



Diversity of *Termitomyces* in Kodagu and Need for Conservation

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Abstract: Termites of the subfamily of *Macrotermitinae* have established an obligate symbiosis with the basidiomycete *Termitomyces* on substrate called a fungus garden or fungus comb inside the nest. An extensive exploration carried out during May 2009 to September 2010 at a different geographical location of Kodagu District, Karnataka. Eight different species of *Termitomyces* namely *T. microcarpus*, *T. indicus*, *T. clypeatus*, *T. cylindricus*, *T. globulus*, *T. eurhizus*, *T. heimii* and *T. mammiformis* were identified. The ecological significance of Termites and *Termitomyces* in Kodagu region of Karnataka and its role as a food for local communities has been discussed. All hotspot diversity of all species well recorded. Some strategy also recommended for conserving one of the rear examples of symbiosis on the earth. This is the first report on the occurrence and diversity of *Termitomyces* species in the Kodagu region of Karnataka.

Keywords: *Termitomyces*, Diversity, Termites, Conservation.

1. Introduction

The systematic farming by humans is only about 10,000 year's old¹. However, termites started farming around 30 million years ago². Both human farming and fungus growing termites share defining features of modern agriculture with reference to habitual planting, cultivation and harvesting³. The members of the subfamily of *Macrotermitinae* cultivate a specialized fungus *Termitomyces* in their combs prepared from a special substrate composed of dead plant material, which is generally as referred to as fungus garden. The development of fungus and emergence of the macroscopic, umbrella-like basidiocarp of *Termitomyces* is due to its obligate symbiotic relationship with termites^{4, 5}. Out of 2600 described termite species, around 330 species belonging to the subfamily *Macrotermitinae* cultivate a specialized fungus *Termitomyces*³. The genus *Termitomyces* which belong to the family Tricholomataceae, order Agaricales, class Agaricomycetes and division Basidiomycota. All species of *Termitomyces* are well

known among local communities because of traditional folklore, which is believed to have the highest nutritional and economical value.

The prominent effect of the fungus in termite nutrition is still debated, but it may have some benefits. The fungal symbiont degrades complex substances such as lignin or cellulose into smaller substances that will be digestible food for termites and also *Termitomyces* mycelium acts as source of proteins. On the other hand, the termites provide the favorable environment for the fungus to grow, preventing the growth of intruders by constructing a hill structure. Many researchers worldwide have described this association of termites with diverse species of *Termitomyces*. Hence, it was proposed to conduct an investigation to know the diversity of *Termitomyces* in Kodagu region of Karnataka and their role in the ecosystem of the Kodagu region (Figure 1a) which falls on the belt of the Western Ghats.

Kodagu is about 4100 square kilometers of land in the Western Ghats of southwestern Karnataka and receives an appreciable amount of rainfall during the

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month of June to October with an average rainfall of 2963 MMs (Kodagu district statistics, Government of Karnataka, 2009). Among all the popular edible mushrooms, the species of *Termitomyces* have the highest demand both in terms of nutrition and in terms of commercial value. The best season to procure well flourished *Termitomyces* species would be in early and/or late monsoon (June–October) in Kodagu region and are collected by localities and commercial merchants (figures 1 b, c and d).

In this study, the diversity of *Termitomyces* in Kodagu region, which is considered as a hot spot for mushrooms biodiversity extensively studied.

2. Material and Methods

Exploration had been taken during May 2009 to September 2010 in different geographical locations of Kodagu district at Anekadu forest (N 12°25' 51.7", E 075°53'54.16"), Perambady forests (N 12°11' 53.33", E 075°51'20.66"), Manchadevanahalli (N 12°24' 38.7", E 076°00'33.14"), Sampaje (N 12°29' 10.31", E 075°32'49.64), Somwarpet (N 12°36' 33.73", E 075°50'52.40") and Hakathur village (N 12°24' 17.88", E 075°44'39.13"). Fruiting bodies were sampled and photographed at different stages of their development in the field and samples were also examined for their macro and microscopic characteristics. The species were also identified based on keys and description of Pegler⁶ (1994). The voucher specimens were deposited in the Museum in the Department of Studies in Botany, University of Mysore, Mysore, India.

3. Result and Discussion

Eight different species namely *T. microcarpus*, *T. indicus*, *T. clypeatus*, *T. cylindricus*, *T. globulus*, *T. eurhizus*, *T. heimii* and *T. mammiformis* belonging to *Termitomyces* genera (Fig. 2) were identified based on the key identification features described by Pegler and Vanhaecke⁶, out of which, four species (*T. microcarpus*, *T. indicus*, *T. heimii* and *T. mammiformis*) have been well-known among local communities because of traditional folklore which is believed to have the highest nutritional and economical value. Based on this survey, we were able to identify major hot spots for all species of *Termitomyces*, which were located in the district (Anekadu and Perambady forests, Alanahalli, Manchadevanahalli, Sampaje, Somwarpet and Hakathur villages). On an average, merchants could collect around 2000 kg of *T. Mammiformis* only in the belt of Alanahalli and Kushalnagar with an approximate cost varying from 1.5-2\$ for mature and 4-5\$ for immature once per kg. These hot spots should be rightly named as “*The land of Termitomyces*” (Fig. 1a), (Table 1) which has a great embedded potency to attract tourist and mushroom lovers. Due to the high nutritive value, low-fat, high fiber, rich in protein, minerals (Ca, P, K), vitamins and nutraceutical properties of these mushrooms has created an interest in local communities⁷. In monsoon, this mushroom becomes one of the major components of serving dish in all villages of this region.

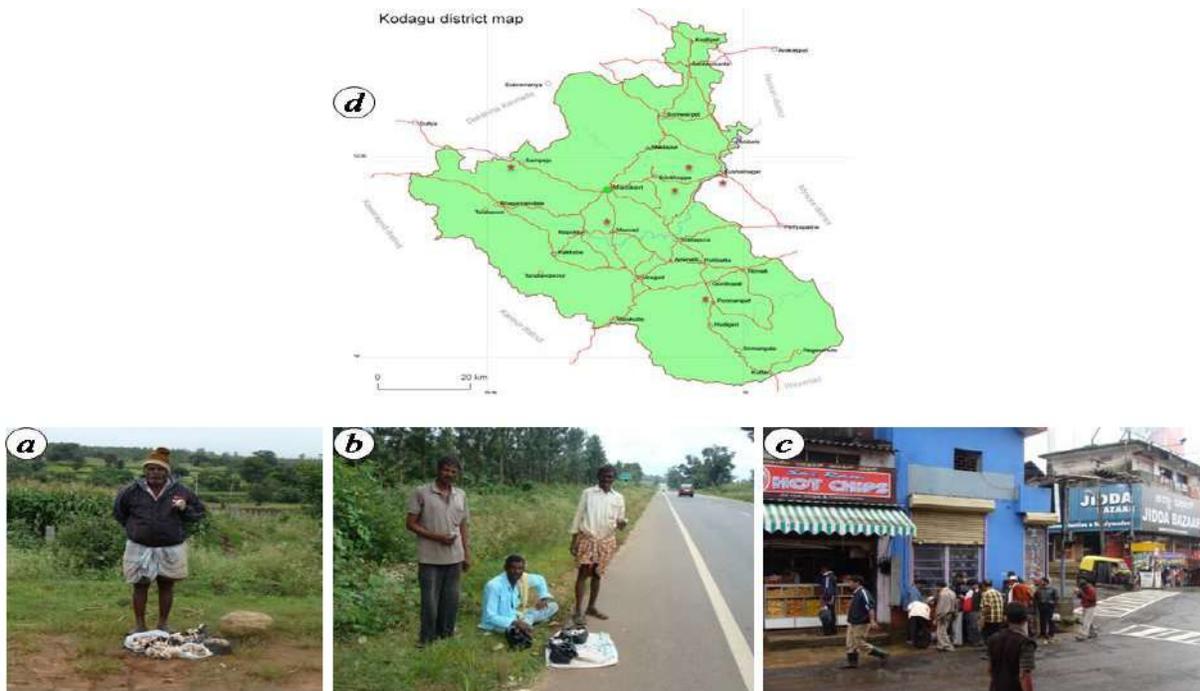


Fig. 1(a). Map of Kodagu district showing the major hot spots regions for *Termitomyces* Species. **1(b) and 1(c):** Local people selling the collected basidiocarps of *Termitomyces* on roadsides (Kushalnagar) and **1(d):** Local marketplace (Madikeri).

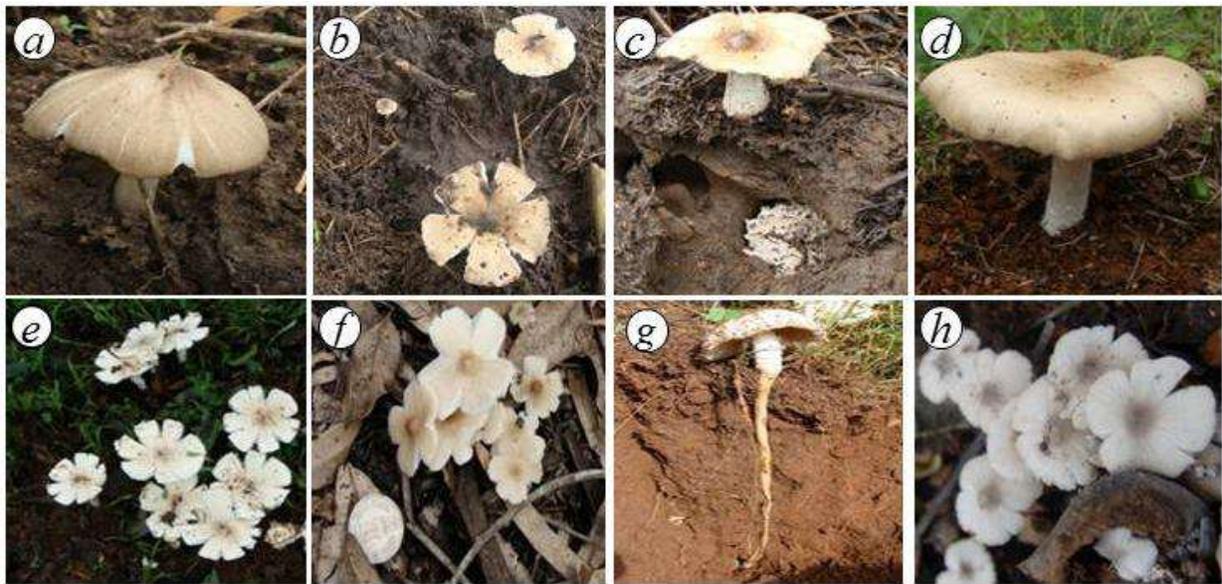


Fig. 2. Different species of *Termitomyces* in Kodagu (a) *T. clypeatus*, (b) *T. cylindricus*, (c) *T. eurhizus*, (d) *T. globulus*, (e) *T. heimii*, (f) *T. indicus*, (g) *T. mammiformis* and (h) *T. microcarpus*.

Table 1. Hot spots of *Termitomyces* in Kodagu district and their availability during the year.

Location	<i>Termitomyces</i> Species	Month of Collection
Kushalnagar	<i>T. clypeatus</i> , <i>T. globulus</i> , <i>T. heimii</i> , <i>T. mammiformis</i>	June to August
Anekadu forest	<i>T. microcarpus</i> , <i>T. indicus</i> , <i>T. clypeatus</i> , <i>T. cylindricus</i> , <i>T. globulus</i> , <i>T. eurhizus</i> , <i>Sinotermitomyces taiwanensis</i>	June to October
Sampaje village	<i>T. heimii</i> , <i>T. mammiformis</i>	June
Hakathur village	<i>T. heimii</i>	June to August
Perambady forest	<i>T. heimii</i>	June
Somwarpet	<i>T. heimii</i>	July

The importance of termites in ecosystem especially in forest ecosystem is widely recognized, and they play a significant role in carbon mineralization, recycling process, nitrogen fixation, soil fertility and have a great impact on plant litter decomposition. About 22- 32% of all above-ground plant litter in the tropical and subtropical forest are decomposed by fungus-growing termites (20% of all carbon mineralization)^{9,10}.

4. Conclusion

The Kodagu region of Western Ghats is rich in fungal diversity especially macrofungi which belong to class basidiomycetes. However, no attention was given to document diversity of fungi and their conservation when compared to flora and fauna. This study is an attempt to investigate the diversity of edible *Termitomyces* species. There is a great threat to diversity of *Termitomyces* from human activities.

Any effect on this symbiosis would lead to a serious imbalance in the ecosystem in terms of *Termitomyces* and termites. The study revealed that there is an unscientific method of collections of *Termitomyces* species from the Kodagu region of Karnataka. The Goa government has already imposed ban on collection and selling of *Termitomyces* from the

Western Ghats region of Goa. Similar amendments need to be made and their implication of the government as a law and only then the conservation of both *Termitomyces* and termites would be possible.

A ban on mushroom collection in sanctuary areas of Kodagu should be imposed. The ban should aim at primarily conservation of the rich, diverse and precious edible *Termitomyces* gene pool. On the other hand, localities should be educated about the symbiotic relationship with the awareness of *Termitomyces* in their ecosystem and in particular human welfare. The forest officials should also maintain a statistical record on the hot spot areas and the annual yield of the species. Stress should be emphasized on global warming; converting the forest and agricultural lands to civilities, collecting of immature *Termitomyces* for more profit and lack of any plane to conserving this rare example of symbiosis without fully understanding the relationship can have a big regret in future.

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