Khan, Md.Shahdat Hossain, S.M. Ruhul Amin and Liakot A. Kha, 2007. Nutritional Analysis of Dietary Mushroom-Pleurotus florida Eger and Pleurotus sajor-caju (Fr.) Singer, Bangladesh J. Mushroom, 1(2): 1-7.
22. Md. Asaduzzaman Khan, Liakot A. Khan, Md. Shahdat Hossain, Mousumi Tania and Md. Nazim Uddin, 2009. Investigation on the Nutritional Composition of Common Edible and Medicinal Mushrooms Cultivated in Bangaladesh. Bangladesh J. Mushrooms, 3(1): 21-28.
23. Nina Pandey and Usha Budhathoki, 2007. Protein Determination through Bradford's method of Nepalese Mushrooms, Scientific World, 5(5): 85-88.
24. Anantachai Placklumyong and Noomnuan Udompongsanontha, 1986. Nutritional value in Russula delica Fr. 24th National Conference: Poster Session, Bangkok (Thailand), pp: 27-29.
25. Goyal, R., R.B. Grewal and R.K. Goyal, 2006. Nutritional attributes of *Agaricus bisporus* and *Pleurotus sajor caju* mushrooms. Nuture health. 18(2): 179-184.
26. Braaksma, A. and D.J. Schaap, 1996. Protein analysis of the common mushroom *Agaricus bisporus,* Postharvest Biology and Technol., 7(1-2): 119-127.
27. Arun Ingale and Anita Ramtek, 2010. Studies on Cultivation and biological efficiency of mushrooms grown on different agro-residue. Innovative Romanian Food Biotechnol., 6: 1-4.
28. Muhsin Konuk, Ahmet Afyon and Dursum Yagiz, 2006. Chemical compostion of some naturally growing and edible mushrooms. Pakistan J. Botany, 38(3): 799-804.
29. AOAC., 1990. Official methods of analysis. Association of Analytical Chemists. Washington D.C. 15th edition, pp: 1298.