



## SNAIL MUCIN – AN INNOVATIVE INGREDIENT USED IN COSMETOLOGY AND MEDICAL INDUSTRY - A REVIEW

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### ABSTRACT

Mucin is a highly glycosylated protein family that are secreted by animals for hydration, lubrication, and other functions. Snails produce mucin proteins in their mucous for a wide array of biological functions, including microbial protection, adhesion, hydration and lubrication. Recently, snail mucins have also become an innovation with wide ranging applications across chemistry, biology, biotechnology, and biomedicine. Specifically, snail mucus have been applied as skin care products, wound healing agents, anti-ageing properties, anti-acne, moisturizing properties, anti-inflammatory, antimicrobial, scar reduction and hydration properties. This review describes the research on snail mucin in cosmetics and medical field.

**KEYWORDS:** Snail mucin, hyaluronic acid, anti-ageing, glycolic acid, wound healing, aloe vera.

## 1. INTRODUCTION TO SNAIL MUCIN

### 1.1. DEFINITION

Snail mucus are the slimy textured secretion naturally produced by snails. Mucin produced from snails are used for different purposes, such as protection from microbes, adhering to surfaces, and reduces friction while they move. The Scientific name of snail mucin is *Cryptomphalus aspersus*.



### 1.2. ORIGIN OF SNAIL MUCIN

Molluscs, the second-largest animal group with around 80,000 species, are a valuable source of therapeutically promising compounds. This diverse class comprises both aquatic and terrestrial species, including gastropods – a subgroup of land snails. Helix snails, specifically, have

garnered research attention. Two key species, *Cornu aspersum aspersum* and *Cornu aspersum maximum*, are commonly studied for their potential benefits.



The outer surface of snails is coated with a unique substance known as snail mucus, produced by specialized pedal glands. This multifunctional secretion serves several purposes, including.

- Adhesion.
- Softening
- Moisturizing
- Lubrication
- Protection
- Repair

The mucus's diverse functions are attributed to its intricate composition, which remains poorly understood due to its complex characteristics.

### 1.3. HISTORICAL USES OF SNAIL MUCIN IN TRADITIONAL MEDICINE AND BEAUTY TREATMENTS

For thousands of years, molluscs have been utilized for their medicinal properties. Ancient civilizations, including the Greeks, recognized the therapeutic potential of snail secretion. Notable historical figures, such as Hippocrates, Celse, Pliny, and Galien, documented various uses of snail-derived remedies, including.

- Relieving skin inflammation with crushed snails.
- Treating wounds, burns, abscesses, and Nosebleeds.
- Softening properties from cooked snail shells.

Historical records also reveal that snail mucus was employed in the 18th century to treat dermatological conditions, tuberculosis symptoms, and nephritis. The development of the pharmaceutical industry in the 19th century led to the creation of numerous snail mucus-based preparations.<sup>[1]</sup>

## 2. CHEMICAL COMPOSITION OF SNAIL MUCIN

### 2.1. KEY ACTIVE INGREDIENTS

Snail mucus stands out as a distinct natural product, resistant to replication through synthetic chemical compounds due to its complex composition. Its unique blend varies depending on factors such as species, functional role, and adhesive properties. Typically, snail mucus consists of

- ✓ Water (90-99.7%)
- ✓ Proteoglycans
- ✓ Glycosaminoglycans (including Hyaluronic acid)
- ✓ Glycoprotein enzymes
- ✓ Copper peptides
- ✓ Antimicrobial peptides



Notably, a specific type of mucus, cryptosin, exhibits thicker and denser characteristics. When snails experience biological stress, they produce a specialized mucus called cryptosin. This mucus is rich in beneficial compounds, including

- Mucin
- Mitomycin AF
- Allantoin
- Collagen
- Elastin
- Glycolic acid
- Acaciin

Snail mucus has demonstrated impressive medical potential due to its multifaceted properties. Research highlights its:

1. Wound healing capabilities
2. Anti-inflammatory effects on gum tissue
3. Skin-nourishing benefits

The intricate composition and unique properties of snail mucus make it an intriguing subject for further medical research and exploration. Snail mucin is composed of various beneficial nutrients. They include the following.

**1. Hyaluronic Acid** - Hyaluronic acid is known for its remarkable ability to moisturize and volumize the skin, diminishing the visibility of fine lines as well as wrinkles.

**2. Glycoproteins** - Glycoproteins are complexes that play a crucial role in repairing damaged skin by promoting cellular growth and help in maintaining skin health by enhancing the skin's natural defense mechanism.

**3. Peptides** - Peptides aid in stimulating the production of collagen. These are short chains of amino acids. Collagen is vital for maintaining skin elasticity, firmness, and an overall youthful appearance.

**4. Antioxidants** – Antioxidants present in snail mucus are glutathione, vitamin E, and vitamin C. They help protect the skin from harmful substances that can cause premature aging and damage.<sup>[2]</sup>

## 3. SNAIL MUCIN IN COSMETOLOGY

### 3.1. SKIN REPAIR AND REGENERATION

Snail mucus has diverse applications in

1. Skincare products
2. Wound healing agents
3. Surgical adhesives
4. Gastric ulcer treatment



Mucin's benefits include

1. Enhanced wound healing
2. Tissue regeneration
3. Natural repair mechanisms

Research shows snail mucus:

1. Promotes cell viability
2. Stimulates fibroblast proliferation
3. Influences extracellular matrix transformation



Studies demonstrate its role in

1. Keratinocyte and fibroblast migration
2. Cell-cell and cell-substrate adhesion molecule expression (in mammals)

Additionally, snail mucus may aid bone and tooth reconstruction by

1. Upregulating osteopenia and NF-KB expression
2. Inducing inflammatory gene expression in pulp cells



### 3.2. ANTI AGEING PROPERTIES

Research highlights the anti-aging properties of snail mucin through various mechanisms

1. Glycoproteins and peptides stimulate collagen and elastin production, combating age-related decline.
2. Snail mucin counteracts skin aging by:
3. Inhibiting matrix metalloproteinase expression.

Resulting benefits include

- Improved skin elasticity
- Enhanced firmness
- More youthful appearance

**Studies on *Helix aspera muller* mucin, commonly used in cosmetics, demonstrate**

- Protection from cell apoptosis
- Induced fibroblast proliferation via cytokine release and cytoskeleton reorganization

**Similar findings were observed with *Cryptomphalus aspersa* mucin (SCA)**

- Maintenance of actin cytoskeleton
- Regulation of metalloproteinase activity

**Clinical trials (25 patients) using SCA mucin showed**

- Improved periorcular and facial wrinkles after 8 and 12 weeks of daily use.
- Enhanced skin texture, confirmed by silicone skin impressions.

### 3.3. MOISTURIZING AND HYDRATING PROPERTIES

Snail mucin's hyaluronic acid content underscores its potent hydrating properties. As a glycosaminoglycan, hyaluronic acid boasts a distinctive helical structure, enabling it to retain 1000 times its weight in water.

This unique capacity

- Stabilizes the extracellular matrix
- Maintains hydration

Research on *H. aspera* mucin, conducted on healthy Caucasian female subjects, demonstrated its hydration efficacy through.

1. Reduced trans-epidermal water loss (TEWL), measured using a TEWAMETER and cranionometer probe.
2. Significant decreases in TEWL observed immediately, 1 hour, and 24 hours post- application.

**Cosmetic applications of snail mucin extend to scar treatment, particularly those resulting from acne or skin damage. Research on *Cryptomphalus Aspersa* mucin reveals**

- Fibroblasts (time- and dose-dependent).
- Increased expression of adhesion proteins (E-cadherin,  $\beta$ -catenin, vinculin,  $\beta$ 1- integrin).
- Indicating scar healing potential.

Alpha-hydroxy acids (AHAs), such as lactic acid, also aid scar treatment by: -Enhanced proliferation and migration of human keratinocytes, Loosening epidermal

connections between desmosomes and Facilitating deeper product penetration.

Notably, snail mucin contains minor amounts of lactic and glycolic acid, which:

- Exfoliate and promote new skin cell development.
- Target atrophic acne scars and post-inflammatory hyperpigmentation through keratolytic properties

Glycolic acid's benefits in scar treatment are attributed to its ability to.

- Break down keratin
- Encourage cell renewal

This study highlights snail mucin's potential to provide long-lasting hydration benefits.

### 3.4. POPULAR SNAIL MUCIN BASED PRODUCTS

The growing demand for snail mucin products has created a lucrative market poised for expansion. A recent analysis valued the global snail beauty product market at \$457.50 million in 2021, with projected growth to \$982.70 million by 2031.

Key market insights:

- Compound Annual Growth Rate (CAGR): 8.3%
- Regional distribution: North America, Europe, Asia-Pacific, and LAMEA (Latin America, Middle East, and Africa).
- Asia-Pacific dominates the market, driven by South Korea

Major market players:

- Kao Corporation
- InnoVactiv Inc.
- Tonymoly Co. Ltd
- Clariant AG
- Kenra Professional LLC
- Murad LLC
- Croda International plc
- SkinCeuticals
- COSRX Official
- Mizon Ltd



Product categories:

- Multifunction cream
- Cell renewal cream

Anti-aging cream (projected market leader by 2031)

- Anti-acne cream
- Other

Distribution channels:

- E-commerce (largest contributor, estimated to reach \$265.1 million by 2031)
- Offline channels

The growth of online shopping has bridged geographical gaps, fueling the snail mucin market's expansion.<sup>[3]</sup>

## 4. SNAIL MUCIN IN DERMATOLOGY AND MEDICINE

### 4.1 WOUND HEALING AND TISSUE REPAIR

Wound healing is a complex, highly organized process aimed at restoring epithelial integrity and skin barrier function after injury. The ideal outcome is rapid, scar-free healing, facilitated by various growth factors and cellular processes. Snail mucin, rich in glycosaminoglycans, hyaluronic acid, collagen and elastin, has gained popularity in Asian beauty culture for its skin- soothing and humectant properties. Its potential benefits for wound healing, inflammation reduction and anti-aging have sparked interest.

Cornu aspersum and Achatina fulica, commonly used in cosmetics, boast GAGs-rich compositions supporting skin structural proteins. Additional components, such as anti- inflammatory A chasin, glycoconjugates for fibroblast proliferation, soothing allantoin and glycolic acid, contribute to skin cell turnover. Topical therapy, a targeted, minimally invasive approach, delivers medications directly to the wound site, minimizing side effects.

Snail mucin's natural, humectant properties make it a promising treatment for disrupted skin barriers. However, its effectiveness in facilitating wound healing phases remains unclear. This systematic review aims to evaluate the evidence on topical snail mucin administration from A. fulica and C. aspersum, assessing its ability to accelerate wound healing.

1. Paraphrased sentences for clarity.
2. Removed direct citations and rephrased text.
3. Changed sentence structure for improved flow.
4. Maintained original meaning and content.
5. Added transitional phrases for coherence.

### 4.2 ANTI INFLAMMATORY ANTI MICROBIAL EFFECTS

Research has identified antimicrobial peptides in the mucus of Achatina fulica and Cornu aspersum, exhibiting potent antibacterial activity against harmful pathogens. This discovery supports the incorporation of snail

secretion into over-the-counter cosmeceuticals, enhancing their antimicrobial efficacy.

Moreover, the remarkable skin regenerative properties of mollusk-derived products have sparked significant interest in their cosmeceutical applications, particularly for addressing skin aging concerns. Commercial products, such as Endocare (Tensage; Biopelle, Inc.), have been developed utilizing snail-derived ingredients, including SCA and ICF-CAF, to promote skin rejuvenation.

This systematic review aims to investigate the clinical efficacy of snail-derived products on skin health, focusing on their protective effects in human trials. Specifically, we examine the benefits of snail secretions and egg extracts on skin well-being.

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5. Added transitional phrases for coherence<sup>[4]</sup>

## 5. SAFETY AND EFFICACY OF SNAIL MUCIN

### 5.1 RESEARCH AND CLINICAL TRIALS SUPPORTING EFFICACY AND OF SNAIL MUCIN

Today, snail mucus is a prized ingredient in skincare products, with the global market projected to reach \$770 million by 2025 (Coherent Market Insights, 2018). Despite its commercial success, research on mucus remains surprisingly limited.



Mucins, heavily glycosylated proteins produced in epithelial cells, are the primary constituents responsible for mucus's unique properties (Dhanisha *et al.*, 2018). These proteins can be membrane-bound or secreted, with distinct functions and capabilities (Van Putten and Strijbis, 2017). Secreted mucins form mucous membranes that cover a significant portion of multicellular organisms' surface area, with humans having approximately 99% of their surface area comprised of mucosal membranes (Sompayrac, 2012; Ma *et al.*, 2018; Cerullo, 2020).

Different snail species secrete multiple functional mucuses, such as adhesive and lubricating mucus from their foot and antimicrobial mucus from their back (Gould

*et al.*, 2019; Barrientos, 2020). Recent advances in omics technologies have expanded the exploration of gastropod mucins, revealing applications in chemistry, biology, biotechnology, and medicine (Amah *et al.*, 2019; Gentili *et al.*, 2020). Researchers are investigating snail mucins for their antimicrobial properties, therapeutic potential, and surfactant-like properties (Petrou and Crouzier, 2018).

However, the hierarchical mucin structures and their relationship to diverse functional properties remain poorly understood. Further research is needed to examine the biological and chemical diversity of snail mucin genes and elucidate the guiding principles determining their properties.

Numerous clinical trials have investigated the therapeutic potential of snail mucin in various health conditions, yielding promising results.

**Wound Healing:** Research suggests that snail mucin can alleviate pain from skin burns and potentially reduce hypertrophic scarring and keloid formation. Moreover, snail mucus has demonstrated superior antibacterial properties compared to commercial antibiotics in wound care.

1. **Skin Aging:** Studies have shown that snail extract treatment of snails. These methods typically involve stressing snails to stimulate mucin treatment improves skin texture, firmness, and elasticity in middle-aged women.
2. **Acne:** A 12-week trial found that snail mucin significantly reduced acne lesions.
3. **Skin Hydration:** Another study revealed that snail mucin helped minimize moisture loss from the skin in female participants.
4. **Anti-Aging Effects:** Oral administration of snail mucin has been shown to mitigate UV-induced wrinkles, moisture loss, and skin elasticity decline in mice.
5. **Immune Response:** Snail mucin has also been found to enhance the immune response to the recombinant Hepatitis B Vaccine (rHBsAg).

Snail mucin's benefits can be attributed to its rich composition, including hyaluronic acid, which retains moisture, and its antimicrobial properties.<sup>[5]</sup>

### 5.2. POTENTIAL SIDE EFFECTS OR ALLERGIC REACTION

Despite its generally favorable tolerance, it's essential to acknowledge the limitations of current research on snail mucin's interactions with human biology. While external application of snail mucin has not yielded clinically documented adverse effects, ongoing research aims to deepen understanding of its properties.

Individuals with shellfish or snail allergies should exercise caution, as these allergies can have severe consequences. If you have a known allergy to snails,

shellfish, or mollusks, consult your healthcare provider before using snail mucin products.

Be aware of potential skin allergy signs, which may include:

- Rash
- Redness
- Itching
- Swelling
- Raised bumps
- Cracked skin
- Scaling or flaking of the skin

If you experience any of these symptoms while using snail mucin products, promptly contact your healthcare provider.<sup>[6]</sup>

### 5.3. REGULATORY STATUS (FDA AND OTHER GLOBAL REGULATIONS ON SNAIL MUCIN)

The European Food Safety Authority (EFSA) was asked by the European Commission to assess Helix Complex Snail Mucus (HSM) as a novel food ingredient for adult supplements. HSM is derived from snail mucus collected from *Helix aspersa maxima*. However, the EFSA Panel on Nutrition, Novel Foods and Food Allergens found the provided data on composition, stability, and subchronic toxicity to be unsatisfactory.

Specifically, the panel noted inconsistencies in the reporting of certificates of analysis and subchronic toxicity data. These deficiencies made it impossible to determine a safe intake level for HSM. As a result, the EFSA concluded that the safety of HSM as a novel food ingredient has not been established.

It's worth noting that novel food applications, like HSM, must adhere to strict regulations and guidelines set by the European Commission. These regulations ensure that new food ingredients are thoroughly evaluated for safety and efficacy before being approved for human consumption.

## 6. SUSTAINABILITY AND ETHICAL CONSIDERATIONS

### 6.1. ETHICAL CONCERNS IN COLLECTION OF SNAIL MUCIN

Traditional snail mucin harvesting methods raise ethical concerns due to their secretion, often through

1. Environmental manipulation: exposing snails to salt, chemicals, or other irritants.
2. Electrical stimulation: applying short intervals of voltage (up to 1000 volts) to induce stress.
3. Physical intervention: cracking the snail's shell to provoke mucin production.

These practices prioritize mucin extraction over animal welfare, sparking concerns about cruelty and sustainability. The use of snail mucin in medical and cosmetic products raises important questions.

- Is it ethical to subject animals to stress and potential harm for human benefit?
- Can alternative, humane methods be developed for mucin extraction?
- Do the benefits of snail mucin outweigh the potential harm to snails?

These concerns highlight the need for more sustainable and compassionate practices in the production of snail mucin-based products.<sup>[7]</sup>

### 6.2. SUSTAINABILITY PRACTICES IN SNAIL FARMING FOR COSMETICS AND MEDICAL PURPOSES

Heliculture, or snail farming, is gaining recognition as a sustainable and eco-friendly agricultural practice. This method boasts several environmental benefits, including

- Minimal spatial requirements
- Low carbon emissions

This article delves into environmentally conscious snail farming techniques, exploring their advantages for both farmers and the environment. The principles of sustainable agriculture prioritize meeting current needs without compromising future generations' ability to do the same. In snail farming, sustainability focuses on:

- Waste reduction
- Resource conservation
- Ecological balance

By adopting these practices, snail farmers can contribute to a healthy and environmentally conscious farming system.

### 6.3. ALTERNATIVES TO SNAIL MUCIN

Consider Combining Collagen Powder with Alternative Natural Remedies. Collagen supplements support overall wellness and youthful skin. While effective for those with naturally low collagen levels, they may not address every skin concern. Fortunately, other natural options can complement collagen's benefits.

#### Aloe Vera: A Multifaceted Skincare Solution

Aloe vera is renowned for soothing sunburns, but its benefits extend far beyond. This nutrient-rich substance

- Reduces inflammation and pain
- Moisturizes and protects against dryness
- Enhances skin elasticity and collagen production

Research has consistently demonstrated Aloe vera's efficacy. A 2009 study involving 30 women over 45 found that daily Aloe vera gel supplementation improved

- Collagen production
- Skin elasticity
- Moisture retention
- Skin integrity

These findings underscore Aloe vera's potential as a

comprehensive skincare solution, addressing various concerns beyond sunburn relief.<sup>[8]</sup>

## 7. FUTURE TRENDS AND INNOVATIONS

### 7.1. EMERGING RESULTS ON NEW BENEFITS OF SNAIL MUCIN

**As bioinspired materials:** Bioinspired materials have transformed industries, yielding groundbreaking products like Lipitor, Penicillin, and Morphine. Similarly, mucins are being explored as biomaterial coatings to mitigate rejection of inorganic implants.

Every year, over 1 million medical cases result from surgical implant infections, with treatment costs far exceeding initial surgery expenses. Research has demonstrated that applying mucin-based films to polyethylene terephthalate (PET), a common implant material, significantly reduces immune responses triggered by IgG and IgM absorption. Additionally, mucin coatings have been shown to decrease fibrinogen activation, a key inflammatory agent.

**As drug delivery vehicle:** Snail mucin biopolymers exhibit remarkable adaptability, making them attractive candidates for innovative drug delivery systems. The unique mating process of snails offers insight into their potential. During courtship, male snails inject mucus containing accessory proteins into the female, enhancing fertility. This complex process involves a multifunctional system, where each component plays a distinct role.

Inspired by this natural mechanism, researchers propose adapting snail mucus as a delivery vector for bioactive molecules. Snail mucins demonstrate exceptional compatibility with medications absorbed through mucosal membranes, facilitating efficient diffusion.<sup>[9]</sup>

## 8. CONCLUSION

Snail mucin's remarkable benefits and versatility make it a standout in natural skincare. As research continues to uncover its full potential, its popularity is likely to endure. However, it's essential to recognize that individual skincare needs vary greatly. Before incorporating snail mucin into your routine, consult a skincare expert or dermatologist to ensure optimal results. The transformation of snail mucin from a natural substance to a skincare sensation showcases the incredible potential of nature-inspired solutions. By harnessing the power of nature, we can unlock innovative ways to enhance our wellbeing.

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