AGRI MAGAZINE
(International E-Magazine for Agricultural Articles)
Volume: 03, Issue: 06 (June, 2026)
Available online at http://www.agrimagazine.in
©Agri Magazine, ISSN: 3048-8656

Therapeutic Use of Insects and Insect Products: A Comprehensive Review of Entomotherapy

*Mohit
Maharana Pratap Horticultural University, Karnal-132116, Haryana, India
*Corresponding Author's email: myadav5223@gmail.com

Insects and their derived products have constituted a fundamental reservoir of pharmacological and therapeutic agents since antiquity, a practice formally defined as entomotherapy (Costa-Neto, 2018). Comprising the largest and most biodiverse phylum, Arthropoda, insects synthesize an extraordinary array of structurally and functionally diverse bioactive molecules, including polyketides, terpenoids, antimicrobial peptides (AMPs), and complex proteins. Historically embedded in traditional medical frameworks such as Ayurveda and Traditional Chinese Medicine (TCM), these natural compounds are now undergoing rigorous scientific validation (Pandey et al., 2013). Modern pharmaceutical research is increasingly exploiting insect-derived substances—such as apitoxin, cantharidin, maggot excretions/secretions, and silk fibroin—to combat the escalating crisis of antimicrobial resistance, manage chronic wounds, and develop novel antineoplastic therapies (Dutta et al., 2019). This review synthesizes the historical context, biochemical mechanisms, clinical applications, and commercial viability of insect-derived therapeutics, while emphasizing the sustainable management of these resources.

Introduction

Insects represent the most diverse and abundant group of multicellular organisms on the planet, with over a million described species. Beyond their widely recognized ecological roles in pollination, organic matter decomposition, and maintaining food webs, insects serve as an underutilized but profoundly valuable reservoir of therapeutic compounds. The intersection of entomology and pharmacology—termed Entomotherapy—investigates the medicinal use of insects and their derivative products. Because insects have co-evolved with a myriad of pathogens, predators, and environmental stressors over hundreds of millions of years, they have developed highly specialized biochemical defense mechanisms (Hancock et al., 2012). These defenses manifest as venoms, toxins, secretions, and immune peptides that possess remarkable pharmacological properties, including remedial, analgesic, antibacterial, diuretic, sedative, antineoplastic, and anti-rheumatic effects. While the concept of consuming or applying insect products for health benefits may seem novel to some modern Western medical paradigms, it is deeply rooted in human history (Costa-Neto, 2018). Currently, therapies based on insects are finding increased clinical acceptance.

Traditional Entomotherapy in Historical Medicine

Traditional entomotherapy involves the direct empirical use of whole insects or unprocessed insect products as remedies. Historically, these practices have been documented across various continents, particularly within ancient Asian, African, and indigenous American cultures. In Traditional Chinese Medicine (TCM), over 1,700 different therapeutic regimens have been formulated utilizing approximately 300 distinct insect species. These formulations were historically prescribed for ailments ranging from simple inflammatory conditions to severe neurological and cardiovascular disorders.

In the Indian subcontinent, the ancient system of Ayurveda has prominently featured insect products. Ayurvedic scriptures frequently reference honey, termed 'madhu', as a primary vehicle (anupana) for administering other herbal medicines, in addition to being a potent therapeutic agent in its own right, used to balance the bodily doshas (Pandey et al., 2013). Furthermore, during the Ayurvedic era, termites (Order Isoptera) were utilized to treat a broad spectrum of undiagnosed systemic illnesses. The consumption of medicinal termites, rich in proteins, essential fatty acids, and unique gut-microbiome-derived metabolites, provided both nutritional supplementation and therapeutic relief, showcasing an early understanding of functional foods.

Apitherapy: The Biochemical Arsenal of Bees

Apitherapy is perhaps the most globally recognized and scientifically validated sub-discipline of entomotherapy. It encompasses the medical use of products derived primarily from the European honeybee (*Apis mellifera*). The pharmacological complexity of these products allows for the management of gastrointestinal, cardiovascular, dermatological, and hepatic diseases. Honey is a supersaturated sugar solution produced from floral nectar. Medically, its high osmolarity, low water activity, and acidic pH (typically between 3.2 and 4.5) create a highly inhospitable environment for bacterial proliferation. Furthermore, the presence of the enzyme glucose oxidase in honey produces hydrogen peroxide upon contact with wound exudate, providing a sustained, low-level antimicrobial effect. Clinical-grade honeys (such as Manuka honey) are highly effective in wound healing, reducing inflammation, and stimulating angiogenesis and fibroblast activity.

Maggot Debridement Therapy (MDT)

Maggot Debridement Therapy (MDT), also known as larval therapy, represents a biologically active approach to chronic wound management. Approved by regulatory bodies such as the US FDA as a medical device, MDT utilizes the sterile, live larvae of necrophagous flies, most commonly the green bottle fly (*Lucilia sericata*). MDT is primarily indicated for treating non-healing, infected, sloughy, and necrotic wounds, such as diabetic foot ulcers, pressure sores, and venous stasis ulcers (Sherman, 2019). The clinical efficacy of MDT relies on three concurrent mechanisms: biochemical debridement, antimicrobial action, and tissue regeneration. The larvae secrete a potent milieu of proteolytic enzymes that selectively liquefy necrotic tissue. Their excretions and secretions (ES) actively eradicate pathogens, including multidrug-resistant strains like MRSA. Concurrently, biochemical signals from the ES promote fibroblast migration and angiogenesis, rapidly accelerating wound closure (Sherman, 2019).

Cantharidin: From Chemical Defense to Clinical Dermatology

Cantharidin is a highly toxic, odorless, and colorless terpenoid synthesized by blister beetles (Family Meloidae). In modern clinical dermatology, cantharidin is deployed as a highly effective topical vesicant. It was approved by the FDA in 2004 for the treatment of specific cutaneous viral infections, most notably warts (*Verruca vulgaris*) and *Molluscum contagiosum*. When applied by a physician, cantharidin induces a controlled blister at the dermo-epidermal junction. As the blister heals, it lifts and sloughs off the virally infected keratinocytes without causing underlying tissue scarring. Beyond dermatology, oncological pharmacology is heavily investigating cantharidin and its synthetic analogues for significant antineoplastic activity against various carcinomas (Dutta et al., 2019).

Insect Antimicrobial Peptides (AMPs)

Unlike vertebrates, insects lack an adaptive, antibody-based immune system. Instead, they rely entirely on a rapid, robust innate immune response to survive in microbe-rich environments. The cornerstone of this defense is the production of Antimicrobial Peptides (AMPs)—short, positively charged sequences of amino acids that exhibit broad-spectrum efficacy against bacteria, fungi, viruses, and parasites. The pioneering discovery of insect AMPs occurred when the first peptide was isolated from the pupae of the giant silk moth

(*Hyalophora cecropia*) (Hancock et al., 2012). AMPs act primarily by binding to the negatively charged phospholipid bilayers of microbial cell membranes, forming pores that cause cell lysis and death. Because this mechanism targets fundamental structural components, it is exceedingly difficult for pathogens to develop resistance against AMPs. Notable classes include Cecropins, Defensins, and Drosomycin (first isolated from *Drosophila*) (Hancock et al., 2012).

Tables and Figures

Table 1: Key Insect-Derived Therapeutic Agents and Their Clinical Applications

Insect Source / Product	Primary Active Compound	Mechanism of Action	Clinical Indication
Honeybee (*Apis mellifera*)	Melittin (Bee Venom)	Inhibits NF-kB pathway, anti-inflammatory	Rheumatoid arthritis, pain syndromes
Green Bottle Fly (*Lucilia sericata*)	Proteolytic Enzymes & Lucifensin	Biochemical debridement, antimicrobial	Diabetic foot ulcers, necrotic wounds
Blister Beetles (Meloidae)	Cantharidin	Topical vesicant, PP2A inhibition	Verruca vulgaris, Molluscum contagiosum
Giant Silk Moth (*Hyalophora cecropia*)	Cecropins (AMPs)	Pore formation in microbial membranes	Broad-spectrum bacterial infections

Conclusion

Insects are unequivocally proving to be versatile contributors to commercial markets and modern healthcare, far beyond their traditional roles. With a growing global emphasis on sustainability and natural pharmacological solutions, insect-derived compounds are expected to play an increasingly vital role in drug discovery. The defensive molecules they have acquired over millennia of co-evolution represent a virtually limitless resource. By preserving insect biodiversity and investing in sustainable biotechnological manufacturing, entomotherapy offers a profound pathway to overcoming some of the 21st century's most pressing medical challenges, bridging the gap between ancient ethnomedicine and future pharmacology. Furthermore, I want to address the farming community directly regarding the immense potential highlighted in this article. As agriculturists, we often view insects solely as pests to be eradicated. However, they are a goldmine of biological and medical resources. By adopting sustainable farming practices, minimizing the indiscriminate use of harsh chemical pesticides, and actively preserving local insect biodiversity, we protect these invaluable species. As the demand for medical-grade insect products—such as specialized honey, propolis, and clinical larvae—continues to grow rapidly, farmers can explore new, highly profitable avenues through controlled, commercial insect rearing. This allows us to diversify farm income while simultaneously contributing to life-saving medical advancements for global healthcare.

References

1. Costa-Neto, E. M. (2018). Entomotherapy or the medicinal use of insects. Journal of Ethnobiology, 38, 93-114.
2. Dutta, P., Sahu, R. K., Dey, T., Lahkar, M. D., Manna, P., & Kalita, J. (2019). Beneficial role of insect-derived bioactive components against inflammation and its associated complications (colitis and arthritis) and cancer. Chemico-biological interactions, 313, 1-10.
3. Hancock, R. E., Nijnik, A., & Philpott, D. J. (2012). Modulating immunity as a therapy for bacterial infections. Nature Reviews Microbiology, 10, 243-254.

4. Pandey, M. M., Rastogi, S., & Rawat, A. K. S. (2013). Indian traditional ayurvedic system of medicine and nutritional supplementation. Evidence Based Complementary and Alternative Medicine, 1-12.
5. Sherman, R. A. (2019). Maggot therapy takes us back to the future of wound care: new and improved maggot therapy for the 21st century. Journal of Diabetes Science and Technology, 13, 336-344.
6. Zhang, S., Liu, Y., Ye, Y., Wang, X. R., Lin, L. T., Xiao, L. Y., & Liu, C. Z. (2018). Bee venom therapy: Potential mechanisms and therapeutic applications. Toxicon, 148, 64-73.