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**Original Research Article**

# Nutrient analysis of indigenous *Termitomyces eurrhizus* (Berk.) Heim of Manipur, India

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**A B S T R A C T**

**Keywords**

Wild mushroom, *Termitomyces eurrhizus,* sawdust, macronutrient and micronutrient.

The nutrients composition of indigenous *Termitomyces eurrhizus*, fungus combs, *Tetmitomyces* growing soil and sawdust of *Phoebe* sp. of Manipur were determined. Atomic absorption spectrophotometry was used to determine the mineral element composition. The results showed that all the tested samples contained appreciable amount of essential nutrients. The results on a dry weight (mg/kg) basis demonstrated that all the tested samples shows significant amount of macro and micronutrients ranging from Ca (0.151-15.10), Mg (0.70-2.78), K (1.05-5.47), Cu (0.048-0.459), Mn (0.13-7.94), Fe (0.90-22.225) and Zn (3.50-6.25) respectively. Sawdust of *phoebe* sp. was relatively low nutrients in comparison with other three tested samples. Iron is the most abundant nutrients in all the tested samples except sawdust.

## Introduction

Mushrooms have been used as food and medicine in many countries of the world. The consumption of wild mushrooms is increasing even in the developed world due to the good nutritional value of these wild species especially as a source of proteins and trace minerals (Thimmel and Kluthe, 1998; Jiskani, 2001). Wild edible mushrooms are a popular food source among the indigenous people of Manipur.

The high humidity, ample rainfall and favourable temperature of the state provide atmospheric conditions of the growth of many saprophytes, including the mushrooms. There are several wild mushrooms that grow in the forests and the locals relish them. These wild mushrooms form an integral part of the diet during monsoon months when these are abundantly available. Among the edible mushroom, *Termitomyces* is the most popular and found during the rainy seasons (i.e., May-July) due to their unique and subtle flavor.

*Termitomyces* R. Heim is a genus of termitophilous fungi living symbiotically in termite nest with species of the Macroterminae (Isoptera) (Heim, 1977; Batra & Batra, 1979; Bels & Patragetvit, 1982; Rouland-Lefevre *et. al*., 2002). The *Termitomyces* species are usually characterized by the termite association, pinkish spore print, prominent perforation on the pileus and the subterranean connected to the comb in the termite nest. *Termitomyces* species were generally rich in minerals such as potassium, calcium, magnesium, iron and manganese (Mattila *et. al*., 2001). No information is however available on their artificial cultivation and nutrient information of their growing substrate i.e., termite nest or fungus combs. An attempt was therefore, made to identify the *Termitomyces* species and to study the nutrient composition of the termite nest along with the surrounding soil. The study would able to set up an artificial substrate i.e., fungus combs for cultivating these *Termitomyces* and also such information would display the potential of these wild mushrooms to serve as a source of nutrients for the indigenous people.

## Materials and Methods

Regular survey of the forests and local areas were conducted in all the nine districts of Manipur state by frequent field and market visits during 2009 – 2011. The mushroom specimens were collected from forests or local areas by picking up individually the fruit bodies carefully by digging them up with the help of a sharp knife. Attempts were made to collect fructifications of *Termitomyces* at all stages of development, termite nest i.e., fungus combs and surrounding soil where *Termitomyces* grows. Data on habitat and other ecological parameters such as temperature, humidity, altitude etc. were also recorded in the field. Each sample were wrapped in wax paper and brought to the laboratory where collection numbers were assigned to each sample. The collected *Termitomyces* samples were identified with the help of standard references (Singer, 1986; Bilgrami et. al., 1979; Manjula, 1983; Purkayastha and Chandra, 1985). The *Termitomyces* samples were washed thoroughly to removed mud and other extraneous materials before oven dried at 45$^{o}$C. The collected fungus combs and soils were also oven dried and ground into fine powder prior to further analysis.

Three strains of *Termitomyces eurrhizus* collected from three different sites (Site 1, 2 and 3 respectively) were carried out for analysis. Te1, FC1 and S1 represent *T. eurrhizus*, fungus comb and soil for Site 1. Te2, FC2 and S2 represent *T. eurrhizus*, fungus comb and soil for Site 2. Te3, FC3 and S3 represent *T. eurrhizus*, fungus comb and soil for Site 3 respectively. All the analyses were carried out in triplicate to ensure replicability of the results. Sawdust of *Phoebe* sp. (SP) was taken as an artificial fungus comb for *Termitomyces eurrhizus*. pH of the samples were measured by pH meter. The nutrients such as Cu, Mn, Fe, Zn, Ca, Mg, Na and K were determined by atomic absorption spectrophotometer. Analyses were performed with a microwave digester (Perkin Elmer 3110) working in the temperature range upto 40$^{o}$C and 1250psi.

## Results and Discussion

The mineral constituents of both major and minor nutrient contained in all the tested samples are given in Table 1 and Fig.1 & 2. The concentrations of all the minerals in each three of the different tested samples were insignificantly different but the concentration of sawdust

*Phoebe* sp. in comparison with FC1, 2 and 3 were significantly different. Among the major nutrient, the quantities of Calcium and Magnesium were the highest followed by Potassium and Sodium in FC and sawdust of *Phoebe* sp. In case of micro nutrients, Iron and Manganese were the highest followed by Zinc and Copper in FC but Zinc was highest in sawdust of *Phoebe* sp. followed by Iron respectively. Iron (Fe) was most abundant mineral element in all the tested samples except sawdust.

Potassium and Magnesium were the predominant macro nutrient among the three strains of *Termitomyces eurrhizus* (Te1, Te2 and Te3) analyzed in this study. Iron and Zinc were the most abundant elements among the minor nutrient analyzed. Similar observations on mineral content profiles have been reported for some cultivated mushrooms of *Agaricus*, *Pleurotus*, *Lentinula* and *Coprinus* sp. (Chang & Buswell, 1996; Shah *et. al*., 1997, Mattila *et. al*., 2001; Anthony & Joyce, 2007). The mineral concentration of three strains of *T. eurrhizus* can be influenced by a number of factors including strain type, stage of the mushroom, the composition of the growth substrate and the environment (water, temperature and humidity).

The current analysis shows that the three strains of *T. eurrhizus* (Te1, Te2 and Te3) ranged between 0.15 and 5.47 mg/kg on dry weight basis for major nutrients and between 0.418 and 12.00 mg/kg on dry weight basis for micro nutrients. Fungus combs (FC1, FC2 and FC3) ranged between 0.45 and 15.10 mg/kg on dry weight basis for major minerals and 0.24 and 16.80 mg/kg on dry weight basis for micro nutrients. 0.24 and 4.90 mg /kg on dry weight for macro nutrients of *Termitomyces* growing soils (S1, S2 and S3) and 0.34 and 22.50 mg/kg on dry weight for micro nutrients. The value of macro nutrients of sawdust of *Phoebe* sp. ranges between 0.44 and 1.65 mg/kg and 0.048 and 3.50 mg/kg on a dry weight basis for micro nutrients respectively. However, no mineral concentration data were available in the past literatures for *Termitomyce eurrhizus* along with their growing substrate and growing soil. From the mineral analysis reported in this study, it seems that *Termitomyces eurrhizus* can provide a useful source of Iron, Potassium, Zinc, Magnesium and Sodium.

The wild edible *Termitomyces eurrhizus* consumed by the indigenous people of Manipur state have always been harvested wild and no effect has been made to cultivate these varieties on a commercial scale. With growing urbanization, and changes in the food habits occurring due to it, the ancient tradition of gathering and consuming wild mushrooms by the local people is slowly on the decline. The high nutritional quality and unique flavors of wild edible mushrooms are likely to be lost if these edible are not documented.

Based on the data presented in this study, it appears that *Termitomyces eurrhizus* analysed are highly nutritious and can be concluded that these edible mushrooms hold tremendous promise in addressing the minerals such as Iron, Potassium and Zinc deficits prevalent in the diets particularly among the low income families, women and children (Towo *et. al*., 2006). Therefore, it is now imperative that a nutritional database of these *Termitomyces eurrhizus* is set up to retain the information on these unique species. Substrate composition is also an important factor besides the great differences exist in uptake of individual trace elements by the fruiting body of mushrooms.

**Table.1** Nutrients and pH contents of *Termitomyces eurrhizus*, fungus comb, *Termitomyces* growing soil and sawdust of *Phoebe* sp.

| Sl. No. | Samples | Macro-Nutrients (mg/kg dry wt.) | | | | Micro-Nutrients (mg/kg dry wt.) | | | | pH |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Ca | Mg | Na | K | Cu | Mn | Fe | Zn | |
| 1. | Te 1 | 0.160 | 2.52 | 0.87 | 5.45 | 0.418 | 0.72 | 11.45 | 4.86 | 5.0 |
| 2. | Te 2 | 0.151 | 2.38 | 0.64 | 5.24 | 0.453 | 0.90 | 11.08 | 4.81 | 5.2 |
| 3. | Te 3 | 0.187 | 2.74 | 0.91 | 5.47 | 0.459 | 1.08 | 12.00 | 4.92 | 5.4 |
| 4. | FC 1 | 9.25 | 2.41 | 0.67 | 2.42 | 0.432 | 6.45 | 16.35 | 5.90 | 5.1 |
| 5. | FC 2 | 8.78 | 2.60 | 0.73 | 2.39 | 0.244 | 5.30 | 16.80 | 6.25 | 5.2 |
| 6. | FC 3 | 15.10 | 2.78 | 0.45 | 2.08 | 0.272 | 7.94 | 16.80 | 5.97 | 5.0 |
| 7. | S1 | 0.24 | 1.95 | 0.53 | 4.90 | 0.440 | 3.42 | 22.25 | 5.18 | 6.1 |
| 8. | S2 | 0.45 | 2.48 | 0.65 | 4.22 | 0.340 | 3.39 | 21.50 | 5.64 | 5.7 |
| 9. | S3 | 0.48 | 1.68 | 0.73 | 4.14 | 0.445 | 3.18 | 22.00 | 6.12 | 5.3 |
| 10. | SP | 1.65 | 0.70 | 0.44 | 1.05 | 0.048 | 0.13 | 0.90 | 3.50 | 5.4 |

Te1, FC1,S1: *Termitomyces eurrhizus*, fungus comb, *Termitomyces* growing soil for site 1
Te2, FC2,S2: *Termitomyces eurrhizus*, fungus comb, *Termitomyces* growing soil for site 2
Te3, FC3,S3: *Termitomyces eurrhizus*, fungus comb, *Termitomyces* growing soil for site 3
SP: sawdust of *Phoebe* sp.

**Fig.1** Macro-nutrients of *Termitomyces eurrhizus*, fungus comb, *Termitomyces* growing soil and sawdust of *Phoebe* sp.

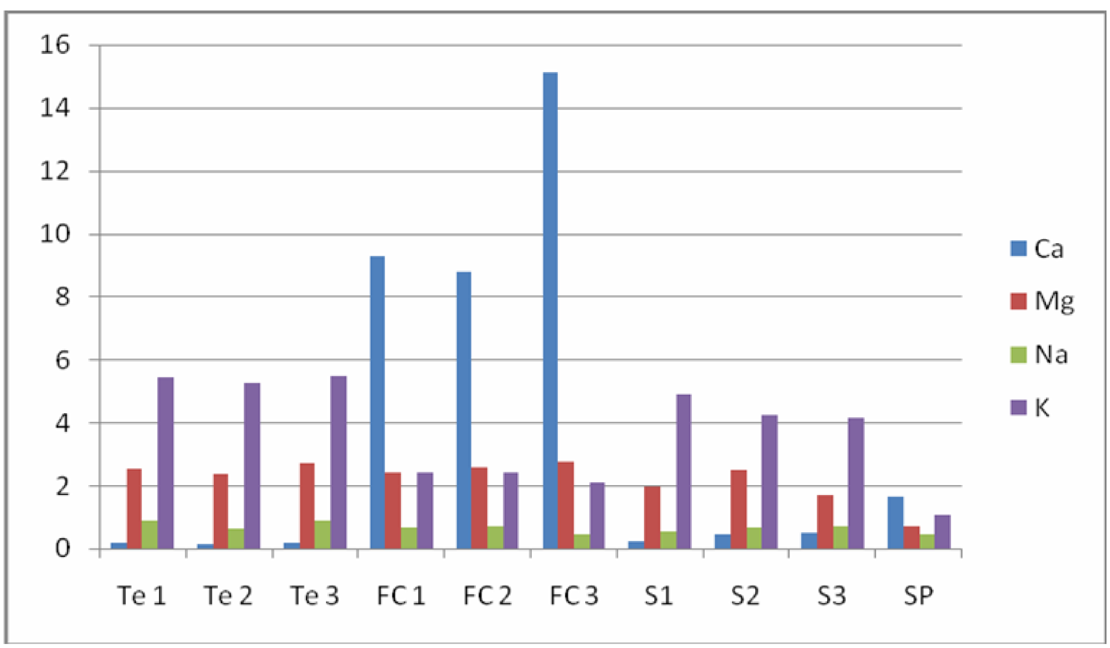


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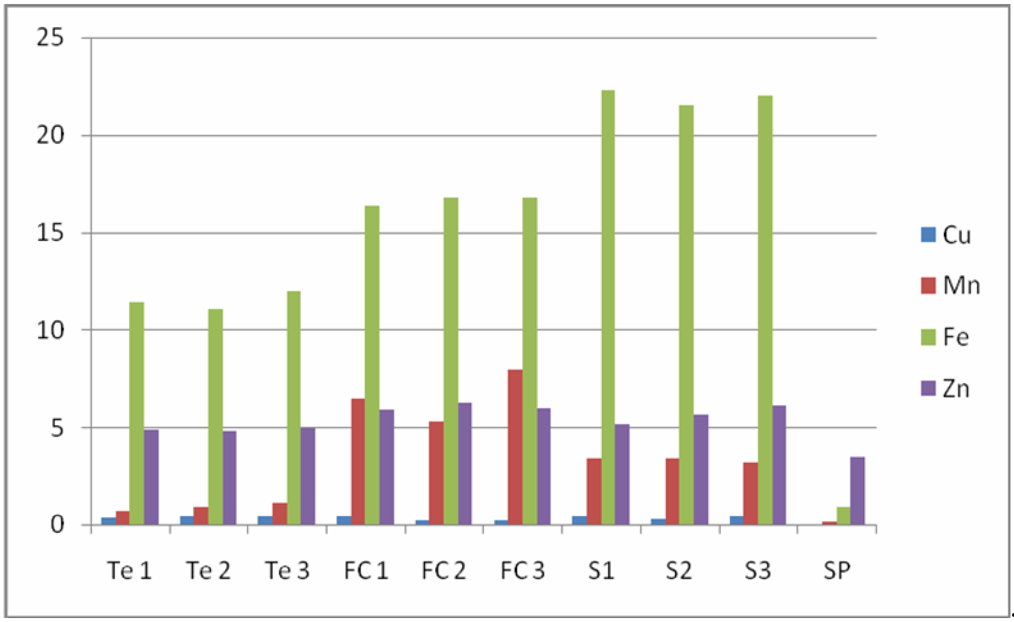
**Fig.2** Micro-nutrients of *Termitomyces eurrhizus*, fungus comb, *Termitomyces* growing soil and sawdust of *Phoebe* sp.




From the present study, further research is needed on *Termitomyces eurrhizus* spp. that intensive should be geared toward their cultivation locally available sawdust supplement with minerals as a substrate.

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