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(REVIEW ARTICLE)

The potential therapeutic applications and mechanisms of action of *Cryptomphalus aspersa* (snail) extracts in dermatology and wound healing

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Abstract

Cryptomphalus aspersa, commonly known as the garden snail, has emerged as a promising therapeutic agent in the fields of dermatology and wound healing. This review explores the diverse therapeutic applications and underlying mechanisms of action of *Cryptomphalus aspersa* extracts. With a rich history in traditional medicine and growing scientific evidence supporting their efficacy, snail extracts offer multifaceted benefits including anti-inflammatory, antioxidant, collagen-stimulating, and immunomodulatory activities. In dermatology, snail extracts have shown promise in managing conditions such as acne vulgaris, atopic dermatitis, photoaging, and hyperpigmentation, while also demonstrating efficacy in promoting wound healing in various types of wounds, including full-thickness and chronic wounds. Mechanistically, snail extracts modulate inflammatory pathways, neutralize oxidative stress, stimulate collagen synthesis, and regulate immune responses, contributing to their therapeutic effects. While the potential of *Cryptomphalus aspersa* extracts is vast, further research and clinical trials are warranted to establish their efficacy and safety profiles for specific dermatological conditions and wound types. Overall, *Cryptomphalus aspersa* extracts represent a novel and promising approach in dermatology and wound healing, offering a natural and multifaceted solution for improving skin health and promoting tissue repair.

Keywords: *Cryptomphalus aspersa*; Dermatology; Wound healing; Anti-inflammatory; Antioxidant

1. Introduction

In the world of skin care and healing wounds, people are increasingly turning to natural remedies. One such remedy that's caught the attention of scientists and doctors is *Cryptomphalus aspersa* (*Cornu aspersum*), which comes from snails. Yes, you read that right – snails! These little creatures have been used in traditional medicine for ages, and now, modern research is showing that their gooey secretions might actually be helpful for our skin. In this article, we're going to explore how snail extracts could be beneficial for our skin and for healing wounds. We'll break down the science behind why these slimy substances might work wonders for us. When it comes to skin problems like acne, atopic dermatitis (a type of eczema), wrinkles, and dark spots, snail extracts seem to offer some promising solutions. Research suggests that they can help with acne by calming down inflammation, reducing oily skin, and even helping wounds heal faster [1]. For people struggling with atopic dermatitis, snail goo might be a game-changer too. It seems to soothe irritated skin and strengthen its natural defenses, which could mean fewer flare-ups and less discomfort [2]. And what about those pesky signs of aging, like wrinkles and sagging skin? Well, snail extracts contain antioxidants that can fight off damage from the sun and help keep skin looking youthful and firm [3]. Even problems like dark spots and uneven skin tone might meet their match with snail extracts. Studies suggest that these extracts can stop the production of excess pigment in the skin, which means fewer spots and a more even complexion [4]. But it's not just about making our

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skin look better – snail extracts could also help it heal faster. Whether it's a small cut or a serious burn, snail secretions have been shown to speed up the healing process by encouraging new skin growth and reducing inflammation [1][3]. So, how do snail extracts actually work their magic? We'll dive into the science behind it all – from their anti-inflammatory and antioxidant properties to their ability to boost collagen production and even tweak our immune systems. In short, snail extracts might be tiny heroes for our skin, offering natural solutions to common problems. While more research is needed to fully understand their benefits, the evidence so far is promising. By exploring the potential of snail extracts, we're opening up new possibilities for healthier, happier skin.

2. Composition of Snail Secretions

The common garden snail is often called *Cryptomphalus aspersa* (*Cornu aspersum*), and is a gastropod that makes many bioactive mixes of glycoproteins, antioxidants, peptides, and growth factors among other substances. Their secretions contain compounds that can perform various functions such as antimicrobial action, inflammation control as well as brain disorders [5].

Snail slime has many glycoproteins inside it. It is composed of glycoproteins, enzymes, proteoglycans like achacin, hyaluronic acid, glycosaminoglycans, antimicrobial peptides, copper peptides, metal ions among is glycoproteins famously known to be found in snail's slime [5]. These glycoproteins possess different biological characteristics including promoting fibroblast cell growth as well as metabolism acceleration promoting metabolic stimulation in fibroblasts and proliferation as well as metabolic stimulation in them [5].

The mucus secretions of *Cryptomphalus aspersa* contain antioxidants including superoxide dismutase (SOD) and glutathione that exhibit antioxidant activity [6]. This as such offers protection for the skin, elimination of dull tone appearance as well as smoothing out rough skins.

Snail secretions contain peptides which have different biological activities, for example: diminishing the number and depth of wrinkles thus stimulating a rejuvenation of the skin. Moreover, they help make it firmer and smoother, and provide additional luminosity.

Growth factors exist in *Cryptomphallus aspersa* secretions and they have been proven to restore damaged skin structures. They help in re-invigorating the skin through reducing wrinkles and increasing elasticity, firmness and brightness of the skin using SCA® Growth Factor Technology which is a refined glycoprotein compound extracted from *Cryptomphalus aspersa* secretions.

In conclusion, it is known that *Cryptomphallus aspersa* secretions consist of many bioactive substances, among them glycoproteins, antioxidants, peptides, growth factors with potential for promoting cell proliferation ability, inhibiting oxygen free radicals quenching them scavenging fibroblast hyperplasia and metabolism boost skin rehydration. Their potential application in industries such as cosmetics and pharmaceuticals makes these compounds matter widely studied.

3. Dermatological Applications

3.1. Acne Vulgaris

Acne vulgaris, a common skin condition characterized by the formation of comedones, papules, pustules, and nodules, affects individuals of all ages and can have significant psychological and social implications [7]. The multifactorial pathogenesis of acne involves factors such as increased sebum production, follicular hyperkeratinization, inflammation, and colonization of *Propionibacterium* acnes bacteria [7].

Cryptomphalus aspersa extracts have emerged as a potential adjunct therapy for acne vulgaris due to their diverse pharmacological properties. Several studies have investigated the effects of snail extracts on acne-prone skin, revealing promising results.

Firstly, snail extracts have been shown to regulate sebum production, which plays a pivotal role in the pathogenesis of acne. By modulating sebaceous gland activity, snail extracts help reduce excess oiliness on the skin surface, thereby minimizing the risk of pore clogging and acne formation [1].

Moreover, *Cryptomphalus aspersa* extracts exhibit anti-inflammatory properties, which are crucial for alleviating the inflammatory component of acne. Inflammation contributes to the development of inflammatory acne lesions, including papules, pustules, and nodules. Snail extracts have been found to inhibit pro-inflammatory cytokines and enzymes involved in the inflammatory cascade, thereby attenuating the inflammatory response within acne lesions [1].

Additionally, snail extracts promote wound healing processes, which are essential for resolving existing acne lesions and preventing the formation of new ones. By accelerating the repair of damaged skin tissue, snail extracts facilitate the resolution of acne lesions and minimize the risk of scarring [1].

3.2. Atopic Dermatitis

Atopic dermatitis, a chronic inflammatory skin condition characterized by pruritus, erythema, and eczematous lesions, poses significant challenges in management due to its complex pathophysiology [8]. Disruption of the skin barrier function and dysregulated immune responses contribute to the development and exacerbation of atopic dermatitis lesions [8].

Snail extracts have emerged as a potential therapeutic option for managing atopic dermatitis symptoms, owing to their anti-inflammatory effects and ability to improve skin barrier function. Research has demonstrated the efficacy of snail extracts in ameliorating various aspects of atopic dermatitis pathology. Firstly, *Cryptomphalus aspersa* extracts exhibit potent anti-inflammatory properties, which play a crucial role in attenuating the inflammatory response associated with atopic dermatitis. By modulating pro-inflammatory cytokines and signaling pathways, snail extracts help mitigate the immune-mediated inflammation observed in atopic dermatitis lesions, thereby alleviating symptoms such as erythema and pruritus [4]. Moreover, snail extracts have been shown to enhance skin barrier function, which is compromised in individuals with atopic dermatitis. By reinforcing the stratum corneum and promoting the synthesis of key barrier components such as ceramides and filaggrin, snail extracts help restore skin integrity and prevent transepidermal water loss, thereby reducing dryness and improving overall skin health [4]. Furthermore, the moisturizing properties of snail extracts contribute to their therapeutic efficacy in atopic dermatitis management. By hydrating the skin and preventing excessive dryness, snail extracts alleviate discomfort and support the repair of damaged skin barrier function [4].

3.3. Photoaging and Wrinkles

Photoaging, characterized by premature skin aging due to chronic sun exposure, manifests as wrinkles, fine lines, hyperpigmentation, and loss of skin elasticity [9]. Collagen degradation and oxidative stress are key mechanisms underlying photoaging, necessitating interventions that target these processes to mitigate its effects. *Cryptomphalus aspersa* extracts have garnered attention for their ability to counteract the signs of photoaging and improve skin elasticity, primarily attributed to their antioxidant and collagen-stimulating properties. Firstly, snail extracts are rich in antioxidants, including vitamins and enzymes, which scavenge free radicals generated by UV radiation and environmental stressors [3]. By neutralizing oxidative stress, snail extracts protect skin cells from damage and prevent collagen breakdown, thereby preserving skin firmness and elasticity. Moreover, *Cryptomphalus aspersa* extracts stimulate collagen synthesis by fibroblasts, the key cells responsible for producing extracellular matrix components such as collagen and elastin [3]. By promoting collagen production and inhibiting enzymes that degrade collagen, snail extracts contribute to skin rejuvenation and the reduction of fine lines and wrinkles. Furthermore, snail extracts exhibit moisturizing properties, which enhance skin hydration and improve its overall appearance [3]. Hydrated skin appears plumper and smoother, reducing the visibility of wrinkles and imparting a more youthful complexion.

3.4. Hyperpigmentation

Hyperpigmentation, characterized by dark patches on the skin due to excess melanin production, is a common concern affecting individuals of all skin types. Conditions such as melasma and post-inflammatory hyperpigmentation pose significant challenges in treatment and often require interventions that target melanin synthesis. Recent research has highlighted the potential of *Cryptomphalus aspersa* extracts in managing hyperpigmentation disorders. Studies have shown that snail extracts possess inhibitory effects on melanin synthesis, making them promising candidates for treating conditions like melasma and post-inflammatory hyperpigmentation. Melanin is the pigment responsible for skin color, and its overproduction can lead to hyperpigmented patches. Snail extracts interfere with the melanogenesis process, inhibiting the enzymes and signaling pathways involved in melanin synthesis [2]. By reducing melanin production, snail extracts help lighten dark spots and promote a more even skin tone. Moreover, snail extracts exhibit antioxidant properties, which further contribute to their efficacy in treating hyperpigmentation disorders. Oxidative stress can exacerbate hyperpigmentation by stimulating melanocyte activity and melanin production. By neutralizing free radicals and reducing oxidative damage, snail extracts help address the underlying causes of hyperpigmentation and prevent its recurrence [3]. Furthermore, snail extracts may aid in the dispersion of melanin, helping to fade existing

hyperpigmented lesions. This depigmenting effect, coupled with their ability to inhibit melanin synthesis, makes snail extracts a promising option for individuals seeking to address hyperpigmentation concerns.

These findings lend support to the use of *Cryptomphalus aspersa* secretion in dermatological applications, notably for wound healing and skin aging (Table 1)[10]. However, further study is required to properly comprehend the mechanics and possible advantages of utilizing SCA in dermatological therapies.

Table 1 The dermatological applications of *Cryptomphallus aspersa*

Application	Description
Scar Reduction	*C. aspersa* secretion contains glycoproteins, hyaluronic acid, and antioxidants, which can aid in minimizing scar formation by promoting collagen synthesis and tissue remodeling.
Acne Treatment	The mucin in *C. aspersa* secretion has moisturizing properties and helps in reducing inflammation, making it beneficial for acne-prone skin. It also aids in reducing acne scarring.
Anti-Aging	The secretion is rich in glycosaminoglycans, which help in maintaining skin elasticity and hydration. It also contains enzymes that stimulate collagen and elastin production, reducing fine lines and wrinkles.
Skin Repair	*C. aspersa* secretion contains allantoin, a compound known for its skin-regenerative properties. It accelerates cell turnover and helps in repairing damaged skin, including sun- damaged skin.
Dermatitis Relief	The anti-inflammatory and soothing properties of *C. aspersa* secretion make it effective in alleviating symptoms associated with dermatitis, such as redness, itching, and irritation.

4. Wound Healing Applications

4.1. Full-thickness Wounds

Full-thickness wounds, which penetrate through the entire dermis and sometimes reach underlying tissues, present significant challenges in healing and tissue regeneration. Efficient wound closure, re-epithelialization, and collagen synthesis are essential processes for successful wound healing. *Cryptomphalus aspersa* extracts have emerged as promising agents for accelerating the healing of full-thickness wounds. Research has demonstrated their ability to enhance wound closure, promote re-epithelialization, and stimulate collagen synthesis, thereby expediting the healing process. Studies have shown that snail extracts facilitate wound closure by promoting the migration and proliferation of skin cells at the wound site [1]. By accelerating the formation of granulation tissue and promoting angiogenesis, snail extracts create an optimal environment for tissue regeneration and wound closure. Moreover, *Cryptomphalus aspersa* extracts stimulate re-epithelialization, the process by which new epithelial cells migrate and proliferate to cover the wound surface. By enhancing the migration and proliferation of keratinocytes, snail extracts facilitate the formation of a new epithelial layer over the wound, promoting wound closure and preventing infection [1]. Furthermore, snail extracts stimulate collagen synthesis, a crucial step in the remodeling phase of wound healing. Collagen provides structural support to the healing wound and contributes to its tensile strength. By promoting collagen production by fibroblasts and inhibiting enzymes that degrade collagen, snail extracts accelerate the formation of mature scar tissue, leading to improved wound healing outcomes [1][11].

4.2. Burn Wounds

Studies have shown that snail extracts possess antibacterial properties, reduce inflammation, and enhance angiogenesis, making them a promising adjunct therapy for burn wound management [12]. In addition, several research have shown that mollusk secretions are useful to burnt skin and open wounds [13].

4.3. Chronic Wounds

Chronic wounds, such as diabetic ulcers and venous leg ulcers, pose significant challenges in healing and often require interventions that promote tissue regeneration and granulation for successful wound closure. The bioactive components present in *Cryptomphalus aspersa* extracts have demonstrated potential efficacy in treating chronic wounds by contributing to tissue regeneration and granulation. Studies have shown that snail extracts contain growth factors and peptides that stimulate cellular proliferation and tissue repair mechanisms [14]. These bioactive molecules

play crucial roles in promoting angiogenesis, collagen synthesis, and epithelialization, essential processes for chronic wound healing. Furthermore, snail extracts exhibit antimicrobial properties, which are beneficial for managing chronic wounds prone to infections [14]. By inhibiting the growth of pathogenic microorganisms and promoting a sterile wound environment, snail extracts help prevent complications and facilitate the healing process. Moreover, *Cryptomphalus aspersa* extracts have been found to modulate the inflammatory response in chronic wounds, promoting a balanced immune reaction conducive to tissue repair [14][1]. By reducing excessive inflammation and promoting the resolution of chronic inflammation, snail extracts create an environment favorable for wound healing.

5. Mechanisms of Action

5.1. Anti-inflammatory Effects

Snail extracts exhibit remarkable anti-inflammatory properties, making them valuable in managing various inflammatory conditions. These effects are mediated through several mechanisms, including the inhibition of pro-inflammatory cytokines, reduction of oxidative stress, and promotion of anti-inflammatory mediators (Fig 1)[5]. One study by Bordignon et al. (2017) demonstrated that snail extracts effectively inhibit the production and activity of pro-inflammatory cytokines such as tumor necrosis factor-alpha (TNF-α) and interleukin-6 (IL-6) [1]. By suppressing these cytokines, snail extracts help attenuate the inflammatory response and mitigate tissue damage associated with excessive inflammation. Additionally, snail extracts possess potent antioxidant properties, as highlighted in a study by García-Vilas et al. (2018) [14]. These antioxidants scavenge free radicals and neutralize reactive oxygen species (ROS), thereby reducing oxidative stress and dampening the inflammatory response. This antioxidant activity plays a crucial role in mitigating inflammation-induced tissue damage. Furthermore, snail extracts promote the release of anti-inflammatory mediators, such as interleukin-10 (IL-10) and transforming growth factor-beta (TGF-β), as demonstrated in research by Bordignon et al. (2017) [1]. These mediators help resolve inflammation and promote tissue repair, contributing to the restoration of tissue homeostasis.

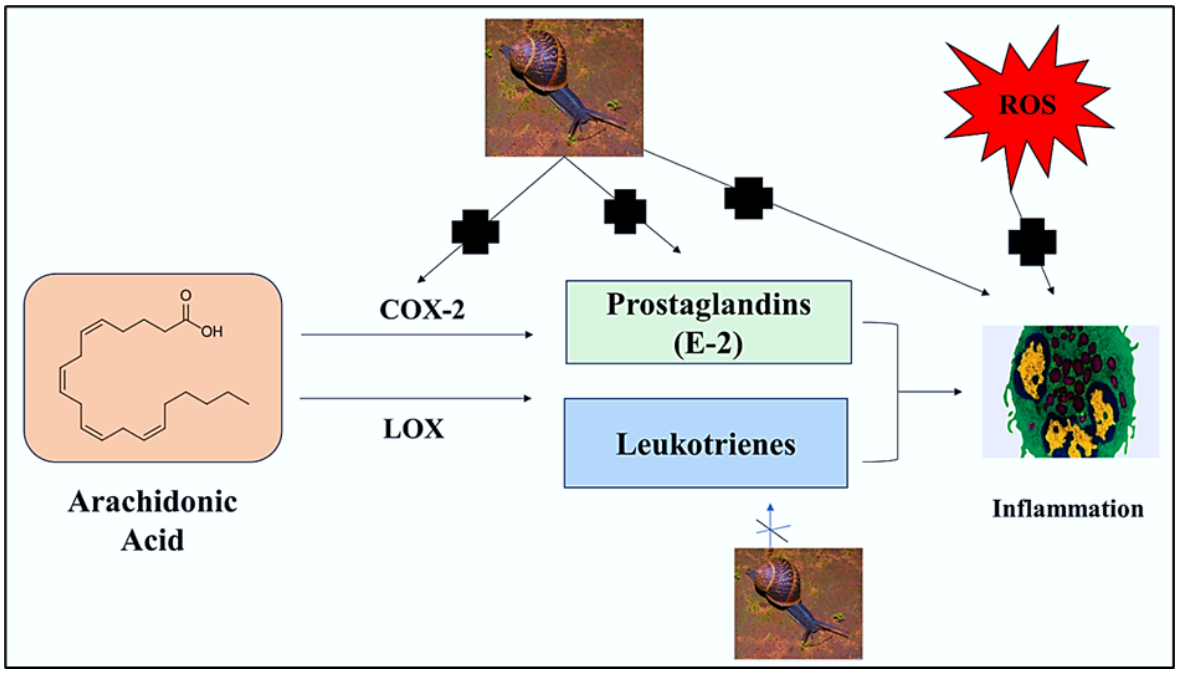

Figure 1 Anti-inflammatory Effects *Cryptomphalus aspersa* (**COX-2**: Cyclooxygenase, **LOX**: Lipoxygenase, ROS : Reactive oxygen species)

5.2. Antioxidant Activity

The antioxidant activity of *Cryptomphalus aspersa* extracts is instrumental in protecting the skin from oxidative damage caused by reactive oxygen species (ROS). These extracts contain a high concentration of antioxidants, including vitamins and enzymes, which play a crucial role in neutralizing ROS and preserving skin health. Research by García-Vilas et al. (2018) has highlighted the potent antioxidant properties of snail extracts [14]. These antioxidants scavenge free radicals and mitigate oxidative stress, thereby preventing oxidative damage to skin cells and tissues. By neutralizing ROS, snail extracts help maintain the integrity of cellular structures and prevent premature aging caused by oxidative stress.

Moreover, the presence of vitamins and enzymes in *Cryptomphalus aspersa* extracts further enhances their antioxidant activity. Vitamins such as vitamin E and vitamin C act as potent antioxidants, protecting the skin from oxidative damage and promoting skin health [3]. Enzymes such as superoxide dismutase (SOD) and catalase catalyze the breakdown of ROS, contributing to the overall antioxidant defense system of the skin. Furthermore, the antioxidant activity of snail extracts extends beyond scavenging free radicals to include the regulation of cellular signaling pathways involved in oxidative stress response [3]. By modulating these pathways, snail extracts help mitigate oxidative damage and maintain skin homeostasis.

5.3. Collagen Synthesis

Collagen is a fundamental protein that provides structural support to the skin, promoting wound healing and maintaining skin elasticity. *Cryptomphalus aspersa* extracts have been found to promote collagen synthesis by fibroblasts and inhibit enzymes that degrade collagen, leading to improved wound healing and skin rejuvenation. Studies have demonstrated that snail extracts stimulate collagen production by fibroblasts, the primary cells responsible for synthesizing collagen in the skin [14]. By enhancing the activity of fibroblasts, snail extracts promote the synthesis of new collagen fibers, contributing to tissue repair and regeneration. Moreover, snail extracts inhibit enzymes that degrade collagen, such as matrix metalloproteinases (MMPs), which are involved in the breakdown of extracellular matrix components [2]. By inhibiting MMP activity, snail extracts help preserve existing collagen fibers and prevent premature collagen degradation, leading to improved skin texture and firmness. Furthermore, the collagen-stimulating effects of snail extracts extend beyond wound healing to include skin rejuvenation. Research has shown that snail extracts promote dermal remodeling and improve skin elasticity, resulting in a more youthful appearance [3]. By enhancing collagen synthesis and preserving collagen integrity, snail extracts contribute to overall skin health and vitality.

5.4. Immunomodulatory Effects

The immunomodulatory properties of snail extracts play a crucial role in modulating immune responses, facilitating tissue repair, and reducing inflammatory reactions. *Cryptomphalus aspersa* extracts have been found to exert immunomodulatory effects that contribute to the overall efficacy of these extracts in wound healing and skin health. Studies have shown that snail extracts modulate immune responses by regulating the activity of immune cells and cytokines involved in inflammation and tissue repair [12]. By promoting a balanced immune response, snail extracts create an optimal environment for tissue regeneration and wound healing. Moreover, snail extracts exhibit anti-inflammatory effects, which are partly mediated by their immunomodulatory properties [14]. By inhibiting pro-inflammatory cytokines and promoting the release of anti-inflammatory mediators, snail extracts help attenuate inflammation and reduce tissue damage associated with excessive immune activation. Furthermore, the immunomodulatory effects of snail extracts extend beyond wound healing to include the regulation of immune responses in various skin conditions. Research has shown that snail extracts can modulate immune responses in conditions such as atopic dermatitis and psoriasis, where dysregulated immune responses play a central role [12].

6. Future Directions and Challenges

Cryptomphallus aspersa extracts have showed promise in a variety of cosmetic and medicinal uses, including skin rejuvenation and wound healing. However, various future approaches and challenges must be addressed before these extracts' promise may be fully realized.

6.1. Potential synergies with other therapies

One promising way forward is to study whether or not *Cryptomphallus aspersa* extracts work better when combined with other treatments or ingredients. Take for instance combining the regenerative abilities of *Cryptomphallus aspersa* extracts with additional antioxidants or growth factors would make it more effective in general. In addition, by studying how an extract of *Cryptomphallus aspersus*, combines with different healing agents like growth factors and antibiotics might be a new approach to enhancing efficacy in chronic wound treatment [2].

6.2. Standardization of *Cryptomphallus aspersa* extract formulations

Cryptomphallus aspersa extract formulation standardization is yet another challenge. It is important to have a regulated approach to obtaining these extracts that can help ascertain their quality since their compositions and activities are likely to differ depending on where they were obtained from and how they were extracted [3].

6.3. Regulatory considerations and quality control

When it comes to the use of *Cryptomphallus aspera* extracts in cosmetics and pharmaceuticals, one should pay attention to the regulatory and quality issues. However, these extracts are still new and thus clear quality control measures and regulatory guidelines are essential. This involves instituting safety and efficacy standards that are appropriate as well as that these extracts are produced and tested in line with specified quality control processes [2].

In conclusion, while *Cryptomphallus aspersa* extracts have demonstrated promising results in a variety of applications, significant future directions and obstacles must be addressed in order to fully realize their potential. By concentrating on these areas, academics and industry experts may further our understanding and application of these extracts for the benefit of patients and consumers.

7. Conclusion

In conclusion, *Cryptomphalus aspersa* extracts hold tremendous promise in the fields of dermatology and wound healing, owing to their multifaceted therapeutic effects. These extracts exhibit potent anti-inflammatory, antioxidant, collagen-stimulating, and immunomodulatory activities, which collectively contribute to their efficacy in promoting skin health and facilitating wound repair. The anti-inflammatory properties of snail extracts help attenuate inflammation, reduce tissue damage, and promote a balanced immune response conducive to tissue repair. Additionally, their antioxidant activity protects the skin from oxidative damage, while their ability to stimulate collagen synthesis and inhibit collagen degradation enhances wound healing and skin rejuvenation. Moreover, the immunomodulatory effects of snail extracts regulate immune responses, further promoting tissue repair and maintaining skin homeostasis. These diverse mechanisms of action make *Cryptomphalus aspersa* extracts valuable therapeutic agents for managing various dermatological conditions and promoting wound healing. However, despite the promising findings from preclinical and clinical studies, further research and rigorous clinical trials are warranted to establish the efficacy and safety profiles of snail extracts for specific dermatological conditions and wound types. Comprehensive studies will help elucidate the optimal formulations, dosages, and treatment regimens for maximizing the therapeutic benefits of *Cryptomphalus aspersa* extracts in clinical practice. In conclusion, *Cryptomphalus aspersa* extracts represent a novel and promising avenue in dermatology and wound healing, offering multifaceted therapeutic effects that hold great potential for improving patient outcomes and quality of life.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

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