

## Wound Healing Potentials of some Fin Fishes

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**Abstract:** Fish is an important source of animal protein. Fish have been widely been exploited by human as food and pharmaceutical sector. Fin fish are distinguished from other fishes (shellfish) by the presence of distinctive anatomical features such as fins and gills. Fishes have been reported to confer several medicinal properties. This study reviewed fin fishes with wound healing potentials. The study showed that fresh water fishes like *Channa striatus*, *Clarias gariepinus*, *Oncorhynchus mykiss* and *Cyprinus carpio* has mucilaginous compounds that helps as laxative and in healing wounds. Specifically, slime coat of *Clarias gariepinus* contain mucin that possess antimicrobial properties. Marine fin fish such as *Otolithes ruber*, *Magalaspis cordyla* and *Oreochromis niloticus* possess different forms of collagens that play essential role in wound healing. Therefore, there is the need for research to focus on the isolation and purification of the exact constituents of the fishes that possesses wound healing potentials.

### 1. INTRODUCTION

The human skin protects the tissues and organs from physical, mechanical, chemical and microbial damage and they mainly consist of the epidermis, dermis and subcutaneous tissue (Da *et al.*, 2017; Bi and Jin, 2013). Skin injury often cause disruption of neutrophils, monocytes and macrophages on the site of injury (Barrientos *et al.*, 2008; Akunne *et al.*, 2016). Wound infection is one of the health concerns that are caused and aggravated by the invasion of pathogenic microorganisms (Mama *et al.*, 2014). Generally wound infections create barrier during restoration of the skin due to abrupt loss of integrity of the skin. This could lead to adverse impact on the patient's quality of life as well as on the healing rate of the wound (Mama *et al.*, 2014).

Several types of wound occurs including traumatic wounds (viz: cuts, punctures, lacerations or scrapes etc) which can also be classified into penetrating, cut and acute wounds (Giametti *et al.*, 2000), surgical wound (viz: cut or incision in the skin made by a scalpel blade during surgery) and can be classified into four that is Class I (wounds that is clean both in sight and aseptic presenting no inflammation and are mainly found in the eye, skin and the vascular system), Class II (wounds that appear clean and shows no sign of contamination but usually at risk of been infected due to their location (gastrointestinal tract), Class III (wound that comes in contact with unsterile outside object such as gunshot wound) and Class IV (surgical wound that is considered dirty either during or after surgery probably due to environmental factors (De Pietro, 2016), burn wounds (viz: skin injuries caused by fire, light, heat, radiation, electricity, chemical and volcanicity) etc. Furthermore, Obi (2015) classified wound into accidental, pathological or post-operative. Da *et al.* (2017), Patrulea *et al.* (2015) also classified wound based on its thickness including superficial, partial-thickness and full-thickness.

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The cause, source, size or depth of the injury cannot be underrated in clinical practice. Several factors are known to enhance healing of wound including hygiene status of the wound (clean, contaminated or dirty). Uncontaminated wound could suggest unlikely chance of inflammation which tends to heal faster probably due to the absence of pus among other factors.

Several species of microbes have been reported in wound infection (Thanni *et al.*, 2003; Shittu *et al.*, 2002; Okesola and Kehinde, 2008; Obi, 2015; Muhammad *et al.*, 2014; Iregbu *et al.*, 2013; Gadzama *et al.*, 2007). Sensitivity profile has been widely carried out on the pathogens found in wound infections (Taiwo *et al.*, 2002; Obi, 2015; Iregbu *et al.*, 2013). The level of microbial infestation with regard to diversity and density also influence the wound healing rate. Like most pathogenic organisms, when their population is high, it tends to contend with the defense mechanism/ system of the host. This is because wound healing requires a good healthy environment so that the normal physiological process will result in normal healing process with slight scar formation (Mama *et al.*, 2014).

The knowledge of wound infections agents is helpful in the selection of empiric antimicrobial therapy and on the infection control measures (Obi, 2015; Thanni *et al.*, 2003). Furthermore, the interplay between host, microbial and other factors eventually determines the prevention of wound infection (Obi, 2015). Studies on the medicinal potentials of plants and animal have increased. But studies on the therapeutic potentials of animals are often reported in literature compared to that of wildlife (Izah and Seiyaboh, 2018). This could be due to claim of traditional medicine practitioner that several species of plants have therapeutic properties against several human diseases and parasites that affects human and other animals. On the other hands wildlife have several healing potentials. Authors have variously reported the role of animals in traditional medicine practice (Ajagun *et al.*, 2017; Ajagun and Anyaku, 2017; Alves, 2008; Alves *et al.*, 2011; Banjo *et al.*, 2002; Costa-Neto, 2005; Mbaya and Malgwi, 2010; Oduntan *et al.*, 2012; Osunsina *et al.*, 2012; Soewu, 2008; Soewu and Ayodele, 2009; Soewu *et al.*, 2012; Saidu and Buij, 2013).

Fishes are a group of live forms that thrives in aquatic ecosystem where they complete all their life forms. Fishes is a major source of animal protein to human (Ineyougha *et al.*, 2015; Izah and Angaye, 2015; 2016; Angaye *et al.*, 2015) and have been widely employed in other downstream applications including feed production. Hence this present study focused on the wound healing potentials of fishes.

## 2. FISHES AND THEIR ROLES IN HUMAN HEALTH

Fishes are only a source of animal protein required by human but they are been widely used in combatting certain disease condition including would healing. Typically, Ramalingum and Mahomoodally (2014) reported that pharmaceutical and nutritional sciences appear to be coexisting for maintaining normal human health. This is because several food resources are being used in treatment of several types of diseases. In addition medical professionals have recognized the synergism of drug therapy and nutrition in the fight against certain diseases condition (Ramalingum and Mahomoodally, 2014). Studies have been conducted while several others are still ongoing on the prophylactic benefits of food for potential use as novel medicine due to the presence of therapeutic active compounds (Ramalingum and Mahomoodally, 2014).

Like some species of mammals, amphibians, birds, reptiles, fishes plays important role in the management of some disease condition including asthma, mental illness, eye diseases, low birth weight, nutrient deficiencies (Rajani and Alka, 2015). Fish is a major source of animal protein and are included in daily diet of humans. Studies have considered fish as cheap source of animal protein (Ineyougha *et al.*, 2015; Angaye *et al.*, 2015). Studies have indicated that fish contain important nutrients such as vitamins, minerals and proximate compositions (especially protein and lipids/fats) (Rajani and Alka, 2015).

Most fishes with therapeutic potentials are found in both fresh and marine ecosystem. For instance, Venkatesan *et al.* (2017) reviewed marine fish with medicinal potentials to include *Setipinna taty* and *Scomber scombrus* (antimicrobial properties); *Scomber austriasicus*, *Thunnus obesus*, *Salmon alcalase*, *Decapterus maruadsi*, *Johnius belengerii*, *Paralichthys olivaceus*, *Magalaspis cordyla*, *Otolithes ruber*, *Merluccius productus*, *Oreochromis niloticus*, *Hypoptychus dybowskii* (bioactive antioxidant peptides potentials); *Lagocephalus gloveri*, *Thunnus obesus*, *Paralichthys olivaceus*, *Sebastes schlegeli*, *Lateolabrax maculatus*, *Pagrus major*, *Takifugu rubripes*, *Sepiella inermis*, *Lutjanus vitta*, *Magalaspis cordyla*, *Otolithes ruber*, *Evenchelys macrura*, *Saurida spp.*, *Trachurus*

*japonicus*, *Mugil cephalis*, *Cypselurus melanurus*, *Dentex tumifrons*, *Cyaneano zakii*, *Sardinella longiceps*, *Priacanthus tayenus*, *Priacanthus macracanthus*, *Parupeneus heptacanthus*, *Mystus macropterus*, *Syngnathus schlegeli*, *Chrysaora sp* (collagen on some parts of their body viz: skin, scale, bone, whole body). Furthermore, others studies have indicated that *Clarias gariepinus*, *Anabas testudineus* and *Channa striatus* have medicinal properties.

### 3. FIN FISHES WITH WOUND HEALING POTENTIALS

Several physiological processes are involved in the repair of skin and other soft tissues injury in humans and other animals (Akunne *et al.*, 2016). The mechanism of wound healing is a complex processes that involve resurfacing, reconstruction and restoration of the tensile strength of the injured tissue at cellular level (Akunne *et al.*, 2016). Wound healing typically involves four major phases viz: haemostasis, inflammation, proliferation and remodeling/ maturation (Akunne *et al.*, 2016; Kerstein, 1997). According to Pastar *et al.* (2014), Akunne *et al.* (2016), several processing occurring at both cellular and molecular phase are involved in initiation, maintenance, and completion of epithelialization for complete wound closure.

Chemical components have been used for treatment of wound and research is still ongoing for the development of new synthetic and organic chemicals with effective wound healing. Mathivanan *et al.* (2012) reported that 10% and 20% solution of silver nanoparticles showed the wound healing within 12 and 8 days respectively for wound in the skin of *Anabas testudineus*. This study focused on fishes with wound healing properties. Several fishes with wound healing potentials are found in marine and freshwater ecosystem.

#### 3.1. Freshwater Fin Fishes with Wound Healing Potentials

Freshwater fishes such as *Channa striatus* and *Clarias gariepinus* have been widely studied for potentials utilization in injury closure (Table 1). *Clarias gariepinus* is a common Niger Delta wetland fish that have been widely used in toxicological studies (Inyang *et al.*, 2017; Ogamba *et al.*, 2016). The body of the fresh cat fish is slime. According to Akunne *et al.* (2016), the slime coat of catfish contain carbohydrates (76.31%), moisture content (10.86%), proteins (7.38%), ash (2.34%), fibre (2.06%) and fats (1.06%) per 100 mg of the mucin, and it has antibacterial efficacy against *Staphylococcus aureus*, *Bacillus subtilis*, *Escherichia coli*, *Pseudomona aeruginosa*, *Salmonella typhi*, *Klebsiella pneumonia*, *Candida albicans* and *Aspergillu sniger*. The authors also reported that the slime coat have wound healing potentials. This group of bacteria reported by Akunne *et al.* (2016) has some similarity with the bacteria isolates that have been isolated from would infections from different regions of the world. Some of this microbial isolates include *Staphylococcus aureus*, *Staphylococcus epidermidis*, Coagulase negative *Staphylococci*, *Streptococcus pyogene*,  $\alpha$ -haemolytic *Streptococcus*, *Pseudomonas aeruginosa*, *Pseudomonas* species, *Escherichia coli*, *Enterobacter* species, *Enterococcus faecalis*, *Klebsiella aerogene*, *Klebsiella pneumonia*, *Klebsiella* species, *Citrobacter freundii*, *Proteus vulgaris*, *Proteus mirabilis*, *Proteus* species (bacteria), *Candida albicans* (yeast) (Mama *et al.*, 2014; Obi, 2015; Muhammad *et al.*, 2014; Iregbu *et al.*, 2013; Gadzama *et al.*, 2007; Okesola and Kehinde, 2008; Shittu *et al.*, 2002). *Staphylococcus aureus*, *Escherichia coli* and *Pseudomonas aeruginosa* are microbes that often have high occurrence density in wound infection. Mama also reported that *Staphylococcus aureus* sand *Pseudomonas aeruginosa* as nosocomial infection that is often associated with surgery and burns (Mama *et al.*, 2014).

*Channa striatus* often called snakehead fish or Haruan is a freshwater carnivorous supra branchial air breathing fish that is widely found in Malaysia (Mohd and Abdul, 2012; Manan, 2007; Khan *et al.*, 2014). Studies have revealed that the fish has several therapeutic properties including anti-microbial, anti-inflammatory, cell proliferation, induction of platelet aggregation and anti-nociceptive properties of the mucus (Manan, 2007; Shafri and Abdul Manan, 2012; Wahab *et al.*, 2015). Gam *et al.* (2006) reported that snakehead fish is used as wound healing remedy in Asia Pacific countries. The authors also reported that the fish has the tendency to reduce post-operative pain and discomfort. Like most other freshwater fishes, *Channa striatus* are cultured and also found in the wild. Nutritional composition include the presence of essential amino acids, fatty acids that that essential for would healing. The specific amino acids are glycine, while the fatty acids are arachidonic acid (Wahab *et al.*, 2015; Baie and Sheikh, 2000 a, b). Mohd and Abdul (2012) also reported the important amino acids of the fish include glycine, lysine and arginine, while its fatty acids are arachidonic acid, palmitic acid and docosahexaenoic acid. These compound is believed to enhance wound healing through initiation

of several mechanisms involving the collagen remodeling, wound reepithelialisation and induction of wound contraction (Wahab *et al.*, 2015; Mohd and Abdul, 2012; Baie and Sheikh, 2000 a, b; Wild *et al.*, 2010; Park *et al.*, 2017). Parts of snakehead fish mostly used include whole fish, mucus and skin of the fish (Mohd and Abdul, 2012).

Rajani and Alka (2015) have also reported that *Cyprinus carpio* (Common carp), *Chanda raga* (Indian glassy fish), *Heteropneustes fossilis* (Stinging catfish), *Anabas testudineus* (climbing perch), *Clarias batrachus* (walking catfish) have antimicrobial properties. These fish are found in varying environmental condition. For instance, Schmidt *et al.* (2013) *Cyprinus carpio* an omnivorous fish with body weight of 45 – 50kg is a warm water species (20-25°C optimum) that survive in freshwater, lakes and slow flowing rivers, often in turbid water, while *Oncorhynchus mykiss* a carnivorous fish with body weight of 20 – 25kg is a temperate water species (10-15°C optimum) that is found in freshwater and it possesses anadromous life-strategy.

**Table1.** Fresh water fin fishes with wound healing properties

| Scientific name            | Common name      | Role  | References                   |
|----------------------------|------------------|---|------------------------------|
| <i>Clarias gariepinus</i>  | Catfish          | The mucoprotein slime coat of catfish possess wound healing and it also have antibacterial activity with bactericidal potentials  | Akunne <i>et al.</i> , 2016  |
| <i>Clarias gariepinus</i>  | Catfish          | 5% of catfish mucin ointment showed 100 % wound healing properties on the 12 <sup>th</sup> day. The ointment showed a significant higher tensile strength and hydroxyproline in the skin, with no record of toxicity  | Momoh <i>et al.</i> , 2013   |
| <i>Channa striatus</i>     | snakehead murrel | The use of 500 mg of snakehead fish extract of 6 weeks had differences in wound cosmetic appearance and patient’s satisfaction and it is safe for human consumption.  | Wahab <i>et al.</i> , 2015   |
| <i>Channa striatus</i>     | snakehead murrel | <i>Channa striatus</i> had raised tensile strength, epithelialisation, and fibroblastic proliferation in the healing of laparotomy wound  | Pasha <i>et al.</i> , 2015   |
| <i>Channa striatus</i>     | snakehead murrel | 40% and 50% w/v of aqueous extract of <i>Channa striata</i> significantly decreased the volume of gastric juice and increased the levels of catalase while considerable decrease in free and total acidities and increase in superoxide dismutase. The study also indicated a decline in ulcer index and malondialdehyde. This suggest that the aqueous extract of <i>Channa striata</i> have anti-secretory and antiulcer activities | Khan <i>et al.</i> , 2014    |
| <i>Oncorhynchus mykiss</i> | Rainbow trout    | The fish have tissue regeneration potentials  | Schmidt <i>et al.</i> , 2013 |
| <i>Cyprinus carpio</i>     | Common carp      | The fish possess wound healing potentials.  | Schmidt <i>et al.</i> , 2013 |

### 3.2. Marine Fin Fishes with Wound Healing Potentials

Several marine fish are used as food source of human. Most fishes that are sold at commercial scale in many markets in Nigeria are from marine ecosystem. Wastes of marine fish are often discharged into the environment where they cause attendant environmental impacts but studies have suggested that important bioactive ingredients that are beneficial to human health could be isolated from their wastes (Venkatesan *et al.*, 2017). Venkatesan *et al.* (2017) reported that collagens have been extracted from bone, skin of many marine fish and they have bioactivity toward skin repair and regeneration. The authors further reported that bioactive protein and peptides can also be extracted from marine fish. Authors have widely reported that peptides from fish wastes have antioxidant, antimicrobial, antihypertensive, calcium-binding, and obesity control properties and as such have been applied in cosmeceutical and nutraceutical industries (Najafianand Babji, 2012; Pangestuti and Kim, 2017; Venkatesan *et al.*, 2017),

Collagens have been widely reported in marine fishes. Acid and peptide soluble collagens have been reported Swim Bladders of Miiuy Croaker (*Miichthys miiuy*) (Zhao *et al.*, 2018), *Otolithes ruber* and *Magalaspis cordyla* (Kumar *et al.* 2012) (Table 2). These suggested that some important constituents of marine fish also promote wound healing.



**Table2.** Marine fin fishes with wound healing potentials

| Scientific name              | Common name                            | Role  | References                    |
|------------------------------|--|---|-------------------------------|
| <i>Caranx melampygus</i>     | Bluefin Trevally                       | The collagen films derived from bones of the fish have biocompatibility and wound healing potentials  | Rethinam <i>et al.</i> , 2016 |
| <i>Otolithes ruber</i>       | Tigertooth croaker                     | The bone of the fish which is often considered as a wastes is a source of acid and pepsin soluble collagens which are cross-linked with glutaraldehyde and play essential role in wound healing | Kumar <i>et al.</i> , 2012    |
| <i>Magalaspis cordyla</i>    | Finletted mackerel scad or cordylascad | Bone of the fish is a source of acid and pepsin soluble collagens which are cross-linked with glutaraldehyde and it possess three dimensional pores that aid in wound healing                   | Kumar <i>et al.</i> , 2012    |
| <i>Oreochromis niloticus</i> | Nile Tilapia                           | Marine collagen peptides from the skin of the fish enhance wound healing processes  | Hu <i>et al.</i> , 2017       |

#### 4. CONCLUSION

In recent time studies into organic material with therapeutic properties have increased. This is as a result of varying difficulty being encountered on surmounting different disease conditions especially disease cause by microorganism. Wound healing is a major task often encountered by health practitioners especially on individual with comorbidity such as diabetes or vascular disease. Probably due to these effects several studies have been conducted to ascertain the role of some constituents of fish on wound healing. To this effect freshwater fish such as *Clarias gariepinus*, *Channa striatus*, *Oncorhynchus mykiss* and *Cyprinus carpio*; and marine fish such as *Otolithes ruber*, *Magalaspis cordyla* and *Oreochromis niloticus* have bioactive ingredient that promotes would healing. As such this research paper tends to recommend that should be focused on isolation and purification of the exact constituents of the fish that possesses wound healing potentials.

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