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THERAPEUTIC POTENTIAL OF INSECTS IN MODERN MEDICINE: CURRENT ADVANCES AND CLINICAL PROSPECTS

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Abstract
Bugs are used in medicines for years, and they are also trending in the latest medical care. Entomotherapy is a term that means using bugs to cure medical issues. Countless bugs are making natural chemicals that promote healing and fight infection. Scientists have discovered that insects contain valuable substances that include enzymes, antimicrobial peptides, and other bioactive compounds. These substances help eliminate damaging bacteria, viruses, and parasites from the body. As a consequence, scientists think that the bugs may help humans in synthesizing innovative medicines. Many scientists have recently begun studying insects. Scientists try to identify the natural compound found in insects that will be helpful in drug making. Insects have various medicinal uses. The use of pests as herbal life is called. Some flies' larvae have served as a case study in maggot therapy. These larvae clean up infections in wounds by munching on dead tissue and preventing the growth of bad bacteria. It reduces the chance of infection at the injury site and speeds healing. Various products such as silk, honey and bee venom obtained from bugs have been used in medicine traditionally and now. Using honey for burns or wounds is a common practice. It is well known for its bacterial properties. All insect species produce a variety of substances exhibiting antibacterial, antifungal, and anti-inflammatory properties, making them an excellent source of new drug. Insects are a treasure trove of medical and drug research because of their incredible diversity and abundance in nature. To understand how insects create defensive compounds, researchers are continuously studying insect biology. As a result, it may be possible to use compounds in pharmaceuticals for use in humans. Medications of this sort may be useful for the treatment of diseases that are becoming difficult to treat.

Introduction

Insects are an important but underexplored resource for medicines. A brief history they are used directly or indirectly for medicinal purposes in many traditional medicinal systems such as Traditional Chinese Medicine and Ayurveda and African and Latin American traditional medicine. A few thousand years have known the medicinal use of insects or insect products to cure wounds and infections and respiratory, digestive, pain, inflammatory diseases, and other body conditions. Current Interest in Bug Therapy Researchers have realized recently that natural compounds can be an effective, safe, and cheaper bioactive chemical

agent Antibiotic resistance has increased in past years, and diseases have started to increase and reemerge and synthetic drugs are not effective as usual, hence researchers have a stronger reason to test natural alternatives to discover and develop drugs. One of these resources is insects because they have various (Costa-Neto & E. M. 2005).

Bioactive compounds found in medicinal insects

Insects are incredible and have given mankind resources vital to the health field, from aphids and cuttlefish for asthma to ending consumption. Many insects produce antimicrobial peptides (AMPs) that possess important medicinal properties. Numerous antimicrobial peptides have been isolated from insects like bees, wasps, ants, beetles and flies etc. The collection encompasses defensins, cecropins, attacins, ponericins, pyrrhocoricin, and also melittin (Hui-Yu Yi, 2014).

Over the years, insects have been sources of secondary metabolites and enzymes with medicinal potentials. Apart from antimicrobial peptides, insects generate several other types of peptides, including lipases and proteases. Peptides and other secondary metabolites in insects like phenolic compounds and alkaloids have medicinal properties. For instance, enzymes obtained from fly larvae can decompose decaying tissue and inhibit the bacteria growth. As a result, maggots are used for wound treatment. Propolis is high in phenolic compounds which exhibit antioxidant and anti-inflammatory properties. These substances destroy free radicals in the body and protect tissues from damage caused by oxidation (Dossey, A. T. 2010).

Worker honeybees are producing a number of substances which are being used commonly in the medical world. Along with the honey, beekeepers also collect propolis, royal jelly and bee venom. The natural sugars, enzymes, amino acids and antioxidants in honey give it healing and antimicrobial properties. The honeybees collect a sticky mixture from plants to produce propolis (Gallmann, P. 2008).

Therapeutic Applications

Bees and honey have been a staple in folk medicine for thousands of years. Honey is used to treat burns and wounds by preventing the growth of bacteria as well as tissue regeneration. The concept of bee venom therapy which gained a significant attention in the last decade has found usage in treating inflammatory diseases like arthritis and rheumatism and neurological diseases. Melittin is a honeybee venomous peptide (Sforcin, J. M. 2016).

Medicinal insects can be found in many parts of the world, including as Asia, Africa, Latin America, and parts of Europe. Numerous insect species have been used to cure ailments like infections, skin conditions, digestive problems, and inflammatory symptoms in traditional medical systems like Traditional Chinese Medicine (TCM), Ayurveda, and indigenous ethnomedicine. According to studies, traditional Chinese medicine alone has identified about 300 insect species from 13 different groups, including flies, blister beetles, wasps, bees, and silkworms. These insects' accessibility and usage as medicine by different individuals are impacted by the fact that they can be found in a range of habitats, such as tropical ecosystems, forests, and agricultural areas (Zhang et al., 2023).

Medicinal insects are found all over the world in Asia, Africa, Latin America and some parts of Europe. The use of many species of insect found in traditional medical system, such as, Traditional Chinese Medicine (TCM), Ayurveda, and the indigenous ethnomedicine has been extensive for patients suffering from infection, skin diseases, digestive disorders and inflammation. According to studies, traditional medicines in China alone rely on an installation that includes nearly three hundred species belonging to around thirteen groups of insects. Different types of people, e.g. indigenous people, use these insects for various medicines. These insects are easily available from different ecosystems, e.g. tropical ecosystem, forest and agricultural ecosystem. (Zhang et al. 2023).

The ecological factors affecting medicinal insect development includes climate, biodiversity and local culture of the area. Insects are utilized as a

remedy in many indigenous communities across the globe and are always available. The findings of various ethnobiological studies show that useful insects (like ants, beetles, bees, larvae, etc.) used by indigenous communities carry a range of bioactive chemicals that can cure a large number of ailments. It is true that various medicinal insect species are declining due to habitat loss and change in environment. This also threatens their availability in traditional medicine as well as future drug discovery. (Devi et al., 2024).

For millennia, honey was produced by honey bees, which was seen as a natural cure for various ailments and illnesses. Recent studies indicate that honey has some medicinal value due to various bioactive substances including enzymes, phenolic compounds, antioxidants, and antimicrobial peptides. These compounds give honey its antifungal, antibacterial, anti-inflammatory, and antioxidant properties that would help heal infections. As per findings, honey can prevent the growth of harmful bacteria. These include bacteria which do not respond to antibiotics such as *Pseudomonas aeruginosa* and *Staphylococcus aureus*. Due to these beneficial properties, honey is receiving increasing attention in modern medicine as complementary therapy or supplementary natural medicine (Ogwu & Izah, 2025).

Research has demonstrated that burns, wounds and ulcers heal more quickly when treated with honey. Honey seems to encourage the regeneration of new tissue while minimizing the bacterial content of the wound. Honey helps to heal a burn by keeping the skin hydrated, swelling down and speeding up new skin cells. Honey bandages are found to be an excellent therapy for burn injury, diabetic ulcer and other chronic wound (Rahmania, F., & Fawzy, A. 2024).

Treatment of Medical Conditions with Bee Venom

Bee venom therapy, also known as apitherapy, involves the use of Western honey bee venom. The venom of the bee exhibits pain-relieving effects as it contains four main components. Melittin is an important constituent which has powerful anti-inflammatory, antibacterial, and immune-regulating powers. Scientists are studying the use of bee venom, due to their bioactive compounds, to treat conditions such as neurological or inflammatory diseases as well as more disorders. Recent studies suggest that bee venom therapy could be a new natural alternative treatment for immune-related diseases, arthritis, and skin diseases (Stela et al., 2024; Morovvati et al., 2024). Recent study suggests that melittin, bee venom's major component, may be useful for treating cancer and/or neurological diseases. It has been indicated that melittin has neuroprotective properties, reduces inflammation, and inhibits the growth of different cancers. Researches are looking into other components of bee venom to see if they could be used for treatment of neurological diseases such as Parkinson's and Alzheimer's. Owing to a number of potential discoveries, including the treatment of breast cancer and other ailments, researchers are actively pursuing honeybee venom and its applications to the exploitation of bees. (Nguyen et al., 2024; Gajski et al., 2024).

Future Research

With ongoing resolution of the long-lasting ethical and environmental challenges, more attention in future insect-based therapy research must be given to optimization of manufacturing techniques and relevance and development of cross-disciplinary collaborations. To ensure these interventions are safe and effective for humans in communities, clinical trials will be necessary to build on preliminary information (Dube et al., 2024). To effectively utilize insect adaptations, future biomedical research must focus on a number of cutting-edge areas.

The development of genetically engineered insect biosensors with enhanced sensitivity and specificity and signal amplification based on nanotechnology, would be beneficial. Technological advancements in stabilization methods and custom-made delivery systems are necessary for compliance of ease of application. Maggots are not only useful for cleaning skin wounds, but their natural secretions can also be

harnessed to treat cancers and other serious diseases, writes an expert. Microbes, like bacteria and fungi, that live on or inside insects can be used to discover powerful new antibiotics, scientists have shown. The importance of this discovery is immediate, as many drugs currently are useless against antibiotic-resistant bacteria (Abbasi, 2026). Scientists are finding better and better ways to use insects in medicine and research. To illustrate, modern microscopes can help people see how the brains of bees and ants work. Bioengineering will transform medicine delivery through insects as an effective substance provider. Insect hunting or cultivation methods involve killing millions of insects to obtain very negligible amounts of venom or silk, which is slow, cost-heavy and hard to scale. Scientists are able to bioengineer. Scientists can use synthetic biology to take the genetic blueprint for useful insect chemicals, such as melittin from bee venom, or chitin from shells. We can educate tiny microbes, such as bacteria and yeast, to develop in a lab setting. As this method is a sure supply of medicine, it offers a game changing approach at a lesser price. This finally makes insect-based medicines a viable option for traditional treatment (Al-Khikani et al., 2025).

Demand for medical grade honey:

Honey is a highly sophisticated medicine. We cannot treat the hospital patients by just using a jar from a market. Some honeys have distinct chemical properties so we need to focus on specific honeys. The honey that eliminates bacteria or cures cancer must conduct standardization which is required so any clinician exactly will know what to expect from using the honey in health treatment. Honey occupies an important place in the health tradition as early as the first century, honey was used as a wound dressing. In summary, honey contains a variety of compounds that contribute to its uniqueness and health benefits (Koo et al., 2024).

Conclusion

Insects could give us new ways of tackle anything from enduring aches to resisting infections that no longer respond to our drugs. Our bodies can utilize the rich chemical library of insects. There are still challenges and limitations have arisen in their usage progress in Medicine. Advanced research may help us overcome these challenges and unlock the medical potential that insects can show in the health care industry. Insects could be the inspiration behind the next generation of life-saving medicine if researchers can harness their potential.

REFERENCES

Abbasi, E. (2026). The role of insects in future medicine: Diagnostic and therapeutic potential of insect-derived biomolecules and microbiota. Entomologia Experimentalis et Applicata, 174(1), 1-15. https://doi.org/10.1111/eea.70033

Al-Khikani, F. H. O., Hilal, S. M., & Ayit, A. S. (2025). Medical applications of insects: A global perspective with future insights and innovative ideas. World News of Natural Sciences, 60, 205-216.

Altman, G. H., Diaz, F., Jakuba, C., Calabro, T., Horan, R. L., Chen, J., Lu, H., Richmond, J., & Kaplan, D. L. (2003). Silk-based biomaterials. Biomaterials, 24(3), 401–416.

Bazali´nski, D.;Przybek-Mita, J.; Pytlak, K.; Kardy´s,D.; Bazali´nski, A.; Kucharzewski, M.;Wi ˛ech, P. Larval Wound Therapy:Possibilities and Potential Limitations—A Literature Review. J.Clin. Med. 2023, 12, 6862. https://doi.org/10.3390/jcm12216862

Belluco, S.; Bertola, M.;Montarsi, F.; Di Martino, G.; Granato,A.; Stella, R.; Martinello, M.; Bordin,F.; Mutinelli, F. Insects and Public Health: An Overview. Insects 2023,14, 240. https://doi.org/10.3390/insects14030240

Bogdanov, S., Jurendic, T., Sieber, R., & Gallmann, P. (2008). Honey for Nutrition and Health: A Review. *Journal of the American College of Nutrition*, *27*(6), 677–689. https://doi.org/10.1080/07315724.2008.10719745

Bucciarelli, A., & Motta, A. (2022). Use of Bombyx mori silk fibroin in tissue engineering: From cocoons to medical devices, challenges, and future perspectives. Biomaterials Advances, 139, 212982.

Cengiz, M. M., Bektaş, M., Babagil, A., Nadaroğlu, H., & Bariş, Ö. (2024). Experimental applications of natural and technological drugs with honey bees: Status, opportunities and challenges. Arı ve Arıcılık Teknolojileri Dergisi - The Journal of Bee and Beekeeping Technologies, 3(2), 64-71.

Costa-Neto, E. M. (2005). Entomotherapy, or the Medicinal Use of Insects. *Journal of Ethnobiology*, *25*(1), 93-114.

Devi, W. D., Bonysana, R., Singh, K. D., Koijam, A. S., & Mukherjee, P. K. (2024). Bio-economic potential of ethno-entomophagy and its therapeutics in India. *npj Science of Food, 8*, 1–10.

Dube, P. N., Thombare, Y. B., Aher, S. B., & Jadhav, S. A. (2024). The role of insects in Medicine: Unlocking novel treatments and bioactive compounds. International Journal of Entomology Research, 9(12), 116-119.

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 and cancer. Chemico-Biological Interactions, 313, 108824. https://doi.org/10.1016/j.cbi.2019.108824

Erler, S., Cotter, S. C., Freitak, D., Koch, H., Palmer-Young, E. C., de Roode, J. C., Smilanich, A. M., & Lattorff, H. M. G. (2024). Insects' essential role in understanding and broadening animal medication. *Trends in Parasitology, 40*(4), 338–349. https://doi.org/10.1016/j.pt.2024.02.003.

Insect natural products and processes: New treatments for human disease. *Insect Biochemistry and Molecular Biology, 41*(10), 747–769. https://doi.org/10.1016/j.ibmb.2011.05.007.

Koo, T. H., Zakaria, A. D., & Mustafa, M. Z. (2024). Honey clinical applications in complementary medicine: A critical review. Journal of Pharmacy & Pharmacognosy Research, 12(6), 1040-1055. https://doi.org/10.56499/jppres24.1870

Maurice-Lira, J. V. (2025). Antimicrobial-producing microorganisms in fungus-farming ants: A critical review on insights into a natural biological defense with biotechnological potential. Annals of the Entomological Society of America, 118(1),

Mohd Zubir, M. Z., Holloway, S., & Mohd Noor, N. (2020). Maggot Therapy in Wound Healing: A Systematic Review. *International Journal of Environmental Research and Public Health*, *17*(17), 6103. https://doi.org/10.3390/ijerph17176103

Mora-Román, J. J., Calderón-Arguedas, S., Esquivel-Solano, A., Rojas-Salas, M. F., González-Corrales, D., Matarrita-Brenes, D., & Madrigal-Redondo, G. (2022). Potential applications of drugs obtained from insect venoms. IAR Journal of Pharmacy, 3(1), 1– https://doi.org/10.47310/iarjp.2022.v03i01.002

Morovvati, H., Keyhan, H., Koohi, M. K., & Hassan, J. (2024). Bee Venom and Its Therapeutic Uses. Journal of Apitherapy and Nature, 7(2), 65-84. https://doi.org/10.35206/jan.1378226

Nguyen, C. D., Yoo, J., Jeong, S. J., et al. (2024). Melittin—the main component of bee venom: A promising therapeutic agent for neuroprotection. *Chinese Medicine, 19*, 166

Ogwu, M. C., & Izah, S. C. (2025). Honey as a Natural Antimicrobial. *Antibiotics*, *14*(3), 255. https://doi.org/10.3390/antibiotics14030255

Penick, C. A., et al. (2025). Dual strategies in ant antimicrobial defences: Evidence for chemical diversity and microbial specificity. Biological Journal of the Linnean Society, 146(4).

Quah, Y., Tong, S.-R., Bojarska, J., Giller, K., Tan, S.-A., Ziora, Z. M., Esatbeyoglu, T., & Chai, T.-T. (2023). Bioactive Peptide Discovery from Edible Insects for Potential Applications in Human Health and Agriculture. *Molecules*, *28*(3), 1233. https://doi.org/10.3390/molecules28031233.

Rahman, M. M., et al. (2023). Unravelling the potential of insects for medicinal purposes: A comprehensive review. Heliyon, 9(5), e15938. https://doi.org/10.1016/j.heliyon.2023.e15938

Rahmania, F., & Fawzy, A. (2024). Efficacy of Honey-Based Wound Dressing Versus Hydrogel-Based Wound Dressing in Wound Healing Process: A Literature Review. *International Journal of Medical Science and Clinical Research Studies*, *4*(05), 812–817. https://doi.org/10.47191/ijmscrs/v4-i05-05

Sforcin, J. M. (2016) Biological Properties and Therapeutic Applications of Propolis. Phytother. Res., 30: 894–905. doi: 10.1002/ptr.5605.

Siddiqui, S. A., Li, C., Aidoo, O. F., Fernando, I., Haddad, M. A., Pereira, J. A. M., Blinov, A., Golik, A., & Câmara, J. S. (2023). Unravelling the potential of insects for medicinal purposes: A comprehensive review. *Heliyon*, *9*(5), e15938. https://doi.org/10.1016/j.heliyon.2023.e15938.

Stela, M., Cichon, N., Spławska, A., Szyposzynska, M., & Bijak, M. (2024). Therapeutic Potential and Mechanisms of Bee Venom Therapy: A Comprehensive Review of Apitoxin Applications and Safety Enhancement Strategies. *Pharmaceuticals*, *17*(9), 1211. https://doi.org/10.3390/ph17091211

Sun, X. J., Chen, J. A., Li, G., Wang, L., Wang, T. Y., & Wang, A. P. (2024). Maggot debridement therapy stimulates wound healing by altering macrophage activation. *International wound journal*, *21*(3), e14477. https://doi.org/10.1111/iwj.

Zhang E, Ji X, Ouyang F, Lei Y, Deng S, Rong H, Deng X and Shen H (2023) A minireview of the medicinal and edible insects from the traditional Chinese medicine (TCM). Front. Pharmacol. 14:1125600. doi: 10.3389/fphar.2023.1125600

Zhang, X., Yang, Z., Yang, X., Zhang, F., & Pan, Z. (2023). Sustainable antibacterial surgical suture based on recycled silk resource by an internal combination of inorganic nanomaterials. ACS Applied Materials & Interfaces, 15(25), 29971–29981.