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Insect's therapeutic potential and their primary use in traditional medicine in India

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Abstract
In India, traditional medicine, exemplified by Ayurveda, Siddha, and Unani, has used natural resources heavily in the provision of health care. The most notable of them is the application of insects in treatment (entomotherapy) which is under-researched but a valuable practice, especially in tribal and rural societies. This review outlines the therapeutic potential of insects and their uses in traditional Indian medicine with an emphasis on ethnomedicinal uses, bioactive compounds, and scientific validation. Major medicinal insects used include Apis cerana indica, *Oecophylla smaragdina*, *Bombyx mori*, *Mylabris phalerata*, *Odontotermes obesus* and *Laccifer lacca*, which are frequently used to treat wounds, respiratory illnesses, skin diseases, and nutritional disorders. They have therapeutic effects credited to their bioactive constituents such as peptides, enzymes, lipids and compounds derived by chitin that have antimicrobial, antioxidant, anti-inflammatory and anti-cancer effects. Although there are encouraging traditional and preliminary scientific results, the incorporation of insect-based therapeutics into modern medicine is minimal because of the safety, toxicity, standardization, and limited clinical validation. Such products are not yet well-developed by regulatory frameworks. Insects provide a new and sustainable source of drug discovery, but systematic studies, safety assessment, and regulatory backup are necessary to achieve a transition between traditional knowledge into evidence-based therapeutic uses.

Keywords: Insects, traditional medicine, entomotherapy, enthnomedicine

Introduction

Traditional medicine has been a foundation of Indian healthcare, with a strong cultural basis, biodiversity and indigenous knowledge systems. Plant, mineral, and animal substances have been greatly used in prevention as well as treatment of diseases in systems like Ayurveda, Siddha and Unani. Although these systems rely predominantly on plant-based remedies, the insect-based approach to medicine known as entomotherapy is with a minor component of traditional medicine that is under-researched but still holds considerable importance. Entomotherapy refers to the application of insects and their derivatives in therapeutic modalities e.g. honey, venom, larvae, and secretions. This practice is more common among tribal and rural groups in India where the insects are utilized to treat various diseases such as respiratory problems, gastrointestinal ailments, skin disorders and inflammatory diseases. An example is honey honey produced by Apis species that has broadly been used due to its antimicrobial and wound-healing qualities, and some ant species and beetles, which are traditionally used due to their perceived immunomodulatory and aphrodisiac properties [1].

It is possible to attribute the therapeutic capability of insect to their high content of bioactive compounds, such as peptides, enzymes, lipids, and structural biopolymers, such as chitin and chitosan. Scientific studies have shown that these compounds have varied pharmacological properties such as antimicrobial, antioxidant, anti-inflammatory and even anticancer property in preliminary research studies. The last few years have seen a marked international interest in insects as a new source of drug leads, due to the desire to find a sustainable and alternative source of therapeutics agents, particularly in the face of dilemmas like antimicrobial resistance [2].

Although they are traditionally relevant and have become the focus of scientific attention more recently, the application of insects in medicine is under-documented and under-validated in comparison to plant-based therapy. The problems faced include standardization, safety, and insufficient clinical evidence that impede their acceptance into mainstream healthcare. Moreover, the loss of indigenous knowledge to modernization is a major challenge to the continuation of the entomotherapeutic practices [3].

Thus, this review is an attempt to exhaustively investigate the therapeutic potential of insects, as well as their main uses in traditional medicine in India. It aims to summarize ethnomedicinal data, identify the most important insect species and bioactive compounds, and critically analyze the existing scientific data to bridge the gap between traditional medicine and modern pharmacological research.

Medicinal Insects in India

1. *Apis cerana indica* (Honeybee)

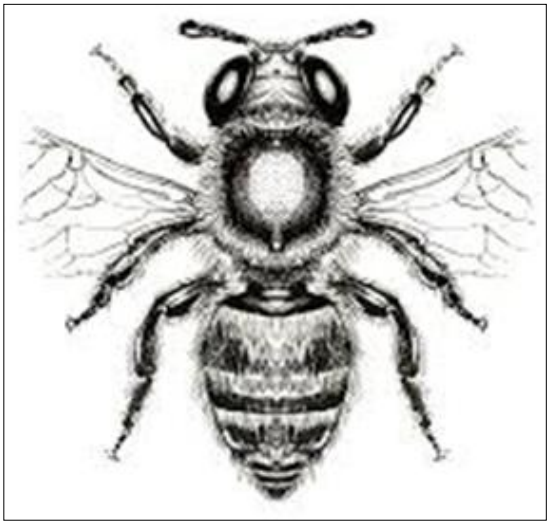

Fig 1: *Apis cerana indica*

Honeybees such as *Apis cerana indica* are among the most extensively utilized insects in traditional Indian medicine. Honey has been used since ancient times in Ayurveda as a *Yogavahi* (bioenhancer), enhancing the efficacy of other therapeutic agents, and is well known for its antimicrobial, antioxidant, and wound-healing properties. Additionally, bee venom therapy (apitherapy) is practiced in certain regions for the management of inflammatory conditions. Traditionally, honey is used for wound healing, as a cough suppressant, and as an energy booster. Its therapeutic effects are attributed to flavonoids, phenolic acids, enzymes, and melittin (present in venom). Scientific studies have validated its antimicrobial and anti-inflammatory activities, along with its ability to promote tissue regeneration. It is commonly administered orally (honey), topically for wound care, and through controlled venom therapy in specialized practices [4].

2. *Oecophylla smaragdina* (Red Weaver Ant)

Fig 2: *Oecophylla smaragdina*

The ant species *Oecophylla smaragdina* is widely used by tribal communities in states such as Odisha, Chhattisgarh, and Maharashtra, where it holds significant ethnomedicinal value. A traditional chutney prepared from these ants is commonly consumed for boosting immunity and managing respiratory ailments. The species is regarded as an immunomodulator and stimulant, with its therapeutic properties attributed to the presence of formic acid, proteins, and essential minerals. Scientific studies have demonstrated antioxidant and antimicrobial activities, supporting its traditional applications. It is typically consumed in various forms, including chutney, paste, or raw, depending on regional practices [5].

2. *Bombyx mori* (Silkworm)

Fig 3: *Bombyx mori*

Silkworms such as *Bombyx mori*, particularly their larvae and pupae, are rich sources of proteins and diverse bioactive compounds. In traditional medicine, they are widely regarded as aphrodisiacs and general tonics, especially for enhancing vitality and supporting reproductive health. Their therapeutic properties are attributed to the presence of proteins, essential amino acids, and bioactive peptides, which contribute to overall physiological benefits. Scientific studies have reported antioxidant, anti-fatigue, and neuroprotective effects, supporting their traditional use. Silkworms are commonly consumed as cooked food or in powdered formulations, depending on regional practices and medicinal applications [6].

3. *Mylabris phalerata* (Blister Beetle)

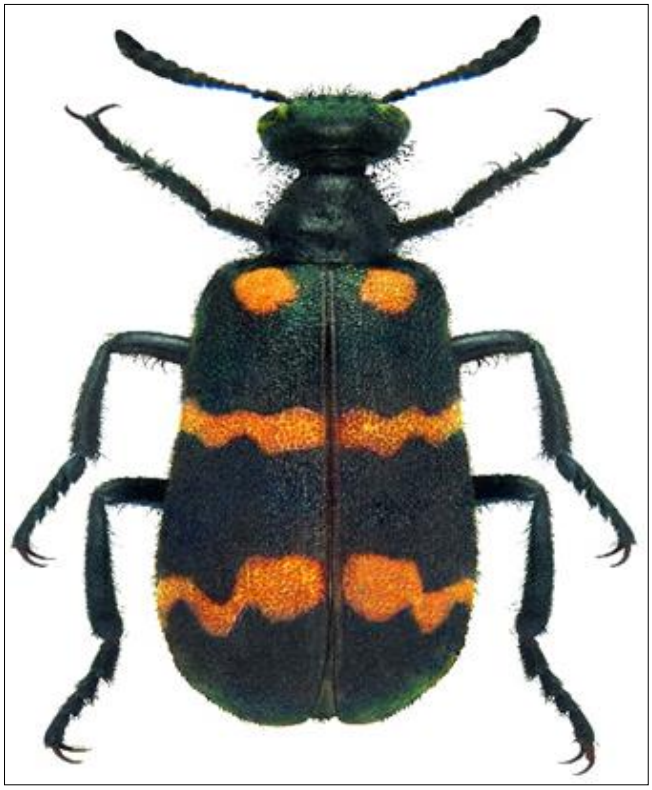

Fig 4: *Mylabris phalerata*

Cantharidin is a strong bioactive compound that has great pharmacological effectiveness and is known to be produced by blister beetles like *Mylabris phalerata*. Historically they have been employed as a vesicant, and to remove warts among other applications in the treatment of skin ailments like warts and lesions, but their use must be done with utmost care since they are inherently toxic. The therapeutic effect has been largely due to cantharidin, which has demonstrated anticancer and antiviral effects in experimental research. Practically, blister beetles are only applied externally in processed form, since poor handling or administration may result in serious skin irritation, blistering and systemic toxicity. Thus, their application in the traditional medicine highlights the potential of their use as therapeutic agents and the importance of controlled and informed use [7].

5. *Odontotermes obesus* (Termite)

Fig 5: *Odontotermes obesus*

Termites like *Odontotermes obesus* are also commonly eaten in various tribal societies where it is used as a source of food due to its richness in nutrients or minerals and medicines, especially because of its high protein and mineral value. They are traditionally consumed as a nutritional supplement and an overall tonic to fight weakness and malnutrition. Their medicinal benefit is due to the availability of proteins, lipids and key micronutrients like iron and zinc that enhance general health and wellbeing. They have high nutritional value that is supported by scientific studies and have potential antimicrobial properties, further confirming their traditional application. In most instances, termites are usually eaten in different ways, roasted, raw or as a paste depending on the culture and the area of its usage [8].

6. *Laccifer lacca* (Lac Insect)

Fig 6: *Laccifer lacca*

The *Laccifer lacca* produces a natural resin which has been used in the past in medicinal as well as industrial use. The wide applicability of lac is demonstrated by its use in Indian folk medicine where it is used to treat wounds and support the liver. Lac is also believed to be biologically active largely due to its resin acids, natural dyes and wax components which also make it have pharmacological properties. Scientific research has shown that lac has antimicrobial and hepatoprotective effects, which justifies its traditional role in the treatment of infections and liver-related diseases. It is normally used as topical dressing to the wounds and orally to produce systemic therapeutic action [9].

Traditional Uses of Insects in Indian Medicine

Sr. No.	Insect (Scientific Name)	Common Name	Part/Product Used	Traditional Use	Ailments Treated	Mode of Administration	References
1	*Apis mellifera / Apis cerana indica*	Honeybee	Honey, venom	Antimicrobial, wound healing, energy booster	Wounds, cough, cold, ulcers	Oral consumption, topical application	[8, 10, 11, 12, 13]
2	*Oecophylla smaragdina*	Red ant	Whole insect, eggs	Immunity booster, stimulant	Asthma, arthritis, fever	Consumed raw, chutney, paste	
3	*Odontotermes obesus*	Termite	Whole insect	Nutritional supplement, tonic	Weakness, malnutrition	Consumed roasted or raw	
4	*Bombyx mori*	Silkworm	Larvae, pupae	Aphrodisiac, tonic	Male infertility, general debility	Cooked, powder form	
5	*Mylabris phalerata*	Blister beetle	Whole insect (processed)	Vesicant, aphrodisiac	Skin diseases, warts	External application (paste)	
6	*Periplaneta americana*	Cockroach	Whole insect extract	Anti-inflammatory	Asthma, bronchitis	Decoction, extract	
7	*Gryllus bimaculatus*	Cricket	Whole insect	Protein supplement, tonic	Weakness, anemia	Fried or powdered	
8	*Laccifer lacca*	Lac insect	Resin (lac)	Hepatoprotective, wound healing	Liver disorders, injuries	Oral, topical	
9	*Musca domestica*	Housefly	Larvae (maggots)	Wound debridement	Chronic wounds, ulcers	Applied to wounds	
10	*Vespa orientalis*	Wasp	Venom	Anti-inflammatory, analgesic	Joint pain, arthritis	Topical (sting therapy)	

Conclusion

The insects are a rich but an underutilized resource in indigenous Indian medicine, which plays a crucial role in ethnomedicine, especially in tribal and rural people. The consumption of insect products like honey, venom, and larvae and resins is indicative of a long-standing entomotherapy tradition, alongside plant- and mineral-based systems within regulatory frameworks. Those practices demonstrate the therapeutic diversity of insects in the treatment of a broad spectrum of illnesses, such as infections, inflammatory diseases, wounds, and nutritional disorders. Science has been able to substantiate most of these traditional claims with solid scientific evidence showing that insects are abundant sources of bioactive compounds including peptides, enzymes, lipids and chitin-derived polymers, which possess antimicrobial, antioxidant, anti-inflammatory and anticancer properties. This puts insects as a potential source of new drug discovery and

development, especially to solve new global health challenges like antimicrobial resistance. Nevertheless, the use of insect-based therapeutics in modern healthcare is underdeveloped despite their potential as these categories of therapeutics are characterized by the absence of standardization, safety issues, the absence of clinical data, and regulatory uncertainties. Moreover, the sustainability, preservation of biodiversity and ethical use of indigenous knowledge should be carefully considered. That is why, the multidisciplinary and systematic approach is the key to full utilization of the medicinal potential of insects. This consists of scientific validation and standardized formulation, development of transparent regulatory systems and encouragement of sustainable use practices. The acknowledgement and safeguarding of traditional knowledge systems by fair benefit-sharing processes are also important. The gap between the conventional entomotherapy and the contemporary pharmacological studies can open the door to the development of safe, effective and sustainable therapeutic agents. Insects can greatly contribute to the future of integrative and natural product-based medicine, with further research and policy assistance.

Conflict of Interest

All the authors declare that they have no conflict of interest.

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