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Review Article

Appliance of Fish Skin for Dermal Burns and Wounds Recovery

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Abstract

The natural healing process of skin wounds and burns is a time taking phase during which there is also risk of pathogenic invasion and to avoid this possible complication, various types of wound dressings i.e., organic, herbal and synthetic origin have been prepared and applied. Among them, recently explored dermal healing potential of collagen of wasted fish skin is getting attention. It is not only a low cost locally available form of organic waste but also exhibit antimicrobial properties. Recent data indicates that a wounded or burnt skin coated with fish skin recovers comparatively faster. Thus, further optimization is required to make pharmaceutically accessible for general public.

Keywords: Skin wounds; burns; collagen; fish skin; low cost; general public.

INTRODUCTION

The external protective dermal coat is considered as the largest form of connective tissue which also serves as sensory and physical barrier to avoid fluctuations of the internal homeostasis. But often it is exposed to diverse burns and injuries and rate of skin regeneration and recovery indirectly ensures the reestablishment of internal normal state of the body. World Health Organization recently reported that more than 300,000 deaths occur annually due to fire burns, scalds and other forms of injuries caused by mainly electricity, chemicals and radiation (Yao *et al*., 2019). Later on, wound infection may occur which further increases the local tissue damage and in case of systemic inflammatory and immunological responses, might lead to a higher risk of sepsis and multi-organ failure (Bhatia, 2008; Kawalkar, 2015). The major influential factors which may impair recovery and regeneration (Pravina *et al*., 2013) are: inappropriate diet, wounded site infection (Javed *et al*., 2021) tissue perfusion and development of hypoxic state, intake of drugs, aging, diabetes mellitus and other health disorders (Kerstein, 2007). Different wound treatments are designed to promote quick closure of injured or burnt site and should be potent enough to prevent infection, along with pain suppression and functional recovery. For initiation of dermal recovery, deposition of temporary fibroblasts matrix occurs first and it is followed by inflammation and keratinocytes based re-epithelization. On later stages, wound revascularization parallel to extra cellular matrix deposition, angiogenesis, and remodeling takes place for complete skin regeneration (Harvey, 2005; Wu *et al*., 2007). But under natural circumstances, usually this process is slow and additional boosters are required which may be either of natural or synthetic origin (Oberlies, 2020). In this regard, natural produce like herbal remedies (Javed *et al*., 2019) and apitherapy (Javed, 2021) are common but in recent era appliance of fish skin an scales of diverse species on skin burns and wounds are also getting much popularity due to vast range of benefits of this technique. These fish products are used for the treatment of skin burns and other type of dermal wounds are usually obtained from low cost sources which are fish processing units and their waste includes considerable amount of fish skin and scales along with other forms of debris. So it is also an ecofriendly technique of wounds treatment (Veeruraj *et al*, 2019).

The fish skin which is available as form organic waste has much high percentage of collagen content. Collagen has already been widely utilized in pharmaceuticals, cosmetics, and food. But in the pharmaceutical field along with it's already reported much diverse applications, recently started use of collagen obtained as organic waste is quite effective skin burns and wounds healer (Schrieber & Gareis,

2007). Collagen is biochemically categorized as form of animal fibrous protein and its major content is found in skin, tendons, and bones. Reported data presents that the collagen present only in fish scale has about 25%-35% of the total protein content of the body (Peranginangin *et al*, 2014). Different types of skin burns usually have lengthy healing phase, so the collagen extracted from fish waste is expected to be applied as a wound dressing to accelerate their recovery and it is utilized as a product of high economic value (Afifah *et al*, 2019). Fish skin is mainly composed of two tissues, i.e. outer epidermal tissue and inner dermis tissue. This fish dermis layer is a chief source of collagen fibers (Padmasari, 2002). The wasted fish skin of different species contains 11%-63% collagen as shown in figure 1 (Nagai & Suzuki, 2000).

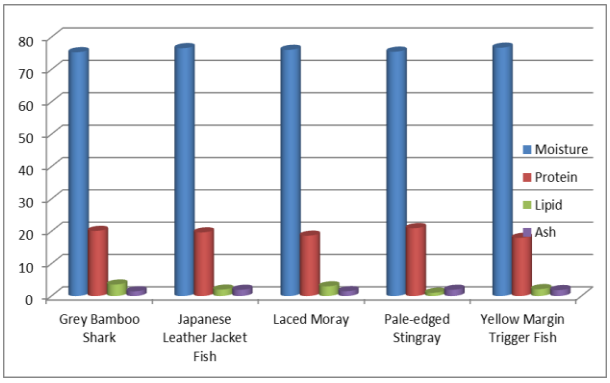

Fig-1: Proximate composition of fish skin parameters in percentage (Abustam *et al*, 2018)

Use of Fish Skin Components as Ideal healers

Current research is focused on fish skin collagen extraction either by chemical or enzymatic hydrolysis (Zavareze *et al*., 2009) e.g., Acid Soluble Collagen (ASC), Pepsin Soluble Collagen (PSC) and hydro- extraction (Huang *et al*., 2016). As process of burns Healing is much painful, slow and often prone to infection exposure along with continuous hypertrophic scarring (Wang *et al*., 2018). Burn wound healing involves several phases (Zhang *et al*., 2018) but usually it is divided into three major phases of inflammation, proliferation, and maturation. Among them, the last phase of remodeling or maturation may prolong from several weeks to two years due to improper amount of regenerated collagen which is required to change the shape of wounded site and increases its tensile strength (Kartika, 2015). So far research efforts have not only gradually improved the pace of skin wounds and burns regeneration but still such these dressings are inadequate to renew skin function and are unable to resolve the issues of morbidity and mortality which may occurs in case of serious dermal injuries (Garfein *et al*., 2003). In this regard, the recovery results of biosynthetic dressings are better to heal damaged dermal layers due to their hydrating and antimicrobial additional potentials (Noer *et al*., 2014; Wang *et al*., 2018). Similarly, a histopathological analysis of regenerating skin wound which was treated with fish collagen based dressings showed boosted immunity due to antimicrobial nature and improved tensile strength and also introduced a cost effective remedy. Because fish farming is common way of earning globally and current medical research progress is highlighting healing potential of its organic waste of this industry like fish skin and scales for dermal wounds and burns recovery (Shettigar *et al*., 1981). With the help of recently reported data related to the under discussion topic, following table has been prepared (Table 1) which will be helpful for next research efforts of this domain.

Table-1: Appliance of fish skin for dermal wounds and burns recovery

Species of Fish	Role	Reference (s)
Catfish (*Clarias gariepinus*)	The mucoprotein based slime coat exhibits remarkable wound healing ability due to its antibacterial nature, along with developing significant tensile strength, more dermal hydroxyproline and without producing any side effect.	(Akunne *et al*., 2016; Momoh *et al*., 2013)
Snakehead Murrel (*Channa striatus*)	The appliance of skin of murrel not only increases tensile strength, epithelialization but also enhances fibroblastic proliferation at wounded and burnt sites.	(Khan *et al*., 2014; Pasha *et al*., 2015; Wahab *et al*., 2015)
Rainbow Trout (*Oncorhynchus mykiss*)	Reported data indicates that this fish has great tissue regeneration potential.	(Schmidt, 2013)
Common Carp (*Cyprinus carpio*)	Skin of carp is also much potent healer of dermal wounds and burns.	(Schmidt, 2013)
Bluefin Trevally (*Caranx melampygus*)	Currently, collagen films are derived from Bluefin skin for recovery of skin wounds and burns.	(Rethinam *et al*., 2016)
Tigertooth croaker (*Otolithes ruber*)	The collagen obtained from this species improves skin burns and wounds recovery.	(Kumar *et al*., 2012)
Finletted mackerel scad (*Magalaspis cordyla*)	It is a source of soluble collagen which is biochemically cross-linked with glutaraldehyde and aids in wound healing.	(Kumar *et al*., 2012)
Nile Tilapia (*Oreochromis niloticus*)	Dermal collagen peptides of marine fishes enhance wound healing rate.	(Hu *et al*., 2017)

Contribution of Pakistan

Data of Pakistan region indicates that researchers are much focused on implication of skin and scales of locally available vast range diversity of fishes to explore low cost organic alternatives for healing of dermal wounds and burns. Biochemically the skin of fishes belongs to this region is rich in omega-3 fatty and omega-6 fatty acids which not only boost skin wounds and burns recovery rate but also exhibit anti-aging properties (Wilson, 2015). For skin healing and regeneration, Hypophthalmichthys molitrix, Cirrhinus reba, Labeo dero, L. calbasu, Mastacembelus armatus, Pethia ticto, Labeo rohita, Wallago attu, Ctenopharyngodon idella, Cirrhinus mrigala, Mastacembelus armatus, Rita rita and Gagata cenia are frequently reported ethnomedicinal fish species of Pakistan (Altaf *et al*., 2018; Altaf *et al*., 2020; Arshad *et al*., 2014).

CONCLUSION

The selected organic waste (fish skin) should be utilized by pharmaceutical industries to produce rapid healers and low cost wound dressings enrich with collagen which are ideal for slowly recovering burnt wounds and also potent to control microbial invasion. The composition of these wound dressings may be modified further by use collagen in pure form or its combination with other suitable skin wound healers. Thus, further mammalian model based investigations are required to know the so far unclear mechanisms of this organic waste to get its maximum healing benefits (Mei *et al*., 2020).

Future perspective

No doubt, fish industry is the future guarantee of supplying animal based protein to ever growing human population. But the waste of this industry, particularly skin of fish may provide us local and cost effective source as a raw material for the treatment of wounds and infections. It is clear from the above discussion that the fish skin is one of the safest materials which may employ to boost processes of wound healing and skin regeneration. Therefore, the use of this excellent low cost remedy for skin wounds and burns should be further tested through clinical optimization trials to serve mankind.

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