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Collagen Patches for Wound Healing

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Abstract Collagen patches have emerged as a promising wound dressing material for enhancing wound healing. This study explores the development and evaluation of collagen-based patches for wound healing applications. Collagen, a natural biomaterial, provides a conducive environment for cell growth and tissue regeneration. The patches were fabricated using collagen and characterized for their physicochemical properties, biocompatibility, and wound healing efficacy. In vitro and in vivo studies demonstrated that collagen patches promoted cell proliferation, improved wound closure rates, and enhanced tissue regeneration. The results suggest that collagen patches are a potential candidate for effective wound management, offering a natural, biocompatible, and efficient solution for wound healing

Keywords: Collagen, Wound healing, Regeneration, Smooth muscle, Endothelial cells.

INTRODUCTION:

Collagen is one of the primary proteins found in connective tissue. Collagen was first defined as "that component of connective tissue that produces gelatin when boiled," the Greek word "kolla" (glue), and a French in this context, "collagen" was used to refer to the glue-producing component of connective tissue. Furthermore, collagen is the most common protein in mammals and an essential component of connective tissue, comprising roughly 25% of the total protein content. Because of its high tensile strength, this material is frequently used in construction. ligaments and tendons. Collagen is an

extracellular matrix component found in all dental tissues except enamel. Collagen is found in bones, cartilage, and teeth. Furthermore, the cornea is filled with collagen, which is located in the crystal structure. ^[1,2,3]

Collagen is one of the most common proteins produced by the body. anatomy of humans. It is responsible for the stability and strength of the by constructing support nets along the body's cellular structures. Over time, the fiber deteriorates, and as one of Its numerous effects include the unpleasant wrinkling of the skin. Reliable studies have shown that damaged fibers They could be replaced by new ones when a

subject ingested the hydrolyzed protein. As a result, collagen production was stimulated, which helped the tissue's improved appearance and healing. As a result, the cosmetic industry has put a lot of effort into getting this biomolecule on There are several products available.^[4]

Additionally, it has been demonstrated that the collagen hydrolysate exhibits bioactivities like antihypertensive and antioxidant qualities. Activity, the ability to lower cholesterol, and the ability to repair damaged skin. Additionally, it has been noted that this specific collagen presentation has two effects on the skin, first serves as the building block for the synthesis of collagen and elastin, and second, they function as ligands or binding receptors in fibroblasts to promote the production of hyaluronic acid and the aforementioned components.^[5,6]

DEFINITION:

The main ingredient in the extracellular matrix is collagen. The protein is fibrillar, comprising various forms of conjunctive tissue, including skin, cartilage, bone, and tendon Collagen can induce or regulate a variety of structural and cellular processes and functions, including differentiation, movement, communication, and apoptosis. It can also form insoluble fibrils with high resistance characteristics.^[7,8,9]

Collagens of types I, II, and III are the most prevalent and thoroughly studied for use in biomedical applications as a natural scaffold and plastic in medicine and cosmetics, as well as in the pharmaceutical industry as substances that extend the effects of medications in reconstructive medicine (particularly type I) and tissue engineering.^[10,11]

Human collagen comes in nearly 20 varieties, each of which is determined by a distinct gene. Nonetheless, the different kinds of collagens carry out distinct bodily functions and have somewhat different amino acid compositions.^[12]

TYPES OF COLLAGENS:

Class Type Distribution :

TYPE	DISTRIBUTION
I	Bone, skin, tendon, ligaments, cornea
II	Cartilage, vitreous humor in the eyes
III	Skin, blood vessels
V	Bone, dermis ,co-distribution with type I

XI	Cartilage, invertebral discs, codistribution with type 2
XXIV	Bone, Cartilage
XXVII	Cartilage
VII	Bladder, dermis
IX	Cartilage, cornea
XII	Tendons, dermis
XIV	Bone, dermis, cartilage
XVI	Kidney, dermis
XIX	Basement membrane
XX	Cornea of chick
XXI	Kidney, stomach
XXII	Tissue junction
XXVI	Ovary, testis
IV	Basement membrane
VI	Muscle, Dermis, cornea
VIII	Brain, skin, kidney, heart
X	Cartilage
XXVIII	Dermis, sciatic nerve
XIII	Dermis, eyes, endothelial cells
XVII	Desmosomes
XXIII	Heart, retina
XXV	Heart, testis ,brain
XV	Capillaries, testis, kidney, heart
XVIII	Liver, basement membrane

SOURCES OF COLLAGEN:

1. Natural sources
2. Synthetic sources

NATURAL SOURCES :

Collagen can be found in both plant and animal sources. The most common animal sources are human, pig, and cow collagen as well as marine organisms like scale fish and fish skin.^[13,14] One of these animal sources that is commonly used to temporarily cover burns and extraoral wounds is bovine collagen. It has numerous applications because of its practicality and bodily compatibility. On the other hand, soft tissue grafting might benefit from the use of pig collagen matrices. It provides a biocompatible surgical material as an alternative a naturally occurring transplant.^[15,16,17]

Alligator bone and skin, frog skin, sheepskin, kangaroo tail, rat tail tendons, chicken, duck feet, and equine tendon are examples of animal terrestrial sources. Types I and II are derived from the skin of horses flexor and cartilage. Chicken neck is the source of types I, II, III, and V. The sternal cartilage of chicken

embryos contains type IX, the skin contains types I and III, and the muscle tissue contains type IV.^[18]

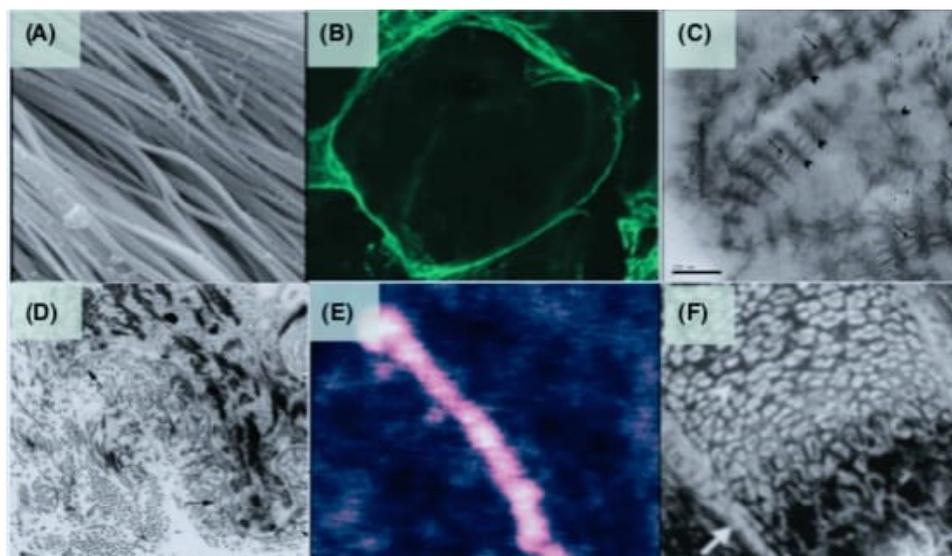


Fig 1: Microscopy of the most Common collagen groups showing in A, Fibril-forming (collagen type I), B, Basement membrane (collagen type IV), C, Microfibrillar (collagen type VI), D, Anchoring fibrils (collagen type VI), E, FACIT (collagen type XIII), F, Transmembrane (collagen type XIII)

SYNTHETIC SOURCES:

Many people use collagen to aid in tissue remodeling, healing, and blood coagulation. Although animal-derived (natural) collagen finds extensive use in clinical settings, its role in inflammation, batch-to-batch variability, and potential for disease transmission raise some concerns. 18 Some synthetic sources, such as the substance marketed under the name KOD, have been discovered to prevent immune issues. This 36-amino acid synthetic protein self-assembles into hydrogels and triple-helix nanofibers, simulating natural collagen and potentially outperforming commercial sponges or collagen-based treatments. The name KOD comes from the peptide's sequence, which is (Pro-Lys-Gly) (Pro-Hyp-Gly) (Asp-Hyp-Gly), and its abbreviation for single-letter amino acids is (P-K-G) (P-O-G) (D-O-G).^[19]

MATERIALS AND METHODS IN PREPARATION OF COLLAGEN :

Skin sampling:

Whole thick skin from the thigh or midsection was used to isolate skin for grafts. Tissue samples were categorized into the following groups according to patient age because the physiological features of skin change at a predictable rate with age: Groups include

fetuses, adolescents (\leq age of 18), adults (>19 y, ≤ 50 y), and senior citizens (>50 y). Ten samples from the experimental group were examined in total. During the recovery period (6–12 months, 12–24 months, and >24 months post burn), samples of post-burn hypertrophic scar tissue ($n=90$; male = 53 and female = 37) were taken. The samples were categorized by age as previously mentioned (adolescent group, adult group, elderly group; $n=10$ samples per group).

Immunohistochemistry:

before being sectioned at 3 μ m, tissue samples were dehydrated, olefin-embedded, and fixed in 4% formaldehyde for 12 hours. The streptavidin–biotin–peroxidase complex (SABC) kit and polyclonal antibodies were used to evaluate type I and type III collagen in fixed sections. In short, 50 g/L of bovine serum albumin was used to confine the slides. The mouse antihuman Type I or Type III collagen is known as BSA. diluted 1:100 in 0.01 mol/L of pH 7.3 phosphate buffered saline (PBS) and allowed to sit at room temperature for one hour before being incubated at 4°C for the entire night. Slides were acclimated to being cleaned in PBS in between incubators the next day.

Qualification Hydroxyproline :

Fresh specimens (0.3 g) were homogenized and dissected on wet ice after being kept in isotonic saline at 4°C. By quantifying hydroxyproline using the Nanjing, China, hydroxyproline kit in accordance with the manufacturer's instructions, the amount of collagen was estimated. In short, the homogenate was centrifuged at 986 x g for 10 minutes. Using spectrophotometry, the absorbance of the hydroxyproline-containing supernatant was

determined at a wavelength of 550 nm. Hydroxyproline's density was determined .

Statistical Analysis :

Data is expressed as mean (x) ± standard deviation (s). Variance and differences among means were determined by analysis of variance (ANOVA) test using SASV 8 Stat Software. Statistical significance was set at P<0.05.^[20]

APPLICATIONS

1. Oral Mucosa Tissue Regeneration

Table 1: (Oral Mucosa Tissue Regeneration)

FORM	ORIGIN	EXTRACTION TECHNIQUE	BIOLOGICAL EVALUATION	RESULT	RF.NO
Scaffold	Tilapia fish scales	Freeze drying	Primary oral keratinocytes	Produced multi layered, polarized with superficial keratinization.	21
Collagen hydrogel	Rat tails	Freeze drying	Keratinocytes	Increased cell viability formation.	22
Collagen peptides	Tilapia skin		tongue mucosa	healing process of oral ulcer	23

2. Vascular tissue regeneration :

Numerous methods have documented the use of collagen as a biomaterial in Due to its exceptional biocompatibility, it can be used in a variety of vascular tissue applications. Using

vascular smooth muscle cells (SMCs) and endothelial cells (ECs), Jeong et al. investigated the viability of using collagen from jellyfish (*Stomolophus nomurae eleagris*) as tissue-engineered vascular grafts in a pulsatile perfusion bioreactor. ^[24,25]

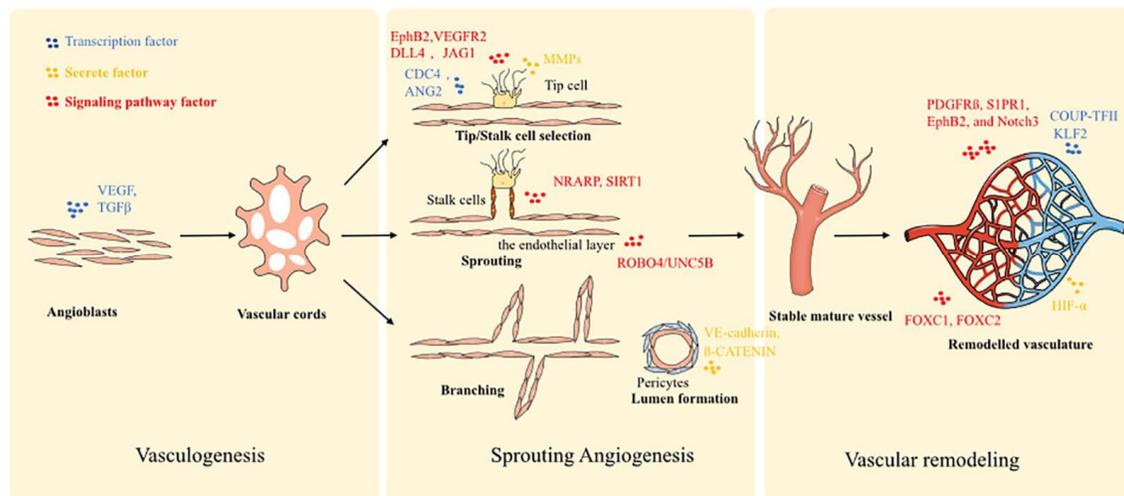


Fig 2: (Vascular tissue regeneration)

3. Skin tissue and wound Healing:

examined the capacity for wound healing of using two wound models (excision and incision) to administer marine collagen peptides (MCP) from the skin of chum salmon (*Oncorhynchus chusketa*) in vivo. Consequently, it was

demonstrated that MCP enhanced wound closure, enhanced angiogenesis, enhanced tissue regeneration at the wound site, and facilitated the formation of thicker and more ordered collagen fiber deposition.^[26]

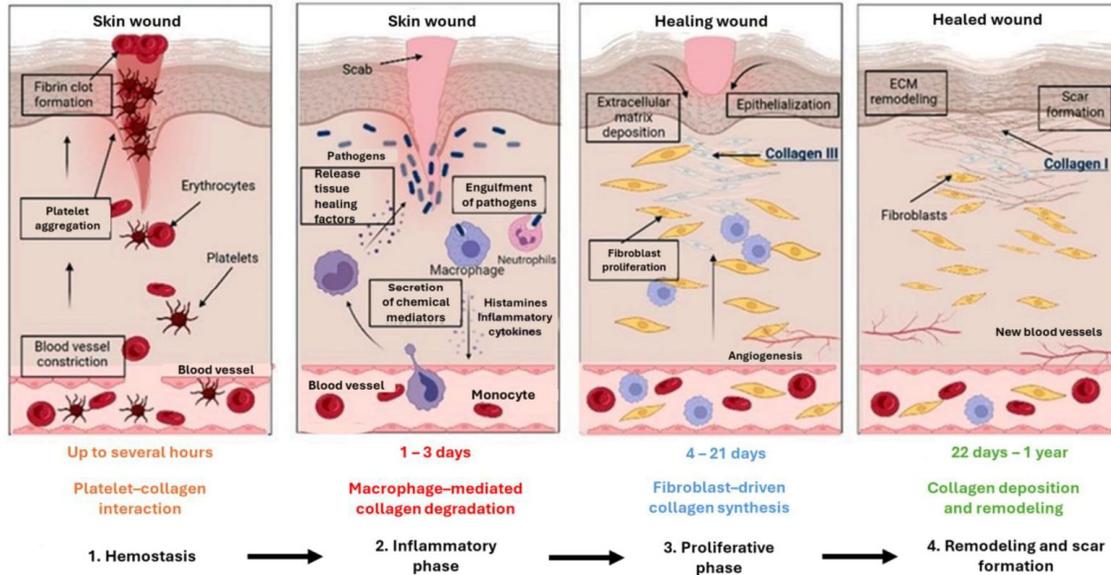


Fig 3: (Skin tissue and wound healing)

4. Dental regeneration :

Collagen has also been shown to play a significant role in the regeneration of dental tissue. In fact, various collagen types that are extracted using a variety of extraction techniques have demonstrated the ability to promote dental tissue regeneration; as a result, they can be

employed in biomedical applications to promote dental tissue regeneration . Rat odontoblast-like cell line was used to test the collagen peptide that was extracted from tilapia scale by enzymatic hydrolysis .and the cells of the human periodontal ligament.^[27,28,29]

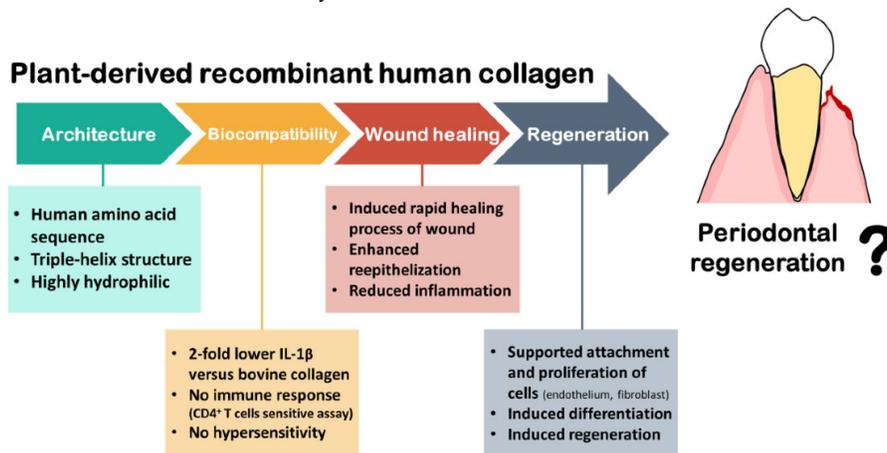


Fig 4: (Dental regeneration)

EVALUATION:

1. Incision wound model:

Para vertebral straight incision of 6cm length was made through the entire thickness of

the skin. On either side of the vertebral column with the help of a sharp scalpel. After complete hemostasis, the wounds were closed by means of interrupted sutures placed at approximately 1 cm

apart. Animals were treated daily with drugs, as mentioned above under excision wound model from 0 days to 9th post wounding day. The wound breaking strength was estimated at 10 the day by tensile tester.

Tensile strength was calculated using the following

Formula:

$$\text{Tensile strength} = \frac{\text{Total breaking load}}{\text{Cross-sectional area}}$$

2. Transmission Electron microscopy (TEM):

The TEM technique was used to visualize the size and shape of AgNps. The Ag Nps generated from aqueous solutions were shown in the TEM pictures below. Extract from *C. auriculata*. The morphology of the AgNps was observed to be predominantly spherical. The general morphology of Ag Np Almost homogeneous Ag NPs was created by reducing Ag⁺ ions with 1 mM AgNO₃. The typical TEM image of the Ag Nps extracts from C that were biosynthesized in water.^[30]

CONCLUSION

REFERENCE:

1. Wang Y, Azaïs T, Robin M, et al.: The predominant role of collagen in the nucleation, growth, structure and orientation of bone apatite. *Nat Mater.* 2012, 11:724-33. 10.1038/nmat3362
2. Proksch E, Schunck M, Zague V, Segger D, Degwert J, Oesser S: Oral intake of specific bioactive collagen peptides reduces skin wrinkles and increases dermal matrix synthesis. *Skin Pharmacol Physiol.* 2014;27:113-9. 10.1159/000355523
3. Kim DU, Chung HC, Choi J, Sakai Y, Lee BY: Oral intake of low-molecular-weight collagen peptide improves hydration, elasticity, and wrinkling in human skin: a randomized, double-blind, placebo-controlled study. *Nutrients.* 2018, 10:10.3390/nu1007082
4. Sibilla S, Godfrey M, Brewer S, Budh-Raja A, Genovese L. An overview of the beneficial effects of hydrolysed collagen as a nutraceutical on skin properties: scientific background and clinical studies. *Open Nutraceutical J.* 2015;8:29-42.
5. Goodsell D. Collagen. PDB-101. 2005. https://doi.org/10.2220/rcsb_pdb/mom_2000_4.
6. Yang L. Mechanical Properties of Collagen Fibers explored by AFM. University of Twente. 2008. ISBN: 978-90-365-2623-4.
7. Brodsky, B.; Eikenberry, E.F.; Belbruno, K.C.; Sterling, K. Variations in collagen fibril structure in tendons. *Biopolymers* 1982, 21, 935-951, <https://doi.org/10.1002/bip.360210507>.
8. Xiong, X. New Insights into Structure and Function of Type I Collagen. *Neuer Einblick in die Structure und Function des Type I-Kollagens* 2008, <https://doi.org/10.18419/opus-1773>.
9. Copes, F.; Pien, N.; Van Vlierberghe, S.; Boccafroschi, F.; Mantovani, D. Collagen-Based Tissue Engineering Strategies for Vascular Medicine. *Front Bioeng Biotechnol* 2019, 7, <https://doi.org/10.3389/fbioe.2019.00166>.
10. Miller, E.J.; Kent Rhodes, R. [2] Preparation and Characterization of the Different Types of Collagens. In: *Methods in Enzymology. Structural and Contractile Proteins Part A: Extracellular Matrix*; Academic Press, Volume 82, 1982; pp 33-64; [https://doi.org/10.1016/0076-6879\(82\)82059-4](https://doi.org/10.1016/0076-6879(82)82059-4).
11. Lin, K.; Zhang, D.; Macedo, M.H.; Cui, W.; Sarmiento, B.; Shen, G. Advanced Collagen-Based Biomaterials for Regenerative Biomedicine. *Advanced Functional Materials* 2019, 29, <https://doi.org/10.1002/adfm.201804943>
12. Krane, S. M. The importance of proline residues in the structure, stability and susceptibility to proteolytic degradation of collagens. *Amino acids* 2008, 35(4), 703.
13. Fan J. Effects of collagen and collagen hydrolysate from jellyfish umbrella on histological immunity changes of mice photoaging. *Nutrients.* 2013;5:223-233
14. Sibilla S, Godfrey M, Brewer S, Budh-Raja A, Genovese L. An overview of the beneficial effects of hydrolysed collagen as a nutraceutical on skin properties: scientific background and clinical studies. *Open Nutraceutical J.* 2015;8:29-42
15. Sowjanya N, Rao N, Bushan S, Krishnan G. Versatility of the use of collagen membrane in

- oral cavity. *J Clin Diagn Res.* 2016;10:ZC30-ZC33.
16. Karsdal M. *Biochemistry of Collagens Structure, Function and Biomarkers.* London, United Kingdom: Academic Press; 2016
 17. Brinckmann JCBC, Not bohm H, Muller PK, Bachinger HP. *Collagen: Primer in Structure, Processing and Assembly.* Berlin, Germany: Springer; 2005:56.
 18. Gupta R, Canerdy T, Skaggs P, et al. Therapeutic efficacy of undenatured type-ii collagen (UC-II) in comparison to glucosamine and chondroitin in arthritic horses. *Vet Pharmacol Ther.* 2009;32:577-584
 19. Kumar V, Taylor N, Jalan A, Hwang L, Wang B, Hartgerink J. A nanostructured synthetic collagen mimic for haemostasis. *Biomacromol.* 2014;15:1484-1490.
 20. Wang Cheng, Rong Yan-hua, Ning Fang-gang and Zhang Guo-an* Department of Burns, Beijing JiShuiTan Hospital, Beijing,100035, China.
 21. Terada, M.; Izumi, K.; Ohnuki, H.; Saito, T.; Kato, H.; Yamamoto, M.; Kawano, Y.; Nozawa-Inoue, K.; Kashiwazaki, H.; Ikoma, T.; Tanaka, J.; Maeda, T. Construction and Characterization of a Tissue-Engineered Oral Mucosa Equivalent Based on a Chitosan-Fish Scale Collagen Composite. *Journal of Biomedical Materials Research Part B: Applied Biomaterials* 2012,100B, 1792–1802, <https://doi.org/10.1002/jbm.b.32746>
 22. Tabatabaei, F.; Moharamzadeh, K.; Tayebi, L. Fibroblast Encapsulation in Gelatin Methacryloyl (GelMA) versus Collagen Hydrogel as Substrates for Oral Mucosa Tissue Engineering. *Journal of Oral Biology and Craniofacial Research* 2020, 10, 573–577, <https://doi.org/10.1016/j.jobcr.2020.08.015>.
 23. Shang, Y.; Yao, S.; Qiao, X.; Wang, Z.; Zhao, X.; Huang, Z.; Gu, Q.; Wang, N.; Peng, C. Evaluations of Marine Collagen Peptides from Tilapia Skin on Experimental Oral Ulcer Model of Mice. *Materials Today Communications* 2020, <https://doi.org/10.1016/j.mtcomm.2020.101893>
 24. Jeong, S.; Kim, S.Y.; Cho, S.K.; Chong, M.S.; Kim, K.S.; Kim, H.; Lee, S.B.; Lee, Y.M. Tissue-Engineered Vascular Grafts Composed of Marine Collagen and PLGA Fibers Using Pulsatile Perfusion Bioreactors. *Biomaterials* 2007, 28, 1115–1122, <https://doi.org/10.1016/j.biomaterials.2006.10.025>.
 25. Wang, J.K.; Yeo, K.P.; Chun, Y.Y.; Tan, T.T.Y.; Tan, N.S.; Angeli, V.; Choong, C. Fish Scale-Derived Collagen Patch Promotes Growth of Blood and Lymphatic Vessels in Vivo. *Acta Biomaterial* 2017, 63, 246–260, <https://doi.org/10.1016/j.actbio.2017.09.001>.
 26. Wang, J.; Xu, M.; Liang, R.; Zhao, M.; Zhang, Z.; Li, Y. Oral Administration of Marine Collagen Peptides Prepared from Chum Salmon (*Oncorhynchus Keta*) Improves Wound Healing Following Cesarean Section in Rats. *Food & Nutrition Research* 2015, 59, <https://doi.org/10.3402/fnr.v59.26411>.
 27. Tang, J.; Saito, T. Biocompatibility of Novel Type I Collagen Purified from Tilapia Fish Scale: An In Vitro Comparative Study. *BioMed Research International* 2015, 2015, 1–8, <https://doi.org/10.1155/2015/139476>.
 28. Liu, C.; Sun, J. Hydrolyzed Tilapia Fish Collagen Induces Osteogenic Differentiation of Human Periodontal Ligament Cells. *Biomed. Mater* 2015, 10, <https://doi.org/10.1088/1748-6041/10/6/065020>.
 29. Zhou, T.; Liu, X.; Sui, B.; Liu, C.; Mo, X.; Sun, J. Development of Fish Collagen/Bioactive Glass/Chitosan Composite Nanofibers as a GTR/GBR Membrane for Inducing Periodontal Tissue Regeneration. *Biomed. Mater* 2017b, 12, <https://doi.org/10.1088/1748-605X/aa7b55>.
 30. Jagtap NS, Khadabadi SS, Farooqui IA, Nilambar VP, and Sawarkar HA. Development and evaluation of herbal wound healing formulations. *International Journal of Pharm Tech Research*, 1(4), 2009, 1104-1108