GreenariA
Go Green, Learn Green
An Agricultural Monthly e-Magazine
Volume 02, Issue 10, 2024
ISSN: 2584-153X
Article ID: G-24-1009

MULTIFACETED APPROACHES OF BEE VENOM

Kaustubh Yashvant Deshmukh[1*] and Rutuja Virendra Deshmukh[2]

[1]Research Scholar, Department of Fruit Science, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola-444104, Maharashtra, India.

[2]PG Student, Department of Pharmaceutical Biotechnology, Sanjivani College of Pharmaceutical Education and Research, Singnapur, Kopergaon-423603, Dist.: Ahmednagar, Maharashtra, India.

**Corresponding Author Mail ID: deshmukhkaustubh145@gmail.com*

Introduction

Bee venom, or apitoxin, is a complex mixture of proteins, peptides, and enzymes produced by honeybees (*Apis mellifera*) for defense against predators. Historically used in traditional medicine for various ailments, recent studies have identified novel substances like secapin-1, acid phosphatase, and melittin-S with potential medical applications. Bee venom is now explored for therapeutic uses in conditions such as arthritis and chronic pain, contributing to apitherapy. Natural sources, including honey and bee products, contain secondary metabolites that can lead to medicinal compounds. Key bioactive components of bee venom include hyaluronidase, melittin-S, acid phosphatase, dipeptidyl peptidase, Api m6, CUB serine protease and secapamin-1, 2. Advances in spectroscopic and chromatographic techniques have enhanced research in this area.

Composition of Bee Venom

Bee venom is a highly complex substance made up of various bioactive compounds, it includes:

Melittin: Making up 40-60% of the venom's dry weight, melittin is a powerful peptide with anti-inflammatory and antimicrobial properties. It disrupts cell membranes, causing cell lysis.

Phospholipase A_2: This enzyme breaks down phospholipids in cell membranes, contributing to inflammation and pain.

Hyaluronidase: This enzyme helps the venom spread through tissues by breaking down hyaluronic acid, a key component of the extracellular matrix.

Apamin: A neurotoxin that blocks certain potassium channels, affecting nerve signal transmission and potentially offering therapeutic benefits to the nervous system.

Adolapin: This compound has analgesic and anti-inflammatory effects by inhibiting cyclo-oxygenase activity.

Other components of bee venom include acid phosphatase, mast cell degranulating peptide and histamine which together causes overall bee venom effect.

Mechanisms

The therapeutic potential of bee venom stems from its various mechanisms of action. Key pathways include:

1.Anti-inflammatory effects

Melittin and adolapin inhibit pro-inflammatory enzymes and cytokines, leading to a reduction in inflammation. Melittin also disrupts pain pathways, resulting in significant pain relief.

2. Therapeutic Applications

Arthritis

I. Rheumatoid arthritis

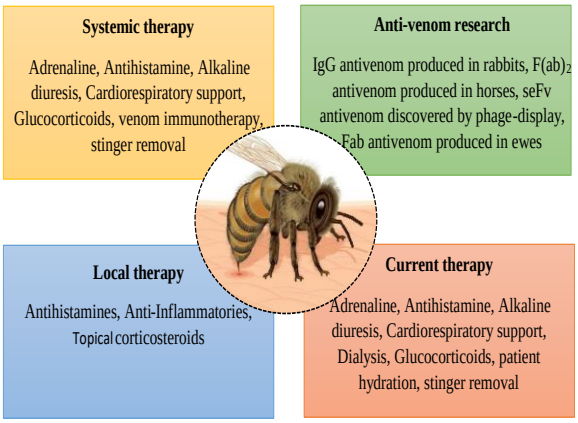
Bee venom therapy (BVT) has shown potential in alleviating pain and inflammation in rheumatoid arthritis patients. Research revealed that, melittin and phospholipase A_2 hinder the production of inflammatory mediators such as prostaglandins and leukotrienes.

II. Osteoarthritis

Clinical trials demonstrated the effectiveness of BVT in relieving symptoms of osteoarthritis, including pain and joint stiffness, due to the anti-inflammatory properties of venom components.

3. Multiple Sclerosis (MS)

MS is an autoimmune condition marked by the deterioration of myelin sheaths in the central nervous system. BVT has been investigated as a complementary treatment for MS, with studies suggesting that bee venom can modulate the immune response and decrease the frequency and severity of relapses.



4. Chronic Pain

I. Fibromyalgia: Patients suffering from fibromyalgia, a chronic pain disorder, have reported notable pain relief and improved quality of life following BVT. The analgesic and anti-inflammatory effects of bee venom are thought to contribute to these improvements.

II. Neuropathic pain: Experimental studies on neuropathic pain have shown that bee venom can downregulate the expression of nuclear factor-kappa B (NF-κB), a key regulator of inflammation.

5. Immunomodulatory effects

Components of bee venom modulate the immune system, enhancing both innate and adaptive immune responses. This property is particularly beneficial in autoimmune diseases where immune regulation is compromised.

6. Neuroprotective effects

Apamin and other peptides in bee venom affect neuronal activity and offer protection against neurodegenerative diseases by modulating ion channels and neurotransmitter release.

7. Analgesic effects

The combined action of melittin, phospholipase A_2, and adolapin on nerve pathways alleviates pain by modulating ion channels and reducing inflammation.

8. Dermatological conditions

I. Psoriasis: BVT has been utilized to treat psoriasis, a chronic inflammatory skin disorder. The anti-inflammatory and immunomodulatory properties of bee venom help alleviate the severity of skin lesions and related symptoms.

II. Wound healing: Components of bee venom, such as melittin and hyaluronidase, promote wound healing by enhancing cell proliferation and lowering the risk of infection.

Safety and side effects

Although bee venom therapy (BVT) offers potential therapeutic advantages, it also carries risks. Adverse effects can vary from mild local reactions to severe systemic responses. Common side effects include:

- **Allergic reactions:** Bee venom may cause allergic reactions in some individuals, which can range from mild hives to severe anaphylaxis. Allergy testing is essential before administering bee venom.
- **Systemic Reactions:** In rare instances, systemic symptoms like fever, dizziness and nausea may occur.
- **Local reactions:** Pain, swelling and redness at the site of the sting or injection are frequently observed. BVT should be administered cautiously and under medical supervision to prevent worsening of the condition.

Contraindications and Precautions

- **Pregnancy and breast feeding:** The safety of BVT during pregnancy and breastfeeding has not been tested, so it should be avoided in these group of patients.
- **Allergy to bee venom:** Individual with a known allergy to bee stings should refrain from using BVT.
- **Autoimmune diseases:** While BVT can be beneficial for autoimmune disorders like Multiple Sclerosis, it should still be approached with caution under supervision of medical practitioner.

Conclusion

Bee venom is a powerful natural substance with significant therapeutic potential due to its anti-inflammatory, neuroprotective, immunomodulatory and analgesic properties. Its use in treatment of arthritis, chronic pain, multiple sclerosis and dermatological problems is supported by clinical trials and scientific studies. However, the execution of bee venom therapy requires careful assessment of potential risks and contraindications. Future research should emphasize on optimizing treatment protocols, enhancing safety profiles and clarifying the molecular mechanisms that underlie its therapeutic effects.

References:

1. Han, S. M., Kim, J. M., Park, K. K., Chang, Y. C., Pak, S. C. and Kim, H. S. (2014). Anti-inflammatory activity and immune response of bee venom in a human keratinocyte HaCaT cells. *Journal of Toxicology and Environmental Health*, Part A, 77(21): 1307- 1315
2. Hwang, D. S., Kim, S. K., Bae, H. and Kim, Y. H. (2010). Bee venom attenuates carrageenan-induced inflammatory pain through activation of spinal alpha 2-adrenergic and 5- HT 1A receptors. *Phytomedicin*e, 17(3-4): 175-180.
3. Kim, H., Lee, G. and Park, S. (2009). Bee venom reduces neuroinflammation in the MPTP-induced model of Parkinson's disease. *Journal of Neuroinflammation*, 6(1): 1-12.
4. Kwon, Y. B., Lee, J. D., Lee, H. J., Han, H. J., Mar, W. C., Kang, S. K., ... and Kim, K. H. (2001). Bee venom injection into an acupuncture point reduces arthritis associated edema and nociceptive responses. *Pain*, 90(3): 271-280.
5. Nam, K. W., Je, K. H., Lee, J. H., Han, H. J., Lee, H. J., Kang, S. K. and Bae, H. (2003). Effect of whole bee venom on arthritis in rats. *Journal of Ethnopharmacology*, 84(2-3): 183-187.
6. Son, D. J., Lee, J. W., Lee, Y. H., Song, H. S., Lee, C. K. and Hong, J. T. (2007). Therapeutic

application of anti-arthritis, pain-releasing, and anti-cancer effects of bee venom and its constituent compounds. *Pharmacology & Therapeutics*, 115(2): 246-270.

7. Wehbe, R., Frangieh, J., Rima, M., El Obeid, D., Sabatier, J. M., Fajloun, Z. and Bejjani, N. (2019). Bee venom: Overview of main compounds and bioactivities for therapeutic interests. *Molecules*, 24(16): 2997.