



The Role of Bee Products in Cosmetic and Skincare Industry: Current Trends and Future Prospects

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

In recent years, honey-based products have gotten a lot of attention for the interesting and varied ways they can be used in cosmetics and skin care. Venom, royal jelly, honey, beeswax, and propolis are among the most well-known bee products. For the goal of healing and maintaining skin health, each part has its own special properties. This review article will examine the potential uses of bee products in the beauty and skincare industries. The purpose of this study is to synthesize previous research with current advancements in order to provide a thorough review of bee-derived compounds and their potential to transform the cosmetics industry. Each bee product is investigated for its distinct cosmetic uses, revealing information on how it moisturizes, rejuvenates, and protects the skin. It is the goal of this study to give a deep look into the latest market trends in honey-based skin care goods. As the need for options that are better for the environment and your skin grows, bee products have become a good choice. Knowing what chemicals are in them and

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how they can help with cosmetics gives both customers and professionals in the field useful information to help them make smart decisions. This review also shows the current trends in the skin care market, which helps us understand the future of bee products in the beauty business. Consumers are looking for eco-friendly and effective ways to take care of their skin, so honey-based cosmetics are likely to become more popular.

Keywords: Honey; propolis; bee venom; royal jelly; bee-wax; anti-ageing; skin-treatment; psoriasis; anti-wrinkle.

1. INTRODUCTION

The ever-growing interest in natural skincare and cosmetic products has paved the way for the resurgence of traditional remedies, and bee products have taken center stage in this trend. Bee products are utilized for their nutritional and medicinal properties, while advanced food processing procedures are employed to produce more wholesome and flavorful products, hence generating profitable prospects in the worldwide bee products market [1]. The potent and multifaceted properties of bee-derived substances have captured the attention of both consumers and the skincare industry alike. There are many other bee products produced by honeybees rather than honey itself, such as royal jelly, bee wax, propolis, bee pollen and bee venom, all of which are responsible for its beneficial properties for skincare and cosmetics. The various honeybee products are mentioned in Table 1.

Throughout history, humans have harnessed the powerful benefits of bee products for various

purposes, ranging from medicinal to nutritional. Among the most notable bee products are honey, beeswax, propolis, royal jelly, and bee venom. Each substance possesses unique and remarkable characteristics traditionally used to treat skin ailments and maintain overall skin health. Furthermore, recent studies have unveiled intriguing new attributes of honey that have proven to be highly beneficial. Notably, *in vitro* research has demonstrated that honey possesses the remarkable ability to diminish microbial pathogenicity while also effectively reversing antimicrobial resistance [2]. Beeswax serves as a fundamental component in lipsticks, lip glosses, and lotions. It not only softens and moisturizes the skin but also reduces the loss of water through the skin's outer layer [3]. Research indicates that bee pollen, which is gathered and stored by bees in their hive as a food source, has the potential to enhance the body's defenses against several conditions such as aging, dryness, UVB radiation, inflammation, oxidative damage, melanogenesis, and cardiovascular, respiratory, and neurological illnesses [4]. These

Table 1. Various honeybee products

HONEY	It is a natural sweet substance produced by bees through the collection and enzymatic modification of nectar from flowers, resulting in a viscous, carbohydrate-rich liquid with antimicrobial properties.
PROPOLIS	It is a sticky substance gathered by bees from botanical buds and exudation. It is then processed and used by bees to seal and protect their hives, exhibiting natural antimicrobial and antioxidant properties.
BEE WAX	It is a natural substance secreted by honeybees. It consists primarily of esters, fatty acids, and long-chain alcohols, forming a complex mixture. Beeswax serves as a structural component in beehives, providing stability to honeycomb cells, and it is produced by bees through the transformation of wax gland secretions.
ROYAL JELLY	It is a secretion produced by worker honeybees and is rich in nutrients and bioactive compounds. It is fed to bee larvae and the queen bee, playing a crucial role in their development and differentiation.
BEE VENOM	It is scientifically known as apitoxin, is a complex mixture of biologically active compounds that is secreted by honeybees through their stingers. It contains various peptides, enzymes, and other molecules, and it serves as the bee's defense mechanism when it stings. Bee venom has diverse applications in medicine and skincare due to its unique composition and properties.

findings not only highlight the immense potential of honey in combating a wide array of infections but also offer a promising solution to the ever-growing concern surrounding antimicrobial resistance. The utilization of honey's unique properties in this manner could have far-reaching implications in the realms of medicine and healthcare, paving the way for innovative approaches to tackle such challenges.

The main motive behind this review paper is to delve into the diverse properties and applications of bee products in the cosmetic and skincare industries. By synthesizing existing research and current trends, this study aims to present a comprehensive overview of the various bee-derived substances and their potential to revolutionize the cosmetics market. This study will also explore their efficacy, safety, and sustainability aspects to gain valuable insights into how these natural wonders can augment the development of innovative cosmetic formulations. This review is crucial in understanding the significant role bee products play in the cosmetics and skincare industry. It offers an opportunity to highlight the invaluable contributions of bees to human well-being and emphasize the importance of sustainable bee products.

2. HONEY-BASED SKINCARE FORMULATIONS

2.1 Chemical Composition of Honey

Honey, a prized ingredient in skincare and cosmetics, boasts a potent composition of active principles. It contains essential sugars such as fructose and glucose, along with proteins, amino acids, and an array of vitamins (biotin, ascorbic acid, nicotinic acid, pyridoxine, pantothenic acid, & thiamine) [5,6]. Enzymes such as invertase,

diastase, catalase, and glucose oxidase further enhance its therapeutic properties. It is also a rich source of essential minerals, including Potassium (K), Calcium (Ca), Phosphorus (Ph), Copper (Cu), Magnesium (Mg), & Iron (Fe). Additionally, its phytochemicals derived from the plant itself contribute to its skincare benefits. These constituents collectively promote skin health, nourishment, and protection, making honey a promising and sustainable ingredient for modern cosmetic formulations [7].

2.2 Role of Honey in Skincare and Cosmetics

Honey has been used for centuries in skincare due to its numerous beneficial properties. It is a natural humectant, which means it helps to attract and retain moisture, making it an excellent ingredient for moisturizers and hydrating skincare products [8]. Additionally, honey contains antioxidants, enzymes, vitamins, and minerals that can help nourish and protect the skin [9]. It also offers numerous benefits due to its elevated content of fruit acids, carbohydrates and trace elements. These components contribute to their nutrition and rejuvenate stimulating microcirculation in cutaneous tissue through osmosis. Enhanced circulation leads to improved nutrition and oxygenation, increased metabolic processes and elimination of harmful metabolites. Honey's hygroscopic properties aid in detoxifying the skin, resulting in increased skin tension, improved elasticity, revitalized color, and reduced wrinkles [10]. Its fruit acids act as exfoliants, removing dead skin cells and allowing for better absorption of essential nutrients, including vitamins [11]. Additionally, the presence of flavonoids in honey may offer sun protection by preventing skin irritation. Overall, honey-based skincare formulations hold great promise in promoting healthy and nourished skin [12].

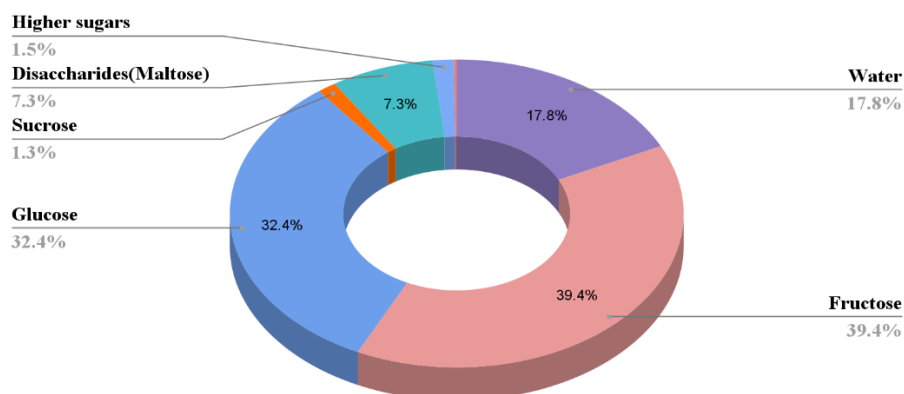


Fig. 1. Chemical composition of honey

2.2.1 Honey as an active component in skincare products

In facial masks, honey is often combined with other ingredients, such as yogurt, oatmeal, or clay, to create a soothing and nourishing treatment for the skin. Honey's antimicrobial properties can be particularly useful in masks aimed at addressing acne or blemishes [13]. When used in serum, honey's ability to promote skin hydration and its antioxidant content can contribute to reducing the emergence of wrinkles and fine lines. It can also help to elevate the tone of the skin and texture on skin [9]. It is safe for most skin types, but individuals with allergies to bee products should exercise caution [14]. As with any skincare ingredient, patch testing is recommended before applying honey-based products to the entire face or body. Furthermore, honey's fatty acids and mineral salts provide relief for xerosis and soothe skin irritation, making it an excellent choice for rough and textured hands, chapped lips and frostbites. With its conditioning, relaxing and toning effects, honey is often incorporated into balms and bath products [11].

3. PROPOLIS IN DERMATOLOGY

3.1 Chemical Composition of Propolis

Propolis plays a vital role as a 3rd principal element in honeybee products. Its composition includes resin (making up 50% of its content), essential oils with 10%, wax with 30%, pollen with 5%, and an array of diverse organic compounds 5% [15]. Within propolis, there are noteworthy organic constituents, which encompass the phenolic compounds flavonoids, esters, beta-steroids, terpenes, alcohol, and aromatic aldehydes [16]. Capillary zone

electrophoresis has revealed the presence of a diverse array of compounds in propolis extracts, including twelve distinct flavonoids—such as pinocembrin, acacetin, and quercetin—along with 2 phenolic acids (cinnamic acid and caffeic acid) and the stilbene derivative resveratrol. In addition, propolis harbours essential vitamins such as riboflavin, thiamine, pyridoxine, tocopherol, and ascorbic acid along with beneficial minerals such as calcium (Ca), magnesium (Mg), sodium (Na), potassium (K), zinc (Zn), copper (Cu), iron (Fe) and manganese (Mn). Additionally, propolis has several enzymes, such as glucose-6-phosphatase, succinic dehydrogenase, acid phosphatase and adenosine triphosphatase [17].

3.2 Propolis as Skin Treatment

3.2.1 Acne

Acne vulgaris stands as the most prevalent skin ailment, primarily afflicting the youthful populace. This condition is intricate in nature, stemming from a combination of factors encompassing heightened keratinization within hair follicles, overgrowth of sebaceous glands, bacterial overpopulation, immune system responses, and inflammatory processes [18]. When addressing acne, topical products reign supreme in usage, either alone or with systemic medication. Alpha-hydroxy acids, antibiotics, keratolytic agents, benzoyl peroxide, azelaic acid, and retinoids are frequently employed [19]. The conventional approach leans toward antibiotic therapy to combat *Propionibacterium acnes*, although concerns related to adverse effects and bacterial resistance linked to synthetic antibiotics have paved the way for the exploration of alternative remedies grounded in natural principles [18].

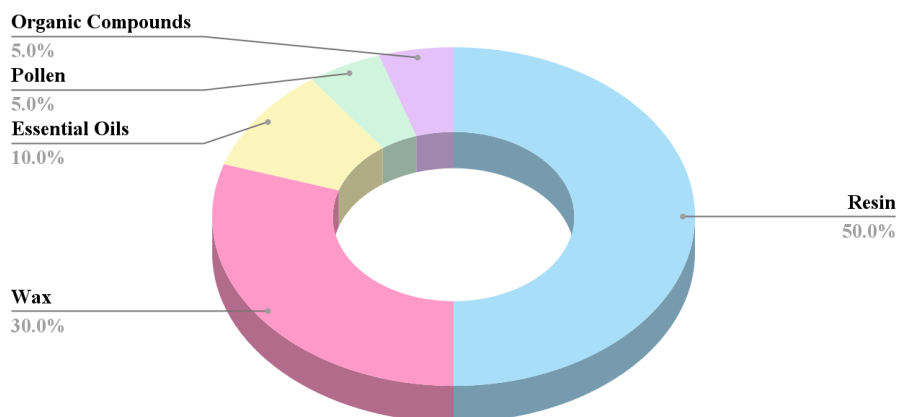


Fig. 2. Chemical composition of propolis

Within this context, propolis emerges as a noteworthy candidate for the management of acne vulgaris. Propolis has remarkable anti-inflammatory and antibacterial properties, effectively mitigating both inflammatory and noninflammatory lesions [20]. Furthermore, it plays a pivotal role in reducing seborrhea and excess skin oiliness, all while demonstrating excellent tolerability [21]. Research reveals that the application of C₂H₅OH extract from propolis onto the skin effectively curtails the proliferation of *Cutibacterium acnes*, a pivotal factor in the pathogenesis of acne vulgaris. Notably, propolis frequently serves as a valuable ingredient in the formulation of cosmetic products tailored for acne management [22]. In a separate study encompassing sixty patients afflicted with mild-moderate acne, distinct treatment regimens were implemented. The 1st group received a cream comprising 20% propolis and 10% aloe vera with 3% tea tree oil, while the 2nd group was administered 3% erythromycin cream, and the last group received a placebo. The propolis-infused mixture exhibited substantial superiority over erythromycin and placebo in terms of diminishing the acne severity index, reducing the total number of lesions, and expediting the healing process of scars [19].

3.2.2 Protection from harmful ultraviolet rays

Furthermore, the presence of coumaric acid, caffeic acid and ferulic acid in propolis endows it with the ability to absorb Ultraviolet light, rendering protection against ultraviolet radiation. Consequently, propolis is a commonly employed additive in sunscreens, capitalizing on its antioxidant, anti-inflammatory, and regenerative attributes [23]. In an additional study conducted on mice, the topical application of propolis was found to confer protective effects against UVB rays [24].

3.2.3 Herpes and warts

Scientific investigations have substantiated the potent in vitro antiviral effectiveness of propolis against Herpes Simplex Virus -1 and Herpes Simplex Virus -2 [25,26]. In a meticulously conducted randomized placebo-controlled trial, a cohort of 135 patients afflicted with warts was systematically divided into three distinct groups. These groups were subjected to treatment regimens involving propolis, echinacea, or placebo. The results revealed statistically significant enhancements in the treatment of flat

warts (75%) and common warts (73%) among those receiving propolis when compared to the outcomes observed in the other treatment groups [27]. These findings underscore the promising therapeutic potential of propolis in the management of viral infections, particularly warts, warranting further exploration and research in the realm of natural antiviral agents.

3.2.4 Psoriasis

Propolis harbors a plethora of flavonoids within its chemical composition, which exhibit notable antipsoriatic properties by quelling inflammation through the reduction of various cytokines and mediators, such as TNF-alpha (Tumour necrosis factor), NF-Kb(Neurofibromatosis), IL-1 beta (Interleukin- 1), and IL-17 [28]. A clinical study involving individuals with mild to moderate palmoplantar psoriasis employed an ointment comprising 50% propolis and 3% aloe vera, resulting in substantial treatment responses. After a 12-week treatment regimen, 62% of patients achieved complete resolution, while 24% experienced partial yet satisfactory improvements. Histopathological examinations conducted before and after treatment revealed that propolis effectively diminished epidermal acanthosis and hyperkeratosis [29].

4. ROYAL JELLY - AN ANTI-AGING AGENT

4.1 Chemical Composition of the Royal Jelly

The composition of royal jelly encompasses a diverse array of elements. It includes essential peptides, such as jelleines I, II, III, and IV, along with proteins such as royalisin. Notably, enzymes such as amylase, invertase, catalase, acid phosphatase, and lysozymes are present. This regal substance is also rich in exogenous amino acids [30]. Carbohydrates are primarily monosaccharides, including fructose, glucose, and oligosaccharides [31]. The significant role of lipids cannot be understood, with 10H₂DA (10-hydroxy-trans-2-decenoic acid) being a pivotal lipid component [31,32]. Volatile compounds, including phenol, guaiacol, and methyl salicylate, have distinct characteristics. Among its bioelements, traces of sodium, potassium, phosphorus, magnesium, calcium, sulfur, iron, copper, and zinc can be found. The vitamins in the B group, such as riboflavin, thiamine, pantothenic acid, pyridoxine, biotin, and nicotinic acid, are prevalent, and royal jelly is rich in

phenolic compounds, such as quercetin, ferulic acid, and kaempferol. The unique combination of these constituents defines the impressive chemical makeup of royal jelly [33,34].

4.2 Ancient History

In ancient Egypt, royal jelly was utilized as a cosmetic, attaining significant recognition during Cleopatra's reign as one of her personal beauty secrets. Additionally, during that era, royal jelly symbolized the vigor and grandeur of the Pharaohs, who often consumed this substance [35]. Across Asia, particularly in China, royal jelly has been an integral part of traditional medicine for ages. Produced exclusively within imperial gardens, this beekeeping product was strongly associated with the enduring vitality and virility of ancient Chinese dynasties, even in their later years [36].

4.3 Anti-Aging Agent

Consumption of royal jelly has been linked to an expanding lifetime of various species. It has demonstrated its potential to retard the onset of aging naturally and mitigate certain age-related conditions. Additionally, it can contribute to increased lifetime and enhance quality of life in the aging process [37].

Lipids and proteins found in royal jelly have a remarkable ability to prolong the lifespan of a diverse range of organisms, such as nematodes, honeybees, mice and crickets. In 2016, Xin et al

[38] conducted a study revealing that major royal jelly proteins (MRJPs) can enhance the lifetime of the common fruit fly (*Drosophila melanogaster*) by activating an anticuticular tyrosine kinase receptor pathway [39].

About the impact of royal jelly on extending the lifeline of mice, research has unveiled intriguing findings. Everlasting oral control of royal jelly has been found to counteract aging weight loss, enhance remembrance function, and postpone aging atrophic thymus [40]. Notably, the treated animals also exhibited superior physical performance compared to the control group, as indicated by an increase in markers of muscle stem cells and a reduction in muscular atrophy [40]. Furthermore, royal jelly has shown the ability to significantly delay age-related declines in motor functions [37]. The skin serves as the body's largest organ, and its condition is influenced by the reduction in estrogen levels in menopause and senescence. Additionally, alterations in skin collagen levels result in diminished skin elasticity and strength [41]. Royal Jelly gained attention as an anti-aging agent through the synthesis of collagen in ovariectomized rats [42]. In summary, royal jelly presents itself as a beneficial and efficient supplement for nutrition for countering senescence of the skin during post menopause. However, it is imperative that future clinical trials involving humans are conducted to substantiate these findings.

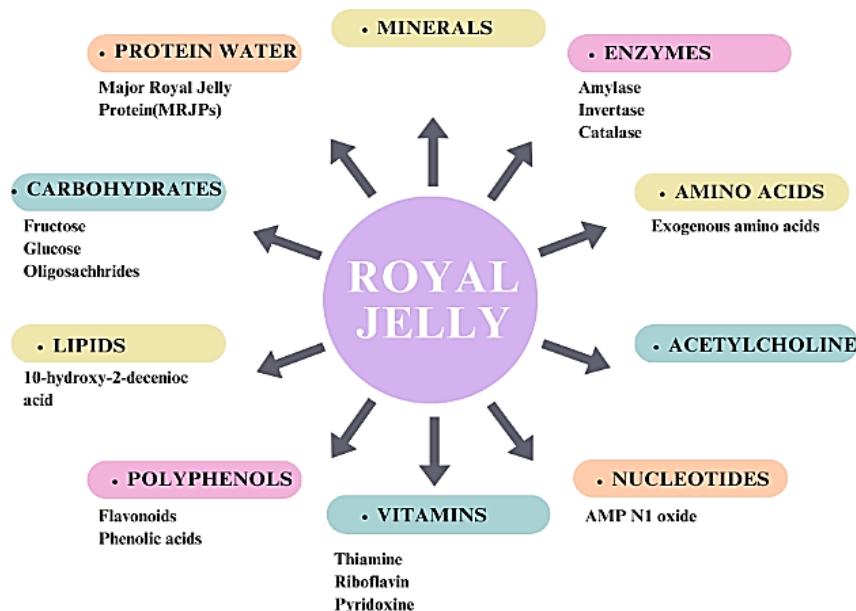


Fig. 3. Chemical composition of royal jelly

5. BEE VENOM SKINCARE

5.1 Chemical Composition of Bee Venom

Bee venom comprises a diverse blend of proteins, amino acids, enzymes, sugars, and lipids. While peptides stand out as the primary constituents of bee venom, melittin, a prominent polypeptide, takes center stage. In humans, melittin stimulates the adrenal cortex, a part of the adrenal gland, prompting the release of cortisol. This hormone is renowned for its role in mitigating inflammation and promoting the healing process [43]. Melittin possesses multifaceted properties; it induces membrane permeability and cell lysis. Furthermore, it houses active amines, including epinephrine, histamine, norepinephrine, and dopamine. Alongside these amines, bee venom also has enzymes such as hyaluronidase, phospholipase A2, acid phosphor monoesterase, and lysophospholipase [44,43]. In addition to peptides, bee venom features additional components, including lipids, carbohydrates, and free amino acids. Remarkably, bee venom exhibits promise as a topical agent, promoting skin regeneration and offering potential treatments for specific epidermal conditions. Importantly, its topical application has demonstrated excellent tolerance on human skin, with no indications of dermal irritation, as corroborated by animal studies [45]. Applying BV directly to the skin of guinea pigs did not produce any noticeable effects and did not cause any adverse reactions during phototoxicity tests [46].

5.2 Cosmetic and Skincare Application

5.2.1 Face wrinkles

These are minute creases on the skin, particularly on the face, and are a consequence of natural aging. Skin, the largest organ of the body and most visible feature, undergoes changes over time. Two key contributing factors to wrinkle formation are chronic sun exposure, especially to intense sunlight, and the natural aging process [47,48]. Researchers conducted a study to explore the positive effects of serum infused with bee venom on facial wrinkles. The application of bee venom serum demonstrated a notable reduction in the appearance of wrinkles, affirming its safety for human use. This reduction in collagen production is a key factor behind wrinkle formation and diminished elasticity of skin. Animal studies have indicated that bee

venom is well accepted, causing no cutaneous irritation. Cosmeceuticals, a category of skincare products, function both as cosmetics and medications. Many cosmeceuticals incorporate naturally derived ingredients, including bee venom. Bee venom serum has gained recognition for its ability to combat face wrinkles by reducing the combined area, count, and size of the wrinkles.

In a medical trial involving twenty Korean women from age 30 to 49, bee venom facial serum at a 0.006% concentration was administered twice daily for a period of 12 weeks (approximately 3 months). Researchers found that bee venom-containing cosmetics were safe and effective, causing minimal irritation. Therefore, the application of bee venom is an effective approach to diminish skin wrinkles, stimulating collagen and elastin production [49].

5.2.2 Acne

Purified bee venom, at a concentration of 500 micrograms, exhibited a reduction in the number of Cuti bacterium acne. The antibacterial properties of bee venom, attributed to melittin, confer bactericidal and bacteriostatic effects. Melittin, a toxic peptide, disrupts bacterial cell walls, making bee venom effective against *Staphylococcus aureus*, *Staphylococcus epidermidis*, and *Staphylococcus pyrogenes* [43,50]. A randomized double-blind controlled trial conducted by Han et al. researched the therapeutic potential of bee venom in treating acne. The study revealed that bee venom effectively reduced acne by targeting microbial cell walls. Furthermore, bee venom can be utilized in the treatment of fungal and viral skin infections and has demonstrated efficacy in inhibiting photoaging processes. In a subjective evaluation, skin care products containing bee venom were applied to individuals with acne for two weeks, and their effects were compared to those of products without bee venom. A gel containing six one-hundredths of a percent bee venom did not trigger a photosensitive skin reaction, as validated in experimental animals [44]. Bee venom's ability to counteract photoaging makes it a valuable option for photodamaged skin. The results showed a 57.5% reduction in Adenosine Triphosphate levels and a decrease in the count of both inflammatory and noninflammatory lesions compared to the control group.

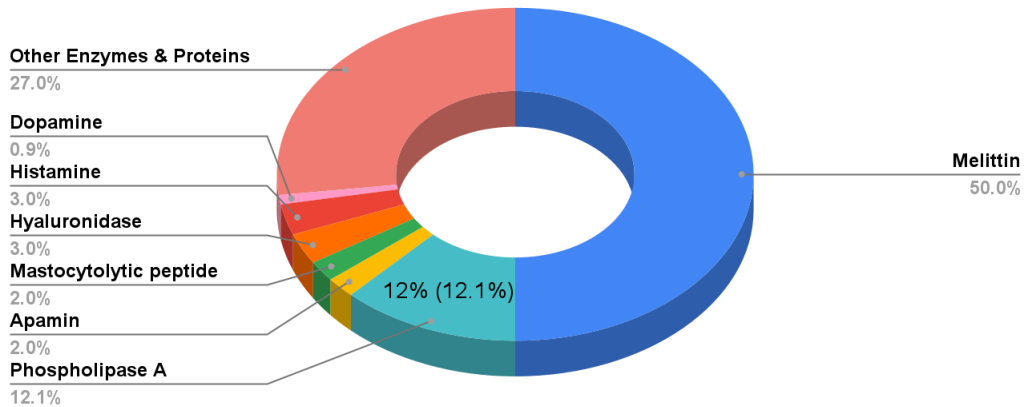


Fig. 4. Chemical composition of bee venom

5.2.3 Other skincare applications

1. **Minimizes Pores:** bee venom's astringent properties effectively reduce excess oil and fluids in skin pores and the uppermost skin layers, helping to shrink pores.
2. **Soothes Inflammation:** bee venom boasts powerful anti-inflammatory effects, primarily attributed to Adolapin. It swiftly alleviates burning, redness, and swelling on the skin's surface.
3. **Fades Blemishes:** bee venom's pore-smoothing properties and ability to shrink pores contribute to the fading of acne blemishes. Additionally, it contains the peptide Melittin, which possesses antibacterial and antimicrobial properties, aiding in the fight against.
4. **Muscle Relaxation:** bee venom helps relax muscles while reinforcing collagen and elastin, maintaining skin tautness.

the utilization of honey-based products. As consumers began to gravitate towards more natural and sustainable ingredients, honey's reputation as a nourishing and hydrating agent gained traction. However, its prevalence was limited, with only a handful of brands incorporating honey into their formulations.

Fast-forward to 2023, the market for honey-based cosmetics and skincare products has experienced substantial growth. The market for royal jelly-based cosmetics and skincare products has experienced significant growth. This can be attributed to heightened consumer interest in holistic and clean beauty solutions. Refer to Fig. 5 for the demand for honey for cosmetic use. royal jelly, derived from honeybee hives, is rich in vitamins, minerals, and amino acids, making it a sought-after ingredient in anti-aging and skin rejuvenation products. Celebrities have played a notable role in popularizing these products, often endorsing royal jelly infused skincare routines in interviews and on social media, further driving consumer interest. Major beauty brands have incorporated propolis into their formulations, while smaller, niche brands

6. MARKET TRENDS AND DEMAND

In 2009, the cosmetics and skincare industry witnessed a subtle but emerging trend towards

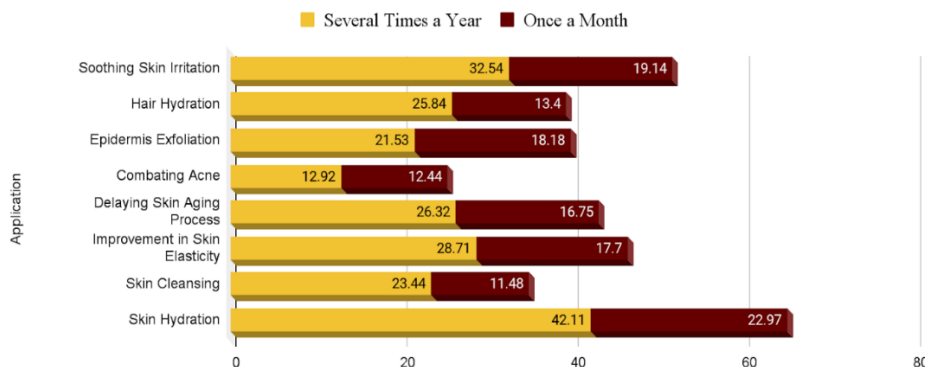


Fig. 5. Demand of honey for cosmetic use [51]

specializing in apitherapy-based skincare have emerged. Celebrities, including skincare influencers and actors, have played a role in propelling propolis into the mainstream by endorsing and highlighting their love for propolis-infused products on social media.

Looking ahead to 2029, the market trends and demands for honeybee-based products in cosmetics and skincare are projected to continue their upwards trajectory. As sustainability and clean beauty movements gain even more prominence, honey's appeal as a natural and ethically sourced ingredient will remain steadfast. With ongoing research and innovation, honey's potential applications in anti-aging, acne-fighting, and sun protection products are expected to expand, further solidifying its position as a staple in the cosmetics and skincare industry.

7. CONCLUSION

In conclusion, this review underscores the promising role of bee products as valuable ingredients in the cosmetics and skincare industry. The chemical diversity and beneficial properties of honey, propolis, royal jelly, and bee venom have been highlighted, shedding light on their potential to address various skincare concerns. The historical utilization of these natural remedies reaffirms their time-tested efficacy.

Moreover, the experiments conducted on both human subjects and animals have provided valuable insights into the safety and effectiveness of incorporating bee-derived ingredients into cosmetic formulations. These studies emphasize the need for further research and clinical trials to fully explore the therapeutic potential of bee products in skincare. It is important to know that some people might have problems with honeybee products such as honey, royal jelly, propolis, and bee venom. For example, some people might get tummy aches or allergies from eating honey or using bee products. royal jelly and propolis can sometimes cause skin rashes or itching. In addition, if someone gets stung by a bee and has an allergy, bee venom can be super dangerous and make them sick. Therefore, while these bee products can be good for some people, it is best to be cautious and check whether someone is allergic or sensitive to them before using them.

This study is evidence that the cosmetics and skincare market is poised for a substantial

growth in demand for products containing bee-based ingredients. This heightened interest is driven not only by the pursuit of natural and sustainable alternatives but also by the increasing awareness of the numerous benefits offered by bee products. Therefore, industry stakeholders, researchers, and consumers alike can anticipate a flourishing market for bee-derived cosmetics and skincare products in the years to come. This trend not only reflects a return to nature but also a recognition of the timeless wisdom encapsulated in the world of bees. In essence, bee products have emerged as more than mere ingredients; they symbolize a harmonious blend of nature's wisdom and scientific innovation, offering a promising pathway toward healthier and more radiant skin.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declares that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of manuscripts.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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