

## Termitomyces: New to the Science

### Research article

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#### Abstract

*Termitomyces palpensis* Aryal and *T. arghakhanchensis* Aryal, collected within an altitudinal range of 800-1500 m a.s.l in subtropical deciduous forest during 2010-2012 is described and illustrated. Its macro- and microscopic features delimit this taxon as a new species in science.

**Keywords:** Agaricales; Arghakhanchi; Palpa; Siwalik; Symbiosis; Taxonomy.

### Introduction

The genus *Termitomyces* is represented by 30 species world over [1]. Regarding the *Termitomyces* mushrooms in Nepal, there are the records of two species from (Banepa) Central Nepal, *T. eurhizus* at 1200 m a.s.l. [2], from Kathmandu valley at 1350 m a.s.l. [3], from Shaktikhori-Chitwan at 300 m a.s.l. [4], from Twarakhola-Makawanpur at 500 m a.s.l. [5] and *T. clypeatus* from Kathmandu valley at 1350 m a.s.l. [6]; 1500 m a.s.l. [7]; and from Dolpa hill at 2954 m a.s.l. [8] and 12 species are taxonomically described [9-12] and 15 species of *Termitomyces* are listed during an ethno mycological study [13].

Termitophilous fungi are a monophyletic group of tropical gilled mushrooms belonging to the genus *Termitomyces*. They are unique fungi that grow in close and intimate association with termites for a group of termitophilous agarics. It comprises fungi that live in an obligate symbiosis with termites of the subfamily Macrotermitinae [14].

Several samples of a *Termitomyces* species, growing on termatorium of the vegetation, dominated by members of the Dipterocarpaceae, Combretaceae and Leguminosae were collected. Collections have been made in -pre-, -during and -post monsoon, possibly as a result of its subtropical affinities, when most agarics grow in the study area. The species are characterized by typical agaricoid

carpophores pluteoid, entire and incurved margin, usually fleshy, large often sharply, differentiated umbo, stipe central, spore print brownish to pinkish, lamellae free to adnexed but with decurrent tooth, crowded, white to pink in colour. Their stipe has cylindrical, solid, fibrous and smooth with pseudorrhiza. It has cylindrical and widening at certain depth, then narrowing down to the point of attachment to the termite nest, its length determined by the depth of the termite comb and with simple veil, hyphae, inamyloids, with a hilum of the open pore type, ellipsoid, smooth, basidia normal, cystidia present, tramal hyphae inamyloids, with or without clamp connection, trame system monomitic, presence of thin walled pyriform cheilocystidia and hymenophoral trama hyaline.

### Materials and Methods

Basidiocarps from the study area (Palpa & Arghakhanchi district of Masyam & Thada VDC) (Figure 1 & 2), the collection was entirely based on their sexual reproductive structures [15]. The habit and habitat including ecological parameters were recorded by the accessory equipment.

The collections were examined from fresh material of both macro- and microscopically with a compound microscope (Olympus CX 22). The specimens were mounted in 5% KOH, 0.01% cotton blue and lactophenol [1]. Amyloidity of spores was observed by using

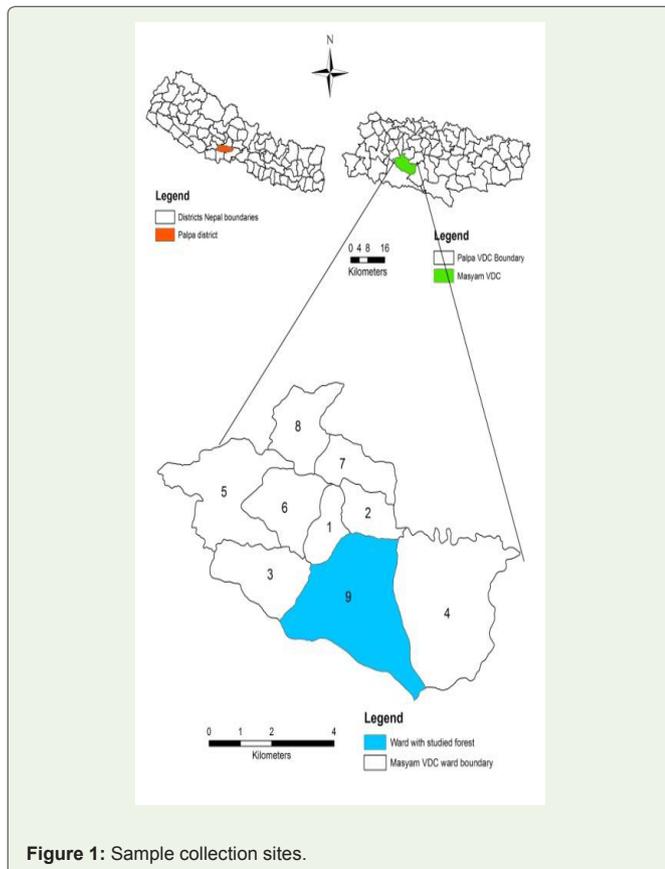


Figure 1: Sample collection sites.

Melzer’s reagent [16]. The measurements were taken with the help of ocular micrometer (1div. =11.66µm under 100x, 3.75µm under 400x and 1.66µm under 1000x). At least 20 spores were measured from lamellae. Selected microscopic photograph was taken by Sony DSC-S 980 mounted on the microscope.

The voucher specimens were identified using publication of [17-20] and on line data base [21-24]. Herbarium specimens were rehydrated in 3% KOH and have been deposited at the Natural History museum (NHM), Swayambhu, Tribhuvan University, Nepal.

**Results and Discussion**

***Termitomyces palpensis* Aryal**

**Local name:** Bhalu mugan (Magar)

**Taxonomic position:** Division: Basidiomycota class: Agaricomycetes sub-class: Agaricomycetidae order: Agaricales family: Tricholomataceae [25].

**Identifying characters:** The most distinguishing characters of this species are fleshy agaric with greyish brown cap, umbonate, white gills and bulbous base of stipe with pseudorrhiza. The basidiocarps scattered to gregarious on termite mounds or on soil, rare, odour pleasant, taste excellent, edible. Generally found in high altitude (800-1500 m a.s.l.) in late to post monsoon on termatorium of the vegetation, dominated by member of the, Combretaceae.

**Etymology:** The species name relates to the district (Palpa) of the

type locality from where the species was collected.

**Description**

**Sporophores:** Usually growing solitary in termite hills, characterized by its obligate symbiont with termites; usually centrally stipitate white but olivaceous near the umbonal region (Figure 3).

**Pileus:** Size 9-15 cm, (Medium size), greyish brown pale toward the margin and olivaceous near the umbonal region, umbonate, incurved margin, surface smooth, radially striate, Perforatorium umbo and brown in colour. **Lamellae:** Free, white, dense. **Stipe:** Size 10 × 2 cm, solid, swollen at base i.e. bulbous base, whitish to pale yellow in colour, surface smooth, fibrillose, absence of annulus. **Pseudorrhiza:** Size 5 × 0.5 cm, buffy brown in colour, solid, cylindrical. **Pseudorrhiza:** 5 × 0.5 cm long, solid, brown in colour, cylindrical, surface glabrous, smooth, widening at certain depth, then narrowing down to the point of attachment to the termite nest, its length determined by the depth of the termite comb. **Flesh:** Grey, soft, inflated, clamp connection absent, nonamyloid. **Spore Print:** pinkish. **Basidia:** 17.5 × 6.5 µm. **Basidiospores:** 4.5 × 3.5 µm, oblong. **Cystidia:** 25 × 15 µm. **Hymenophoral trama:** regular

**Habitat:** On termite nests in subtropical hill forest. **Fruiting season:** August-October.

**Chemical test with**

Phenolphthalein : Sugarcane

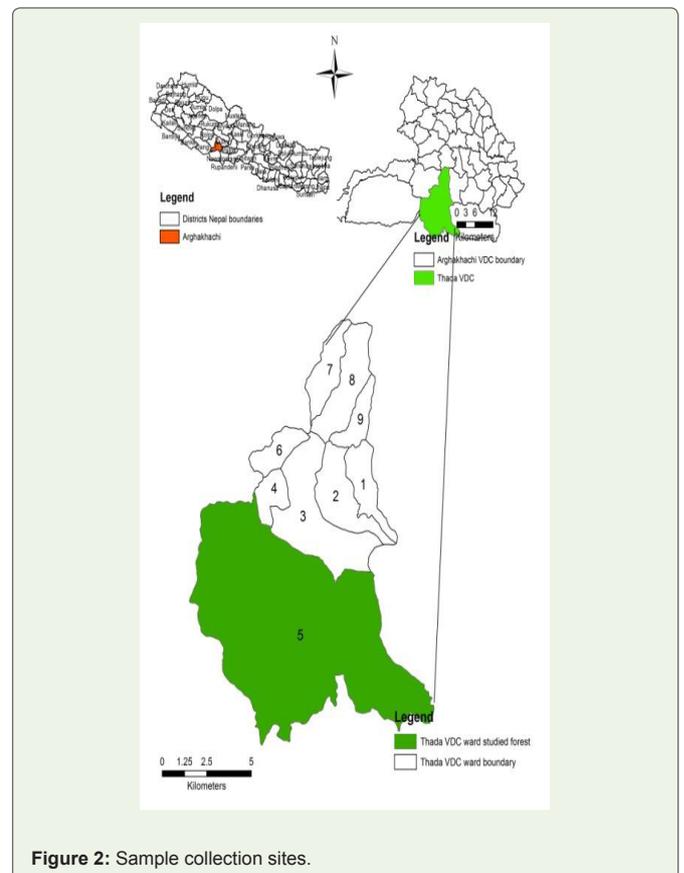
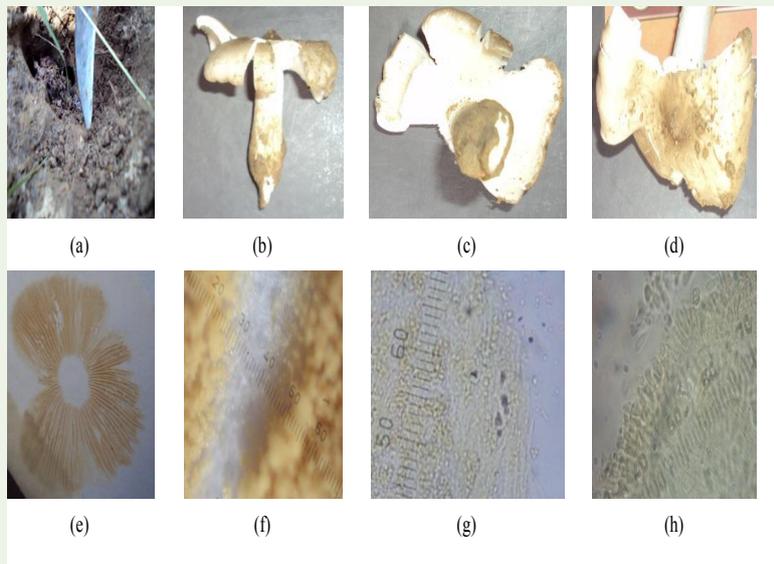
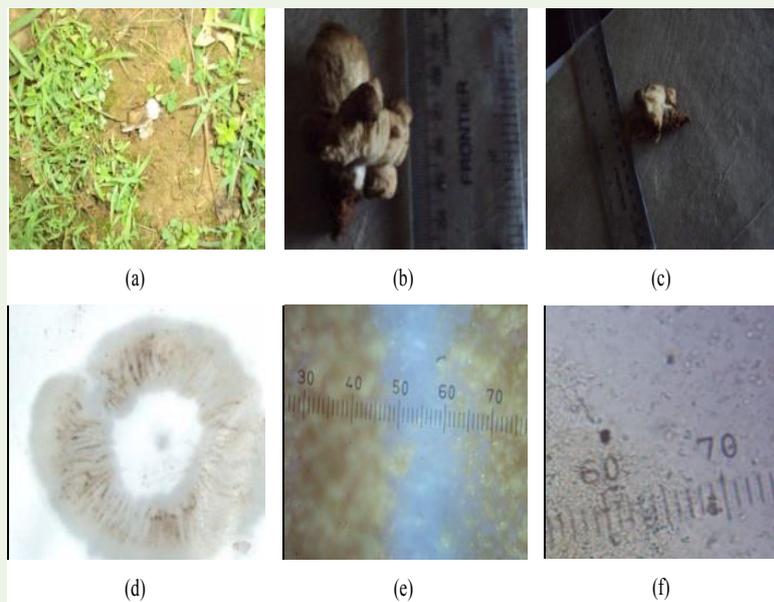


Figure 2: Sample collection sites.



**Figure 3:** *Termitomyces palpensis* sp. nov., a) Termite in termire nest, b) Basidiocarp dorsal view, c) Basidiocarp ventral view, d) Umbonate papilla, e) Spore print, f) Lamellae difference (1div=11.66 μm), g) Spores (1div=11.66 μm) and h) Basidium with spores (1div=3.75 μm).



**Figure 4:** *Termitomyces arghakhanchensis* sp. nov., a) Basidiocarp on habitat, b) and c) Basidiocarp dorsal and ventral view, d) Spore print, e) Lamellae difference (1div=11.66 μm), and f) Spores (1div=11.66 μm).

NH <sub>3</sub> OH	:	No reaction
KOH	:	White
FeSO <sub>4</sub> solution	:	No reaction
FeSO <sub>4</sub> crystal	:	Stipe: outer: White, and inner: Sunrise, Cap: White, Gills: Sugarcane.
Iodine	:	Dorsal: white, Ventral: Beacon.

**Specimen examined:** Growing on termite nest, common. Palpa (Masyam), 816 m a.s.l., long. 83.50969°E, lat. 27.76451° N, Aspect: 270° W, Slop: 50° S/W, Temp.: 21.9-26.8°C, Humidity: 79-87 %, Soil pH: 6.2 Time: 9:43 am, Date: 04.08.2010, Collected by Aryal, H.P., VN-1008184-CDBP, Accession No. NHM TU 2-2-1680. Propose for new to Science.

**Edibility:** They are edible and its syrup is used for the remedy of

jaundice, diarrhoea.

**Distribution:** Ranging 800-1500 m a.s.l. in Nepal.

***Termitomyces arghakhanchensis*** Aryal.

**Local name:** Tuse cyau (Khash)

**Taxonomic position:** Division: Basidiomycota class: Agaricomycetes sub-class: Agaricomycetidae order: Agaricales family: Tricholomataceae [25]

**Identifying characters:** The most distinguishing characters of this species are medium size cap, (usually at least  $\geq 8$  cm in diameter), dark-grey to rusty brown in colour, cap bullate-umbonate in shape, entire in margin, surface wrinkles, smooth, without velar remnant or with few minute whitish evanescent membranous squamules, prominent, cone-like pointed, dark-brown coloured projection at the centre of the cap. Perforatorium are broadly conical. Stipe, are presence of annulus with pseudorrhiza originating from termite nest; no sclerotium. Pseudorrhiza are pale, not entirely blackish. The basidiocarps are rare, odour pleasant, taste excellent, edible. Generally found in high altitude (800-1500 m a.s.l.) in late to post monsoon on termatorium of the vegetation, dominated by member of the, Combretaceae.

**Etymology:** The species name relates to the district (Argkhanchi) of the type locality from where the species was collected.

### Description

**Sporophores:** Usually growing solitary in termite hills, characterized by its obligate symbiont with termites; usually centrally stipitate white but olivaceous near the umbonal region.

**Pileus:** Size 8-16 cm, (Medium size), dark grey to black in colour, bullate-umbonate, surface wrinkled, smooth, entire margin, papilla brown in colour. Lamellae: Free, dense, crowded, white to pale grey. Stipe: Size,  $7 \times 2$  cm, solid, swollen at base, whitish, surface smooth, annulus thin demarcation and persistent. Pseudorrhiza: Size  $7 \times 0.5$  cm long, solid, brown in colour cylindrical, slender, surface glabrous, smooth, and widening at certain depth, then narrowing down to the point of attachment to the termite nest, its length determined by the depth of the termite comb. Flesh: Soft, grey, inflated, clamp connection absent, inamyloid. Spore print: light brown. Basidia:  $19 \times 6 \mu\text{m}$ . Basidiospores:  $4.5 \times 3.5 \mu\text{m}$ , ovoid. Cystidia:  $30 \times 17 \mu\text{m}$ . Hymenophoral trama: regular (Figure 4).

**Habitat:** On termite nests in subtropical hill forest. Fruiting season: August-October.

### Chemical test with

Phenolphthalein	:	Sporty Yellow
NH <sub>3</sub> OH	:	White
KOH	:	Rust
FeSO <sub>4</sub> solution	:	Stipe: outer: Ting of rose, and inner: Pale Rose, Cap: Ting of Rose, Gills: Macrame.
FeSO <sub>4</sub> crystal	:	Stipe: outer: Lavender Dew, and inner: In Vogue, Cap: Lavender Dew, Gills: Magnolia.

Iodine : Dorsal: white, Ventral: Bathstone.

**Specimen examined:** Growing on termite nest, rare. Arghakhanchi (Thada), 1261m a.s.l., Long. 83.09029° E, lati.27.86208° N, Aspect: 270° W, Slop: 20° W, Temp.: 21.9-26.7° C, Humidity: 75-87%, Soil pH: 6.2, Time: 11:46 am, Date: 19.07.2011, Collected by Aryal, H.P., VN-1008227-CDBP. Accession No. NHM TU 2-2-1681, Proposed for new to Science.

**Edibility:** They are edible and its syrup is used for the remedy of Inappetence, Abdominal disorder, Indigestion.

### Key to identification of the species of newly reported *Termitomyces R. Heim*

**Distribution:** Ranging 800-1500 m a.s.l. in Nepal.

- 1a Fruit-body differentiated with short or long stipe, on soil or mound,.....2
- 1b Fruit-body differentiated into prominent head and tail on mound,.....6
- 2a Lower side of the cap with gills, smooth, dense, free, .....5
- 2b Lower side of the cap either decurrent or adnexed gilled,.....3
- 3a Stipe always longitudinally fibrous (when broken), fruit-bodies not so brittle .....*T. aurantiacus*
- 3b Stipe central, slender, hollow, white, fleshy-fibrous, smooth, papilla umbonate,.....4
- 4a Lamellae (mature) white, cream, pale yellow or very pale pink, free, crowded, dense, olivaceous perforatorium, pileus umbonate, incurved margin, stipe not rooting, not bulbous, without annulus, lamellae sub free, adnexed or deeply decurrent,..... *T. badius*
- 4b Lamellae (mature) white and spores dark brown or black; stipe moderately to deeply rooting (pseudorrhiza) or originating from a hypogeous sclerotium with bulbous base, pseudorrhiza originating from termite nest; nosclerotium ... .....*T. palpensis* sp. Nov. newI
- 5a Fruit body with pseudorrhiza (up to 5 cm long), & cap 1-4 cm diam., papilla conic ..... *T. microcarpus f. santalensis*
- 5b Fruit-body small with pseudorrhiza; cap medium, approx 10 cm diameter, dark brown, perforatorium, bullate-umbonate annulus present,.... *T. akhanchensis* sp. Nov. newII
- 6a Pileus medium, 5-10 cm diameters, brownish orange, concentrically scrobiculate, umbo obtuse *T. fuliginosus*
- 6b Pileus expanding to applanato-umbonate, perforatorium prominent and pointed, spiniform papilla, veil absent, stipe solid, pleurocystidia smooth,.....7
- 7a Cap brownish or dark brown, 9-25 cm, perforatorium cylindric, smooth,.....8
- 7b Cap brownish, tomentose; perforatorium cylindric, dark

**Table 1:** Comparisons of morphological characters of the given taxa.

SN	Characters of studies	Taxa	<i>T. aurantiacus</i>	<i>T. badius</i>	<i>T. palpensis</i>	<i>T. microcarpus f. santalensis</i>	<i>T. arghakhachensis</i>	<i>T. fuliginosus</i>	<i>T. letestui</i>	<i>T. Schimperi</i>	<i>T. globulus</i>
1	Cap colour	of <i>T. palpensis</i> similar with		√	√						
		of <i>T. arghanchensis</i> similar with	√				√				√
		of both taxa dissimilar with						x	x		
2	Cap surface	of <i>T. palpensis</i> similar with	√	√	√				√	√	
		of <i>T. arghanchensis</i> similar with				√	√	√			√
		of <i>T. palpensis</i> similar with			√	√	√	√		√	√
3	Cap margin	of <i>T. arghanchensis</i> similar with									
		of both taxa dissimilar with							x		
4	Cap shape	of <i>T. palpensis</i> similar with			√	√					
		of <i>T. arghanchensis</i> similar with					√	√			
		of both taxa dissimilar with							x	x	x
5	Cap size	of <i>T. palpensis</i> similar with	√	√	√		√	√			√
		of <i>T. arghanchensis</i> similar with									
		of both taxa dissimilar with				x					
6	Perforatorium colour	of <i>T. palpensis</i> similar with			√		√		√		
		of <i>T. arghanchensis</i> similar with									
7	Perforatorium shape	of <i>T. palpensis</i> similar with			√		√				
		of both taxa dissimilar with				x					
8	Gills colour	of <i>T. palpensis</i> similar with	√	√	√	√			√	√	√
		of <i>T. arghanchensis</i> similar with									
		of both taxa dissimilar with					x	x			
9	Gills ornamentation	of <i>T. palpensis</i> similar with		√	√			√			
		of <i>T. arghanchensis</i> similar with	√			√	√		√	√	
		of both taxa dissimilar with									x
10	Stipe colour	of <i>T. palpensis</i> similar with		√	√				√	√	√
		of <i>T. arghanchensis</i> similar with	√			√	√				
11	Stipe surface	of <i>T. palpensis</i> similar with	√	√	√	√	√			√	√
		of <i>T. arghanchensis</i> similar with									

12	Stipe shape	of <i>T. palpensis</i> similar with	√		√		√				
		of <i>T. arghanchensis</i> similar with									
		of both taxa dissimilar with						x			
13	Stipe size	of <i>T. palpensis</i> similar with	√		√		√				√
		of <i>T. arghanchensis</i> similar with									
14	Annulus	of <i>T. palpensis</i> similar with	√	√	√	√		√			√
		of <i>T. arghanchensis</i> similar with									
		of both taxa dissimilar with					x		x	x	
15	Pseudorrhizea colour	of <i>T. palpensis</i> similar with	√		√				√	√	√
		of <i>T. arghanchensis</i> similar with		√			√				
		of both taxa dissimilar with				x		x			
16	Pseudorrhizea surface	of <i>T. palpensis</i> similar with		√	√		√	√	√	√	√
		of <i>T. arghanchensis</i> similar with									
		of both taxa dissimilar with				x					
17	Pseudorrhizea shape	of <i>T. palpensis</i> similar with		√	√		√	√		√	√
		of <i>T. arghanchensis</i> similar with									
		of both taxa dissimilar with				x					
18	Pseudorrhizea size	of <i>T. palpensis</i> similar with	√	√	√			√			
		of <i>T. arghanchensis</i> similar with					√				√
		of both taxa dissimilar with				x					
19	Flesh colour	of <i>T. palpensis</i> similar with	√	√	√	√	√		√	√	√
		of <i>T. arghanchensis</i> similar with									
		of both taxa dissimilar with						x			
20	Flesh hyphae	of <i>T. palpensis</i> similar with	√		√	√	√		√		√
		of <i>T. arghanchensis</i> similar with									
21	Flesh clamp connection	of <i>T. palpensis</i> similar with	√	√	√		√	√	√	√	√
		of <i>T. arghanchensis</i> similar with									
		of both taxa dissimilar with				x					
22	Spore print colour	of <i>T. palpensis</i> similar with	√		√	√			√		√
		of <i>T. arghanchensis</i> similar with		√			√			√	
		of both taxa dissimilar with						x			

Note: √ indicate the presence of similar characters and x represents the dissimilarities

brown; annulus persistent,.... *T. letestui*

8a Cap without velar remnants or with few minute whitish evanescent membranous squamules,....9

8b Cap white, with large dark squamules; perforatorium absent,.... *T. schimperi*

9a Cap medium, without papilla and annulus, ochraceous brown,.... *T. robustus*

9b Cap smaller, globose, perforatorium low, small and poorly developed, stipe usually without annulus, greyish brown  
.....*T.globules*

On the basis of macro- and micro-morphometric characters these species are closer to the *T. aurantiacus*, *T. microcarpus* f. *santalensis*, *T. badius*, *T. globulus*, *T. schimperi*, *T. fuliginosus* and *T. le-testui* but they are distinct to rest of other identified *Termitomyces* species recorded till now (table 1). Taxonomic description of survey of literature [7, 9-12-26-39] revealed that these species are newly proposed to the macro fungal flora of the world. Although for determining the species, macro and micro-morphological characters provides ample information. But it is not sufficient at all, so that it is necessary to ascertaining the molecular level of study for determining the more similar species in the systematics.

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### References

1. Kirk PM, Cannon PF, Minter DW, Stalpers JA (2008) Dictionary of the fungi 10<sup>th</sup> ed. CAB International, Wallingford, UK.
2. Singh SC, Shrestha R (1986) Two new records of fungi for Nepal. Him Res Dev (India) 5: 71-72.
3. Joshi K, Joshi AR (2008) Ethnobotanical study on some lower plants of the central development Region, Nepal. Ethnobotanical Leaflets 12: 832-840.
4. Rijal A (2011) Surveying on Knowledge: Ethnobotany of Chepang Community from mid hill of Nepal. Ethnobotany Research and Applications 9: 181-215.
5. Uprety Y, Poudel RC, Shrestha KK, Rajbhandary S, Tiwari NN, et al. (2012) Diversity of use and local knowledge of wild edible plant resources in Nepal. J Ethno bio Ethno med 8: 16.
6. Adhikari MK, Devkota S, Tiwari RD (2005) Ethnomycological knowledge on uses of wild mushrooms in western and central Nepal. Our nature 3: 13-19.
7. Pandey N (2008) Mushroom Diversity in central Nepal: An ethno mycological Approach. Ph. D. Thesis Submitted to the Central Department of Botany, Tribhuvan University, Nepal. 255 pp.
8. Devkota S (2008) Distribution and Status of Highland Mushrooms: A Study from Dolpa, Nepal. J Nat Hist Mus 23: 51-59.
9. Aryal HP, Budhathoki U (2013) *Termitomyces albuminosus* (Berk.) Heim a New Fungal Record from Arghakhnchi, Nepal. OAKS 9: 44-47.
10. Aryal HP, Budhathoki U, Tiwari RD (2014) *Termitomyces microcarpus* (Berk. & broome) R. Heim: A New records from Nepal. J Mycol PI Pathol 44: 13-18.

11. Aryal HP, Budhathoki U (2015a) New Record of Termite Mushrooms from Nepal. J Mycol PI Pathol 45: 182-188.
12. Aryal HP, Budhathoki U (2015b) Systematics of Nepalese *Termitomyces*. Our Nature 13: 31-44.
13. Aryal HP, Budhathoki U (2014) Ethnomycology of *Termitomyces* spp. R. Heim for its medicinal importance in Nepal. An International Journal of Medicinal Plants. New Delhi, India. 6: 128-137.
14. Heim R (1942) Nouvelles etudes descriptives sur les agaris termitophiles d' Afrique tropicale. Arch Mus natl Hist Nat Ser 6: 1-60.
15. Atri NS, Kaur A, Kaur H (2005a) Wild mushrooms collection and identification. Frontiers in Mushroom Biotechnology (Eds.: Rai, R.D., Upadhyay, R.C. and Sharma, S.R.) @ NRMC Solan.
16. Melzer MV (1924) L'ornementation des spores de Russules. Bul Soc Myc Fr 40: 78-81.
17. Heim R (1977) Termites et Champignons. Les termitophiles d'Afrique Noire at d'asie Meridionale. Paris, France: Societe Nouvelle des Edition. 205 pp. Boubee, Paris.
18. Bels PJ, Pataragetvit S (1982) Edible mushroom in Thailand cultivated by termites. In Chang, S.T. and Quimo, T.H. ed. Tropical Mushroom: Biological Nature and cultivation Methods. The Chinese University Press. Hong Kong, pp. 445-462.
19. Singer R (1986) The Agaricales in modern taxonomy (4<sup>th</sup> edition), Bishen Singh Mahendra Pal Singh, Dehradun (India). 981 pp.
20. Harkonen M, Niemela T, Mwasumbi L (2003) Tanzanian Mushrooms. Edible, harmful and other fungi. Botanical Museum Finnish Museum of Natural History, 200 pp.
21. Biodiversity Library.org
22. Index Fungorum
23. Mycobank.org
24. Tropicos.org
25. Kuo M (2003) Mushroom taxonomy The big picture. Retrieved from the Mushroom Expert.com
26. Natarajan NK (1979) South Indian Agaricales v: *Termitomyces heimii*. Mycologia 71: 853-855.
27. Rawla GS, Arya S, Sarwal BM (1983) Species of *Termitomyces* Heim. From Chandigarh. India. Bibliotheca Mycologica. 91 J Cramer 13-21.
28. Leelavathy KM, Flower SL, Suja CP (1985) The genus *Termitomyces* in India. Indian Mush Sci 2: 402-407.
29. Morris B (1986) Notes on the genus *Termitomyces* Heim in Malawi. Society of Malawi Journal 39: 40-49.
30. Pearce GD (1987) The genus *Termitomyces* in Zambia. Mycologist 1: 111-116.
31. Vander WGCA, Eicker A (1990) Species of *Termitomyces* in South Africa. Mycological Res 94: 923-937.
32. Bother WJ, Eicker A (1991) Cultural studies on the genus *Termitomyces* in South Africa. 1. Macro- and microscopic characters of Basidiome contextst cultures. Mycologia Res 95: 435-443.
33. Zang M (1992) Contribution to the study on the genus *Sinotermitomyces* from Asia. Mycotaxon 44: 21-26.
34. Adhikari MK (2000) Mushrooms of Nepal. (Eds.: Durrieu, G.). P.U. Printers, Battishputali, Kathmandu, Nepal. 236 pp.
35. Adhikari MK (2014) Mushrooms of Nepal. (2<sup>nd</sup> Eds.: Durrieu, G. & H.V.T. Cotter). SP printers, Jawalakhel, Lalitpur, Nepal. 340 pp.
36. Atri NS, Kaur H (2003) Wild mushrooms collection and identification. Mushroom Res. 14: 56-59.

37. Atri NS, Kaur A, Kour H (2005b) Systematics and sociobiology of Termitophilous mushrooms from Punjab. The fungi-Diversity and Conservation in India, pp. 159-182. (Eds.: Prof. J.S. Dargan, Dr. N.S. Atri & Dr. G.S. Dhingra) Published by Bishen Singh Mahindra Pal Singh, Dehra Dun, UA (India).
38. Tang BH, Wei TL, Yao YJ (2006) Revision of *Termitomyces* species originally described from China. *Mycotaxon* 95: 285-293.
39. Tie ZW, Tang BH, Yao YJ, Pegler DN (2006) A revision of *Sinotermitomyces*, a synonym of *Termitomyces* (Agaricales). *Fungal Diversity* 21: 225-237.