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Nutritive Value of Edible Wild Mushrooms Collected from the Western Ghats of Kanyakumari District

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Abstract: The nutritional value of 10 edible mushroom species were analyzed, which forms a part of the food culture of the Kaani tribal community settled in the forests of Kanyakumari district in Tamil Nadu. Young and matured carpophores of 10 common wild edible mushrooms were collected from different locations in the Western Ghats of Kanyakumari district. These mushrooms were analyzed for proximate analysis of nutritional values. The macro nutrient profiles in general revealed that the wild mushrooms were rich sources of protein and carbohydrates and had a low amount of fat. The results showed that the samples contained appreciable amount of essential nutrients. Harvesting of sporophores and conducting inquiries among the tribal people allowed to record 10 taxa of edible mushrooms. For each specimen, local and vernacular names were noted. Hence, these nutrient contents revealed that mushrooms were low energy, healthy food and may also be used as a protein supplementary diet.

Key words: Proximate analysis · Vernacular names · Sporophores

INTRODUCTION

Ethno-mycological studies show inevitable differences between populations primarily due to cultural traditions. Mushrooms are much more used by some tribes than others; even within 'mushroom eating' tribes, personal differences exist [1]. Some of the differences are linked to religious belief, others to the surrounding dominant vegetation type or to the combination of several factors. Cultivation of macromycetes is negligible for the moment and the sporophores are simply picked in nature. With the increase of the population the culture could become important, especially for the food supply of very densely populated areas [2].

The Kaani tribal people live in consonance with Nature are heavily dependent on forest resources for their livelihood. Though they are settled in forests, the basic instinct of hunting in the wild for their food resources are still in vogue. They secure their food by various means by hunting, collecting, domesticating and purchasing in the nearby hamlets or villages. With the present soaring cost of meat, fish and vegetables, the Kaani tribal people in Kanyakumari district are hunting mushrooms, usually in close proximity to their inhabited areas in forests as an alternative source of protein. Many genera of mushrooms are edible and are rich in essential nutrients such as carbohydrates, proteins, vitamins, mineral, fat, fibers and various amino acids [3]. A major chunk of the population consumes mushrooms because of their easy availability, flavor, meaty taste and medicinal value [4].

Barros *et al*., [5] reported that the wild mushrooms were richer sources of protein and had a lower amount of fat than commercial mushrooms. Wild mushroom protein also contains considerable amounts of non-essential amino acids such as alanine, arginine, glycine, glutamic acid, aspartic acid, proline and serine. It can be used for the food to solve the malnutrition problem [6]. Mushrooms generally possess most of the attributes of nutritious food as they contain many essential nutrients in good quantity [7]. Eating mushroom is a major menu in their food culture, though its availability is seasonal. Kanyakumari district receives two monsoons and they hunt mushrooms just after the monsoons.

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The greatest need for the food added protein or fat, or food generally is in the overpopulated lands of the Orient where the diet is limited to certain foodstuffs by religion or compelling tradition. Efforts to improve the diets of such people by the introduction of newly introduced foods have met with great resistance from these populations. Almost invariably they refuse to eat other food or change their traditional food habits. The present study describes the existing situation putting emphasis on the importance of the mushrooms hunted in the wild and more particularly the nutritional and ecological approach of harvest.

This study was therefore aimed at determining the nutritional value of some wild species of mushrooms, with the aim of producing them commercially to increase the sources of protein supply and source of income to the tribal people of Kanyakumari district.

MATERIALS AND METHODS

Study Area: Kanyakumari district lies in the southern tip of India and geographically it is the tail end of the Western Ghats. It has Kerala in the north west, Thirunelveli district in north east, Arabian Sea in the south west, Bay of Bengal in the south. Kanyakumari forest division is located between 70°10'-77°35' east longitude and 8°5' - 8°35' north longitude. The forests of the district are rich in biodiversity. The Kanyakumari forests form an integral and important part of Agasthiar hills which is one of the micro-endemic centres.

Collection of Specimens: The specimens were collected from four different locations early in the morning from forests and hills of Kanyakumari district. The specimens were carefully uprooted by gently lifting them up and holding the stipe gently but firmly close to the rhizomorph, thus carrying some soil along with it. This is to avoid damaging the tissue of the mushroom. Each specimen was carefully labeled before transporting to the laboratory in the town. The specimens were air-dried and stored in transparent polythene bags that were loosely kept to allow for proper aeration of the specimens.

Sample Preparation: Mushrooms from the forest were first washed thoroughly to free from mud, ferns and other extraneous material, dried on blotting paper, cut into pieces and dried at 60°C. The mushrooms selected are normally harvested for consumption without division into pileus and stipe. Therefore, the whole mushrooms (Pileus + stipe) were dried, ground to a fine powder and stored under vacuum for further analysis.

The present study is based on field trips and personal interviews with tribals of various tribal settlements in the forests and hills of the Western Ghats of Kanyakumari district. The quaries were made relating to the occurrence, identification, collection and usage of mushrooms. The collected mushrooms were identified by CAS in Botany, University of Madras, Chennai, Tamil Nadu.

Moisture Content: The fresh weight of each mushroom sample was taken using chemical balance. These samples were then oven dried separately at 80°C for 48 h. The loss in weight obtained after drying was regarded as the moisture content [8].

Dry matter Content: This was taken as the final weight obtained after the samples have been dried in the oven at 80°C for 48 h.

Carbohydrates: One gram (1.0 g) of the powdered mushroom sample was extracted with 30 cm^3 of 80% ethyl alcohol by using Soxhlet extractor for 6 h. The crude extract was diluted to 100 cm^3 with 80% ethyl alcohol. The quantity of ethanol soluble sugar in the extract was determined using phenol sulphuric acid method of Dubois *et al*. [9].

Ash Content: The powdered mushroom sample (3.0 g) was ashed in a Gallenkamp furnance in previously ignited and cooled crucible of known weight at 550°C for 6 h. Fairly cooled crucibles were put in desiccators and weighed [10].

Lipid Content: Two grams (2.0 g) of powdered sample was extracted with 30 ml of petroleum ether by using Soxhlet extractor for 4 h. The extract was evaporated to dryness in a weighed flask using a vacuum evaporator. The weighed flask was dried in the oven at 80°C for 2 h, allowed to cool and reweighed. The difference between the initial and final weights was regarded as the lipid content of the sample [1].

Protein Content: Protein content was determined using folin phenol reagent (Kadiri and Fasidi, 1990). 0.5 g of the powdered mushroom sample was extracted with 50 cm of 2% NaCl in a water-bath at 60°C for 1 h. The extract was filtered out and 50.0 cm of 3% copper acetate monohydrate was added to the filtrate to precipitate protein. The precipitated protein was then centrifuged out and dissolves in 50 cm of 0.1 m NaOH. The quantity out and dissolves in 50 cm of 0.1 m NaOH. The quantity of

protein in the alkaline solution was then determined using the folin-phenol method [11].

Crude Fibre: Crude fibres of the mushroom samples were determined according to the standard method Association of Official Agricultural Chemists [12].

Statistical Analysis: Experimental values are given as means ± standard deviation (SD). Statistical significance was determined by one-way variance analysis (ANOVA). Differences at $P < 0.05$ were considered to be significant.

RESULTS AND DISCUSSION

Data Presented: Table 1 showed that several naturally growing edible mushrooms could be found in different places of Kanyakumari district. This result is not a surprise because the vegetation of these areas is typical of tropical rainforest, which support the luxuriant growth of wild fungi. Specific mushroom species were collected from different forest areas of Kanyakumari district. The results only provides indication of the areas where the sporocarps could be collected in large quantities.

The results of the nutritional analysis of the mushroom samples showed that all the specimens have high moisture content (Table 2). The moisture content of the mushrooms analyzed is high, indicating that mushrooms are highly perishable. High moisture content promotes susceptibility to microbial growth and enzyme activity. In the present study it was observed that the moisture content of the collected mushroom samples ranges from 87.13% to 95.17%. The *Pleurotus* species shows more moisture content compared to the other organisms. This is similar to the result obtained by Ragunathan *et al*. [13] on the cultivation of various species of *Pleurotus* on various agro residues. However, the bodies of young mushrooms are soft and brittle and therefore contain higher moisture than fully matured ones which are often tough, almost leathery and must have probably lost some of their water content [14]. In those studies most fresh mushrooms contained about 90% moisture and 10% dry matter and dry mushrooms contained about 90% dry matter and 10% moisture [15, 16].

Edible mushrooms are highly valued as a good source of carbohydrates and their contents usually range from 40.6% to 53.3% of dry weight [17, 18]. In the present study the highest carbohydrates content usually ranges from 33.23% to 50.2%. The relatively high carbohydrates content recorded in the samples (Table 2) is a proof of their being highly nutritious and good for human consumption. This is in line with the report of Fasidi and

Table 1:

S. No	Botanical Name	Collected place	Vernacular name (tribal dialect)	Habitats
1	*Pleurotus roseus*	Keriparai	Vellathazan Kumizh	Dead wood
2	*Pleurotus ostreatus*	keriparai	Vellathazan Kumizh	Dead wood
3	*Pleurotus sajor caju*	Mookaraikal	Vellathazan Kumizh	Dead wood
4	*Termitomyces microcarpus*	Alenkesam	Ari kumizh	White Ant hill
5	*Termitomyces heimii*	Vellambi	Puttu Kumizh	White Ant hill
6	*Auricularia auricula*	Thatcha Malai	Murukan Kumizh	Dead wood
7	*Volvariella volvacea*	Keriparai	Vaikol Kumizh	Paddy straw heaps
8	*Lentinus squarrosulus*	Kodayar	Kollaan Kumizh	Cashew nut tree
9	*Lentinus tuberegium*	Kodayar	Mulan Kumizh	Bamboo tree base
10	*Grifola frondosa*	Vellambi	Vella Murukan Kumizh	Dead wood

Table 2:

Mushroom samples	Moisture content	Dry matter	Carbohydrates	Lipids	Protein	Fibre	Ash
Pleurotus roseus	94.1±0.56	5.9±0.56	42.97±0.15	2.02±0.27	30.27±1.0	4.2±0.66	5.57±0.65
Pleurotus ostreatus	95.13±0.57	4.87±0.57	43.4±0.95	2.47±0.23	37.63±0.78	4.2±0.4	10.17±0.35
Pleurotus sajor caju	92.67±0.29	7.33±0.29	38.57±1.07	1.17±0.34	39.1±0.46	4.9±0.57	5.73±0.47
Termitomyces microcarpus	90.67±0.35	9.33±0.35	46.53±1.01	2.33±0.32	29.4±1.25	11.5±0.72	11.2±0.56
Termitomyces heimii	92.5±0.44	7.5±0.44	39.03±0.96	2.11±0.4	34.2±1	9.73±0.42	16.8±0.4
Auricularia auricula	95.17±0.59	4.83±0.59	33.23±0.97	1.63±0.4	36.3±0.95	8.4±0.5	7.07±0.49
Volvariella volvacea	90.67±0.38	9.67±0.38	43.53±0.70	2.04±0.58	30.57±1.48	9.67±0.40	10.37±0.55
Lentinus squarrosulus	90.5±0.31	11.03±0.31	47.83±0.95	2.58±0.77	37.13±1.10	11.33±0.67	8.33±0.45
Lentinus tuber regium	88.48±0.44	12.3±0.44	50.2±1.01	2.17±0.32	28.93±0.60	12.17±0.95	6.56±0.78
Grifola frondosa	87.3±0.31	9.4±0.31	40.77±1.06	1.49±0.48	31.47±0.91	7±0.56	5.13±0.21

Kadiri [14] that mature *Lentinus subnudus* fruit bodies are rich in glycogen and sugar. Similar result was also obtained by Marlow Foods Limited [19] on their study on mycoproteins. Mycoprotein shares much of the value of mushrooms especially in their nutritional composition [20]. *Pleurotus tuberegium*, a tuberous wild species has the highest amount of sugar recorded (34.8 g) on dry weight basis.

Lipid content ranged from 1.17% to 2.58% in the present study (Table 2). This means that they contained less fat in comparison with other common mushrooms [16-18, 21]. These results were similar with those obtained by Crisan and Sands [22], Yang *et al*. [23] and Kalac [24] in several edible mushrooms. From the results are shown in Table 2, the macronutrient profile, in general, revealed that mushrooms had rich sources of protein and fiber and had low amounts of fat. This high protein and low fat characteristics of the edible wild mushrooms has been previously reported by Aletor [25], Diez and Alvarez [26] and Longvah and Deosthale [27]. Our results are in agreement with those obtained by Bahl [28] and Oei [29] which showed that mushrooms are generally low in crude fat concentration. (Ragunathan and Swaminathan, [15] obtained low fat concentration in three species of *Pleurotus* grown on various agro-wastes.

Edible mushrooms are highly valued as a good source of protein and their protein contents usually range from 28.93% to 39.1% of dry weight [15, 21]. In the present study, the highest protein contents (39.1%) was obtained from *P. sajor-caju*, while the lowest (28.93%) was obtained from *L. tuberegium*. Protein contents of mushrooms were reported to vary according to genetic structure of species and physical and chemical differences in growing medium [15, 21, 30]. This result is in agreement with those reported by Fasidi and Kadiri [31] for *Volvariella esculenta* and Ola and Oboh [32] for *Termitomyces robustus* and *Lentinus subnudus*, which showed higher protein concentration.

Generally, fresh mushrooms contain a relatively high amount of fiber which may be responsible for its relatively high amount of ash [33]. Who also described how edible mushrooms are an ideal food for the prevention of atherosclerosis due to their high fiber content. His study concluded that the inclusion of edible mushrooms into the diet has a hypocholesterolemic effect, perhaps due to dietary fibers such as â-glucans which may increase intestinal motility, reducing bile and cholesterol absorption. The low pH (6.1- 7.2) and low titratable acid in the samples further suggests why they may be edible; they are neither acidic nor basic and so they are not likely to contain toxins which could be harmful to man or animal.

The highest ash content was (10.5%) obtained in the Pleurotus species. The same result was also obtained in *P.ostreatus* by Akyuz and Kirbag [34]. The results also revealed that the specimens have good percentage of ash on dry weight basis with the high value (8.7%) of ash content found in *Lentinus sp.* which normally has a tiny size and soft fruity body which could account for its low percentage of ash. The ash content varied between 6.3% in *Calvulina cinerea*. Barros *et al*., [5] recorded ash content of 16.48 and 14.93 g/100g in the wild edible mushrooms such as *A. silvaticus* and *A. silicola* respectively, which variably seems to be lower than that of crude protein [24].

CONCLUSION

In conclusion, the tested mushrooms possess carbohydrate and protein content in rich quantity and with low fat content. The ash and fiber content were less than other foods of plant and animal origin. Overall, the rich nutritional composition makes wild mushrooms, a choice food for the Kaani tribal community. So, mushrooms are a promising food that may overcome protein energy malnutrition problem to human beings. The protein, fiber, carbohydrates, ash and fat content in mushrooms make them a much sought after ideal vegetable by diabetic, cancer and cardiac patients. With the growing urbanization with fast changes in the food habits of all sectors of people, the ancient traditional culture of hunting and consuming wild mushrooms by the kaani hill tribals of Kanyakumari district is slowly on the decline. The youth of the present generation pays scant regard to the traditional food culture of the community. The current environmental issues of global warming and climate change would adversely affect the regeneration and growth pattern of the delicate fungi which requires a specific micro-climate. Consequently, the high nutritional quality and unique flavor of these mushrooms are likely to be lost if these wild edibles are not properly documented.

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REFERENCES

1. Parent, G. and D. Thoen, 1977. Food value of edible mushroom from Upper Shaba region. Economic Bot, 31: 436-445.
2. Rammeloo, J. and R. Walleyn, 1993. The edible fungi of Africa south of Sahara: a literature survey. Scripta Botanica Belgica, 5: 1-62.
3. Okwulehie, I.C. and E.I. Odunze, 2004. Evaluation of the nutritional value of some tropical edible mushrooms. J. Sustainable Agri. and Environ., 6(2): 157-162.
4. Moore, D. and S.W. Chiu, 2001. Filamentous fungi as food. In: Pointing SB, Hyde D, eds. Exploitation of Filamentous Fungi. Fungal Diversity Press, Hong Kong.
5. 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.
6. Manandhar, K.L., 2003. Mushroom cultivation Technology for women's income. Proceedings of International Conference of Women's Science and Technology for Poverty Alleviation.
7. Fukushima, M., 2000. LDL receptor mRNA in rats is increased by dietary mushroom (*Agarics bisporus*) fibre and sugar beef fibre. J. Nutrition, 130: 2151-2156.
8. Manzi, P., L. Gambelli, S. Marconi, V. Vivanti and L. Pizzoferrato, 1999. Nutrients in edible mushrooms: An interspecific comparative study. Food Chemistry, 65: 477-482.
9. Dubois, M.K.A. Gilles, J.K. Hamilton, P.A. Rebers and F. Smith., 1956. Colorimetric method for determination of sugars and related substances. Analytical Chemistry, 28: 350-356.
10. Manzi, P. A. Aguzzi and L. Pizzoferrato, 2001. Nutritional value of mushroom widely consumed in Italy. Food Chemistry, 73: 321-325.
11. Kadiri, M. and I.O. Fasidi, 1990. Variations in chemical composition chlorophyllum molybodies (Mayerex. Fr) Massres pleurotus tuberregium (fries) during fruitbody development. Nigerian J. Sci., 24: 86-89.
12. AOAC. 1990. Official Methods of Analysis of the Association of Official Analytical Chemists, Vol. II, 15th ed. Sec985.29. The Association: Arlington, VA.
13. Ragunathan, R. R. Gurusamy, M. Palaniswamy and K. Swaminathan, 1995. Cultivation of *Pleurotus* spp. On various agro-residues. Food Chemistry, 55(2): 139-144.
14. Fasidi, I.O. and M. Kadiri, 1993. Use of Agricultural wastes for the cultivation of *Lentinus subnudus* (Polyporales: Polyporaceae) in Nigeria. Revista de Biologia Tropical, 41(3): 411-415.
15. Ragunathan., R. and K. Swaminathan, 2003. Nutritional status of *Pleurotus* spp. grown on various agro-wastes. Food Chemistry, 80: 371-375.
16. Chang, S.T., D.W. Lau and K.Y. Cho, 1981. The cultivation and nutritional value of *Pleurotus sajor-caju*. European J. Appl. Microbiol. and Biotechnol., 12: 58-62.
17. Khanna, P.K., R. Bhandari G.L. Soni, *et al*, 1992. Evaluation of *Pleurotus* spp. for growth, nutritive value and antifungal activity. Indian J. Microbiol., 32: 197-200.
18. Ragunathan, R., R. Gurusamy, M. Palaniswamy, *et al*., 1996. Cultivation of *Pleurotus* spp. on various agro-residues. Food Chemistry, 55: 139-144.
19. Marlow Foods Ltd., 2001. Quorn. http://www.quorn.com/uk/index.htm
20. Trinci, A.P.J., 1992. Myco-protein: A twenty-year overnight success story. Mycological Res., 96: 1-13.
21. Sanmee, R., B. Dell, P. Lumyong, K. Izumori and S. Lumyong, 2003. Nutritive value of popular wild edible mushrooms from northern Thailand. Food Chemistry, 84: 527-532.
22. Crisan, E.V. and A. Sands, 1978. Edible mushrooms: Nutritional value. In: Chang ST, Hayes WA (eds). The biology and cultivation of edible mushrooms. New York: Academic Press, pp: 137-165.
23. Yang, J.H., H.C. Lin and J.L. Mau, 2001. Non-volatile taste components of several speciality mushrooms, Food Chemistry, 72: 465-471.
24. Kalac, P., 2009. Chemical composition and nutritional value of European species of wild growing mushrooms: A review. Food Chemistry, 113: 9-16.
25. Aletor, V.A., 1995. Compositional studies on edible tropical species of mushrooms, Food Chemistry, 54: 265-268.
26. Diez, V.A. and A. Alvarez, 2001. Compositional and nutritional studies on two wild edible mushrooms from northwest Spain. Food Chemistry, 75: 417-422.
27. Longvah, T. and Y.G. Deosthale, 1998. Compositional and nutritional studies on edible wild mushroom from northeast India. Food Chemistry, 63: 331-334.

28. Bahl, N., 1998. Handbook on Mushroom. Oxford 2nd Edition. An IBH Publication Co. Ltd., 21-23.
29. Oei, P., 1991. Manual on mushroom cultivation. Techniques and opportunity for commercial applications in developing countries. CTA. 21-26.
30. Agrahar-Murugkar, D. and G. Subbulakshmi, 2005. Nutritional value of edible wild mushrooms collected from the Khasi hills of Meghalaya. Food Chemistry, 89: 599-603.
31. Fasidi, I.O. and M. Kadiri, 1990. Changes in nutritional content of two Nigerian mushrooms (*T.robustus* and *L. subnudus*) during sporophore development. Die Nahrung, 34: 415-420.
32. Ola, F.L. and G. Oboh, 2001. Nutrient distribution and zinc bioavailability. Estimation in some tropical edible mushrooms. Nahrung, 45: 67-68.
33. Cheung, P.C.K., 1998. Plasma and hepatic cholesterol levels and feacal neutral sterol excretion are altered in hamsters fed straw mushroom diet. J. Nutrition, 128: 1512-1516.
34. Mehmet Akyuz and Sevda Kirbag, 2010. Nutritive value of wild edible and cultured mushrooms. Turkish J. Biol., 34: 97-102.