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Snail mucin as a biological antimicrobial agent: Its role in promoting rapid wound closure and skin repair mechanisms

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Abstract
Researchers and scientists have long been interested in natural resources with remedial properties that may be utilised to treat a range of ailments, including wound care. A naturally occurring substance with a wide range of possible uses in pharmacy and medicine is snail mucus. The biological activities of the slime have received a lot of research because of its various and possibly beneficial properties, including as defensive mechanisms and prospective therapeutic benefits in wound healing, antimicrobial therapy, and inflammation management. The purpose of this review is to provide a summary of snail mucus's antibacterial and wound-healing qualities.

Keywords: Medicine, musin, and snail

Introduction

For many years, scientists have searched for compounds with medicinal properties that may be extracted from a range of sources, such as plants and animals, and used to treat different illnesses. The many new drugs made from natural sources that have been developed over the millennia are proof of the most effective method of drug development. A wide range of natural raw materials are frequently utilised in the production of medications, according to historical study. (Krzysztof Jasik, Ewa Waluga-Kozęska, *et al*., 2021) [6].

The prevalence of catastrophic injuries and chronic wounds makes wound care challenging for clinics. Although medical stitches and staples are commonly used to heal damaged tissues and close wounds, they can result in discomfort, skin scarring, and surgical site infections. Snail mucus is one example of a biological adhesive that is both effective and painless. (Dongxiu Gao, Tuo Deng, *et al*., 2015)

Treating bacterial diseases is becoming more challenging due to the apparent daily increase in the occurrence of antibiotic-resistant bacterial infections in clinical settings. Bacterial strains have endured in a variety of settings because of their long lifespans and capacity to adjust to new environments. Because of this, there is a growing need to create new, more potent antibiotic alternatives using easily accessible resources, such antibacterial proteins made by certain species, like snail mucus. (Chuku Aleruchi, Lawrence B. Etim, *et al*., 2023)

Historical accounts claim that molluscs have been used from ancient times. The ancient Greeks were aware of the use of mucus from snail secretions in medicine. Hippocrates used crushed snails to cure skin inflammation. Celse claims that heating an uncooked snail shell has incredible softening and healing properties. Mucins are a large family of proteins made up of half carbohydrates and half glycosylated proteins. These are a class of nitrogenous compounds released by mucous glandular tissue. These are the primary macromolecules and constituents of the coating's mucous secretions in animals with sensitive epithelial surfaces, where they regulate the viscoelastic properties of mucus discharges and offer defense against microbiological and physical harm. (Dongxiu Gao, Tuo Deng, and others, 2015)

Therefore, it is known that the antibacterial qualities of snail mucus accelerate both the rate and the quality of wound healing. Microbial infections are considered a major worry for patients with burn wounds since they are responsible for between 50% and 75% of hospitalised burn patient mortality. Egypt's lack of research on pathogenicity, burn site bacterial resistance, and statistical data further exacerbates the problem. According to recent reports by Kopeck, certain unaffected stresses of injuries reduce the effectiveness of looped recovery. Numerous Wound healing is regulated by cytokines and growth factors, such as transforming growth factor-beta 1and vascular endothelial growth (Mahy M. Mona *et al*., Nessma A. EL Zawawy1, 2021) During the inflammatory stage of wound healing, the growth factor 1, which is released by T cells, platelets, and macrophages, draws neutrophils and fibroblasts to the injury site. Additionally, TGF-β1 stimulates fibroblast migration, growth, and motivation.

Bacteria, plants, and animals (insects, invertebrates, etc.) are examples of natural suppliers of biomolecules. Molluscs are well known for their capacity to operate at various levels within the body due to their abundance of active compounds. Land snails are one type of terrestrial mollusc utilised in pharmacology. These gastropods' biological screens have already demonstrated potential for beneficial treatments. Snail mucus, a mucoid fluid, is one of the most fascinating materials produced by snails. It is known as an adhesive lubricant that helps snails adhere to a range of surfaces, stay hydrated, and protect themselves from mechanical damage and predators. (Fatima Errajouani, Hanane Bakrim *et al*., 2023) [7]. It has also been proposed for use in the development of medications used to treat wounds and treat chronic bronchitis. There is a lack of scientific evidence to support a comprehensive understanding of the chemical composition, distinct biochemical features, and biological implications of Helix aspersa muller mucus, despite the extensive commercial use of items produced from the mucus. (Stefania Gallo, Roberta Rizzo, Claudio Trapella, *et al*., 2018) [9].

Mucus from snails has a naturally occurring material that has long been used to treat minor injuries and dental issues. The healing process of wounds include the stages of proliferation, maturation, and homeostasis. Numerous snail species, including the land snail, or Achatina fulica, can be found in tropical countries. (Igaap Swastini, Ni Nengah Sumerti, and others, 2023) [11].

Historic perspective

For thousands of years, people have consumed land snails and used them for a variety of medical purposes. Snails use slime for a number of functions, such as defence, adhesion, lubrication, emollient, and hydration. The beauty and cosmetics industries have found uses for this slime in human health. Snail slime has been associated with a variety various biological characteristic, such as antioxidant, anticancer, antibacterial, and anti-tyrosinase ones. It has also been demonstrated that a variety of substances, including as protein, peptides, hyaluronic acid, and allantoin, are present in snail mucus. Snails may also exude large amounts of mucus, which contains antibacterial proteins and offers some protection against pathogen infection. (Marouane Aouji, Amine Rkhaila, *et al*., 2023) [12].

Snail mucus composition

Depending on the species and function, snail mucus usually contains between 90.3% and 99.72% moisture by weight for adhesion or trail purposes. The leftover mucus in the absence of water is composed of proteoglycans, glycosaminoglycans, glycoprotein enzymes, hyaluronic acids, copper peptides, peptides that are antimicrobial, and metal ions. (Filippo Fratini, Giovanni Cilia, and others, 2018) [4]. Glycollic acid, collagen, elastin, and allantoin are the primary constituents of snail mucus. Glycoproteins and mucopolysaccharides are physiologically active bio-macromolecular structures found in snail mucus. Helix aspersa mucus contains the enzymes Glutathione-S-transferase and superoxide dismutase. (Simone Sampò, Muhammad Rashad, *et al*., 2023) [13].

Fig 1: Showing the preparing the mucin

Wound healing and antimicrobial property

Bacterial infection is one of the primary variables affecting wound healing. The healing process is hampered by swelling and fluid accumulation brought on by a bacterial infection in a wound. (Filippo Fratini, Giovanni Cilia, *et al*., 2018) [4] Many bacterial species, including Staphylococcus aureus, Coagulase-negative Staphylococci, Escherichia coli, Pseudomonas aeruginosa, Acinetobacter, Enterococcus faecalis, Proteus species, and Klebsiella pneumonia, have been linked to wound infections.

Staphylococcus aureus is reportedly the most common isolate. These microorganisms enter injured skin through burn or surgical wounds, the host's skin, or contaminated ambient surfaces.

Pseudomonas aeruginosa and Staphylococcus aureus account for five to fifteen percent and between 20 and 40% of nosocomial infections, respectively, according to numerous investigations. Unfortunately, research has revealed that some of these bacteria exhibit high rates of multiple drug resistance to commonly used antibiotics, which is a challenge when treating wound infections. Mucin, which has been demonstrated to include antimicrobial proteins, is abundant in slime, the mucus released by snails. It was discovered that the mucus fraction from the common brown snail H. aspersa, which has a molecular weight (Mw) between 30 and 100 kDa, has a strong antibacterial effect on several strains of P. aeruginosa. (Lyudmila Velkova, Aleksandar Dolashki, *et al*., 2020) [11].

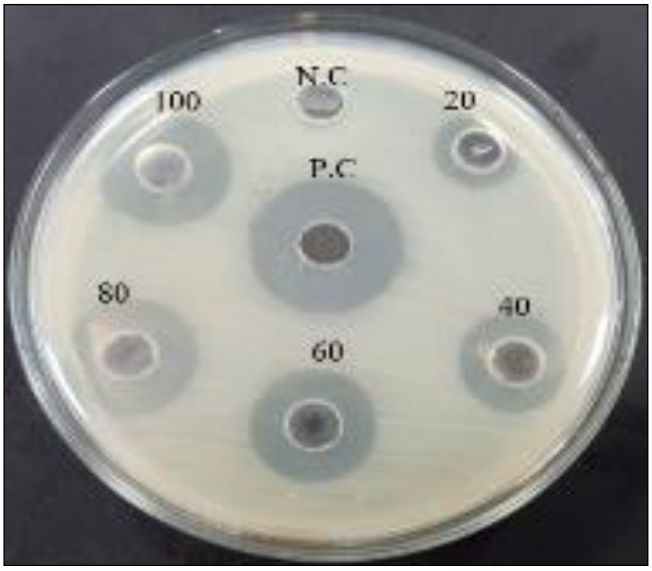

Fig 2: Showing the antimicrobial propertity in the snail mucin

Snail mucus in current medicine

Snail mucus is a substance with several medical applications. According to scientific research, this substance has skin-care properties, lowers gum inflammation, and promotes wound healing. Research on the components of snail secretions shows that Helix aspersa slime has a significant number of organic compounds that are good for human skin, like glycollic acid and allantoin. (Amine Rkhaila, Marouane Aouji, *et al*., 2023) [12].

Furthermore, a number of studies have shown the potential application of bioactive compounds derived from different mucus snails in a range of therapeutic situations, including as therapies for respiratory disorders, heartburn, and skin abrasions and scars. (Nessma A. EL-Zawawy, Mahy M. Mona, *et al*., 2021) [3, 5].

Future perspectives

Our knowledge of gastropod mucins as a research resource with several applications has been enhanced by recent advances in the domains of science, biology, biotechnology, and medicine. Transcriptomic, proteomic, glycomic, and

genomic sciences are some of these domains. For example, snail mucus's antibacterial properties are being used to treat human illnesses such as stomach ulcers and infections after surgery (Amah *et al*., 2019; Gentili *et al*., 2020). Additionally, lectins are being added to approved drugs to improve their effectiveness in treating diseases including diabetes and ulcerative colitis (Gugu *et al*., 2020).

Despite their enormous potential, the numerous functional characteristics of the hierarchical mucin structures remain unclear. The biological and chemical diversity of snail mucin genes must be examined in order to provide light on the guiding principles that define the many traits connected with each gene. The latest applications of secreted snail mucus that demonstrate the potential application of this biopolymer in the development of biotechnology and medicines will be covered in this viewpoint essay. Furthermore, we will offer an integrated genomics method for examining the biological and chemical diversity of gene variations in snail mucus. (Maxwell McDermott, Antonio R. Cerullo, *et al*., 2021) [14].

Conclusion

Antibacterial and wound-healing properties of snail mucus (musin) make it one of the most important products in the pharmaceutical and cosmetic sectors. Because snail mucin is a natural substance, it has no side effects and long-lasting benefits. As a result, gels, lotions, and other items include snail mucus.

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