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Bee venom: A Natural Agent in the Treatment of Human Diseases

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Abstract

Bee venom is a complex biological active product that is produced by the venom glands of honeybees. Its utilisation in the folk medicine of diverse cultures, including those of India, China and Greece, dates back millennia. In the contemporary medical context, the therapeutic potential of bee venom has garnered significant attention, with numerous studies supporting its role as a natural remedy for a wide range of diseases. The chemical composition of bee venom is intricate, comprising over 40 active components, the most significant of which are melitin, apamin, adolapin, hyaluronidase and phospholipase A2. These substances have been shown to possess anti-inflammatory, analgesic and antibacterial properties. Melitin in particular has garnered significant attention due to its remarkable anti-inflammatory properties, thus positioning it as a potential therapeutic agent for conditions such as rheumatoid arthritis, osteoarthritis, and sciatica, among others that affect the musculoskeletal system. In addition, studies demonstrate the potential of bee venom in treating nervous system disorders such as multiple sclerosis, Parkinson's disease and neuropathies. Apitherapy, a therapeutic modality that involves the utilisation of bee-derived products, encompasses both direct bee stings and the application of ointments, creams, and injections containing purified apitoxin. The study of the antitumour properties of bee venom is of particular interest. In vitro studies have demonstrated that melittin, a component of bee venom, can trigger apoptosis (programmed cell death) in cancer cells without significant harm to healthy tissues, suggesting its potential for use in the development of novel anti-cancer therapies. However, it is imperative to exercise caution when utilising this therapy, as it can potentially induce severe allergic reactions, including anaphylactic shock. Consequently, prior to the initiation of any therapeutic intervention, it is imperative to seek the counsel of a medical professional and undergo allergy assessments. The potential of bee venom as a valuable natural resource with a wide range of therapeutic effects is therefore evident. Further study of this substance and its integration into mainstream medicine may lead to new treatments for a range of chronic and intractable diseases.

***Keywords*:** bee venom, chemical composition, disease, treatment

Introduction

Apitoxin, a complex biologically active substance produced by the glands of bees, has been utilized for centuries in folk medicine for the treatment of various human diseases. In recent decades, there has been a notable increase in the scientific interest in bee venom, owing to the substance's diverse pharmacological effects and its potential for the treatment of human diseases. As stated by Smith et al. (2022), bee venom is comprised of a multitude of biologically active substances, including but not limited to melittin, apamin, phospholipase A2, hyaluronidase, and various amino acids. The unique properties of these substances have the capacity to affect the cells and tissues of the body. Recent medical research and clinical trials have demonstrated the efficacy of bee venom in the treatment of inflammatory diseases, including osteoarthritis and rheumatoid arthritis, as well as neurodegenerative disorders, such as Parkinson's disease. Osteoarthritis is a degenerative joint disease, characterized by the destruction of cartilage and alterations in joint structure. The principal symptoms encompass discomfort, impaired mobility and inflammation. In contradistinction to rheumatoid arthritis, osteoarthritis is not associated with systemic inflammation or immune system disorders. Rheumatoid arthritis is an autoimmune disease in which the immune system mistakenly identifies joint tissues as foreign agents and attacks them, causing chronic inflammation. This can result in joint damage and even joint deformity. In addition to the manifestation of joint problems, rheumatoid arthritis has the potential to affect other organs. Moreover, the therapeutic potential of bee venom extends to the fields of cosmetology and dermatology. The anti-inflammatory and antimicrobial properties of bee venom have been demonstrated to be efficacious in the treatment of acne, psoriasis and other dermatological conditions (Smith et al., 2022). Furthermore, the potential of bee venom in oncology is equally promising, with its components demonstrating the capacity to induce apoptosis in tumour cells. However, despite the promising results, the use of bee venom is associated with a number of risks, including the possibility of allergic reactions. In order to avoid such risks, strict monitoring and dosing is required when using it for therapeutic purposes. In this context, further research is required to improve methods for the safe use of bee venom, as well as to better understand its molecular mechanisms of action. The objective of this paper is to evaluate the extant data on the medical use of bee venom, to identify its therapeutic potential and limiting factors, and to discuss the prospects for its further use in clinical practice [1].

Present status of research on the utilization of bee venom

The utilization of bee venom, otherwise referred to as apitoxin, has a long history in folk and traditional medicine. However, it is only in recent decades that scientific research has begun to comprehensively study its therapeutic properties. Recent studies have corroborated the high biological activity of the components of bee venom, with particular emphasis on melittin, which has been shown to possess significant anti-inflammatory, antimicrobial and antitumor properties [2]. In light of recent advancements in biotechnology and pharmacology, the potential of bee venom as a therapeutic agent for the management of oncological, autoimmune and neurological diseases has been a subject of considerable interest. The necessity for new, safer and more effective therapeutic approaches, as well as the growing interest of the scientific community in natural compounds in medicine, renders the topic highly relevant. The utilization of bee venom in therapeutic contexts can be categorized into several primary directions. Its use in oncology is of particular pertinence. In recent years, melittin has attracted the greatest attention from researchers. This is because it is considered to be the main component of bee venom. As demonstrated in, it has exhibited the most significant activity against a variety of malignant tumors, including those affecting the breast, liver, lung and skin [3]. Melittin has been shown to have the capacity to disrupt tumor cell membranes, thereby inhibiting their growth and inducing apoptosis, or programmed cell death. Furthermore, it has been demonstrated that this compound can enhance the effects of chemotherapy drugs such as doxetaxel while concomitantly reducing their toxic effects on healthy vital tissues. The subsequent focus will be on the treatment of inflammatory and autoimmune diseases. The utilization of bee venom in the therapeutic management of rheumatoid arthritis, osteoarthritis, and other inflammatory joint diseases has gained significant traction in recent years. A substantial body of research has repeatedly demonstrated that regular injections of low doses of apitxin have a significant analgesic effect, reduce inflammation, and enhance joint mobility. Research is also ongoing into the use of bee venom in multiple sclerosis, where it shows potential as a neuroprotective and immunomodulatory agent. Another popular application of the technology is in the fields of neurology and dermatology. Its utilization is prevalent in the treatment of diseases affecting both the central and peripheral nervous systems, encompassing conditions such as neuralgia, radiculitis, and paralysis. It is evident that apamin exerts a stimulant effect on the nervous system, albeit one that is mild in nature. In the field of dermatology, research is underway to explore the potential of bee venom as an active ingredient in cosmetic products, with a view to treating conditions such as psoriasis, acne, and promoting skin rejuvenation. In contemporary times, the administration of bee venom can be accomplished through a variety of methodologies. These include the utilization of direct bee stings, the injection of purified venom, the application of ointments and creams, and the formulation of nano preparations and transdermal patches. Contemporary pharmacological formulations enable more precise dosage regulation and mitigate adverse effects. This is widely regarded as one of the most significant advantages of the method of application. However, despite the promising results of this study, the use of bee venom requires caution and should be carried out strictly under the supervision of specialists, taking into account possible allergic reactions and individual intolerance. In the future, the expansion of the potential applications of apitoxin in modern medicine will be driven by in-depth clinical studies and the development of safe pharmacological forms [4].

Thirdly, the therapeutic potential of bee venom will be examined in detail.

The apitoxin is produced by a special gland in the abdomen. The venom itself is transparent and has a bitter taste. It is noteworthy that the odor rarely resembles the smell of ripe bananas. It is highly soluble in water and acids, but almost insoluble in alcohol. The venom contains approximately 30% solids, and its drying process occurs rapidly at ambient temperatures. The resultant solid is of a viscous nature. It is evident that bee venom is a distinctive pharmaceutical agent that has been utilized since the inception of beekeeping. The treatment of bee venom is a distinctive and time-honored technique. It has become one of the most valuable healing methods, having withstood the test of time. The effectiveness of bee venom is measured in units of 0.1 mg, which is equivalent to the amount of venom typically found in a bee sting. Excessive ingestion of bee venom has been demonstrated to induce anaphylactic shock, with the potential for fatal consequences. The pharmaceutical substance is administered in minimal doses for therapeutic purposes. The efficacy of bee venom is attributable to its ability to stimulate the body's innate capacity to counteract the disease with immediate effect. It has been demonstrated that the application of bee venom results in an increase in blood flow at the site of the sting. The process of destruction of microbes and already damaged tissues is initiated by antibodies, defense cells and enzymes. Inflammation caused by the venom is known to dissipate rapidly, with foreign elements and altered chemicals being eliminated from the affected area. It is evident that bee venom exerts a marked influence on the immune, vascular and nervous systems [5]. The following investigation will explore the mechanisms by which bee venom exerts its effects. The efficacy of bee venom is attributable to its ability to stimulate the body's innate capacity for immediate disease resistance. It has been demonstrated that the application of bee venom results in an increase in blood flow at the site of injection. The process of destruction of microbes and already damaged tissues is initiated by antibodies, defense cells and enzymes. The inflammation caused by the venom is known to dissipate rapidly, accompanied by the removal of foreign bodies and altered chemicals from the affected area. The range of applications of bee venom is extensive. It is evident that bee venom exerts a marked influence on the immune,

vascular and nervous systems. Furthermore, it has been demonstrated that the activation of this process results in the production of hormones that are essential for the suppression of pathologies. Furthermore, the venom activates the work of all systems and organs. The bee bath has been employed in the treatment of a wide range of ailments, including diseases of the nervous system (e.g. neuralgia, radiculitis, plexopathy, neuritis), the muscular system, polyarthritis, traumatic lesions, thrombophlebitis, hypertensive diseases, pneumonia, asthma, prostatic diseases, psoriasis, gynecological diseases, trophic ulcers, and eye diseases [6]. Indications for treatment with bee venom. The utilization of bee venom as a component of a multifaceted therapeutic approach is indicated for the management of chronic infectious diseases, which frequently emerge as a consequence of multifarious exacerbations precipitated by immune system deficiencies. It is an effective pharmaceutical agent employed in the treatment of rheumatic diseases for which hormonal therapy is the standard of care. In this particular instance, bee venom constitutes a highly effective alternative, given that, in contrast to hormones, this substance is not associated with the development of dependency. The utilization of bee venom has been demonstrated to be efficacious in the treatment of metabolic disorders of various etiologies. In this case, the stimulation is systemic. Following the conclusion of the treatment sessions, a number of changes to the body are observed. Firstly, the metabolism of lipids is restored to normal levels. Secondly, memory is improved. Thirdly, the blood pressure is normalized. Finally, the salts that are deposited in the spinal and joint regions are dissolved. The utilization of bee venom in the treatment of chronic hepatitis and cirrhosis of the liver has also been documented. The therapeutic benefits of bee stings extend to the treatment of scars, the alleviation of sciatic pain, and the management of sciatic attacks. It is asserted that a multitude of diseases can be remedied through a single session of bee stings. Prior to the administration of venom, it is imperative to seek the counsel of a medical professional. It is imperative to recall that the lethal dose of bee venom is 0.2 g, which is equivalent to 300–500 stings. The effectiveness of this method is contingent upon the subject's weight. However, it should be noted that some individuals are allergic to bee venom, and death can result from a single sting. The therapeutic modality that utilizes bee products, including bee venom (apitoxin), is now designated as apitherapy [7]. This approach is currently employed in both conventional medicine and folk practice, due to the aforementioned properties of the substance. A taxonomy of apitherapy methods has been established. Bee stinging is a conventional technique in which bees inject their venom into specific body parts. The procedure is carried out under the strict control of a specialist to avoid allergic reactions. The application of ointments and creams is an essential component of a comprehensive healthcare regimen. The utilization of ointments and creams containing bee venom facilitates the administration of the therapy in the comfort of one's own home. Examples of such means include "Apizartron," "Virapin," and "Sofya" [8]. These substances have been demonstrated to be efficacious in the treatment of joint diseases, inflammation, and back pain. Injections and ampoule preparations. The utilization of bee venom, administered via a syringe, enables precise dosing of the substance and targeted delivery to specific anatomical regions. This method is employed in the treatment of chronic inflammation and pain. The injection of bee venom into the body is achieved through the utilization of either an electric current or ultrasound, thereby facilitating the application of electrophoresis and phonophoresis, respectively. The efficacy of these remedies extends to conditions such as osteochondrosis, sciatica, and arthritis. Apimassage, a therapeutic modality involving the application of creams containing bee venom, has been demonstrated to promote enhanced blood circulation and muscular relaxation through massage. This method is employed in the treatment of diseases of the musculoskeletal system [9].

It is imperative to exercise caution in the following instance:

Allergic Reactions: Individuals with a history of allergic reactions to bee venom should exercise caution and avoid apitherapy whenever possible, as there is a risk of severe reactions, including anaphylaxis.

A consultation with a physician is necessary. It is imperative for individuals to consult with a physician prior to the initiation of treatment, particularly in cases of chronic conditions or allergies.

Professional supervision: It is imperative that all treatments be administered by a duly qualified professional, thereby ensuring the minimization of potential risks and the maximization of treatment efficacy [7].

The Physical and Chemical Properties of Bee Venom

Bee venom is a complex mixture of more than 50 active components, including:

Proteins and peptides constitute approximately 88% of the dry matter. Melittin, the principal toxic component, exhibits anti-inflammatory and anti-tumor effects. Its concentration ranges from 40 to 50.

Apamin, a neurotoxin, has been shown to block potassium channels.

Phospholipase A2 has been demonstrated to disrupt cell membranes and increase inflammation.

Hyaluronidase, an enzyme that increases tissue permeability, is another potential factor to consider.

Amines;

Histamine, dopamine, and norepinephrine (which play a role in inflammation and pain)

The minerals in question include magnesium (Mg), calcium (Ca), phosphorus (P), and trace elements [10]. The physical properties are summarized in Table 1.

Table 1 - Physical properties and its characterization

Property	Characterization
Shape	When fresh, it is a clear, slightly viscous liquid with a pungent odor; when dried, it is a white or yellowish powder
Color	Transparent or light yellow
Smell	Sharp, irritating, similar to acetic or ammonia
Taste	Bitter and burning
Solubility	It is well soluble in water, poorly in alcohols and fats.
pH	Acidic environment, pH ≈ 4.5 - 5.5
Melting point	There is no exact value, but when heated above 60 ° C, the destruction of proteins begins.
Stability	It quickly loses activity in light, when heated, and when in contact with air.

Conclusion

The utilization of bee venom for medicinal purposes constitutes an ancient practice that is increasingly substantiated by contemporary scientific research. For centuries, the therapeutic use of bee venom in folk medicine has been documented for a wide range of ailments, including arthritis, neurological disorders, skin diseases, and even cardiovascular pathologies. In recent decades, scientific research has confirmed the effectiveness of apitherapy in treating a number of diseases. For instance, the therapeutic application of bee venom has been demonstrated in the treatment of osteochondrosis, sciatica, osteoarthritis, and joint diseases. The therapeutic benefits of bee venom include its capacity to reduce inflammation and pain, enhance blood circulation, and restore mobility. However, the utilization of bee venom is not without contraindications. Apitherapy is a therapeutic modality that has been demonstrated to elicit allergic reactions, including anaphylactic shock. Prudent care is therefore paramount when undertaking this practice. Consequently, individuals contemplating the use of bee venom should seek medical counsel and undergo allergy assessments. It is imperative to meticulously observe the dosage and take into account the unique characteristics of the patient. Therefore, it can be concluded that bee venom has the potential to serve as a therapeutic remedy; however, its utilization must be meticulously regulated. A meticulous examination of the advantages and disadvantages reveals that apitherapy has the potential to enhance conventional therapeutic modalities. However, it is imperative to exercise caution and seek the expertise of a qualified professional to ensure its optimal implementation.

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