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Nature's Tiny Pharmacists: How Insects Are Revolutionizing Modern Medicine

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Insects, often regarded as pests or disease vectors, are increasingly recognized as valuable sources of therapeutic compounds with immense potential for modern medicine. The medicinal use of insects and their products, known as entomotherapy, has been practiced for centuries in traditional healthcare systems across India, China, Egypt, and other civilizations. Recent scientific advances have validated many of these practices by identifying insect-derived bioactive molecules with antimicrobial, antioxidant, anti-inflammatory, wound-healing, immunomodulatory, and anticancer properties. This article highlights the evolution of entomotherapy from ancient traditions to contemporary biomedical applications, focusing on the medicinal value of honey, propolis, royal jelly, bee venom, medicinal maggots, blister beetles, ant sutures, and insect-derived enzymes. These natural products have shown promising applications in wound management, infection control, dermatology, inflammatory disorders, and drug discovery. The article also discusses emerging research, the growing importance of insect-derived therapeutics in addressing antimicrobial resistance, and the need to conserve insect biodiversity as a source of future medicines. By integrating traditional knowledge with modern biotechnology, insects are emerging as an unexpected yet promising frontier in healthcare, offering sustainable and innovative solutions for some of the world's most pressing medical challenges.

Introduction: Looking Beyond the Sting

When most people think about insects, they imagine buzzing mosquitoes, crop-damaging pests, or painful bee stings. Few realize that these tiny creatures are also a rich source of medicinal compounds capable of healing chronic wounds, combating antibiotic-resistant infections, and even offering promising leads for cancer treatment (Costa-Neto, 2005; Ratcliffe et al., 2011).

The therapeutic use of insects and their products is known as entomotherapy. It involves using insects, their secretions, venoms, and other bioactive substances to prevent or treat diseases. Although modern research has renewed interest in this field, entomotherapy has been practiced for thousands of years in traditional medical systems of India, China, Egypt, Greece, and several indigenous cultures, where insects have long been valued for their healing properties (Costa-Neto, 2005; Srivastava et al., 2009).

Modern research is increasingly validating the medicinal value of insects, revealing a wealth of bioactive compounds such as antimicrobial peptides, enzymes, fatty acids, terpenoids, alkaloids, and venom proteins with antibacterial, antiviral, antifungal, anti-inflammatory, wound-healing, immunomodulatory, and anticancer properties (Ratcliffe et al., 2011; Bordon et al., 2020). As the most diverse group of animals, comprising nearly 80% of

known species, insects have evolved unique chemical defence systems that are now inspiring the development of novel pharmaceuticals (Leonhardt et al., 2020).

The global rise in antibiotic resistance has further intensified the search for insect-derived medicines. Many insect compounds have shown broad-spectrum activity against disease-causing microorganisms and hold promise as alternatives to conventional antibiotics (Ratcliffe et al., 2011). Beyond infectious diseases, insect-based products such as honey, propolis, royal jelly, bee venom, medicinal maggots, blister beetle compounds, and silkworm-derived enzymes are being explored for treating chronic wounds, inflammatory disorders, neurological diseases, diabetes, and certain cancers (Ratcliffe et al., 2011; Siddiqui et al., 2023).

Much of this scientific progress has its roots in traditional knowledge. For centuries, indigenous communities across Asia, Africa, and Latin America have used insects for healthcare, and many of these remedies are now being supported by modern research. In India, the medicinal use of honey, termites, ants, lac insects, and edible insects reflects a rich ethnomedicinal heritage with significant pharmaceutical potential (Srivastava et al., 2009; Mozhui et al., 2021). By bridging ancient wisdom with modern science, insects are emerging as an important source of safer, sustainable, and innovative medicines for the future.

A Journey Through History: From Ancient Remedies to Modern Science

The medicinal use of insects, known as entomotherapy, dates back more than 3,000 years, making it one of the oldest forms of natural medicine (Costa-Neto, 2005). Long before the advent of modern medicine, civilizations across the world relied on insects and their products to treat a variety of ailments.

Ancient Egyptians documented the medicinal use of insects in the Ebers Papyrus (1550 B.C.), while traditional Chinese medicine valued honey and silkworms as therapeutic agents and later described more than 70 medicinal insect species in the *Compendium of Materia Medica* (Feng et al., 2009). Greek and Roman physicians, including Dioscorides and Pliny the Elder, also recorded the use of bees, wasps, cicadas, and other insects for treating wounds, fevers, and infections (Costa-Neto, 2005).

In India, Ayurveda has long recognized Madhu (honey) for its wound-healing and therapeutic properties, while tribal communities have traditionally used honey, lac insects, termites, and other insects to manage various health conditions (Srivastava et al., 2009; Mozhui et al., 2021). Similarly, the ancient Maya civilization used live maggots to clean infected wounds a practice that has evolved into the modern clinical use of maggot therapy for chronic wound management (Ratcliffe et al., 2011).

These examples highlight how traditional knowledge has laid the foundation for many modern medical discoveries.

Traditional Entomotherapy: Nature's Pharmacy

For centuries, insects and their products have been used as natural medicines. Honey remains the best-known example, valued for treating wounds, burns, sore throats, digestive disorders, and skin infections. Modern studies have confirmed its antimicrobial, anti-inflammatory, and wound-healing properties (Bansal et al., 2005; Feng et al., 2009).

Other bee products, including propolis, royal jelly, bee pollen, and beeswax, are also recognized for their antimicrobial, antioxidant, anti-inflammatory, and nutritional benefits (Ratcliffe et al., 2011; de Silva et al., 2014). Traditional Chinese medicine employs medicinal insects such as silkworms and ants, while many indigenous communities in India continue to use insects to treat fever, wounds, respiratory illnesses, and digestive disorders (Srivastava et al., 2009; Mozhui et al., 2021).

Today, these traditional remedies are being scientifically investigated to identify their active compounds and develop safe, standardized therapies. The growing evidence suggests that insects are not merely components of traditional medicine but valuable sources of future pharmaceuticals.

Modern Entomotherapy: Ancient Wisdom Meets Modern Medicine

The emergence of antibiotic-resistant pathogens and chronic diseases has renewed scientific interest in entomotherapy. Researchers are increasingly exploring insects as a rich source of bioactive compounds with antimicrobial, antioxidant, anti-inflammatory, immunomodulatory, wound-healing, and anticancer properties, many of which show promise for developing safer and more effective medicines (Ratcliffe et al., 2011; Bordon et al., 2020; Siddiqui et al., 2023).

Maggot Therapy: Tiny Healers

One of the most successful examples of modern entomotherapy is maggot therapy, which uses sterile larvae of the green bottle fly (*Lucilia sericata*) to treat chronic wounds. These larvae selectively remove dead tissue, suppress harmful bacteria, and stimulate tissue regeneration, accelerating wound healing. Recognizing its effectiveness, the U.S. Food and Drug Administration (FDA) approved medicinal maggots for clinical use in 2004, and they are now used worldwide to manage diabetic ulcers and other non-healing wounds (Ratcliffe et al., 2011).

Apitherapy: Medicine from the Beehive

Honeybees contribute far more than pollination. Apitherapy, the therapeutic use of bee products, includes honey, propolis, royal jelly, bee pollen, and bee venom. Honey is widely recognized for its antimicrobial and wound-healing properties, while propolis exhibits antibacterial, antiviral, and anti-inflammatory activities. Royal jelly and bee pollen are valued for their antioxidant and nutritional benefits, whereas bee venom, particularly its active peptide melittin, is being investigated for treating inflammatory diseases and certain cancers (Bansal et al., 2005; Ratcliffe et al., 2011; da Silva et al., 2014; Uddin et al., 2016).

Other Promising Insect-Based Therapies

Nature offers several other remarkable insect-derived medicines. Cantharidin, obtained from blister beetles, is already used in dermatology to treat warts and is being explored for its anticancer potential (Zhang et al., 2017). Some indigenous communities traditionally used soldier ants as natural wound clips, demonstrating an ingenious form of biological surgery that inspired modern wound-closure techniques (Ratcliffe et al., 2011). Another promising compound is serrapeptase, an enzyme produced by bacteria associated with silkworms, which has shown anti-inflammatory and tissue-repair properties and is used as a therapeutic supplement for several inflammatory conditions (Ratcliffe et al., 2011).

Future Prospects

Advances in biotechnology, genomics, proteomics, and artificial intelligence are accelerating the discovery of novel insect-derived medicines (Bordon et al., 2020). Several compounds, including peptides isolated from wasp venom, have shown encouraging activity against cancer cells, highlighting the vast pharmaceutical potential of insect biodiversity (Ratcliffe et al., 2011). However, most insect-derived therapies still require extensive clinical validation, standardized production methods, and regulatory approval before they can be widely adopted (Siddiqui et al., 2023). Conserving insect diversity is therefore essential, as many species may harbor valuable medicinal compounds that remain undiscovered (Mozhui et al., 2021).

Conclusion

From ancient remedies to modern biomedical research, insects have emerged as an unexpected source of life-saving medicines. Products such as honey, medicinal maggots, bee venom, cantharidin, and insect-derived enzymes demonstrate the remarkable therapeutic potential hidden within the insect world. While further research is needed, growing scientific evidence suggests that insects are not merely pests but valuable allies in developing safer, sustainable, and innovative healthcare solutions. As science continues to unlock their chemical diversity, the next breakthrough medicine may well come from nature's smallest pharmacists.

References

1. Bansal, V., Medhi, B., & Pandhi, P. (2005). Honey--a remedy rediscovered and its therapeutic utility. *Kathmandu University medical journal (KUMJ)*, *3*(3), 305-309.
2. Bordon, K. D. C. F., Cologna, C. T., Fornari-Baldo, E. C., Pinheiro-Júnior, E. L., Cerni, F. A., Amorim, F. G., Amorim, F.G., Anjolette, F.A.P., Cordeiro, F.A., Wiezel, G.A., Cardoso, I.A. & Arantes, E. C. (2020). From animal poisons and venoms to medicines: achievements, challenges and perspectives in drug discovery. *Frontiers in pharmacology*, *11*, 1132.
3. Costa-Neto, E. M. (2005). Entomotherapy, or the medicinal use of insects. *Journal of Ethnobiology*, *25*(1), 93-114.
4. Feng, Y., Zhao, M., He, Z., Chen, Z., & Sun, L. (2009). Research and utilization of medicinal insects in China. *Entomological Research*, *39*(5), 313-316.
5. Leonhardt, S. D., Lihoreau, M., & Spaethe, J. (2020). Mechanisms of nutritional resource exploitation by insects. *Insects*, *11*(9), 570.
6. Mozhui, L., Kakati, L. N., & Meyer-Rochow, V. B. (2021). Entomotherapy: a study of medicinal insects of seven ethnic groups in Nagaland, North-East India. *Journal of Ethnobiology and Ethnomedicine*, *17*(1), 17.
7. Ratcliffe, N. A., Mello, C. B., Garcia, E. S., Butt, T. M., & Azambuja, P. (2011). Insect natural products and processes: new treatments for human disease. *Insect biochemistry and molecular biology*, *41*(10), 747-769.
8. Siddiqui, S. A., Li, C., Aidoo, O. F., Fernando, I., Haddad, M. A., Pereira, J. A., Blinov, A., Golik, A. & Câmara, J. S. (2023). Unravelling the potential of insects for medicinal purposes–A comprehensive review. *Heliyon*, *9*(5).
9. da Silva, G. R., da Natividade, T. B., Camara, C. A., da Silva, E. M. S., dos Santos, F. D. A. R., & Silva, T. M. S. (2014). Identification of sugar, amino acids and minerals from the pollen of Jandaíra stingless bees (Melipona subnitida). *Food and Nutrition Sciences*, *5*(11), 1015-1021.
10. Srivastava, S. K., Babu, N., & Pandey, H. (2009). Traditional insect bioprospecting-As human food and medicine. *Indian Journal of Traditional Knowledge*, *8*(4), 485-494.
11. Uddin, M. B., Lee, B. H., Nikapitiya, C., Kim, J. H., Kim, T. H., Lee, H. C., Kim, C.G., Lee, J.S. & Kim, C. J. (2016). Inhibitory effects of bee venom and its components against viruses in vitro and in vivo. *Journal of Microbiology*, *54*(12), 853-866.
12. Zhang, X., Lin, C. C., Chan, W. K. N., Liu, K. L., Yang, Z. J., & Zhang, H. Q. (2017). Augmented anticancer effects of cantharidin with liposomal encapsulation: in vitro and in vivo evaluation. *Molecules*, *22*(7), 1052.