Original Research Paper

Volume - 11 | Issue - 02 | February - 2021 | PRINT ISSN No. 2249 - 555X | DOI : 10.36106/ijar

Biological Science

A REVIEW ON WUOND HEALING AND TISSUE ENGINEERING BIOMATERIALS FROM THE MARINE SOURCE.

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ABSTRACT Marine aquatic organisms are an abundant source of diverse biomaterials with potential intended for an array of applications. There are different types of natural marine biomaterials and their applications especially wound healing, skin regeneration tissue engineering mainly is focused on in this review. Wound dressings, including films and foam dressings, are made from various types of biomaterials, with some containing biologics and having antibacterial properties or agents that can facilitate cell migration. Additionally, there are a number of therapies currently on the market. Recent progress in the development of advanced wound dressings has seen the use of marine biomaterials and/or the incorporation of biologics capable of wound healing by skin regeneration. In this review, we also discuss the mechanism of the various applications of reactive oxygen species quick to respond biomaterials in tissue regeneration and disease therapy, such as cardiovascular diseases, osteoarthritis, chronic diabetic wounds, inflammatory bowel disease, and other inflammatory diseases are summarized.

KEYWORDS : Marine Biomaterials, Biological properties, Wound healing, Tissue engineering, Reactive oxygen species

INTRODUCTION:

A biomaterial is a substance that has been engineering to intermingle with biological systems for a medical treatment purpose either a therapeutic (treat, augment, repair, or replace a tissue function of the body) or a diagnostic one. The biomaterials must be well-matched with the animal's body known as biocompatibility. Biocompatibility is the behavior of biomaterials in different conditions under various physical and chemical environments.

Marine biomaterials for tissue engineering and wound healing are normally sulfated polysaccharides that have diverse functions in the tissues. They bind proteins at several levels of specificity and are mainly involved in the development, cell proliferation, cell adhesion, cell signaling, and cell-matrix interactions (Senni et al., 2011). Marine polysaccharides present an enormous variety of structures. Sulfated polysaccharides, possessing GAG-like biological properties, can be found either in marine pro and eukaryotes.

Marine biomaterials have various health benefits of the biological and biomedical applications. In the present study, we review the identification and the application of different marine biomaterials from different marine sources in detail. Biomaterials described come from different types of marine organisms such as fish, algae, crustaceans, mollusks, and microorganisms like bacteria and fungus. The main marine polysaccharides are alginate, chitin, chitosan, and fucoidan. The marine biomaterials show significant biological properties such as anti-inflammation, antimicrobial, antidiabetic properties, anticoagulant, anticoagulant, anticancer, osteoporosis, and bone-related treatment.

TYPES OF BIOMATERIALS:

Biomaterials can be divided into natural biomaterials and synthetic biomaterials.

MARINE NATURAL BIOMATERIALS:

Marine natural biomaterials, which are derived from algae, bacteria, invertebrates, and fish, are promising candidates for various biomedical and biological uses and show antioxidant properties (Li et al., 2009).

MARINE SYNTHETIC BIOMATERIALS:

Synthetic biomaterials are most commonly used for implants they are mainly, titanium, silver products, polyester, and porcelain, and these synthetic biomaterials can be divided into different types such as metals (stainless steel, pure titanium & titanium alloys), polymers (polyester, polytetrafluoroethylene, and polyurethane), ceramics and composites. One of the drawbacks of using synthetic materials like polycaprolactone as a wound dressing is that the dressing will eventually need to be removed, it may because further damage to the wound.

RESULTS AND DISCUSSION:

Marine natural biomaterials are derived from marine aquatic animals, microorganisms, and plants. One of the benefits of using natural biomaterials is that they are similar substances familiar to the body (Davis, 2003). Wound dressings including films and foam dressing are made up of various materials. Biomaterials are used in skin repair devices (artificial tissue), drug delivery mechanisms, vascular grafts, heart valves, artificial ligaments and tendons, stunts, bone blocks of cement, etc.

Surgical implantation of a biomaterial into the body triggers an organism-inflammatory reaction with the associated healing of the damaged tissue. Depending upon the composition of the implanted material, the surface of the implant, the mechanism of fatigue, and chemical decomposition there are a number of other reactions possible. These can be local as well as systemic.

Tissue damage is mainly caused by the production of marked levels of reactive oxygen species in tissues of organs such as skin, liver, kidney, brain, testes, and ovary, etc. Reactive oxygen species may disrupt cellular homeostasis, cause non-specific damage to vital components, and lead to health hazards. Recently, ROS-responsive biomaterials have been identified as a type of capable therapeutic substance to lessen oxidative stress in tissue. Reactive oxygen species (ROS) is generated in living organisms during the human metabolic process, and it can be produced as hydrogen peroxide, superoxide, hydroxyl, and nitric oxide radical. The excess of ROS causes several diseases from cardiac problems to cancer. Hence, the reduction of ROS is the preliminary step for preventing various diseases.

Antioxidant activity of marine-derived biomaterials is playing a vital role in the sup¬pression of reactive oxygen species. Recently, some of the papers have been published for antioxidant activity with marine biomaterials like peptides, chitin, and chitosan derivatives being discussed in the biological application part (Altiok et al., 2010; Knorr, 1982; Koryagin et al., 2006; Xie et al., 2001; Xing et al., 2005; Yen et al., 2007, 2008) and also sulfated polysaccharides, espe¬cially fucoidan and laminarin (Wang et al., 2009a, b; Xing et al., 2005).With biological systems for a medical purpose either a therapeutic (treat, augment, repair or replace a tissue function of the body) or a diagnostic one. The biomaterials must be compatible with the animal's body known as biocompatibility. Biocompatibility is the behavior of biomaterials in different conditions under various physical and chemical environments.

Marine biomaterials (sulfated polysaccharides, chitin and chitosan etc) can be prepared from various fish by products or fish waste such as skin, bones, fins, gut, scales are generated from shops and factories. The preparation marine biomaterials are carried out different steps such as washing and cutting of raw material, chemical preparation, extraction, precipitation and freezine-drying. The basic biomedical applications of these marine biomaterials are wound healing, tissue engineering, immune modulators and antitumor, antioxidants etc (Figure 1) (Table 1).

Waste raw materials from fish/shrimp/shells/squids

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Washing and cutting of raw material

↓

Chemical preparation

↓

Extraction and Precipitation

↓

Characterization and Freeze-drying

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Biomedical applications like wound healing, tissue engineering, as drug, bone filling, anticoagulant, antitumor, anticancer, skin regeneration, wound cover dressing

Figure:1 Preparation and applications of Marine biomaterials

Table 1: Source And Activity/applications Of Marine Biomaterials

S. No	Biomaterial	Source	Activities/ Applications	Reference
1	Sulfated polysaccharide	Red sea weed algae	Biological activity, wound healing, antioxidant, antitumor, anticoagulant, growth factor and immune modulation activities.	Opoku *et al*., 2006; Zhou *et al*., 2004; Yuan *et al*., 2006; Hoffman, 1993; Farias *et al*., 2000;
2.	Sulfated polysaccharide alginate or laminarins	Brown algae	Tissue engineering, wound healing, injury healing, anticoagulant activity.	Pomin and Mourao, 2008; Morelli and chiellini, 2010; Alves *et al*., 2012,2013
3.	Sulfated polysaccharide	Green algae	Wound healing, Antioxidant, immune stimulant, antioxidant, bone tissue engineering.	Sezer *et al.,* 2008; Murakami *et al*., 2010; Silva *et al*., 2012
4.	Collagen	Fish (Acipenser baerii) (Waste materials of skin, bone, and fins)	Skin wound healing, skin regeneration and tissue engineering.	Raman and Gopakumar, 2018; Lim *et al*., 2019
5.	Collagen	Fish(Tilapia) Waste materials of skin, bone, fin and gills)	Wound healing, skin regeneration, proliferation epidermal differentiation in keratinocytes.	Pikitch *et al*., 2005
6	Collagen	Marine sponge (from skin)	Skin regeneration, wound healing, proliferation, epidermal differentiation in keratinocytes.	Pallela *et al*., 2011a
7	Collagen	Squid (skin)	Bone tissue engineering	Nagai and Suzuki, 2000
8	Chitin and Chitosan	Crabs, fungi, shrimps, Corals, Lobsters, Jelly fish,	Tissue regeneration	Madhavan and Nair, 1974; Shaahidi and Abuzaytoun, 2005

CONCLUSION:

The marine animals in the ocean are not only used for human consumption, but also the source of biomaterials preparation. A marine biomaterial is a substance that is designed with the purpose to intermingle with the body or replace a missing piece or regeneration of tissue by wound healing or organ transplantation or vascular graft of the human body.

ACKNOWLEDGEMENT

The authors are thankful to the Dr. CH. Vijaya, department of Marine Biobiolgy, V.S. University, Nellore for her support to prepare the manuscript.

DECLARATION OF CONFLICTING INTERESTS

The authors declare that there are no conflicts of interest that would prejudice the impartiality of this scientific work.

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