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Ethnomedicine and the Future of Entomotherapy: Navigating Traditional Practices in a Changing World

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Abstract

Modern pharmacognosy faces a critical crisis of mounting antimicrobial resistance and novel therapeutic agents to combat it. However, entomotherapy which represents a critical but historically marginalized component of global ethnomedicine offers unprecedented pharmacological potential and yield diverse bioactive compounds with potent analgesic, antibacterial, and immunological properties that could address this bottleneck. This review aims to systemically evaluate the intersection of traditional entomotherapeutic practices and contemporary scientific validation, to identify viable pathways for modern drug discovery. The literature search was conducted on Google Scholar database using keywords such as entomotherapy, ethnomedicine and insect active compounds. The search yielded over 200 peer-reviewed published articles and citations, which were critically analyzed for this review. The scope of this study encompasses global traditional entomotherapeutic practices, focusing specifically on insect-derived bioactive compounds demonstrating documented analgesic, antibacterial, and immunomodulatory properties, as well as the ethical and ecological challenges of their modern integration. The significance of this work lies in establishing a balanced framework that ethically pairs indigenous wisdom with advanced biotechnological evaluation. By championing sustainable conservation practices like entomoculture, this review demonstrates how the scientific community can exploit the vast, untapped chemical landscape of insects to combat global health crises while actively safeguarding cultural heritage and fragile forest ecosystems.

Keywords: Ethnomedicine, Traditional Ecological Knowledge (TEK), Pharmacognosy, Antimicrobial Peptides, Biodiversity Conservation

INTRODUCTION

The potential of forest resources, as a veritable source of pharmaceutical and therapeutic materials, has been greatly emphasized among these resource are insects. Insects have been historically viewed through the lens of agriculture or ecology, however, their intersection with human health, nutrition, and global environmental shifts has become a major focus of modern research. Through practices such as entomotherapy, the medicinal and/or therapeutic use of insects and insect-derived products (Chantawannakul, 2020; Siddiqui *et al.*, 2023). This includes ancient folk practices as well as modern clinical applications, such as maggot debridement therapy, bee venom therapy (apitoxin) and use of cantharidan from blisters beetles to target specific infections or tumours (Siddiqui *et al.*, 2023) This is different from entomophagy which is the practice of consuming insects as a source of food and dietary nutrition (Chakravorty et al., 2011; Chantawannakul, 2020; Lange & Nakamura, 2021).

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Entomotherapy

As the global healthcare landscape shifts toward sustainable and holistic solutions, entomotherapy offers unique pharmacological potential. Recent research has identified a vast array of insect-derived compounds with potent immunological, analgesic, antibacterial, and anti-inflammatory properties (Siddiqui et al. 2023). Beyond their chemical utility, insects are integral to ecological health, acting as pollinators, decomposers, and biocontrol agents. Consequently, the study of entomotherapy is no longer merely an anthropological curiosity; it is a critical intersection of biodiversity conservation, pharmacological innovation, and sustainable development

Decline in Insect Population

On a global scale, terrestrial insect abundance is estimated to be dropping by approximately 1% to 2% per year. This seemingly small percentage compounds rapidly, translating to a devastating 10% or greater loss of insect abundance per decade in heavily impacted regions. A multi-decade studies from Germany, documented a shocking 75% to 82% seasonal decline in flying insect biomass within protected nature reserves over a 27-year period (Hallmann et al. 2017). Over 40% of insect species are threatened with extinction (Sánchez-Bayo & Wyckhuys, 2019)

Traditional Ecological Knowledge

The decline of the global insect population, driven by climate change, habitat loss, and intensive agricultural practices, as well as socio-economic shifts and a lack of formal documentation, threatens the availability of these medicinal resources and the intergenerational transmission of traditional ecological knowledge (TEK) (UNESCO, 2026). The loss of this knowledge poses a significant barrier to the discovery of novel therapeutic agents to address the escalating burden of human disease (Kemprai *et al*., 2026; Mbanjwa, 2026). This review navigates the evolving landscape of entomotherapy by examining the interplay between ancient ethnomedical wisdom and modern biotechnological advancement. This framework recognises indigenous knowledge as a valid, rigorous system that, when integrated with standardized pharmacological evaluation and ethical conservation strategies, can offer an innovative pathway.

METHODOLOGY

A comprehensive literature search was conducted across using Boolean Search strategy on PubMed and Google Scholar databases with keywords such as "entomotherapy," "ethnomedicine," "insect bioactive compounds," and "pharmacognosy." This review focuses on peer-reviewed qualitative and quantitative studies that detail traditional human ethnomedicine, entomotherapy, and their modern adaptations. It excludes purely agricultural studies, entomophagy research without a medicinal context, animal-only laboratory models lacking traditional ties, and non-peer-reviewed sources like commercial blogs.

RESULTS

Traditional Entomotherapy

This practice explores the ancestral roots of entomotherapy, documenting the diverse ways in which indigenous cultures have historically utilised insect species to treat human ailments through specialised preparations and localised medicinal systems.

Ants Therapy

Ants are social insects that live in large colonies, and one of the problems with overcrowding is the spread of infections, which can spread rapidly in the colony. In order to avert and control the outbreak of infection, ants produce substances that are antimicrobial. Recent reviews confirm that secretions from the metapleural glands of various ant species, including the giant Australian bull-ant (*Myrmecia nigriscapa*) and *Myrmecia gulosa*, strongly inhibit the growth of fungi through specialized compounds like phenylacetic acid (Fernández-Marín et al., 2006; Yek et al., 2012).

Ants combined with other medicinal herbs are used to increase blood circulation and metabolism, boost the immunological system, and alleviate rheumatoid arthritis (Cheng et al., 2020). Modern pharmacological analyses buttress the use of extracts from black ants (such as *Polyrhachis lamellidens*) as functional medicine for patients suffering from rheumatoid arthritis, chronic hepatitis, and as an immunopotentiator to assist in cancer management by enhancing white blood cell functions (Cheng et al., 2020; Seabrooks & Hu, 2017). Furthermore, specific species like the black ant (*Bothroponera rufipes*) continue to feature prominently in traditional medicine for treating various ailments, including scabies, boils, wounds, dysentery, chest pain, high blood pressure, malaria, and rheumatic diseases (Chakravorty et al., 2011; Meyer-Rochow, 2017). Traditional entomotherapy also encompasses the use of trembling red ants during childbirth and for respiratory distress (Meyer-Rochow, 2017).

Honey produced by honey ants (*Myrmecocystus* spp.) is applied directly as a therapeutic pomade for eye diseases, cataracts, or iris growths (pterygia), while the complex anti-inflammatory peptides found in the venom of *Pogonomyrmex* spp. are utilized via controlled stings to treat rheumatic diseases, arthritis, and paralysis symptoms (Santos et al., 2021; Seabrooks & Hu, 2017). Additionally, the use of live ants in operative surgery dates back thousands of years; historical records and biomimetic evaluations highlight how the powerful mandibles of specialized soldier ants (such as *Atta laevigata*) serve as highly effective surgical clamps to approximate wound margins, while bactericidal secretions from their exocrine glands simultaneously prevent localized infection (Brito et al., 2021; Săvulescu et al., 2022). Broadly, ant-derived biocompounds continue to demonstrate profound clinical potential in reducing inflammation, alleviating pain, and managing respiratory spasms like asthma (Santos et al., 2021; Seabrooks & Hu, 2017).

Bees and Bee Product Therapy

Apitherapy uses honey, bee venom, hive air, pollen, propolis, royal jelly, wax, and live stings to modulate inflammation, immunity, pain, and wound healing (El-Didamony *et al.*, 2024; Papa *et al.*, 2022). More than 7000 treatment successes with bee products have been reported by one of the foremost protagonists of apitherapy (Lee *et al.*, 2005). Bees were used to tell if a person was dead or in a coma because bees would not sting a corpse, and there would not be any inflammation if they were made to sting. The Honey of *Apis indica* is used for the treatment of headache, mouth ulcer, burns, cough, asthma, chest infection, throat pain, body pain, fungal infection, cold, insect bite, conjunctivitis, and for general good health (Wilsanand *et al.,* 2007). Chakravorty *et al.* (2011) also reported that concoction of roasted bee powder mixed with honey is used for the treatment of boils, snake bites, and cough. Honey is considered to soothe inflamed membranes of the mucus-secreting tissue of the upper respiratory tract and to relieve irritating symptoms that lead to difficulties in swallowing.

Honey seems to be the most widely used of all bee products. Its uses are common among many cultures in Africa, Asia, and Europe. Honey has been applied in different treatments such as skin grafting, surgical debridement, and even amputation (Efem, 1988). It promotes healing where conventional treatment has failed. In Nigeria, honey mixed with lemon/lime is used to treat cough and sore throat. It is also used in post-surgery wound treatments. El-Kamali (2000) reported the use of honey in the treatment of hepatic and gastrointestinal disorders, gastric ulcers, and wound healing. Traditional healers very often prescribe honey as a medium for all kinds of plant-derived medicines. The honey of *Partamona spp.* and *Melipona scutellaris* is used to treat sore throats, bites from snakes and rabid dogs. Honey is consumed as a food supplement to treat digestive problems and as a general health restorative. The honey (Virgin honey) of the *Trigona* spp. is used for regulating menstruation, decreasing post-childbirth aches, and as a health restorative in elders (Conconi and Moreno, 1988; Chakravorty *et al.*, 2011). Different species of bees feed on different plant species; the components of their honey will differ, and this explains the different uses of different species for varying ailments.

Propolis**,** a resinous substance collected from the buds of some trees and flowers by bees has a wide therapeutic spectrum, ranging from anti-inflammatory to antifungal, antibacterial, anti-tumour, anti-allergic, and wound healing properties. It is a natural remedy that has been employed since ancient times (Hellner, 2007). According to Castaldo and Capasso (2002), the pharmacologically active molecules in propolis have multiple effects on bacteria, protozoa, fungi, and viruses. Propolis is similar to aspirin in its functions without its side effects. Although propolis inhibits the growth of the bifidobacteria, it did have a desirable influence on the release of acetic, propionic, and butyric acids. In humans, these fatty acids are generated during the fermentation of various substrates in the colon that play an essential role in maintaining balanced health.

Royal jelly is a thick milky mix of nutrients, which is produced from a combination of honey and pollen. Ancient Mexicans used it to re-establish healthy conditions in cases of anaemia (Conconi and Moreno, 1988). It is also used for asthma, anorexia, gastrointestinal ulcers, arteriosclerosis, hypo- or hypertension, and neurasthenia or inhibition of sexual libido.

Bee venom has, for more than a century, been utilized intramuscularly through direct stings of live bees to treat parts of the human body afflicted by arthritis, rheumatism, and polyneuritis. Other uses include neuralgias, multiple sclerosis, desensitization to bee stings (venom immunotherapy), tendonitis and tendosynovitis, and muscle conditions such as fibromyositis and enthesitis.

Crickets Therapy

Crickets are frequently recommended for illnesses of the throat and ears (Berenbaum, 1995; Meyer-Rochow, 2017). In south-western Nigeria, an infected foot is treated by smearing and rubbing the gut contents of mole crickets (*Gryllotalpa africana*) on it. Barren women mix burnt mole crickets (*Gryllotalpa africana*) with special soup to increase their chances of getting pregnant (Fasoranti, 1997). *Brachytrupes spp.* are consumed as food to aid mental development and for pre- and postnatal care (Banjo *et al.*, 2003). *Acheta domesitica* legs are crushed, mixed with water, and taken as a powerful diuretic to treat dropsy (Conconi and Moreno, 1988; Dhar, et al., 2024). Crickets are also used to cure stuttering (Antonio, 1994). The paste of *Gryllotalpa Gryllotalpa* is used in the relief of sprains by rubbing it on the affected area (Wilsanand *et al.*, 2007; Seabrooks, L., & Hu, L. (2017).

Beetles Therapy

Early Europeans used powdered ladybird beetles to relieve toothache and to cure measles and colic. Whirligig and rhinoceros beetles were used in preparations to increase libido, and one Javanese click beetle is the primary ingredient of a particularly sexually stimulating potion. Japanese folk medicine incorporated species from several beetles to treat conditions such as convulsions, cancer, hydrophobia, and hemorrhoids. *Palembus dermestoides* is usually used to treat asthma, arthritis, tuberculosis, and sexual impotence (Costa-Neto, 2005). *Strategus aloeus* and *Lytta vesicatoria* are best known for their purported qualities as aphrodisiacs.

Water beetles are used by women of East Africa to stimulate breast growth. They allow the beetles to bite their breasts in the belief that this will stimulate breast growth (Kutalek and Kassa, 2005). This seems to have a scientific basis, as Beetles are known to have a plethora of biologically active chemical compounds. They are preeminent in the biosynthesis of steroids. About 20 steroids have been identified as prothoracic gland products of species in the family Dytiscidae, and many of these compounds are either identical to vertebrate steroids or constitute unique triterpenes that are closely related to these hormones.

Blister beetles, *Mylarbris spp*., are used in treating boils, fungal infection, gonorrhoea, lymphangitis, neoplasm, rabies, syphilis, oedema, and facial paralysis due to stroke. The larvae of the Scarab beetle are prescribed for liver cirrhosis, while the diving beetle (*Cybister tripunctatus*) is a good medicine for polyuria, enuresis in children (nocturnal urination), and all types of blood stasis (Pemberton, 1999).
Coloured beetles in the genus *Paederus*, contain a powerful vesicant that is detected when the beetles are crushed. The major vesicant produced by these beetles is pederin, which is a powerful inhibitor of protein synthesis and mitosis at very low concentrations; it has the remarkable ability to promote the healing of dermal lesions such as bed sores (Nasir et al., 2015)

Termites Therapy

Mandibles of termite soldiers (*Termes bellicosus*) are used to suture wounds, *Cubitermes* spp. is used to cure heart pains, while *Macrotermes* spp. is used to treat child malnutrition (Mbata, 1991). Termites are used to treat rheumatic diseases, body pain, and anaemia. Winged termites are ground into powder and mixed with milk and taken at any time to improve health as well as to get rid of body pain. They can also be fried before grinding them into powder and then administered orally for rheumatic diseases (Wilsanand *et al.*, 2007).

Termites are used to treat internal haemorrhage and to heal haemorrhage from a wound. *Brachygaslra mellifica* mixed with honey forms an eye drop for treating cataracts (Conconi and Moreno, 1988). Antonio (1994) also reported that soldier termites, in combination with tobacco leaves, are used in reviving someone who has fallen into syncope. Table 1 shows therapeutic uses of insect and insect products in different cultures.

Table 1. Therapeutic uses of insects and insect products.

Insects	Parts used	Indications	Prescription	Literature Source
Schistocerca spp (Locusts)	Whole Organism	Post-natal anaemia, asthma and chronic cough	Pulverize and eat (Mexico)	Conconi and Moreno (1988)
Gryllotalpa africana (Mole Crickets)	Adults	Infections: retention of urine, edema, urolithiasis (stones in bladder), lymphangitis, furuncles	Smear the gut contents on the infected part and rub in (Nigeria)	Fasoranti, (1997) Pemberton, (1999)
Phasmida (Walking sticks)	Excreta	Asthma, upset stomach, and muscle pain	Dry and mix with herbs	Boyle (1992)
Boophilus microplus (Tick)	Whole organism	Chickenpox	Bake and eat (In China)	Morge (1973)
Cockroaches		Boils and other wounds.		Mbata (1991)
Triatoma spp. (Bloodsucker bug) Pentatomidae (Stinkbug)	Male	All kinds of heart diseases Unblock noses	Make into tea Crush (Brazil)	Costa-Neto and Melo (1999)
Tegenaria domestica (House spider)	Web	Heal Contusions	Web is applied to wounds and bruises	Quave et al., (2010)
Lampyris spp. (Firefly)	Body	Breaking up kidney stones; haemorrhoids		Lev (2003)
Ephemera danica (Mayfly)	Nymph	Stomach disturbance	Nymphs are roasted or boiled (South India)	Chakravorty *et al.*, (2011)

Conventional Entomotherapy

This examines the modern scientific framework, focusing on how contemporary laboratory practices, such as molecular characterisation and clinical trials, are actively isolating and validating the bioactive compounds responsible for the traditional therapeutic effects of insects.

Maggot Therapy

The application of live larvae to heal open, infected, chronic, and/or necrotic wounds, particularly those associated with diabetic or vascular ulcers, whose treatments by conventional approaches often fail, is termed maggot therapy. This simple and highly successful therapy has received renewed attention because it combines some advantages, such as efficacy, an excellent safety record, and low costs**.** To apply this therapy, a wound-sized hole is cut out of a hydrocolloid dressing. This both protects the skin from irritation by the maggot's proteolytic enzymes and forms the base of the adhesive dressing (Sherman, 2022). The sterile maggots are then moved from their container onto a special piece of nylon netting placed on a non-woven swab to draw away moisture. Dressing is usually kept air permeable because maggots require oxygen to live (Sherman, 2022). To remove necrotic tissue, larvae produce a mixture of proteolytic enzymes that break down the necrotic tissue to a semi-liquid form, which can then be absorbed and digested (Cutteridge & Bera, 2021). Debridement is also facilitated by wound disturbance as the larvae crawl around the tissue using their mouth hooks (Cutteridge & Bera, 2021).

Larvae produce antibacterial chemicals that are designed for self-defence. It is also believed that they ingest microorganisms, which are then destroyed in their gut (Nigam & Wilson, 2022; Valachova et al., 2014). The movement of larvae in wounds stimulates the production of serous exudate and the release of compounds in larval secretions such as ammonium bicarbonate, calcium, allantoin, and urea that inhibit bacterial growth and alter the pH (Whitaker *et al*., 2007). *Proteus mirabilis*, a commensal bacterium of the larval gut, also contributes to the antibacterial effect of the larvae. They produced phenylacetic acid and phenylacetaldehyde, which are antibacterial (Nigam & Wilson, 2022; Valachova et al., 2014). Micro-massage of the wound by maggots' movement stimulates the formation of granulation tissue. Several substances secreted by maggots have been found to stimulate wound healing, with larval secretions inducing fibroblast migration into the wound space, facilitating tissue regeneration (Horobin, *et al.*, 2003).

In vitro, live maggots kill or inhibit the growth of a range of pathogenic bacteria, especially Methicillin-Resistant *Staphylococcus aureus* (MRSA), and Group A and B streptococci and Gram-positive aerobic and anaerobic strains. They show some activity against *Pseudomonas* species but none against *Escherichia coli or Proteus spp.* (Bonn, 2000). As a result of these mechanisms, maggots eliminate odours and kill malignant tissue, producing a clean wound, free from necrotic residues.

In maggot therapy, a large number of small maggots selectively consume only necrotic tissue far more precisely than is possible in a normal surgical operation, and can débride a wound in a day or more, depending on the size of the wound. Maggots do not damage healthy tissue; rather, they operate with precision at the boundary between healthy and necrotic tissue. They derive nutrients through a process known as extracorporeal digestion by secreting a broad spectrum of proteolytic enzymes that liquefy necrotic tissue and absorb the semi-liquid result within a short time.

Vaccine Formulations

Haematophagus arthropods have evolved mechanisms to bypass the vertebrate haemostatic system in order to feed. Their saliva contains different chemicals that are immunomodulatory. The main activities of these compounds are vasodilation, inhibition of platelet aggregation, and inhibition of the blood-coagulating cascade. This wide variety of bioactive molecules apparently contained in the saliva of blood-sucking insects, is of general clinical therapeutic interest. For instance, the salivary components of mosquitoes are becoming better characterized, and there exist in the mosquito saliva vasodilators, apyrases, amylases, and other tissue regulatory factors. Valenzuela *et al.* (2001) successfully used Maxadilan, a vasodilator from sand fly (*Lutzomyia longipalpis*), as a vaccine to control Leishmania infection in mice.

Cantharidin

Cantharidin, a defensive compound found in the heamolymph of blister beetles, is highly toxic to humans, but in smaller doses, it can cause severe gastroenteritis and irreversible kidney damage. In spite of its toxicity, cantharidin extracted from *Lytta vesicatoria* and other blister beetles has been used to treat epilepsy, sterility, asthma, rabies, and lesions resulting from gonorrhoea and molluscum contagiosum (Silverberg *et al.*, 2000; Day *et al.*, 2001). The demethylated form, Norcantharidin, is less toxic to mucous membranes and is now being applied routinely as an anticancer drug against hepatoma and in treatment against human colorectal carcinoma (Chen *et al.*, 2002; Peng *et al.*, 2002; McCluskey *et al.*, 2003).

Silk

Silk is a fine fibre usually secreted by silkworm moths, used in cocoon formation, nest building, traps, web formation, safety lines, and egg protection. Silk is a natural protein that is made up of sericin and fibroin. The unique feature of silk includes antibacterial, UV-resistant, ability to absorb and release moisture easily, resists oxidation, and inhibits the activities of tyrosine and kinase. Silk fibre is also well known for its water absorbency, dyeing affinity, heat tolerance, insulating properties, and lustre, making it a promising biomaterial for many clinical functions (Mondal *et al.*, 2007; Vepari and Kaplan, 2007; Sobajo *et al.*, 2008).

The clinical success of silk sutures and the availability of silkworm silk have encouraged a recent expansion of new biomaterials generated from the original suture-based protein harvested and processed from silkworms. Native silk fibres can be processed into wire ropes and non-woven silk mats. The same fibres can be solubilised and regenerated in aqueous solution, then further processed into sponges, films, hydrogels, and nanoscale electrospun non-woven mats. Silk scaffolds, which are used for various medical applications, are usually produced using fibroin. Sericin removal, regenerated silk fibre (SF) has been reported to have good biocompatibility, heamocompatibility, oxygen and water permeability as well as minimal inflammatory reaction (Santin *et al.*, 1999; Sugihara *et al.*, 2000; Meinel, *et al.*, 2005).

Silk fibroin scaffolds have been applied in wound dressings as Sponge, bone tissue engineering as sponge, film, hydrogel, non-woven mat; Cartilage tissue engineering as porous sponge and hydrogel, ligament tissue engineering as fibre, tendon tissue engineering as fibres, hepatic tissue engineering as films, connective tissue as non-woven mats, endothelial and blood vessel as non-woven mats and anti-thrombogenesis as film (Vepari and Kaplan, 2007).

Other Potential Applications of Insect Products

The discovery of maxidilian in the saliva of biting sand flies has been very exciting, and it is the most potent vasodilator known to science. Tick salivary anticoagulant has been explored as a model agent to prevent undesired blood clotting during open heart surgery (Jones 1998). Active pharmacologic substances synthesized from arthropods or their synthetic analogs are presently being used in medical field. Konno *et al.* (1998) reported that the venoms of the solitary wasps, *Anoplius samariensis* and *Pseudagenia* (*Batozonellus*) *maculifrons*, may be useful not only for basic neuroscience research but also for the development of therapeutic agents for neurological disorders.

Chemical screening of 14 insect species has shown the presence of proteins, terpenoids (triterpenoids and steroids, carotenoids, iridoids, tropolones), sugars, polyols and mucilages, saponins, polyphenolic glycosides, quinones, anthraquinone glycosides, cyanogenic glycosides, and alkaloids (Sánchez-Estrada et al., 2024; Seabrooks & Hu, 2017).

Systematic survey of biologically active substances in solitary wasp venoms has identified novel peptide neurotoxins, pompilidotoxins (PMTXs), from the venom of the spider wasps *Anoplius samariensis* and *Pseudagenia* (*Batozonellus*) *maculifrons* (Konno *et al.*, 1998). These toxins may be useful for basic neuroscience research and the development of therapeutic agents for neurological disorders.

Promising anticancer drugs, such as isoxanthopterin and dichostatin, have been isolated from the wings of *Catopsilia crocale* and the legs of *Allomyrina dichotomusc*. About 4% of the extracts evaluated in 800 species of terrestrial arthropods showed some anticancer activity (Costa-Neto, 2005; Shrivastava, 2015). According to Zimian *et al.* (1997), fifteen species of medicinal insects are currently being used on a regular basis, with pharmacological studies being concentrated on the following species: *Malaphis chinensis*, *Bombyx mori*, *Hepialus armoricanus*, *Mylabris cichori*, and *Buthus martensii*. Scientist studies on how to produce surgical cameras that use compound lenses, modeled after the compound eyes of insects that is smaller than pre-existing cameras and capable of transmitting images with a much higher resolution and clarity are receiving great attention. Also nanorobots are currently being developed that use a physical structure similar to that of many smaller insects such as ants and lice which could potentially be used to target lesions or masses and conduct safe, non-invasive surgery. Table 2 and 3 shows selected active insect-derived chemicals of medical importance in conventional and traditional entomotherapy.

Table 2. Pharmacologically active insect-derived chemicals and products.

Names	Chemicals	Pharmacological actions	Literature Sources
Coleoptera staphylinidae (Rove Beetles)	Pederin	Anticancer, healing of dermal lesions	Kačar et al. (2019)
Lytta vesicatoria (Blister Beetles)	Cantharidin	Vesicant	Berenbaum, (1995)
Allomyrina dichotomus (Stag Beetles)	Dichostatin	Anticancer	Kunin and Lawton, (1996)
Catopsilia crocale (Sulphur Butterfly)	Isoxanthopterin	Anticancer	Kunin and Lawton, (1996)
Drosophilia melanogaster (Fruit fly)	Defensin, Diptericin	Antibacterial	Yamakawa, (1998)
Bombyx mori (Silkworm)	Attacin, Moricin, Drosocin	Antibacterial	Yamakawa, (1998)
Hyalophora cecropia (Silkworm moth)	Cecropin A and B	Antibacterial	Yamakawa, (1998)
Anoplius samariensis (Spider Wasp)	Pompilidotoxin	Neurotoxin	Konno *et al.*, (1998)
Pseudagenia (Batozonellus) maculifron (Spider Wasp)	Pompilidotoxin	Neurotoxin	Konno *et al.*, (1998)
Anterhynchium flavomarginatum micado (Wasp)	Eumenine mastoparan-AF	A mast cell degranulating Peptide	Konno *et al.*, (2000)
Phoenicia sericata (Blow fly)	Allantoin	Antibacterial	Sherman *et al.*, (2000)
Tetragonisca angustula angustula (Bees)	Honey	Antibacterial	Aidar, (2002)
Pieris rapae (Cabbage butterfly)	Pierisin	Anticancer	Srivastava, (2009)

Table 3. Synthesis of selected literature.

Insect Group/Species	Medical Applications	Active Biological Compounds	Primary Mechanisms of Action	References
Hymenoptera (*Apis mellifera* / Honey bee)	Wound healing, inflammation, pain relief	Melittin, Apamin, Propolis (flavonoids)	Antibacterial, antiviral, anti-inflammatory, tissue regeneration	Dumitru et al. (2022); El-Seedi et al. (2022); Stevanović et al. (2024)
Coleoptera (*Mylabris spp*. / Blister beetles)	Treatment of tumors and skin lesions	Cantharidin	Anti-cancer potential, dermatological therapeutic agents	Zhang (2025)
Orthoptera (*Locusta migratoria* / Grasshoppers)	Nutritional supplement, digestive health	Chitin, Chitosan, Omega-3 fatty acids	Immunomodulation, gut microbiome support, metabolic regulation	Lee et al. (2021); Li et al. (2023); Ruiz (2025)
Diptera (*Lucilia sericata* / Blowfly larvae)	Debridement of necrotic wounds	Allantoin, Urea, Ammonium bicarbonate	Bio-surgical debridement of	Dumitru et al. (2022);

			chronic/infected wounds	Nigam & Wilson (2022)
Blattodea (*Periplaneta americana* / Cockroaches)	Healing of burns, gastrointestinal pain	Polyols, Muco-polysaccharides	Accelerated wound healing, tissue repair, gastric ulcer relief	Zhou et al. (2022); Li (2025)

DISCUSSION

This review shows that traditional and conventional entomotherapy offer valuable bioactive leads from ant-derived peptides to blister beetle cantharidin. However, scaling these remedies faces critical clinical and regulatory barriers. A major limitation is toxicity; compounds like pederin and cantharidin possess narrow therapeutic windows, thus risking severe dermatological or systemic harm without strict chemical standardisation and precise dosing protocols. Furthermore, regulatory frameworks lag behind insect-derived pharmaceuticals, complicating quality control, batch consistency, and market approval.

Ethically, commercial bioprospecting of traditional entomotherapeutic knowledge risks exploiting indigenous communities. Sustainable development requires strict adherence to Access and Benefit-Sharing (ABS) principles under the Nagoya Protocol, ensuring equitable compensation, prior informed consent, and protection of local intellectual property.

CONCLUSION

The practice of entomotherapy represents an invaluable reservoir of pharmacological potential that sits at the critical intersection of indigenous wisdom and modern biotechnology. As this review has demonstrated, the transition from traditional, anecdotal application to evidence-based medical integration is not only feasible but necessary. In a changing world marked by rapid biodiversity loss, climate instability, and the urgent need for new antimicrobial agents, the systematic documentation and validation of insect-derived compounds offer a promising frontier for modern medicine.

The uses of insects and their products in medicine should be examined with an open mind, further developed, and integrated with conventional medical procedures to provide the best medical service. Bridging the gap between ancestral heritage and scientific rigor can unlock the full therapeutic value of insects while safeguarding the ecological systems that sustain them.

RECOMMENDATIONS

To advance the field of entomotherapy effectively and maximise insects' potentials as pharmaceutical store house, the following actions are recommended for researchers, policymakers, and local practitioners: There should be integration of Traditional Knowledge in Drug Discovery such that Pharmaceutical research and development would move away from purely synthetic approaches and embrace ethnopharmacology. Collaborations between local healers and laboratory scientists should be formalised to ensure that traditional insights guide the identification of novel bio-active compounds. Pesticide usage should be reduced by developing more efficient methods for collecting insect pests that are also traditional foods and medicines, such as locusts and grasshoppers. While academic and public health institutions should develop standardised protocols for recording traditional entomotherapeutic knowledge. This includes documenting precise preparation methods (dosage, carrier substances, and application frequency) to facilitate the replication of results in clinical settings.

Given that climate change and habitat degradation threaten the availability of medicinal insect species, conservation initiatives must be community-driven. Local communities should be supported in managing their surrounding ecosystems to ensure the sustainable harvest of insects, preventing the over-exploitation of vulnerable populations. Furthermore, the medicinal use of insects in modern society should be destigmatise. Public health campaigns can play a key role in framing entomotherapy as a legitimate, science-backed field, thereby increasing investment and interest in the research of these diverse natural resources.

These processes will help in the advancement of uses of insects, their products in medicine. Hence, measure should be taken to protect these jewels of inestimable value, and the earlier we start studying them and also protecting them the better.

REFERENCES

Antonio T. M. F., (1994). Insects as remedies in Zaire *The Food Insects Newsl* 7: 4-5.

Banjo, A.D., O.A. Lawal, O.A. Owolana, O.A. Olubanjo, J.S. Ashidi, G.A. Dedeke, D.A. Soewu, S.O. Owa and O.A. Sobowale. (2003). An ethnozoological survey of insects and their allies among the Remos (Ogun State) South-western Nigeria. *African Journal of Indigenous Knowledge Systems* 2:61–68.

Berenbaum, M. R. (1995). Bugs in the System: Insects and Their Impact on Human Affairs. Addison-Wesley, Reading, Massachusetts.

Bonn D. (2000). Maggot therapy an alternative for wound infection *Lancet* 356:1174.

Brito, T. O., Elzubair, A., Araújo, L. S., Camargo Júnior, S. A. S., Souza, J. L. P., & Almeida, L. H. (2021). Characterization of the mandible *Atta laevigata* and the bioinspiration for the development of a biomimetic surgical clamp. *Engenharia de Produção: gestão de qualidade, produção e operações*, 121-136. https://doi.org/10.37885/210805803

Castaldo, S. and Capasso, F., (2002). Propolis, an old remedy in modern medicine. *Fitoterapia* 73 (Suppl. 1): S1–S6.

Chakravorty, J., Ghosh, S., & Meyer-Rochow, V. B. (2011). Practices of entomophagy and entomotherapy by members of the Nyishi and Galo tribes, two ethnic groups of the state of Arunachal Pradesh (North-East India). *Journal of Ethnobiology and Ethnomedicine*, *7*(5) pp 1-14 https://doi.org/10.1186/1746-4269-7-5

Chantawannakul, P. (2020). From entomophagy to entomotherapy. *Frontiers in Bioscience*, 25(1), 179-200.

Chen, Y. N., *et al.*, (2002). Effects or mechanisms of norcantharidin- induced mitotic arrest and apoptosis in human hepatoma cells *International Journal of Cancer* 100:158–165.

Cheng, Y.-D., Tseng, C.-H., Wang, H.-P., & Liao, C.-C. (2020). Component analysis of Black ant (*Polyrhachis lamellidens*) extracts from supercritical fluid extraction. *Journal of Food and Drug Analysis*, *9*(1). https://doi.org/10.38212/2224-6614.2801

Conconi, J. E., and Moreno, J. M. P., (1988). The Utilization of Insects in the Empirical Medicine of Ancient Mexicans *J. Ethnobiol.* 8: 195-202.

Costa-Neto, E. M. (1999). Healing with animals in Feira de Santana city, Bahia, Brazil. *Journal of. Ethnopharmacology.* 65:225–230.

Costa-Neto, E. M. (2005). Entomotherapy, or the medicinal use of insects. *Journal of Ethnobiology and Ethnomedicine*, *25*(1), 93–114. https://doi.org/10.2993/0278-0771_2005_25_93_eotmuo_2.0.co_2

Cutteridge, J., & Bera, K. (2021). Maggot debridement therapy for the treatment of diabetic foot ulcers: robbing the rich past to give to the sore. *Journal of the Nuffield Department of Surgical Sciences*, 2(2). https://doi.org/10.37707/jnds.v2i2.144

Day, R. M., Harbord, M., Forbes, A., and Segal. A.W. (2001). Cantharidin blisters: a technique for investigating leukocyte trafficking and cytokine production at sites of inflammation in humans *Journal of Immunological Methods* 257:213–220

Dumitru, C. D., Neacsu, I. A., Grumezescu, A. M., & Andronescu, E. (2022). Bee-Derived Products: Chemical Composition and Applications in Skin Tissue Engineering. *Pharmaceutics*, *14*(4), 750.

https://doi.org/10.3390/pharmaceutics14040750

Efem S. E., (1988). Clinical observations on the wound healing properties of honey *Br. J. Surg.* 75:679-81

El-Didamony, S., Gouda, H., Zidan, M., & Amer, R. (2024). Bee products: An overview of sources, biologicalactivities and advanced approaches used in apitherapy application. *Biotechnology Reports*, 44. https://doi.org/10.1016/j.btre.2024.e00862

El-Kamali H. H., (2000). Folk medicinal use of some animal products in Central Sudan. *J. Ethnopharm.* 72: 279–289

El-Seedi, H. R., Eid, N., Abd El-Wahed, A. A., Rateb, M. E., Afifi, H. S., Algethami, A. F., Zhao, C., Al Naggar, Y., Alsharif, S. M., Tahir, H. E., Xu, B., Wang, K., & Khalifa, S. A. M. (2022). Honey Bee Products: Preclinical and Clinical Studies of Their Anti-inflammatory and Immunomodulatory Properties. *Frontiers in Nutrition*, *8*, 761267. https://doi.org/10.3389/fnut.2021.761267

Fasoranti, J.O. (1997). The place of insects in the traditional medicine of south-western Nigeria *The Food Insects Newsletter* 10(2):1–5

Fernández-Marín, H., Zimmerman, J. K., Rehner, S. A., & Wcislo, W. T. (2006). Active use of the metapleural glands by ants in controlling fungal infection. *Proceedings of the Royal Society B: Biological Sciences*, *273*(1594), 1689–1695. https://doi.org/10.1098/rspb.2006.3492

Hellner, M., Winter, D., von-Georgi, R., and Münstedt, R., (2007). Apitherapy: Usage and Experience in German Beekeepers *Apitherapy & Beekeepers eCAM* pp 1- 5

Horobin, A. J., Shakesheff K. M., Woodrow S, *et al.* (2003). Maggots and wound healing: an investigation of the effects of secretions from *Lucilia sericata* larvae upon interactions between human dermal fibroblasts and extracellular matrix components *Br. J. Dermatol.* 148:923–33

Jones, D., (1998). The neglected saliva: medically important toxins in the saliva of human lice. *Parasitology* 116: 973–981.

Kačar, D., Schleissner, C., Cañedo, L. M., Rodríguez, P., de la Calle, F., Galán, B., & García, J. L. (2019). Genome of Labrenzia sp. PHM005 reveals a complete and active trans-AT PKS gene cluster for the biosynthesis of labrenzin. *Frontiers in Microbiology*, 10, 2561. https://doi.org/10.3389/fmicb.2019.02561

Kemprai, S. R., Tamuli, A. K., & Teron, R. (2026). Entomotherapy: A study of medicinal insects of three ethnic groups in Semkhor Area. *ResearchGate*.

Konno, K., Hisada, M. Itagaki, Y. Naoki, H. Kawai, N. Miwa, A. Yasuhara, T. and Takayama, H. (1998). Isolation and structure of pompilidotoxins, novel peptide neurotoxins in solitary wasp venoms *Biochemical and Biophysical Research Communications* 250 (3): 612–616

Konno, K., Hisada, M., Naoki, H., Itagaki, Y., Kawai, N., Miwa, A., Yasuhara, T., Morimoto, Y., & Nakata, Y. (2000). Structure and biological activities of eumenine mastoparan-AF (EMP-AF), a new mast cell degranulating peptide in the venom of the solitary wasp (Anterhynchium flavomarginatum micado), Toxicon, 38 (11), pp 1505-1515, https://doi.org/10.1016/S0041-0101(00)00083-0.

Kutalek, R., and Kassa, A., (2005). The use of Gyrinids and Dytiscids for stimulating breast growth in East Africa *Journal of Ethnobiology* 25(1): 115–128

Lange, K. W., & Nakamura, Y. (2021). Edible insects as a source of food bioactives and their potential health effects. *Journal of Food Bioactives*, 4-9.

Lee, J. D, Park, H. J., Chae, Y., and Lim, S., (2005). An Overview of Bee Venom Acupuncture in the Treatment of Arthritis *Evid Based Complement Alternat Med* 2:79–84

Lee, J. H., Kim, T.-K., Jeong, C. H., Yong, H. I., Cha, J. Y., Kim, B.-K., & Choi, Y.-S. (2021). Biological activity and processing technologies of edible insects: a review. *Food Science and Biotechnology*, *30*(8), 1003–1023. https://doi.org/10.1007/s10068-021-00942-8

Li, K. (2025). *Periplaneta americana* extract ameliorates recurrent oral ulcers in rats by enhancing the intestinal epithelial barrier and regulating gut microbiota. *Journal of Ethnopharmacology*.

Li, M., Mao, C., Li, X., Jiang, L., Zhang, W., Li, M., Liu, H., Fang, Y., Liu, S., Yang, G., & Hou, X. (2023). Edible Insects: A New Sustainable Nutritional Resource Worth Promoting. *Foods*, *12*(22), 4073. https://doi.org/10.3390/foods12224073

Mbanjwa, S. T. (2026). Climate change and the future of indigenous medicinal plants and traditional healthcare. *Student's Journal of Health Research Africa* 7(3). pp 1-13 https://doi.org/10.51168/sjhrafrica.v7i3.237

Mbata, K. J., (1991). Traditional uses of arthropods in Zambia Food insects Newsletter 8(3): 1, 5-7

McCluskey, A., Ackland, S. P., Bowyer, M. C., Baldwin, M. L., Garner, J. C. Walkom, C., and Sakoff. J. A., (2003). Cantharidin analogues: synthesis and evaluation of growth inhibition in a panel of selected tumour cell lines. *Bioorganic Chemistry* 31:68–79.

Meinel., L, Hofmann, S., Karageorgiou, V., *et al*. (2005). The inflammatory responses to silk films in vitro and in vivo. *Biomaterials*. 26(2):147.

Meyer-Rochow, V. B. (2017). Therapeutic arthropods and other, largely terrestrial, folk-medicinally important invertebrates: a comparative survey and review. *Journal of Ethnobiology and Ethnomedicine*, *13*(1). https://doi.org/10.1186/s13002-017-0136-0

Mondal M., Trivedy K., and Nirmal Kumar S. (2007). The silk proteins, sericin and fibroin in silkworm, *Bombyx mori* Linn. - A Review. *Caspian J. Env. Sci*. Vol. 5 No. 2 pp. 63~76

Nasir, S., Akram, W., Khan, R., Arshad, M., & Nasir, I. (2015). Paederus beetles: the agent of human dermatitis. *Journal of Venomous Animals and Toxins including Tropical Diseases*, 21(5), 1–9. https://doi.org/10.1186/s40409-015-0004-0

Nigam, Y., & Wilson, M. R. (2022). The Antimicrobial Activity of Medicinal Maggots. In A Complete Guide to Maggot Therapy: Clinical Practice, Therapeutic Principles, Production, Distribution, and Ethics. (Frank Stadler (ed.), (pp. 153–174). Cambridge, UK: Open Book Publishers. https://doi.org/10.11647/obp.0300.09

Nigam, Y., & Wilson, M. R. (2022). The Antimicrobial Activity of Medicinal Maggots. In *A Complete Guide to Maggot Therapy* (pp. 153–174). Open Book Publishers. https://doi.org/10.11647/obp.0300.09

Papa, G., Maier, R., Durazzo, A., Lucarini, M., Karabagias, I., Plutino, M., Bianchetto, E., Aromolo, R., Pignatti, G.,Ambrogio, A., Pellecchia, M., & Negri, I. (2022). The Honey Bee Apis mellifera: An Insect at the Interface between Human and Ecosystem Health. *Biology*, *11*(2), pp 233. https://doi.org/10.3390/biology11

Pavillard, E. R., Wright, E. A., (1957). An antibiotic from maggots *Nature*; 180: 916-917.74

Pemberton, R. W. (1999). Insects and other arthropods used as drugs in Korean traditional medicine *Journal of Ethnopharmacology* 65: 207–216.

Peng, F., Wei, Y. Q,, Tian, L,, Yang L,, Zhao X., Lu Y., Mao Y. Q., Kan B., Lei S., Wang G. S., Jiang Y., Wang Q. R., Luo F., Zou L. Q., Liu J. Y.., (2002). Induction of apoptosis by norcantharidin in human colorectal carcinoma cell lines: involvement of the CD95 receptor/ligand *Journal of Cancer Research and Clinical Oncology* 128 (4):223–230.

Ruiz, F. E. A. (2025). Edible insects as functional foods: bioactive compounds, health benefits, safety concerns, allergenicity, and regulatory considerations. *Frontiers in Nutrition*.

Sánchez-Estrada, M. d. l. L., Aguirre-Becerra, H., & Feregrino-Pérez, A. A. (2024). Bioactive compounds and biological activity in edible insects: A review. *Heliyon*, *10*(3), e24045. https://doi.org/10.1016/j.heliyon.2024.e24045

Santin. M., Motta, A., Freddi, G., & Cannas, M. (1999). In vitro evaluation of the inflammatory potential of the silk fibroin *J Biomed Mater Res*. 46(3):382.

Santos, A. T., Cruz, G. S., & Baptista, G. R. (2021). Anti-inflammatory activities of arthropod peptides: a systematic review. *Journal of Venomous Animals and Toxins including Tropical Diseases*, *27*. https://doi.org/10.1590/1678-9199-jvatitd-2020-0152

Săvulescu, A.-F., Cîrlan, C., Blăjuț, F.-C., Iordache, M., Iordache-Petrescu, M.-I., Ionescu, A.-B., Lutencu, C., & Popa, L. (2022). Classic suturing materials overview. *Industria Textila*, *73*(5), 574-579. https://doi.org/10.35530/it.073.05.202211

Seabrooks, L., & Hu, L. (2017). Insects: an underrepresented resource for the discovery of biologically active natural products. *Acta Pharmaceutica Sinica B*, *7*(4), 409-426. https://doi.org/10.1016/j.apsb.2017.05.001

Sherman, R. A. (2022). Medicinal maggot application and maggot therapy dressing technology. In A Complete Guide to Maggot Therapy (ed: Frank Stadler) pp. 79–96. Open Book Publishers. https://doi.org/10.11647/obp.0300.05

Sherman, R. A., Hall, M. J. R., & Thomas, S. (2000). Medicinal maggots: an ancient remedy for some contemporary afflictions. *Annual review of entomology*, *45*(1), 55-81.

Shrivastava, S. K. (2015). Entomotherapy: An un-explored frontier for make in India: A review. *Journal of Applied Zoological Researches*, *26*(2), 113–123.

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

Silverberg, N. B., Sidbury, R., and Mancini, A. J., (2000). Childhood molluscum contagiosum: experience with cantharidin therapy in 300 patients *Journal of the American Academy of Dermatology* 43:503–507.

Sobajo, C., Behzad, F., Yuan, X and Bayat, A., (2008). Silk: A Potential Medium for Tissue Engineering *Open Access Journal of Plastic Surgery* 8: pp 438-446

Stevanović, J., Glavinić, U., Ristanić, M., Erjavec, V., Denk, B., Dolašević, S., & Stanimirović, Z. (2024). Bee-Inspired Healing: Apitherapy in Veterinary Medicine for Maintenance and Improvement Animal Health and Well-Being. *Pharmaceuticals*, *17*(8), 1050. https://doi.org/10.3390/ph17081050

Sugihara, A., Sugiura, K., Morita, H., *et al.* (2000). Promotive effects of a silk film on epidermal recovery from full-thickness skin wounds (44552). *Exp Biol Med*.; 225(1):58.

UNESCO (2026). Advancing Indigenous and local knowledge for biodiversity policy and action in Malawi, Namibia, and Trinidad and Tobago. https://www.unesco.org/en/articles/advancing-indigenous-and-local-knowledge-biodiversity-policy-and-action-malawi-namibia-and-trinidad

Valachova, I., Prochazka, E., Bohova, J., Novak, P., Takac, P., & Majtan, J. (2014). Antibacterial properties of lucifensin in *Lucilia sericata* maggots after septic injury. *Asian Pacific Journal of Tropical Biomedicine*, 4(5), 358-361. https://doi.org/10.12980/apjtb.4.2014c1134

Valenzuela, J. G., Belkaid, Y., Rowton, E., and Ribeiro, J. M., (2001). The salivary apyrase of the blood-sucking sand fly *Phlebotomuspapatasi* belongs to the novel *Cimex* family of apyrases. *J. Exp. Biol.* 204:229–237.

Vepari, C., and Kaplan, D. L., (2007). Silk as a biomaterial *Prog. Polym. Sci*. 32:991–1007

Whitaker, I. S, *et al.*, (2007). Larval therapy from antiquity to the present day: mechanisms of action, clinical applications and future potential *Postgraduate Medical Journal* 83 (980): 409–13.

Wilsanand, V., Varghese, P., and Rajitha, P., (2007). Therapeutics of insects and insect's products in Southern Indian traditional medicine *Indian Journal of Traditional Knowledge* 6: pp 563-568

Yek, S. H., Nash, D. R., Jensen, A. B., & Boomsma, J. L. (2012). Regulation and specificity of antifungal metapleural gland secretion in leaf-cutting ants. *Proceedings of the Royal Society B: Biological Sciences*, *279*(1745), pp 4215-4222. https://doi.org/10.1098/rspb.2012.1458

Zhang J, Tian T, Li C, Liu Y, Wang Y, Liu L, Liu L and Yao Y (2025) Cantharidin: a double-edged sword in medicine and toxicology. Front. Pharmacol. 16:1644186. doi: 10.3389/fphar.2025.1644186

Zhou, X., Yang, M., Jin, J., Chen, J., & Li, Z. (2022). *Periplaneta americana* (Insecta: Blattodea) and organ fibrosis: A mini review. *Medicine*, *101*(50), e32039. https://doi.org/10.1097/md.0000000000032039

Zimian, D., Yonghua, Z., and Xiwu, G., (1997). Medicinal insects in China *Ecology of Food and Nutrition* 36:209–220.