

THE ROLE OF MARINE COMPOUNDS IN PERSONALIZED MEDICINE

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Abstract

It is commonly known that marine life contains a wide variety of active substances that are specific to the marine environment and that allow them to proliferate enormously in any situation. Regarding the latter, marine ingredients have been effectively utilized in cosmetic products for many years, offering several benefits to the skin. With an emphasis on their use as active ingredients in appropriate formulations intended to support various stages of skin regeneration and repair, as well as their indirect use as a tool to facilitate wound closure as a component of a dressing, the current review thoroughly investigates the role of marine compounds in wound healing. The benefits of these sea-derived ingredients are also covered, as is how to properly include them into formulations to boost their efficacy. Numerous studies that show how well they work to heal wounds have been highlighted. Finally, there is a thorough discussion of crucial data regarding its stability, limitations, and application difficulties.

Keywords: innovative skin wound treatments, marine organisms, Personalized Medicine

1. INTRODUCTION

Physical trauma causes wounds when the genetic, anatomical, or functional continuity of a living tissue is disrupted, either internally or outwardly [1]. Heat, fire, chemicals, electricity, or sunshine can all cause burns. The size and healing time of acute and chronic wounds are used to classify them. Acute wounds often heal in a few days or weeks, but chronic wounds may take months or even years. Throughout the intricate physiological process of wound healing, the body tries to repair the skin's barrier functions and replace damaged and destroyed tissue with newly generated tissue. Effective wound healing is one of the most sought-after and comprehensive medical outcomes. Natural products have been used extensively to cure wounds since ancient times[2]. Current study focuses on the utilization of natural chemicals in the wound-healing process. Natural substances found in both plants and animals are crucial active components in the healing of wounds. One new trend in wound treatment is the use of natural materials from marine sources. Numerous biomaterial sources for tissue regeneration and wound healing are available in the marine environment. Marine biomaterials remain an untapped resource despite its potential [11].

This review article highlights the factors impacting the healing mechanism and provides an overview of the common stages of wound healing, which include inflammation, proliferation, and remodelling. Furthermore, this

work gathers fresh evidence of the advantageous impacts of bioactive substances isolated from marine environments on wound healing. Potential improvements are also suggested, along with limitations and challenges pertaining to the stability of these compounds. Concerns are also expressed over the ecological harm that these substances' use causes, as well as the safety of their use and the potential for toxicity of chemical compounds found in the water. The offered graphic portrayal makes it possible to visualize the goal of this review article. Lastly, the regulations pertaining to these active components are reviewed to enable their use in finished products. Scientific databases like PubMed, Science Direct, Scopus, and Web of Science were used to gather academic chapters and articles. "Healing" refers to the body's natural process of recuperating from damage. Hemostasis, inflammation, proliferation, and tissue remodelling are the four separate, overlapping, and sequential stages of normal wound healing. These phases work in a fairly sequential manner to restore the skin barrier's functionality [3]. Hemostasis starts as soon as an injury happens and may continue for a few hours. Damaged endothelial cells release vasoconstrictors, which instantly tighten the blood artery's smooth muscle to prevent blood loss following an injury. This leads to the formation of blood clots.

2. REVIEW OF LITERATURE

Angiogenesis, fibroplasia, and epithelialization are the main processes that occur during the proliferative phase [16]. Two to three weeks after the accident, the remodeling process begins, and it could last for a year or longer. The basis of matrix maturation and tissue remodeling is the balance between the breakdown of extracellular matrix components in granulation tissue and their substitution with connective tissue components, such collagen. Once they inflict harm, they never regain their original form. Animals are incapable of regenerating their organs. Damage to the liver and bones is not included[16]. With the exception of teeth, all human tissues can undergo a healing condition through a common mechanism meant to limit damage and rebuild the injured tissues both physically and functionally. A complex system governed by numerous variables and chemicals makes up the healing process[4]. There are two types of healing: in-depth and epidermal. The healing of epidermal wounds is a vital stage in wound restoration since the epidermis acts as an important physical, chemical, and microbiological barrier. Healing is affected by local elements like temperature, oxygenation, and skin infection in addition to systemic factors including age, diabetes, sexual hormones, genetic predispositions, and autoimmune diseases[6]. Most traditional skin wound treatments use topical corticosteroids, immunomodulating drugs, and non-steroidal anti-inflammatory drugs (NSAIDs) to reduce inflammation. However, in addition to side effects like atrophy, osteoporosis, obesity, and glaucoma, these drugs may negatively affect recovery[5]. Because of its antiviral, anti-inflammatory, antioxidant, and regenerative properties, natural products have been used to treat wounds. Active chemicals found in plant extracts and compounds produced from plants encourage collagen synthesis and re-epithelialization, which aids in the healing process. Because of their unique chemical and biological properties, substances from the marine ecosystem are becoming more and more popular in cosmetics. Marine chemicals are employed as active ingredients for a number of applications, such as moisturizing, UV protection, bleaching, antimicrobial protection (which keeps cosmetics fresh), antioxidant, anti-aging, and anti-acne, in addition to their use as viscosity regulators[13]. The "traditional" active natural elements in Dermo cosmetics have several positive impacts on cellular health as well as the condition of the skin, hair, and nails. However, the time needed for plant cultivation and the chemical makeup of the soil, which changes by season and geographic location, are some limitations because plants do not grow everywhere and all year round. On the other hand, marine microorganisms and plant and animal creatures grow quickly and intensively while creating compounds that are not found in terrestrial ecosystems. Derivatives of chito-oligosaccharides (COS), enzymes, peptides, vitamins and minerals, fluothanes, polysaccharides, carotenoids, and other pigments are examples of bioactive chemicals. However, there is worry that the sustainability of aquatic eco-systems may be further undermined by the growing exploitation of marine elements and their collection by unsustainable methods[7].

3. MATERIAL AND METHODS

Sea cucumbers are a type of photodegradation known as "Holothuroids" that can be found on the sea floor worldwide. Chondroitin, sulphates, collagen, vitamins, amino acids, phenols, triterpene glycosides, carotenoids, bioactive peptides, trace minerals, fatty acids, and gelatine are just a few of the many physiologically active compounds found in sea cucumbers. Their curative efficacy surpasses that of other marine species, and they possess anti-cancer, antioxidant, antibacterial, anticoagulant, and neuroprotective properties. Vitamins and minerals such as calcium, magnesium, iron, zinc, selenium, strontium, germanium, copper, and manganese are abundant in sea cucumber extract. These nutrients hydrate, help heal damaged epidermal cells, and are readily absorbed. The literature claims that sea cucumbers have large levels of collagen and mucopolysaccharides, which

are a little safer than collagen found in land animals. More than 70% of the sea cucumber's insoluble collagen fibers are proteins. One of the possible risks is the presence of small pieces of plastic in sea cucumbers. One significant example of these pervasive, detrimental pollutants in ecosystems is micro-fibers (MFs) [17]. According to research, MFs enter the colony fluid of sea cucumbers from the water through their respiratory system. There is currently no known mechanism of toxicity. A related study on *Posticus japonicus* sea cucumbers found that MFs change the expression of some genes.

Animal studies conducted in vivo show that lesions treated with sea cucumber extracts healed more quickly and effectively. Applying these extracts topically to animal-induced wounds seems to accelerate wound contraction, which is important for the healing phases. *S. use* has improved, according to one study[8]. In the days following a burn, the wound underwent severe contractions when hydrogel was used as a wound patch. The ability of the particular wound patch to hold onto the active components and postpone their release to the burned skin, thereby functioning in the subsequent stage of the healing process, is likely what causes this phenomenon. This patch's capacity to retain the bioactive ingredients trapped in the hydrogel core for extended periods of time permits controlled and sustained release[14]. An effective interaction between the patch and the wound may result in improved activity of the implanted extract during tissue repair, which would ultimately contribute to a favourable outcome for healing at a later period. Another species of sea cucumber, *S. chlorinoides*, seemed to be active in the early phases of healing. It was demonstrated that the aquatic extract had an antioxidant effect that was 80% more than that of its organic equivalent. Since free radicals' unregulated presence has been linked to hindered healing, the antioxidants in the aquatic extract neutralize them, promoting smooth recovery[9].

The genus "Porifera" includes sea sponges, which are invertebrates. They are the oldest multicellular creatures, having existed at the base of the marine food chain for millions of years. In addition to housing other organisms and promoting a wide range of marine activities, they provide a massive source of new biomolecule synthesis. It is important to consider environmental factors and their relationship to the microorganisms and phytoplankton when analyzing the secondary metabolites from marine mushrooms because some of the isolated bioactive secondary metabolites are believed to be produced by functional enzyme groups from the associated microorganism. These bacteria are extremely helpful in the development of novel medications, cosmetics, and foods since they are renewable sources of natural chemicals. Because marine mushrooms serve as reservoirs for a variety of marine microorganisms, there are more research prospects for the advancement of maritime biotechnology. This is demonstrated by the diverse range of metabolites produced by mushrooms that mimic naturally occurring substances from fungus and bacteria. However, these bacteria produce a class of chemical compounds that it belongs to. Numerous studies have verified that many chemical compounds that were first extracted from marine sponge extracts have really been biosynthesised by sponge-associated microorganisms because bacteria reside inside the sponge mesh. According to the literature, these organisms mostly comprise nitrogenous heterocycles, glucose, polyatomic alcohols, carboxylic acids, and free amino acids.

4. RESULT AND DISCUSSION

Cyanobacteria are prokaryotic photosynthetic microorganisms that are frequently referred to as microalgae. They have several biotechnological advantages over other living things (plants, fungi, and bacteria) and are suited to live in both aquatic and terrestrial environments due to their metabolic process, which can produce a wide range of chemical compounds with various applications across various sectors (e.g., food, energy, health, and biomaterials). Cyanobacterial polysaccharides, peptides, fatty acids, and pigments (carotenoids) are biologically active and useful in the production of drugs and cosmetics as well as in the healing of wounds due to their antibacterial, viral, immunomodulating, immunostimulant, antioxidant, and reproductive qualities[15].

Another clinical trial examination showed that after 45 days of treatment, the majority of patients (61%), as shown by the observation of ulcer site, transdermal water loss (TEWL) levels, and epidermal hydration, had full healing[10]. Moreover, scientists established that implementing novel therapy. *Bestrides* extract considerably decreased the ulcer area's size over time. The readings steadily decreased from their high initial values as the wound healed, suggesting that the epidermal barrier had been restored. This also holds true for the amount of moisture in the epidermis, which began low and progressively increased to nearly normal levels during wound healing.

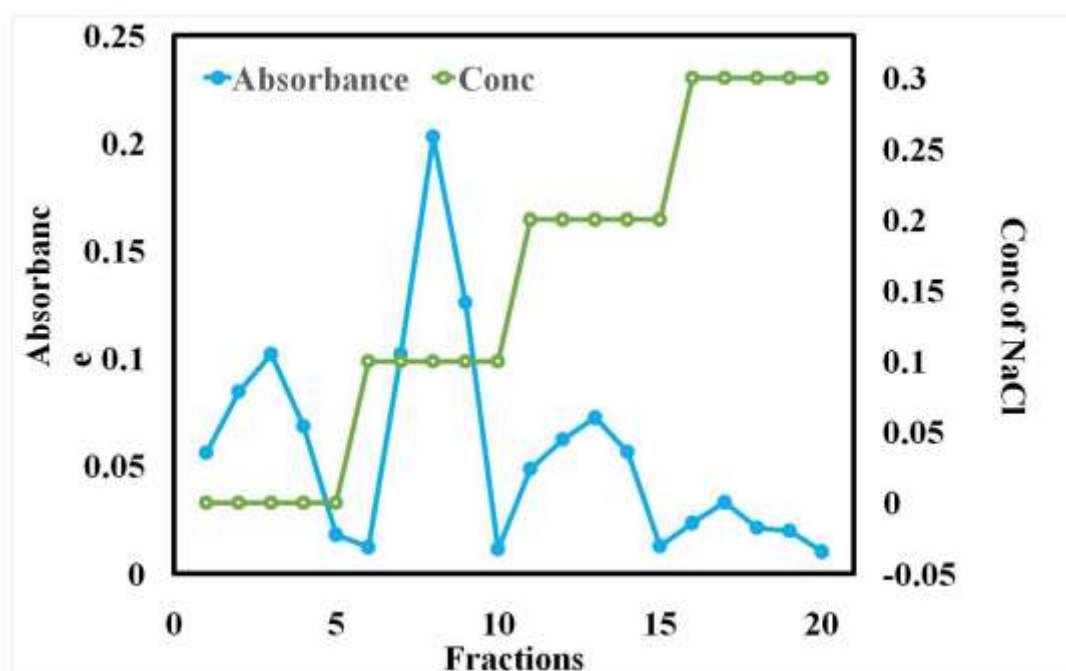


Figure 1: Elution profile

Consequently, following recovery, the skin hydration rate rose from extremely low levels to nearly normal levels. Curing and treating diabetic foot ulcers is very difficult, especially when there are other serious coexisting conditions present, such as immunosuppression.

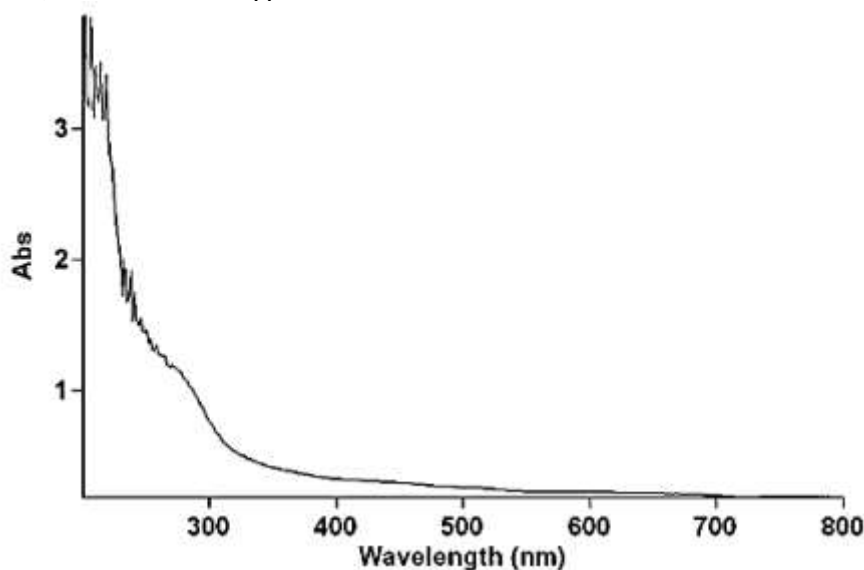


Figure 2: UV-visible spectrum

Within five months of the patient starting treatment, the patient fully recovered. Blood tests conducted after treatment showed a significant decrease in inflammatory markers. Both before and after therapy, ulcer cultures showed no signs of microbial development. Objective testing and clinical evaluation were in agreement and showed full recovery. Consequently, the effectiveness of using the extract-containing ointment. Bestrides offers a cutting-edge substitute for diabetic foot neuropathic ulcers, especially for those with extremely severe coexisting conditions.

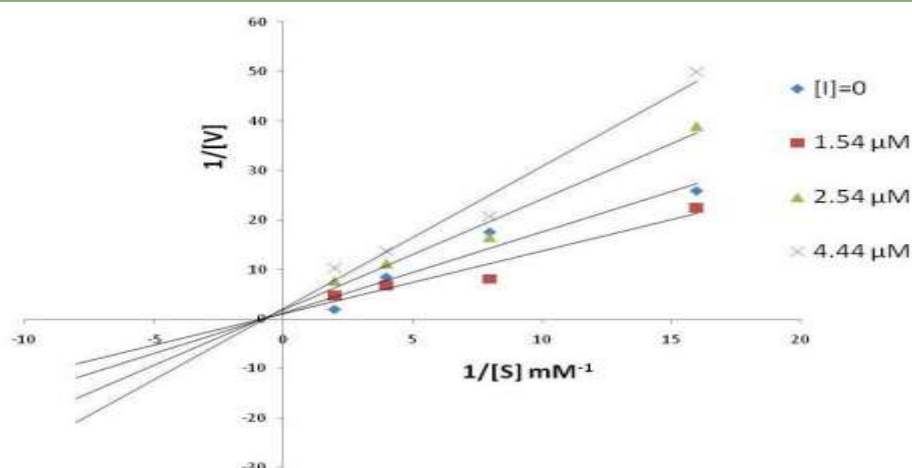


Figure 3: Lineweaver-Burk plots

Based on the available data, there is a significant need for additional study on marine substances in order to determine their safety of use and the possibility of short- and long-term harm. Furthermore, further investigation is needed into their use and application in order to determine the best pharmaceutical formulations and/or cosmetic forms.

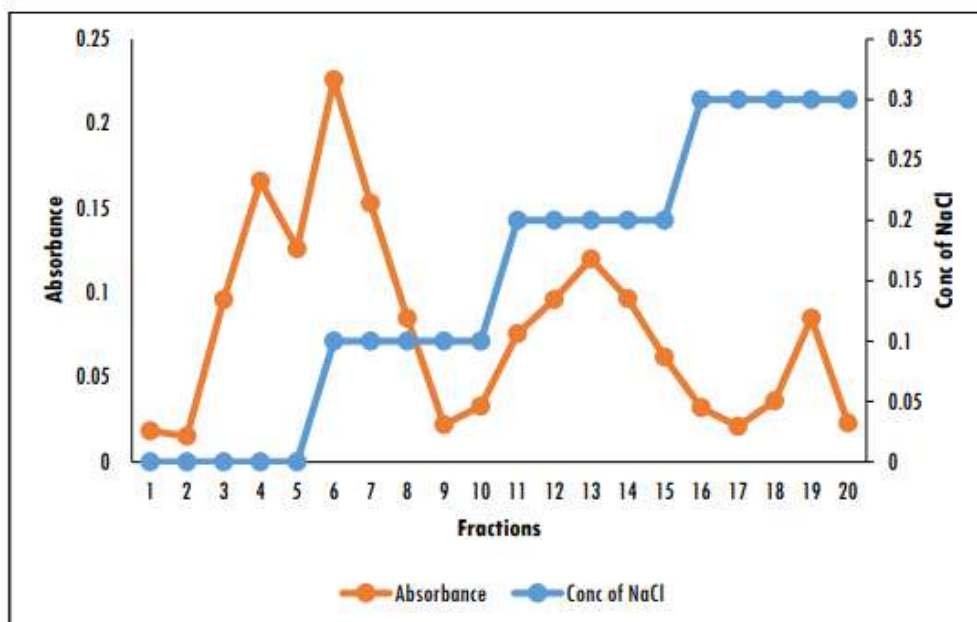


Figure 4: Elution profile

More research is needed to identify the best combinations of these bioactive substances in order to produce the maximum healing impact in the shortest amount of time. To achieve the maximum stability of the ingredients, controlled or prolonged release, avoidance of undesirable effects, and the maximum efficiency potential of active chemical compounds, the proper agents should be used if needed. Lastly, additional procedures are believed to be required to guarantee that future studies are conducted with the least amount of adverse environmental impact, taking into consideration the marine ecosystem and global sustainability.

5. CONCLUSION

The "recruitment" of natural active components has drawn a lot of interest from both the public and science due to the widespread belief that they are safe. The market demand for biomolecules made from sea-derived resources has increased dramatically in recent years due to the inherent chemical and biological characteristics of these resources that continental resources lack. Recent research collected in this review study suggests that chemical compounds from microorganisms and marine organisms may be successfully used in skin repair during wound healing. Based on marine resources, it was shown that the high biodiversity of the marine ecosystem makes it a rich supply of bioactive compounds with a range of structures and activities. All marine organisms have a large

number of them, including proteins, peptides, polysaccharides, and antioxidants, which serve both structural and biological purposes. They are commonly obtained from a variety of marine organisms, such as algae, crabs, fish, shellfish, and bacteria, and have been extensively researched for potential use in a number of sectors, including wound healing.

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