Nutritional analysis of some wild edible mushrooms collected from Ranchi District Jharkhand

Neelima Kumari and Anjani Kumar Srivastava
University Department of Botany, Ranchi University, Ranchi

ABSTRACT

Due to the nutritional importance mushrooms are utilized and consumed frequently by various tribes and localities inhabiting in Ranchi District. In this district wild edible mushrooms are mainly collected during the wet season may – August and valued as a nutriment but, their nutritional values has been little studied. In the current paper nutrient composition of seven wild edible mushroom species namely – Astraeus hygrometricus (Pers.) Morgan 1889, Boletus edulis (Bull 1782), Volvariella volvacea (speg.1898), Termitomyces microcarpus (Berk & Broome 1871). Pleurotus ostreatus (P. Kumm 1871), Termitomyces clypeatus (R. Heim), Termitomyces heimii (Natrajan1979) has been analysed and reported. Regardless of the source of the mushrooms, noteworthy amounts were analysed in protein, carbohydrates and fats on average ranging between 33.46 - 41.73gm/100gm, 31.4-53.2gm/100gm, 0.63-4.2gm/100gm respectively on dry weight basis. The paper chromatography separation of amino acids reveals that among the essential amino acids methionine, phenylalanine, lysine, threonine, tyrosine, isoleucine, leucine were found as major essential amino acids in all the seven species of wild edible mushrooms. The overall Nutrient outline showed that all samples contain rich amount of proteins, carbohydrates and little amount of fat.

INTRODUCTION

Wild edible Mushrooms have been valued as both food and medicine by local ethnic community of Ranchi district since long time. These are liked by local communities due to their very palatable taste, flavor, and nutrimental properties. Man has been hunting for the wild mushrooms since ancient time (Cooke, 1977). Thousands of years ago, the fruiting body of higher fungi has been used as a source of food (Mattila et al., 2001) due to their chemical composition, association with termites, trees of forest which is attractive from the nutrition and economical point of view. During the early days of civilization, mushrooms were consumed mainly for their palatability and unique properties. They are macro-fungi which belong either to Basidiomycetes or Ascomycetes and they are very distinct from plants, animals and bacteria (Mushigeni and Chang, 2001). In most countries including India mushrooms are an important delicacy because of the unique flavor and texture though they do not contribute a significant portion of the human diet (Valentao et al., 2005). The high-energy values with low fat content are their natural endowments. Many workers have been working on wild mushrooms and reported more than 2,000 species of edible mushroom all around and 283 edible species from India (Adhikari, 2000; Purkayastha and Chandra, 1985) out of which some mushrooms are cultivated.

The edible mushrooms have been frequently utilized as a human food for centenary. Mushrooms also have some medicinal and tonic properties (Manzi et al., 2001). They have high nutritive and medicinal values and contribute to a healthy diet because of their rich source of vitamins, minerals and proteins (Garcha et al., 1993). Mushrooms are rich content of protein, fats, carbohydrates, amino acids, vitamins and minerals (Jiskani, 2001). They are also good sources of vitamins like riboflavin, biotin and thiamine (Chang and Buswell, 1996). These are low in fat, carbohydrates and salts (Genders, 1990). Good amount of dietary fibre is present in their fruiting bodies which are important for the regulation of physiological functions in human beings such as regulation of digestive tract (Manzi et al., 2001). Mushrooms are not only important in human diet due to their high nutritional value but are also accepted as delicious human food due to their uniqueness in color, aroma, texture and taste (Chang and Miles, 1991). The rural dwellers are exposed to natural vegetation and they prefer edible higher fungi such as

*Corresponding author: Neelima Kumari
University Department of Botany, Ranchi University, Ranchi
mushrooms, puffballs and morels as luxury food since it has important dietary components (Gbolagade et al., 2006). Though more than 2000 species of mushrooms exist in nature, there is only less than 25 species are widely used as food and only a few have commercialized. The traditional use of mushrooms as food and medicine in Asian countries are also known (Manzi et al., 1999; Sanjeev et al., 2003). Mushrooms are healthy foods rich with proteins, vitamins, minerals, fibers, trace elements and poor in calorie and cholesterol (Caglarlrmak et al., 2002; Barros et al., 2008). Mushrooms are comparable to meat, egg, and milk because it contains amino acid. Mushrooms have been used as food and medicine in many parts of the world since time immemorial. Although mushrooms are often grouped with vegetables and fruits, they are actually fungi. The mushrooms are comparable to meat, egg, and milk because it contains amino acid composition similar to that of animal proteins. Wild mushrooms serve as rich source of protein and lower amount of fat compared to commercial mushrooms (Barros et al., 2008). Wild mushrooms are thus nutritionally rich (Breene, 1990; Manzi et al., 1999) and its consumption is increasing in the developed world (Thimmel and Kluhne, 1998). In Ranchi district due to its diverse and favourable climate, many types of wild edible mushrooms are found in the various locations, and play key role in nutriment of local communities. Apart from number of nutritional value of mushrooms available in the literature, there are no data reported about the nutritional value of wild edible mushrooms of Ranchi district. Thus the research was conducted to analyze their nutrient value.

**Study Area**

Study area Ranchi district is a part of naturally rich biodiversification southern part of the Chota Nagpur plateau, which is eastern section of Deccan plateau. It lies at 23°22’N 85°20’E near Tropic of Cancer. The geographical area of the district is about 10, 58,000 ha with a forest area of 3, 27,000 ha. The annual rainfall is about 1430 mm (56.34 inches). From June to September rain fall is about 1,100 mm; temp is avg. of max 29.3°C and min of 18.0°C (Wikipedia), which favour the growth of wild edible mushrooms.

![Map of Ranchi district](image)

**Materials and Methods**

**Collection of Specimens:** The specimens were collected from forests and hills of Ranchi district. The Specimen samples of wild edible mushrooms were collected during the rainy season from the different forest and habitat of Ranchi district. After collection specimens were kept in sterile container, each container was labelled with their date & place of collection and brought to the laboratory for identification and preservation. Identification of the specimen were done by locally available literature, morphological characteristic of fruiting body, traditional knowledge provided by ethnic tribal community and guideline mention in the books of Adhikari, 2000, 2014.

**Preparation of mushroom extract:** The Fresh plucked wild mushrooms were cleaned to remove dirt and weight to get the fresh weight, sample were further oven dried and their dry weight were taken after then samples were finely powdered with the help of mortar and pestle.

**Biochemical analysis of samples:** All the samples were analyzed for carbohydrate, protein, amino acid and crude fat contents (AOAC, 1990). The powdered sample was mixed with 96% Ethanol and collected in centrifuge tube. The sample was incubated at room temperature for 10 minutes. After incubation, the sample was centrifuged at 5000 RPM for 5 minutes. Supernatant was collected in fresh centrifuge tube. The Ethanol extract of the sample was concentrated in desiccators for overnight.

**Protein determination:** 0.1 gm of mushroom sample was taken in 10 ml of cell lysis buffer and left at room temperature for 2 days. Then the samples were centrifuged at 7000 rpm for 10 minutes and the preparation was then used for estimation of protein as per Lowry’s method (Lowry et al. 1951).

**Amino Acids estimation:** 100 microlitre of the extract was spotted on to the chromatography paper. The chromatography paper was placed in the Running Solvent I (1 Phenol: Water (4:1)) in the chromatography chamber (presaturated), 1st Direction along X-axis, after 1st direction the paper was placed in Running Solvent II (Butanol: Acetic Acid: Water (15:3:7)) for 2nd direction along Y-axis (presaturated with solvent II). The paper was dried in the oven and Ninhydrin solution was sprayed on the papers and incubated for overnight for amino acid spot generation. The amino acid spots were marked with and chromatographically Analysis of amino acids constituents were done by the method of Sinha and Prasad (1983).

**Total carbohydrate determination:** The total carbohydrate content of wild edible mushrooms is estimated by the anthrone method (Hedge and Hofreiter, 1962).

**Fat determination:** Crude fat was analysed using soxhlet extraction apparatus. Petroleum ether (Its boiling point lies between 60 – 80°C) was added to a 5.0 g of finely grounded dried wild edible mushroom sample and were placed in the soxhlet extraction apparatus. Extraction was carried out for 24 hours; sample was cooled down by removing the condensing unit from extraction apparatus after which the ether was evaporated to dryness. The amount of fat was determined by the formulae from the difference in the weight of the flask and after drying of the ether. % crude fat \(= \frac{(w_2-w_1)}{w_1} \times 100\)

Weight of empty flask= w1, Weight of flask and extracted fat (g) = w2. Weight of sample = s.

**Data analysis:** All data analysed using statistics description.
RESULT AND DISCUSSION

Wild edible mushrooms are one of the major natural deposit on which the local people of Ranchi district depends and it play a vital role in providing nourishment. Being latent qualities wild mushrooms with palatability value has not been studied much, present study was therefore aimed at determining the nutritional value of some common wild species of mushrooms. The results of the protein, carbohydrate and fat evaluation of wild edible mushrooms are presented in table 1 and results of amino acids are shown in table 2 and table 3.

### Table 1 Nutrient value of wild edible mushrooms (mean ± Standard Deviation)

<table>
<thead>
<tr>
<th>Species of mushroom</th>
<th>Carbohydrate content</th>
<th>Protein content</th>
<th>Fat content</th>
</tr>
</thead>
<tbody>
<tr>
<td>Termitomyces heimi</td>
<td>31.4 ± 0.26</td>
<td>41.73 ± 0.15</td>
<td>0.63 ± 0.3</td>
</tr>
<tr>
<td>Termitomyces clypeatus</td>
<td>36.5 ± 0.43</td>
<td>35.26 ± 0.05</td>
<td>1.01 ± 0.07</td>
</tr>
<tr>
<td>Termitomyces microcarpus</td>
<td>32.1 ± 0.05</td>
<td>33.66 ± 0.25</td>
<td>1.46 ± 0.20</td>
</tr>
<tr>
<td>Boletus edulis</td>
<td>35.1 ± 0.05</td>
<td>33.46 ± 0.32</td>
<td>3.26 ± 0.15</td>
</tr>
<tr>
<td>Volvariella volvacea</td>
<td>48.8 ± 0.1</td>
<td>36.43 ± 0.25</td>
<td>4.2 ± 0.43</td>
</tr>
<tr>
<td>Pleurotus ostreatus</td>
<td>42.7 ± 0.15</td>
<td>37.66 ± 0.20</td>
<td>2.76 ± 0.11</td>
</tr>
<tr>
<td>Astraeus hygrometricus</td>
<td>53.2 ± 0.1</td>
<td>39.7 ± 0.20</td>
<td>3.5 ± 0.11</td>
</tr>
</tbody>
</table>

All data are the mean ± standard deviation of the three replications. Probability range (p) = 0.05. All data are expressed in g/100gm.

### Table 2 Analysis of amino acid using paper chromatography

<table>
<thead>
<tr>
<th>Name of sample</th>
<th>Number of amino acid spots</th>
</tr>
</thead>
<tbody>
<tr>
<td>Termitomyces heimi</td>
<td>111</td>
</tr>
<tr>
<td>Termitomyces clypeatus</td>
<td>71</td>
</tr>
<tr>
<td>Termitomyces microcarpus</td>
<td>67</td>
</tr>
<tr>
<td>Boletus edulis</td>
<td>87</td>
</tr>
<tr>
<td>Volvariella volvacea</td>
<td>91</td>
</tr>
<tr>
<td>Pleurotus ostreatus</td>
<td>160</td>
</tr>
<tr>
<td>Astraeus hygrometricus</td>
<td>164</td>
</tr>
</tbody>
</table>

The data presented in table revealed that Termitomyces heimi had the highest (41.73%) content of protein followed by Astraeus hygrometricus (39.7%), Pleurotus ostreatus (37.66%), Volvariella volvacea (36.43%), Termitomyces clypeatus (35.26%), Termitomyces microcarpus (33.6%) and Boletus edulis (33.46%). Carbohydrate content also showed slight difference in all the seven edible mushroom species, the highest carbohydrate content was found in Astraeus hygrometricus (53.2 g%) followed by Volvariella volvacea (48.8%) Pleurotus ostreatus (42.7%), Termitomyces clypeatus (36.5%), Boletus edulis (35.1%) Termitomyces microcarpus (32.1%) Termitomyces heimi (31.4 g/100g) respectively on dry weight basis. Fat content vary from 0.63 to 4.2gm/100gm, Volvariella volvacea(4.2%) were found to contain highest fat content while lowest percentage of fat was found in Termitomyces heimi (0.633%).

The result of paper chromatography separation of amino acids (table 3) reveals among essential amino acids methionine phenylalanine, lysine, threonine tyrosine, isoleucine, leucine were present in all samples, valine and Histidine were absent in Volvariella volvacea and valine were absent in Pleurotus ostreatus. The present research investigated that wild edible mushrooms were rich source of protein and major essential amino acids Nutritive value of mushroom is predominantly related to their protein content as protein is a vital constituent of dry matter of mushrooms. (Wang et.al., 2014). The protein content in this research, for Termitomyces species lies between 32.1-41.7% which is in agreement with Parent and Thoen (1977) who found that species of Termitomyces contain protein with values ranging from 33-45 % dry weight basidiocarps proteins, but value of Termitomyces microcarpus was higher than Oliha et al. (2007) who reported a protein content (25.8 %) for same species. The protein content reported for Boletus edulis (33.46gm/100gm) was higher than Rana (2016) who reported 25.29 mg/g protein content for it. The present results were very much similar to work of Johnsy et al. (2011) who determined nutritional values of 10 edible mushrooms from Western Ghats of Kanyakumari district and reported that edible mushrooms were highly valued as a good source of protein ranged from 28.93 to 39.1% of dry weight.

Work of wani et.al 2010 reported rich nutritional value of mushrooms with high content of proteins, vitamins, minerals, fibers, trace elements and low/no calories and cholesterol. The present investigation on nutritional potential of wild edible mushrooms species has shown that carbohydrate content of wild mushrooms varying from 31.4% in Termitomyces heimi to 53.2% in Astraeus hygrometricus, but these values were in little lower then value reported for termitomyces heimi (39.03 ± 0.96) by Davidson and Kaviyarasan (2012) and (Biswas et.al 2017) 64.33% reported for Astraeus hygrometricus. These result were not much similar to the work of Manikandan (2011) where he had reported that total carbohydrate content varies from 26-82%
on dry weight basis in different mushrooms. Gruen and Wong (1982) reported that edible mushrooms were highly nutritional and can be easily compared with egg, meat and milk food sources. The amino acids spots (Table 2) done by Chromatographically qualitatively analysis of amino acids constitutions indicated the presence of 17 amino acids and confirms that they are rich source of protein. Hayes and Haddad, (1976) reported that Mushrooms contain all the essential amino acids needed by an adult. The present study was in agreement with other studies of distinct species of mushrooms (Barros et al 2007, Cheung 1997, Wahid et al. 1988, Khanna et al. 1992 Agrahar and Subbulakshmi 2005.). The protein value of mushrooms is twice as that of asparagus and potatoes, four times as that of tomatoes and carrots, and six times as that of oranges (Jiskani, 2001). Some research workers have even compared the amino acid composition of mushroom with animal protein (longvah and deosthale 1998 ;). The fat content of mushrooms were found to be very low as its value ranging between (0.633 – 4.2%). The work is in accordance to the observation made by (León-Guzmán et al. 1997 and Gruen and Wong 1982). Many factors explain variation in the protein content of mushrooms, including the use of particular strains, time of analyses after harvest, the substrate used for the production and stage of development (Bano and Rajarathnam, 1988).

The relatively high carbohydrates, protein and low fats content recorded in the wild edible mushrooms samples were an evidence of being their highly healthful and beneficial for human consumption.

CONCLUSION

The present results of the nutritional analysis concludes that wild mushrooms collected from forest of Ranchi district were highly rich with protein (with outstanding composition of amino acids), carbohydrates and contain low amount of fat. Hence, the continuation of these mushrooms can overcome the protein energy malnutrition of poor local community. It can also be consumed in dried form with all nutrients. Consumption of wild edible mushrooms should be encouraged in supplementation of the staple food of the poor person as it can help curing of malnutrition problem in children and elder and effort should be made to cultivate them under controlled condition.

References

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