

Ecological and Medicinal Importance of Termite Fauna

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ABSTRACT

Termites are a diverse group of insects with wide distribution worldwide. Most commonly, termites are regarded as pests of different plants and woods. However, they have a lot of ecological and medicinal importance. Here, we reviewed papers published between 2000 and 2015 in different literature sources on the ecological and medicinal importance of termites. The role of termites in the decomposition process of wood, fallen logs and leaves etc., in recycling of organic matter and nutrients, and in bioturbation is highlighted. Furthermore, termites are also used by tribes to treat different ailments such as asthma, influenza, tonsillitis, bronchitis etc. in traditional medicines.

Keywords: Termites, Medicinal Importance, *Odontotermes*

Introduction

Termites are hemimetabolous, eusocial insects that fall under the infraorder-Isoptera and order Blattaria (Saha *et al.*, 2016). Termites share the same order with that of cockroaches as phylogenetic studies indicate that both termites and cockroaches have evolved from the same ancestor. Termites are generally divided into two groups, viz., higher termites (members of the families-Termitidae, Serritermitidae, Rhinotermitidae,

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Termopsidae) and lower termites (members of the families- Mastotermitidae, Kalotermitidae, Hodotermitidae) (Aanen *et al.*, 2002). The principal feed of termites is cellulose in the form of wood, leaf litter, soil, animal dung etc., which they digest with the help of rich microbial community including protozoa and bacteria in their hindgut. Based on their ecological behaviour such as nesting and feeding habits, termites are grouped into two life types: the first are the one-piece nesting termite such as Kalotermitidae or commonly referred to as wood-dwellers. These species spend their entire colony life in a single piece of wood which serves as food source as well as shelter. The second type is the multiple pieces nesting termites such as Termitidae. These species live in a well-defined nest which is more or less separated from the foraging grounds (Korb, 2007). The nests of termites can be categorized into three categories: Subterranean (completely below the ground), Epigeal (protruding above the soil surface) and Arboreal (built above the ground, but always connected to the ground via shelter tubes) (Noirot *et al.*, 2000).

The termite colonies are generally founded by a single primary king and queen who pair during nuptial flight, mate and produce other colony members (Vargo *et al.*, 2011). In a colony generally two castes are there: neuter castes (workers and soldiers) and reproductive castes (alates, nymphoids and ergatoids). Queen exclusively undergoes sexual reproduction to produce workers, soldiers and alates and asexual reproduction to produce their replacements, i.e., parthenogenetically produced daughter of the queen (Matsuura *et al.*, 2009). A queen can lay about 3000 eggs a day through its extremely enlarged abdomen (Thompson, 2000). When the king or queen dies, they are often replaced by the neotenic (wingless reproductive forms) that developed from nymph (nymphoids) or workers (ergatoids) from within the colony (Thorne, 1999; Vargo *et al.*, 2009). In case of some species like *Reticulitermes speratus*, if females fail to find a male to mate after nuptial flight they join with another female to start a colony or sometimes reproduce parthenogenetically to start a colony alone (Matsuura and Nishida, 2001; Matsuura, 2002) which is known as thelytoky. Excavation into nest wood, i.e., initiation of colony foundation, is significantly more delayed in single female than female-female and female-male pairs (Matsuura *et al.*, 2009).

Diversity of Termites

Termites are a diverse and important group of insects. A total of 3,106 species of termites have been described so far by different workers worldwide under

12 families (Krishna *et al.*, 2013). In India also some studies are there carried out by many workers from different places on the diversity and distribution of termites.

Table 1. Worldwide representation of diversity of termites.

Study areas	Number of Species	References
International		
Southern Guinea savanna zone of Nigeria	64	Wood <i>et al.</i> (1982)
Primary rainforests in Brazilian Amazon	64	Constantino (1992)
Mexico, Argentina and Florida	543	Constantino (1998)
Nicargua, USA	37	Scheffrahn <i>et al.</i> (2005)
Venezuela	58	Issa (2006)
Khao kitchagoot national park, Thailand	30	Inoue (2006)
Bhakkar, Pakistan	6	Manzoor <i>et al.</i> (2011)
National		
Assam region (NE States except Sikkim)	34	Roonwal (1961)
Rajasthan	18	Roonwal (1978)
Kerela	11	Verma <i>et al.</i> (2007)
Andhra Pradesh	13	Rao <i>et al.</i> (2012)
Western Ghat	14	Shanbhag (2013)
Bangalore	5	Pranesh (2015)
Chhattisgarh	6	Saha <i>et al.</i> (2016)

Ecological importance of termites

Termites are considered as one of the most problematic pests in plant communities and in building infrastructure. Among all the known species of termites, 300 are considered to be pests (Kumari *et al.*, 2013). Individuals that belong to the families Hodotermitidae (Anacanthotermes and Hodotermes), Kalotermitidae (Amitermes), Rhinotermitidae (Coptotermes, Heteotermes and Psammotermes), and Termitidae (Amitermes, Ancistrotermes, Cornitermes, Macrotermes, Microcerotermes, Microtermes, Odototermes, Procornitermes, and Syntermes) cause great loss in agriculture (UNEP Report, 2000). Out of 300 species of termite known from India, about 35 species have been reported damaging agricultural crops and buildings (Sharma *et al.*, 2009).

Though termites are commonly described as pests, they are the major detritivores, particularly in tropical and subtropical regions, and their recycling of wood and plant matter are of considerable ecological importance. In the tropics, termites are arguably the most important soil ecosystem engineers (Bignell, 2006). Termites have the ability to forage over long distances (one metre to ten metres) and typically control their own living environment through the reaction of the nest structures where the humidity and the

temperature remain constant throughout all seasons (Jouquet *et al.*, 2011). Termites contribute to the consumption and mineralization of a significant part of litter by processing large quantities of plant materials (Bignell *et al.*, 2000). They can mechanically chop up plant materials with their mandibles and grind it with their gizzard, thereby increasing the surface area accessible to soil microorganisms, as well as their own intestinal symbionts and speed up next decay by protists, bacterial and fungal agents. Termites also help in the soil loosening (reduction of bulk density) and both vertical and horizontal transport through bioturbation and subsequent erosion of their constructions. They enrich the soil with organic matter and mineral nutrients through their faeces, salivary secretions, corpses and predators (Jouquet *et al.*, 2011). Their nests comprise of high level of nitrogen, greater cationic exchange capacity and more mineral nutrients than surrounding soils (Holt *et al.*, 2000; Mujinya *et al.*, 2010).

Medicinal Importance of Termites

Besides the importance of termites as pest and as an ecological engineer, termites have therapeutic importance in traditional medicine. Around nine species of termites are known to have use in traditional medicine worldwide, most commonly in Brazil (4 species) followed by India (2 species), Zambia (1 species), Nigeria (1 species) and Somalia (1 species) (Table. 1) (Figueiredo *et al.*, 2015). Termites are used in the treatment of various human diseases like, influenza, asthma, bronchitis, whooping cough, sinusitis, tonsillitis and hoarseness etc. (Alves, 2009). In northeastern Brazil, the termite species *Nasutitermes corniger* is commonly used in traditional medicine (Alves *et al.*, 2006, 2007). Natural product from *N. corniger* could be used as product with modifying antibiotic activity to aminoglycosides to be used against multidrug resistant bacteria (Coutinho *et al.*, 2009). The molecular biology and bioinformatics studies on the species from the genus *Nasutitermes* from Australia, showed antifungal and antibacterial activity (Bulmer *et al.*, 2004, 2006). Lamberty *et al.* (2001) isolated two novel peptides viz., *termicine* (*antifungal*) and *Spinigerin* (*antifungal and antibacterial*) from the fungus growing species *Pseudocanthotermes spiniger*. In southern part of India, termites (*Odontotermes formosanus*) are used by many tribes (Fig. 1), viz., Kannikaran, Paniyan, Sholaga, Irular, Kota etc., to treat asthma (Wilsanand, 2005). The Irular and Mudugar tribes have also been using termites for the treatment of rheumatic diseases, body pain, better health and anaemia (Wilsanand *et al.*, 2007).

Table 2. Termite species used in medicinal purposes in different parts of the world

Species Name	Country's name
<i>Hodotermes mossambicus</i>	Zambia
<i>Macrotermes bellicosus</i>	Somalia
<i>Macrocerotermes exiguus</i>	Brazil
<i>Nasutitermes corniger</i>	Brazil
<i>Nasutitermes macrocephalus</i>	Brazil
<i>Pseudacanthotermes spiniger</i>	Brazil
<i>Macrotermes nigeriensis</i>	Nigeria
<i>Odontotermes feae</i>	India
<i>Odontotermes formosanus</i>	India

*Fig. 1. Termite species (Genus – Odontotermes) used for medicinal purposes in India***Conclusion**

The available literature on termite fauna shows that termites are studied extensively worldwide including India. Besides the common tag on termites as pest, they are very useful from the ecological point of view. They are also being used in traditional medicine worldwide and could serve as a good model for isolation of medicinally importance compounds to treat different human diseases.

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