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Fish Skin Collagen: A Game-Changer in Wound Healing and Burn Treatment

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Abstract

The skin, as the largest connective tissue in the body, acts as a crucial physical and sensory barrier to maintain internal stability. Despite its protective function, the skin is prone to burns and injuries, necessitating effective wound healing and skin regeneration processes. The World Health Organization reports a significant number of annual deaths attributed to burns and injuries caused by various agents. Factors such as poor diet, infections, impaired blood flow, drug use, aging, diabetes, and other health conditions can hinder the recovery process. Collagen, a key protein found in fish skin, has been identified as a potential remedy for wound healing. Fish skin dressings have emerged as a game-changer in wound care, offering practicality, faster healing, and antibacterial properties. Research efforts are focused on collagen extraction from fish waste, and its application has shown promising results in treating skin burns and wounds. Collaborative efforts between researchers and healthcare professionals aim to optimize fish skin dressings and explore their widespread application in clinical settings, potentially transforming the landscape of wound treatment.

Keywords: Fish skin, Collagen, Dermal burns, Wound healing,

Introduction

The skin is the largest connective tissue in the body and acts as a sensory and physical barrier to maintain internal stability. However, it is susceptible to various burns and injuries. The rate of skin regeneration and recovery plays a vital role in restoring the body's normal state. The World Health Organization reported a 300,000 number of deaths each year due to burns and injuries caused by electricity, chemicals, and radiation. Wounds can get infected, leading to more tissue damage, and severe inflammatory responses can increase the risk of sepsis and organ failure. Factors that hinder recovery include poor diet, infections at the wound site, inadequate blood flow, drug use, aging, diabetes, and other health conditions. Effective wound treatments aim to promote quick healing,

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prevent infection, manage pain, and restore functionality.

The process of dermal recovery begins with the deposition of a temporary fibroblast's matrix, followed by inflammation and reepithelization driven by keratinocytes. Subsequently, wound revascularization, alongside extracellular matrix deposition, angiogenesis, and remodeling, contributes to complete skin regeneration. However, this natural process is typically slow, necessitating additional boosters of either natural or synthetic origin. Herbal remedies and apitherapy are common natural options, while the application of fish skin and scales from various species has gained popularity in recent times due to its numerous benefits. These fish-derived products, obtained from cost-effective sources like fish processing units and their waste, offer a wide range of advantages for treating skin burns and other dermal wounds. Moreover, this technique is environmentally friendly, making it a systematic approach to wound treatment.

Fish skin, a type of organic waste, contains a high percentage of collagen. Collagen has various applications in pharmaceuticals, cosmetics, and food industries. Recently, the use of collagen extracted from fish waste has proven to be effective in healing skin burns and wounds. Collagen is a fibrous protein found in animal tissues like skin, tendons, and bones. The collagen from fish waste is expected to be used as a wound dressing to speed up the healing process of different types of skin burns, offering economic value. Fish skin comprises two main tissues: the outer epidermal tissue and the inner dermis tissue, with the latter being a major source of collagen fibers.

The Collagen Connection

Collagen, constituting around 30% of total body proteins, is present in both vertebrate and invertebrate animals. So far, 28 types of collagens have been identified, with collagen I being the most prevalent, accounting for over 90% of the total. As a fibrin protein, collagen forms an essential part of the extracellular matrix, providing structural integrity to tissues. Its presence is notable in fibrous tissues like tendons, ligaments, skin, cornea, cartilage, bones, blood vessels, and intestines. Additionally, collagen plays a vital role in building bones, teeth, joints, muscles, and skin.

Collagen exhibits the ability to expand under specific conditions, as its molecular structure weakens when subjected to a pH below 4 or above 10. This unique property makes collagen applicable in various industries, including leather manufacturing, gelatin production, adhesives, food, pharmaceuticals, and cosmetics. The use of collagen in pharmaceutical and cosmetic fields holds significant economic value. However, its utilization in the cosmetic sector remains limited to certain groups, while in the pharmaceutical domain, collagen finds essential applications in treating various large open wounds.

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Healing Burns with Fish Skin

Primary research is focused on the extraction of fish skin collagen using either chemical or enzymatic hydrolysis methods, such as Acid Soluble Collagen (ASC), Pepsin Soluble Collagen (PSC), and hydro-extraction (Huang et al., 2016). Burn wound healing is a painful, slow process that is susceptible to infection exposure and hypertrophic scarring. It typically involves three main phases: inflammation, proliferation, and maturation. The final maturation phase can extend from several weeks to two years due to insufficient regenerated collagen, necessary for reshaping the wounded site and increasing its tensile strength (Kartika, 2015). Although research has gradually improved the pace of skin wounds and burns regeneration, current dressings remain insufficient in restoring skin function and addressing the morbidity and mortality associated with severe dermal injuries. In contrast, biosynthetic dressings offer better recovery results for damaged dermal layers due to their hydrating and antimicrobial properties (Wang et al., 2018). Histopathological analysis of regenerating skin wounds treated with fish collagen-based dressings demonstrated enhanced immunity, improved tensile strength, and cost-effectiveness. Considering the global prevalence of fish farming and the ongoing medical research, the potential healing properties of organic waste from this industry, such as fish skin and scales, are being highlighted for dermal wounds and burns recovery.

From Research to Real-World Application

The application of fish skin for dermal burns and wounds recovery has already gained significant momentum in medical research. In 2019, groundbreaking research demonstrated the significant benefits of fish skin in treating burn wounds. The clinical trial involving 23-year-old Brazilian man who was injured by a gunpowder explosion showed that fish skin surpasses routine management with gauze and burn creams, speeding up healing, reducing dressing changes, pain, and treatment costs (Lima-Junior et al., 2019).

Figure 1. Tilapia fish skin applied onto the left arm

Figure 2. The results after 17 days

Source: (Lima-Junior et al., 2019)

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Product Made from Fish Skin

Kerecis, the leading company in utilizing fish skin and fatty acids for tissue regeneration and protection, has introduced two innovative burn products: GraftGuide Mano™ and GraftGuide Micro™. GraftGuide Mano fits the hand's 3D structure, reducing the need for multiple grafts and bulky fixation. Patients can begin physical therapy immediately, speeding up recovery and preserving range of motion.

Figure 3. Kerecis' New GraftGuide Mano Product
Source: Kk@kerecis.com

Future Prospects

Undoubtedly, the fish industry holds promise as a reliable source of animal-based protein to meet the increasing needs of the growing human population. However, the waste generated by this industry, specifically fish skin, could serve as a viable and cost-effective local resource for treating wounds and infections. As demonstrated in the preceding discussion, fish skin presents a safe material that can enhance wound healing and skin regeneration processes. Therefore, further clinical optimization trials are needed to explore the potential of this excellent and affordable remedy for skin wounds and burns, ultimately benefiting humanity.

Conclusion

Fish skin solid waste has significant economic value when utilized to produce products. Collagen-based wound dressings offer practical advantages over conventional wound dressings, as they promote faster wound healing without causing pain. The collagen dressings, created through cross-linking and incorporating other ingredients, exhibit superior mechanical and antibacterial properties. Compared to traditional wound dressings, collagen-based dressings accelerate the healing process. For burns, which typically have prolonged healing times, using collagen wound dressings in combination with other materials could provide a more effective approach to healing. In addition,

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for better healing and improved patient outcomes, the healing power of fish skin stands as a testament to the untapped potential lying within nature's resources. Through ongoing scientific exploration and innovative practices, we may witness a future where fish skin becomes a cornerstone in the treatment of dermal burns and wounds, leaving a lasting positive impact on the lives of countless individuals worldwide.

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