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Extraction, Characterization and utilization of Collagen from Fish Waste: Review

Asmelash Berhie[1,2] and Archana Pandita [1*]

[1]Department of Biotechnology, School of Engineering and Technology, Sharda University Greater Noida, India.

[2]Ministry of Agriculture and Livestock Resource Development Office Addis Ababa, Ethiopia.

Corresponding Author: archana.pandit@sharda.ac.in

Abstract: *-Collagen incorporates about 30 of the animal frames total protein and it's the most abundant animal protein polymer. In animal skin, bone and connective tissue, it is the most important structural protein. Collagen is also determined in invertebrates inside the body partitions and cuticles. It is a crucial natural biological material and has been notably studied as a polymer for use in industrial materials. Technology involving collagen in the form of leather-based and gelatine goes back several millennia. The cosmetic, pharmaceutical, biomedical, film and leather industries, collagen has a broad variety of applications. For this reason, fish waste can also be an effective opportunity source for collagen manufacturing.*

Management and processing of bi-products and waste is an environmental, social and political priority for many nations and is more complicated due to growing production volumes. In France, the meals industry annually generates more than 48 million tons of bi-products and waste from main sorts of transformation: the animal industry and the plant sector. Bi-products from fish processing are part of those ones and account for at least 215 000 tons (0.4% of the complete deposit) in line with latest estimates for the period 2004-2005 (Perez-Galvez, 2012).

The objective of this study has on the quantification of collagen subunit differentiation between tilapia and yellowfin tuna fish species by acid soluble extraction characteristics of collagen in the skin. The inferences of this review were focused on: - To identify the role of type 1 collagen on health improvement and environment benefit.

Key Words: - Fish waste, Collagen, Gelatine, tropocollagen

1.Introduction

India is one of the countries endowed with good sized and varied resources owning river ecological heritage and wealthy biodiversity. Freshwater fishery sites are numerous like 45,000 km of rivers, 126,334 km of canals, ponds, and tanks 2.36 million hectares and a pair of 5 million hectares of reservoirs. In recent times the total population in the worldwide approximately 21,730 fish species had been recorded and total 11.7% are found in Indian water bodies. Out of the 2546 species so far listed, 73 (3.32%) belong to the cold freshwater regime, 544 (24.73%) to the warm freshwater domain, 143 (6.50%) to the brackish waters and 1440 (65.45%) to the marine ecosystem. (Shivaraju and Venkateshwarlu,2018).

There are 223 endemic fish species are observed in India, which representing 8.75 % of the diversity among freshwater fish, does not have many endemic species within India due to its jagged political boundary. There are about 450 families of freshwater fishes globally. kind of 40 are represented in India (warm freshwater species) (Rajashekhar etal.,2007).About 25 of these families include commercially critical species. Wide variety of endemic species in warm water is about 544. Freshwater fishes are a poorly studied group due to the fact records concerning distribution, population dynamics, and threats are incomplete, and most of the information available is from a few well-studied locations only (Sabuj Kumar, 2010).

India's inland water resources are diversified, as they are abundant reservoirs that contribute the single biggest inland fishery resources both in terms of size and production capacity. Fish fauna of a reservoir basically represents the diversity of fish and their abundance. Indian reservoirs preserve a rich variety of fish species, which helps to the commercial fisheries. Reservoirs present an excellent opportunity for scientific studying the effect of scale on the fish species commercial production in India (Fernando etal.,1991).

The yield of marine capture production in 2005 was 84.2 million tons, accounting 59.5% of worldwide production (food agricultural organization,2009). Commonly available marine fishes in India consists of ribbon fish, croaker fish, eel fish, horse mackerel, Katti fish, leather jacket, and Mahi. With the fast development of fishery, various processing companies were installed in and around the coastal areas. Moreover, at some point of the harvest season, many fishes are discarded, due to not being processed on time. Hence, comprehensive utilization of marine fish, especially the production of value-added products, has both environmental and economic importance. Freshwater fish such as Oreochromis species, Pangasius specious and Clarias species are typically processed as a frozen whole, frozen fillet and fresh fillet in factories. Due to environmental defence in shallow water, freshwater fish comprise of the excessive amount of skin, scales, and fins per unit mass. This type of fish also had grown in popularity in fish farming due to their exact growth in ponds and their number of traits, such as culture rightness in a cage or some other system in aquaculture (Helfrich et al.,2009).

A few fish processing companies were set up as the bi-products of fishery processing, around 170,000 tons have been generated annually and for the processors, interest is growing in obtaining acquiring financial benefit from the processing wastes. So, there's tremendous scope for utilization of these abundantly available fish processing wastes for extraction of a value-added product like collagen (Kim and Park,2005). More specifically, refinery discharge from the Pacific whiting surimi process, representing around 4-8% of whole fish, consisted of muscle (95%), skin (2.1%), bone (2.9%) and trace amounts of scale fragments (Kim and Park,2005). Collagen is found basically in skin, cartilage, ligament and the visceral parts in Animal and Fish, where it is the most plentiful protein in (Mammals Bae,2007).

It constitutes up to 25-30% of the total protein content of the body and on the other hand, collagen constitutes 1-2% of muscle tissue besides contributing to the tune of 6% of the weight of strong and tendinous muscles. Even the people of early civilization discovered collagen's multiple utility value, such as waterproofing, adhesive, and decoration (Zahrani, 2011). Collagen has become very useful in both bio-medical and non-bio medical industries in this modern era, with an extended range of usage (Bret D et al.,2011). Collagen, due to its biocompatibility, stability and bioactivity have been widely used as a biomaterial, e.g. scaffold of cell and growth factors, wound dressing, soft tissue augmentation, and dietary supplement (Ber et al.,2005; Tanaka et al.,2009). Collagen extracted from by-products such as fish scales are bio-composites of highly ordered type I collagen fibres and hydroxyapatite $Ca_{10}(OH)_2(PO4)_6$. In fact, previous studies showed that collagen extracted from fish scales of black drum, sheep's head sea bream, Red sea bream, tilapia, sardine, Japanese sea bass, skipjack tuna, ayu, yellow sea bream, and horse mackerel mainly type I collagen with a lower denaturation temperature than the collagen of porcine dermis (Guillén et al.,2011).

In numerous parts of the world, distinct fish species are being fed on each day in huge quantities. As an end result, a massive amount of wastes, ranging from 50–70% of original uncooked materials are generated in fish shops and processing factories (Kittiphattanabawonet al.,2005). The solid waste from surimi processing could also be the initial material for obtaining gelatine or collagen from under-utilized fish resources (Guillén et al.,2011). On other hand an improper utilization of fishery production in different processing shop, supermarket and processing industry that caused critical surroundings pollution with offensive odours become as a result of the improper disposal of the wastes from aquaculture industry together with scales, skins, faces and bones that were those resource were especially used as animal feedstuff or fertilizer (Nagai and Suzuki,2000). The marine ecosystem is understood for its most valuable food useful resource as shellfish and finish. The extraordinary evolution of marine biodiversity has made the marine environment as the world's richest natural resource with a wide variety of specific and effective bioactive compounds.

Marine food from a very long time has been connected to beneficial health properties and in current beyond innumerable research, teams have been actively engaged in exploring the health benefits of various marine bioactive components. These encompass polyunsaturated fatty acids (PUFA), collagen, gelatine, marine carbohydrates (polysaccharides/prebiotics), minerals, vitamins, antioxidants, enzymes and bioactive peptides with valuable nutraceutical, pharmaceutical, and cosmeceutical potentials. These were reported to show massive nutritional and health benefits. Various marine sources such as fish pores and skin, muscle, bone, intestine, etc. From pre-processing and processing facilities are used to isolate lots of those bioactive compounds. Fish peptides and algal polysaccharides have additionally attracted considerable interest due to their anticancer, antidiabetic, anticoagulant, antimicrobial and antihypercholesterolemic activities (Lordan, et al.,2011). These researches have gained enormous interest in recent past because of the growing need for novel health substances with least side-effects that would not only aid in the prevention and treatment of several communicable and non-communicable diseases but also supplement the diet and are easily obtainable. On this context, marine bioactive compounds are viewed as a giant for their noteworthy potentiality as healing and nutraceutical compounds. As the human population is growing and their consumption behaviour changing, the global demand for the fishery product is growing as is the demand for geared up to prepare food in the form of loins or steaks. These types of processed product generate a huge amount of by-product within the shape of skin and pore, bones, viscera, heads, scales, etc. Those natural substances are taken into consideration post-harvest fish losses (with the aid of products) and are the main problem for modern fishery management policies due to the fact they constitute a significant source of valuable compounds as proteins, fats, minerals, and many others.

Despite of the fact that, a part of this bi-product is already being used, either for fish meal or oil production (35% of worldwide fishmeal manufacturing changed into obtained from fish bi-product (Food Agricultural Organization: Roma, Italy, 2016). This kind of utilization is taken into consideration to offer little or no brought-value, however, due to the prevailing technological improvement, a more valuable and profitable use is possible (Blanco et al.,2015). Fishing tasks in Galicia (North-West Spain) constitutes a key sector for the economy of the region, with excessive attention of small, medium, and large companies committed to fish processing activities that render a huge kind of by-products susceptible to valorisation. All through fish processing operations, the elimination of collagen-containing materials (especially pores and skin, bones and scales) could account for as much as 30% of the total bi-products generated after filleting (75% of the overall trap weight) (Gómez-Guillén et al.,2002; Karayannakidis et al.,2014). In spite of that, the Collagen is the principal protein component of fish skin and its particular heterotrimeric structure [α1(I)]2 α2(I) has been various literature formerly defined, there have been just a few publications describing the properties of fish skin collagen hydrolysates (Chi et al.,2014; Halim et al.,2016). The meagre study was done on the characterization of hydrolysates obtained from pepsin soluble collagen of marine origin. As acid solubilization of collagen has been proven to render low yields, enzymatic proteolysis has been studied as an alternative to enhance the yield and at the same time obtaining hydrolysates with good nutritional composition, improved solubility and better emulsifying, foaming, and gelatine properties, as well as biologically active peptides (Chalamaiah et al.,2012; Jia et al.,2010). However, no information on the quantification of collagen subunit differentiation between yellowfin tuna and tilapia fish species by acid soluble extraction characteristics of collagen in the skin. The inferences of this review were focused on: - to identify the role of type 1 collagen on health improvement and environmental benefit.

2.Definition of collagen

Collagen is accommodating approximately 30 of the animal body's and also the most plentiful animal protein polymer. In animal connective tissue and skin, it is the major structural protein (Gelse et al., 2003; Singh et al., 2011). Primarily Based on their structure and supramolecular organization, they can be grouped into fibril-forming collagens, Fibril related collagens with Interrupted Triple helices (FACIT), network-forming collagens, anchoring fibrils, transmembrane collagens, basement membrane collagens, and others with specific functions. The unique collagen types are characterized by a huge complexity and diversity in their structure or shape, their splice variants, the presence of extra, non-helical domains, their assembly and their function. The maximum considerable and substantial own family of collagens with about 90% of the overall collagen is represented through the fibril-forming collagens. Type I and V collagen fibrils make a contribution to the structural backbone of bone and types II and XI collagens predominantly make a contribution to the fibrillar matrix of articular cartilage. Their torsional firmness and tensile strength lead to the firmness and integrity of those tissues okay. (von der Mark,1999), (D.E. Birk et al.,1988) and (R. Mayne,1989). Type IV collagens with a more flexible triple helix bring together into meshwork's restricted to basement membranes. The microfibrillar type VI collagen is exceptionally disulphide cross-linked and contributes to a network of beaded filaments interwoven with different collagen fibrils. Fibril-associated collagens with interrupted triple helices (FACIT) such as types IX, XII, and XIV collagens associate as single molecules with huge collagen fibrils and probably play a role in regulating the diameter of collagen fibrils. These are probably formed by three identical chains (homotrimers) as in collagens II, III, VII, VIII, X, and others or by using two or more distinctive chains (heterotrimers) as in collagen types I, IV, V, VI, IX, and XI. Each of the 3 a-chains within the molecule forms a prolonged left-handed helix with a pitch of 18 amino acids per turn (H. Hofmann et al.,1978).

The 3 chains, staggered through one residue relative to each other, are supercoiled around a central axis in a right-handed is a way to form the triple helix (R.D. Fraser et al.,1979). A structural prerequisite for the assembly into a triple helix is a glycine residue, the minutest amino acid, in every third position of the polypeptide chains resulting in a (GlyX-Y) n repeat structure which characterizes the ‘‘collagenous’’ domains of all collagens.

Collagen incorporates 25-30% of the protein content material of the entire body in particular in mammals (Muller and Werner, 2003). It's far observed in the corneas, bones, blood vessels, cartilage, the dentin of teeth, and so on. In fibrous tissues encompassing of the skin, tendons, and ligaments its miles determined as elongated fibrils. It constitutes 1 up to 2% of muscle tissue in which it is an important thing of the endomysium.

2.1 Collagen structure and it's chemical composition

Collagen is formed basically by way of the fibroblast of connective tissue and also through a variety of different epithelial cells (Lullo et al., 2002; Kadler et al., 2007). The primary structural unit of collagen has consisted three polypeptide chain organized inside the form of a triple helix with two identical chains (α1) and the third which differs to some degree in its chemical composition (α2). Hence it is a heteropolymer. every chain has 1050 amino acids wound around each other in an ordinary right-handed helical structure that's 300 nm lengthy. Its diameter is about 1. 5nm and molecular weight of about 290,000. Its assembly has a repeating motif Gly-X-Y, in which X and Y can be any amino acid, however usually are proline and hydroxyproline. At each 1/3 amino acid function glycine is crucial so that it will allow a firm packaging of the three α chains inside a tropocollagen molecule. Collagen is packed into hexagonal and quasi hexagonal shapes forming fibrillar collagen types. This packing might be sheet-like or microfibrillar. Microscopically collagen is located as an elongated fibril (Szpak and Paul, 2011).

It is a plentiful structural protein in both animal species. In humans, collagen accommodates one-third of the full protein, versions for 3 quarters of the dry weight of skin, and is the most predominant thing of the extracellular matrix (ECM). Twenty-eight diverse kinds of collagen self-possessed of as a minimum forty-six different polypeptide chains had been known in vertebrates and plenty of extra proteins embrace collagenous domain names, (Brinckmann, 2005); (Veit et al.,2006).

The defining distinctive attribute of collagen is well-designed formation motif in which three parallel polypeptide strands in a left-handed, polyproline II-type (PPII) helical confirmation coil about each other with a one-residue stagger to form a right-exceeded triple helix. The firmly compressed of (polyproline) PPII helices inside the triple helix mandates that each third residue be Gly, resulting in a recapping XaaYaaGly sequence, wherever Xaa and Yaa may be at all amino acid. This replication happens most common types of collagen, although it is interrupted undoubted locations within the triple-helical domain of nonfibrillar collagens (Brazel et al. 1987).

The amino acids in the Xaa and Yaa locations of collagen are often (2S)-proline (Pro, 28%) and (2S,4R)- 4-hydroxyproline (Hyp, 38%), individually. ProHypGly is the most common triplet (10.5%) (Ramshaw et al.,1998) in collagen. In animals, distinct collagen triple helices, known as subunit tropocollagen (TC), accumulate in a complex, hierarchical way that eventually guides to the macroscopic fibres and networks detected in tissue, bone, and basement membranes.

Collagen polypeptide chains are structurally organized in three α-helices forming its secondary structure. This is called subunit a protein be composed of three polypeptides units (Ehrlich, 2010).

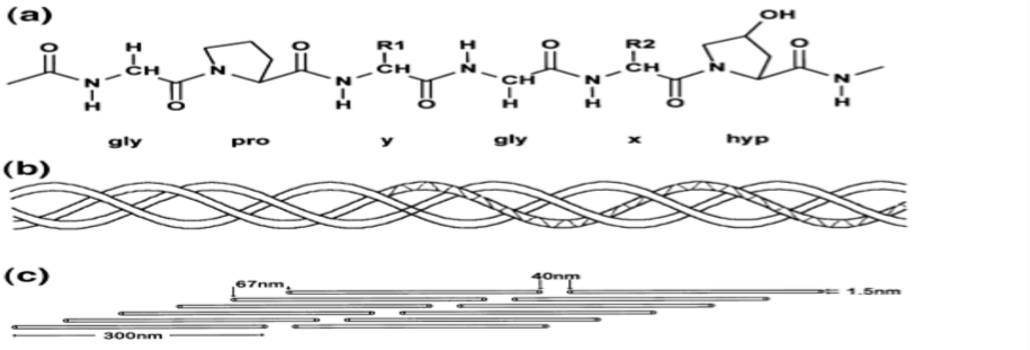

Fig 1. Chemical structure of collagen type I. a) primary amino acid sequence b) secondary left handed helix and tertiary right handed triple-helix structure and c) staggered quaternary structure

Mammal collagen I usually affect the affiliation of α1(I) and one α2(I) chains. In dissimilar collagen types, the three α-helices are distinct, for instance in collagen IX (Gelse, et al.,2003; Ferreira et al.,2012)

The polypeptide chains wrap around each other forming a characteristic triple helix-tertiary structure. As in all protein complexes, the organization of numerous protein molecule quaternary structure is determinant of protein function and in collagen the triple helices self-bring together in a staggered development and arrangement of collagen fibrils. Those fibrils are also packed collectively to form collagen fibres, responsible for the tensile strength of this material (Ferreira et al.,2012).

The structural combine of collagen molecules may be lost by a process so-called denaturation, an irreversible kinetic process, resulting in random coiled polymeric chains, termed gelatine. Denaturation may be promoted by chemical treatments or sincerely with the aid of thermal treatment when the helix-coil transition temperature is exceeded (Wright and Humphrey, 2002). The thermal denaturation of collagen is historically related through its application. In truth, collagen into formerly known as the fact of the connective tissue that renders gelatine upon boiling and that process was used to produce glue (Vanderrest et al.,1991).

2.2 Collagen type I separation and isolation

The parting of collagen needs the segregation of the protein from the beginning material in a solvable or unsolvable form. Solvable collagen can be isolated by way of either neutral salts (NaCl), Dilute acidic diluters CH3COOH (acetic acid), or HCl (hydrochloric acid) or by treatment through alkali (NaOH) and (Na2SO4) or enzymes (ficin, pepsin or chymotrypsin) (Friess, 1998; Machado-Silveiro et al., 2004).

The more of neutral salts can reduction protein solubility (salting out) (Martins et al., 1998). The kind of solvent required to isolate collagen will rely meaningfully on the tissue from which it's far extracted, the expanse of crosslinking present (adulthood of the skin, connective tissue, and mucosal epithelium, etc) and whether decalcification is needed. Other detachment methods consist of gel electrophoresis (Roveri et al., 2003). Collagen is then recuperated commonly via centrifugation.

Unsolvable collagen can be outlined through means of modifying its structural configuration (slight denaturation agents) and through mechanical fragmentation (Friess, 1998). Collagen adjustment and decontamination Collagen type I may be modified chemically to achieve a polyanionic protein or a purified protein, known as atelocollagen. Polyanionic chemical modification can be achieved via selective hydrolysis of the asparagine (Asn) and glutamine (Gln) side chains of the collagen type I molecule and have the characteristic of having higher carboxyl group content (Bet et al., 2001). It's far decided within the corneas, bones, blood vessels, cartilage, the dentin of teeth, etc. In fibrous skin, connective tissue, mucosal epithelium together with the pores and skin, tendons and ligaments it's far located as elongated fibrils. It constitutes 1-2% of muscle tissue in which it is a primary aspect of the endomysium. Collagen is molded broadly through the fibroblast of skin, connective tissue, mucosal epithelium and additionally via kind of different epithelial cells (Kadler et al., 2007).

3 Role of the collagen

Collagen is a crucial natural organic material and has been notably studied as a polymer for use in synthetic materials. Technology involving collagen in the form of leather and gelatine goes back numerous millennia. Leather is chemically handled or treated animal skin, even as gelatine is the animal connective tissue that is denatured and degraded through warmth and chemicals. Both consist largely of collagen however are very different in chemistry and form.

The term 'collagen' commonly implies the collagen present in pores and bone, tendon and skin. The existing, ten distinctive vertebrate collagens have been recognized. All collagens composed a completely exceptional triple helix. But, the duration of the helix and the nature and size of non-helical percentages of the molecule vary from type to type.

The dominant collagen of skin, tendon, and bone is type-I collagen. Type II collagen is largely specific to cartilage, and type-I collagen happens in adult pores and skin (5-10%) in association with type I and maybe a minor contaminant of type I collagen prepared from this source. The alternative types occur in small quantity and are typically related to unique biological structures (Miller E J, 1984).

Advantages of its use encompass - (1) plentiful resources of exceedingly purified (medical grade) collagen, (2) the capacity can be reconstituted into excessive strength forms useful in surgical operation, (3) the wealth of studies literature on the characterization of collagen, (4) progressed processing techniques, (5) introduction of several commercial collagen products and (6) recent advances in the use of collagen as a delivery system (Chandrakasan G, Torchi D A and Piez K A 1976 J. Biol. Chem. 251 6062).Collagen have both biomedical and industrial applications. It's far particularly used for sutures, as haemostatic agents and tissue replacements and for sausage casings those can be made of dispersed insoluble collagen extruded as a tube and formed or reduced into links as it is filled. But, the industrial uses of collagen in the form of gelatine and leather are very large (Cowan, 1983).

Collagen is likewise an element in cosmetics, dental composites, skin regeneration templates, biodegradable matrices and collagen shields in the discipline of ophthalmology. It is also used as strong-assist microcarrier within the production of enzymes. Gelatine, other parts that can able to create from the collagen contained in bones and animal hides and is used as the principal element in bioreactors. It is discovered in two forms - type A, which is prepared with the aid of acid treatment of collagen, and type B, received with the aid of alkaline treatment. The alkaline processing of hides as the collagen row material requires them to be soaked for 5-12 weeks in a solution of 5-15% lime. There is also a technique now in which lime is changed by an alkaline protease and the processing time is decreased to 24 h, followed by the conditioning of the gelatine, which is then extracted into hot water and dried normally (Cowan, 1983).

Its conditioning is done via a process where pores and skin are first to cut into small slices and washed, after which 200% through the weight of enzymatic conditioners is brought and the pH is adjusted to 9. The combination is agitated for 6-24 h at 25°C after which decanted and Biomedical and industrial applications of collagen 321 washed twice with acidified water at pH 2 to activate the enzyme with 30 min contact time. Eventually, gelatine (pH 6-7) is extracted at 70°C (Berg 1984 Parfuem. Kosmet. 65 391). The cosmetic industry uses hydrolysed gelatine as a component of shampoos and ointments. It is observed that the use of proteins in cosmetic emulsions outcomes in stable and safe products (Coy,1953). Stable beauty creams containing collagen have been prepared. Those creams contain stabilizers 0-5-10%, H20 75-95%, and soluble natural collagen (mol. wt. 1 x 106-3 x 10 6) 0.1-5%,) and are stable and non-worrying to skin. Collagens are powerful in penetrating growing old pores and skin. A lotion containing soluble natural collagens 0.5, glucose 5, NaC1 (stabilizer) 0.8, Na2CO3 0.02, preservative 0.1 and H20 93-58%, and various perfumes, is solid at room temperature for up to 6 months (Mochida Pharmaceutical Co. Ltd.,1983).

3.1Application of collagen

These days, collagen has an extensive range of applications in the health-associated sectors, namely in cosmetics, the pharmaceutical industry and in medical care (including plastic surgery, orthopaedics, ophthalmology, and dentistry) (Meena et al.,1999). In pharmaceutical industries collagen is utilized as microparticles, injectable dispersions, shields in ophthalmology sponges, medicine transfer system. It’s application in the pharmaceutical and furthermore to the biomedical field is because of its characteristics such as weak antigenicity, cell fitting ability, biodegradability and biocompatibility (Leitinger and Hohenester, 2007). Tissue engineering Collagen type I is thought to be the gold fashionable for this field because of its high biocompatibility. It is used as the primary matrix for mobile lifestyle machine. In the form of biomaterials collagen are widely applied in tissue engineering which includes injectable matrices, frameworks meant for bone regeneration, etc. Those biomaterials are produced specifically from fibril-forming collagen which incorporates type I, II, III, V, XI (Oliveira et al., 2009; Parenteau-Bareil et al., 2010).

In biomedical industry for tissue regeneration scaffolds is needed and it serves the purpose in the form of decellularized extracellular matrix (ECM). Such a cellular collagen matrix is acquired from the porcine or human dermis and swine sub-mucosa or gut. Collagen frameworks serve numerous functions such to visualize cells in the nervous system and in ex-vivo cultivation of organs as 3-D models for various diseases like cancer (Badylak, 2004; Giingras et al., 2008; Che et al., 2006). It has also played an essential role in the scientific area in existing medicinal drug collagen-based framework. In urogenital problems, corneal defects, examine neural migration, dental reason, bone grafting, arthritis, and obesity. It has diverse applications such as like Cardiology (heart valve), Dermatology (for pores and skin reserve, augmentation of soft tissue, skin tissue engineering, artificial skin dermis) surgical operation (as haemostatic agent, wound restore and dressing, nerve repair, blood vessel prostheses) Orthopaedic (tendon, bone, and ligament restore, cartilage reconstruction) Ophthalmology (corneal grafts, contact lenses) Urology (dialysis membrane haemodialysis, sphincter restore) Vascular (vascular graft, vessel alternative) (Rose & Oreffo, 2002).The detailed applications of collagen are mentioned in table 1(Maya Raman and K Gopakumar,.2018).

Table 1. Distribution of collagen and it's applications

Domesticated in	Collagen Type	Delivery	Application
Fibril-forming	I	Skin, bone, tendon (non-cartilage), dermis, cornea, ligament	Membrane for guided tissue regeneration
	II	Cartilage, vitreous humour, nucleus pulposus, lung, cornea, skin, bone	Cartilage repair, arthritis treatment
	III	Extensible connective tissue (skin, lung, visceral system viz. artery), skin, vessel wall, reticular fibres of most tissues (lungs, liver, spleen)	Haemostats and tissue sealants
	V	Co-distributed with type I, especially in cornea	Corneal tissue
	XI	Along with type II, vitreous body and cartilage	mAnb development for osteoarthritis

4 Source of collagen

Collagen Source is found in different Animal, such as like Bovine, Porcine and Fish were the main collagen source that widely used as a row material for industrial input. Bovine is made use of in particular improvement stages collectively with deadly bovine dermis used for tendon reinforcement, pores, and skin and wound recovery within the form of collagen matrix. Neonatal or new born bovine dermis is used for hernia repair, plastic and reconstructive surgical treatment and adult bovine pericardium for hernia repair and muscle flap reinforcement (Parenteau-Bareil et al., 2010; Ahuja et al., 2012). The pores and skin and bones of pigs are applied and delivered significantly to obtaining collagen for the use of industrial input. For the reason of that porcine collagen is having a resemblance to human collagen and adult porcine dermis and small intestinal mucosa is used for tendon reinforcement, hernia restore, pores and significant play for skin and wound restoration, plastic and reconstructive surgical operation (Cortial et al., 2006). Marine source is found to be the safest source for obtaining collagen presently. Another reason for approving this source is due to the belief that "life originated from marine". Collagen extraction from animal source is complex, time consuming and expensive (Addad et al., 2011; Perumal, 2013; Exposito et al., 1999, 2002;). Marine supply is discovered to be the most secure supply for obtaining collagen currently. every other purpose for approving this source is due to the belief that “life originated from marine”. Collagen extraction from the animal supply is complex, time-consuming and high priced. The yield acquired is also lower while as compared to another resource (approximately 12 g of collagen in per 1 kg of the uncooked fabric used). Because of the concern over unfavourable inflammatory and immunologic reaction and occurrence of numerous diseases amongst land animals which reasons health complications, marine sources have started out to be researched (Addad et al., 2011; Perumal, 2013; Exposito et al., 1999, 2002;).

The bones, pores and skin, fins, scales of salt water fishes are specifically used for as alternative source of collagen. In other hand that helps to reduce environmental pollution, these are considered a waste at some point of fish processing area. These much of collagen from marine originate accommodates a large resource that used for different industrial application. Vertebrates contain specifically the fishes (Liang et al., 2010; Tzaphlidou and Berillis, 2002). Identification of recent supply is highly vital. Marine species may be used as an alternative and secure source for the extraction of collagen. Special kinds of marine species like Eel fish, Cuttlefish, Seaweed pipefish, Squid, Catfish, Ocellate puffer fish were recognized as ability supply for collagen (Khan et al., 2009; Kołodziejska et al., 1999; Nagai et al., 2002; Shanmugam, 2012; Veeruraj et al., 2013; Zhang et al., 2009).

5 Utilization of different fish by-product for environmental benefits

Specialists have blended views on the future of fishing; though, no significant growth is expected because of the present position of wild fish stocks. The future delivery of aquatic products in world market rests on the improvement of aquaculture (Food Agricultural Organization, 2010). According to Food Agricultural Organization, the fish culture production must double via 2030 (given the improved population of the planet) to fulfil the intake of sea product growing from 12 kg to 17 kg /year per capita between 2006 and 2008(Food Agricultural Organization, 2010). Already, breeding aquatic products constitute nearly 46% of 6 the current word international fish market place against only 9% in 1980. The boom in production is largely due to Asia, China covering greater than 70% of worldwide fish culture production. Management and processing of bi-products and waste is an environmental, social and political priority for many nations and is more complicated due to growing production volumes. In France, the meals industry annually generates in excess of 48 million tons of by-products and waste from key sorts of transformation: the animal industry and the plant sector bi-products from fish processing are part of those ones and account for at least 215 000 tons (0.4% of the complete deposit) in line with latest estimates for the period 2004-2005 (Perez-Galvez, 2012).

5.1 Fish waste/by-products as an alternative resource

Fish bi-product is an amazing supply of sea fish, proteins, and fat, capacity exploitation of by-product fish scraps from five sea fish (white croaker, horse mackerel, flying fish, chub mackerel, Sardine) to provide fish protein hydrolysate through enzymic treatment became investigated by Mohammed Abu Ali Khan, (Khan et al. 2003).The fish protein hydrolysate may be used as a cryoprotectant to suppress the denaturation of proteins of lizardfish surimi during frozen storage (Ohba et al. 2003) stated that collagen or keratin confined in farm animals and fish bi-product may be transformed to beneficial products by enzymic hydrolysis, imparting new physiologically useful food materials.

Collagens containing yellowtail fish bone and swine pores and skin wastes have been used as uncooked fish bi-product for production of protein hydrolysates and peptides. Those hydrolysates may be of capacity use as food components (Morimura et al. 2002). Bioactive peptides and enzymes acquired from fish bi-product and used for fish silage, fish feed or fish sauce production (Gildberg 2004). However, the outbreaks of bovine spongiform encephalopathy (BSE) and transmissible spongiform encephalopathy (TSE) have resulted in anxieties a few of the customers of cattle collagen-derived product. The collagen from pig's skin and bone isn't always allowed for use in a few spiritual groups. As the result of the motive, the option in different angle has to be searching to resolve the problem encountered in the market. So, fish bi-product, which includes scales and bones, as well as skins, could be very rich in collagen (Gomez-Guillen et al.,2002).

Although the physical and chemical property of fish collagen is one-of-a-kind from those of mammalian collagen, it's unlikely to be related to bovine spongiform encephalopathy (BSE) and transmissible spongiform encephalopathy (TSE). The bi-product from fish waste were not be forbidden for non-secular motives (Zhang,2009). For this reason, fish processing wastes can be alternative collagen sources and this has attracted the attention of all over the international scientific community (Wang et al.,2007; Nagai et al., 2008).

There are numerous alternatives makes use of fish processing waste have been used for various application such as fish gelatine, as a source of nutraceutical components, fishmeal production. The recapture of proteins from fish bi-products by using alkaline extraction resulted a great yield of protein from lake waste (Batista 1999). Production of natural or organic acids and amino acids from fish meat by sub-essential water hydrolysis would be an efficient technique for improving beneficial substances from organic wastes (Yoshida et al. 1999). Use of fish waste for animal feed production become investigated by Hammoumi et al. (1998) and the significant capability for use of fish waste for poultry feeding was established. The detailed description of the various bi-products of the fishes used for the benefits of the environment are described in table 2 (Global Manufacturing Management,June 2015)

Table 2- Applications of fish bi-products

Types of Process	Types of raw materials	raw materials	Application	Products that available in market
Filleting	Skin		Gallatin Collagen Leather Pet food	Medical Pharmaceutical Cosmetics Fashion Feed industry
	Trimmings	Bone	Collagen Organic fertilizer Salted and exported as such	Pharmaceutical Agriculture Food industry
		Meat	Food products (surimi, fishcakes, etc) Pet foods	Food/Feed industry
Heading	Fins		Fishmeal	Food/Feed industry
	Head	Gills Collar Chicks Tongue Bones Head Eyes	Human consumption (salted, dried, exported	Food industry
Gutting	Viscera	Roe	Human consumption (salted, smoking, canning)	Food industry
		Stomach	Enzymes Cosmetics	Medical/Pharmaceutical
		Intestines	Enzymes	Cosmetics Medical
		Rest	Enzymes, Fishmeal	Medical Feed ingredients

6. Collagen and amino acid composition

Collagen and its amino acid composition have been played important factor to regulate anti-overweight effect or obesity. It could be created with the aid of an abnormal accumulation of body fat that contributes to the aetiologies of various metabolic disorder along with dyslipidaemia, hepatic steatosis, insulin resistance, and type 2 diabetes mellitus (Savage et al.,2007). Similarly, hyperlipidaemia is induced by the dysregulation of hepatic lipid metabolism, which upregulates the synthesis of triglyceride (TG) and cholesterol and downregulates fatty acid oxidation (Savage et al.,2007). Those metabolic reactions could accelerate fat accumulation in the liver and aggravate hepatic steatosis. Therefore, dietary strategies for attenuating hyperlipidemia, lowering unfastened fatty acid level, and inhibiting hepatic lipid synthesis and fat accumulation have attracted interest in obesity prevention or treatment.

Its fibrous protein composed of amino acid collection glycine (Gly)-proline (pro)-X and Gly-hydroxyproline (Hyp)-X, plays a vital role in the maintenance of the structure of various tissues and organs within the body. It has been widely used as a material within the food, beauty, and pharmaceutical industries because of its organic and functional properties (Han, et al.,2011). These days, marine collagen has been preferred over farm animals or porcine collagen, because of bovine spongiform encephalopathy (BSE) and transmissible spongiform encephalopathy (TSE), or religious reasons (Gómez-Guillén, et al.,2011). The pores and skin, scale, cartilage and bone of marine fish are right resources of collagen (Park et al.,2011). Numerous researches have focused on the development of a method to utilize marine collagen peptides to minimize pollutants.

Marine collagen has various beneficial properties together with antioxidative (Zhuang, et al.,2009; Mendis, et al.,2005; Lai et al.,2008). Anti-pores and skin growing old (Tanaka et al.,2009) antihypertensive (Fahmi, et al.,2004) anti-ulcer (Zolotarev et al.,2006) and bone integrity maintenance (Bello and Oesser,2006) effects. Especially as a biomaterial in tissue engineering, marine collagen has less pass-linking and better solubility than bovine collagen and exerts anti-getting older and anti-wrinkling outcomes.

Athletes of all calibre use nutritional supplements to improve the performance of physical exercise and overall performance. Beta-alanine (βA), a commonly used ergogenic resource, is produced endogenously in the liver and is ingested in high-protein meals which includes chicken and turkey (Jordan et al.,2010). βA supplementation is used to enhance exercise performance by using improving the buffering capacity of muscle, therefore delaying the onset of neuromuscular fatigue (Stout et al.,2008).

7. Marine activities and it's effects

Know a day, the population of the world rapidly increases and also, the demand for aquaculture products were growing simultaneously. In recent years, the interest of purchasers on aquaculture products which include fish and arthropod enhanced in EU, there via fish farming rapidly accelerated, in contrast, the natural fish stock has been reduced (Rosenthal, et al.,2000). Over the past decade, aquaculture enterprise is developing continuously, as a result of this the environmental effect of the aquaculture activities are revealed in different processing area that covered large quantity fish waste of volume. Although, the surrounding aquatic environment is getting greater polluted biologically, physically and chemically. Therefore, the ultimate result lead to altering the appearance of the natural environment (Kim et al.,2004).

The aquaculture activities in the sea and the facilities that offer interest disrupt the natural appearance. Seas are becoming polluted by means of direct waste dumping and chemicals that used for treatment. It dissolved with various constituents such as ammonium, phosphorus, and nitrogen dissolved natural carbons (Avadi et al.,2015) ;(Kelly et al.,1996). Drugs are used for disease treatment or deterrence of diseases and are released to the water column, undesired negative effects on the environment and organisms are inevitable (Tovar et al.,2000); (Rico et al. 2013).

The main source of organic pollution is fish feces, un eaten feed. Feces produced by fish are associated with the feed elements. 25-50% of the ate up feeds are excreted to surroundings as feces. intensive fish farming cause massive quantities of organic waste accumulation in the sediments and water column (Massey et al.2010); Lumb,(1989).

Aquaculture activities lead some of the ecological issues. for instance, aquaculture centres inclusive of cage structures extensively reduce water current speed for that reason an accumulation of organic substances in the surrounding environment is the main problem of encountered in this sector. Decomposition of these natural wastes lead deterioration of water quality and enhance water oxygen requirement. Terrible results like turbidity, accumulation of natural waste inside the sediment, formation of anoxic zone close to the seafloor, accumulation of poisonous materials and spread of disease are influential in regions wherein aquaculture is in exercise, especially in confined exchange environments. Formation of gasses which include H2S (hydrogen sulphide), CH4 (Methane) and CO2 (Carbon dioxide) on sediment slows down boom amount of living organisms in the nearby place and makes them larger vulnerable to disease, Shumway, (1989).

Water oxygen level is decreased through the direct breakdown of natural waste originated from aquaculture activities. Water quality adjustments with the aid of liberating nutrients like nitrogen and phosphate into the water column. an excessive quantity of natural nutrients promotes boom of water plants and algae. when toxin-producing algae grow excessively, they may reach blooming concentrations and reason negative effects to different organisms. Cultured fish may additionally die off because of the disorder occurring in the gills and oxygen deficiency as a result of water quality changes associated with a sudden increase of algae. consumers of biotoxin infected shellfish can get poisoned and die as well. while algae die in large numbers, dead natural substances begin to deterioration and this system consumes oxygen, leads to hypoxia (GESAMP, 1997).

Conclusion

Collagen protein was found in the different animal body those includes both land animal and aquatic animals. These were reported to show massive nutritional and health benefits. Various sea sources such as fish pores and skin, muscle, bone, intestine, etc. from pre-processing and processing facilities are used to isolate lots of those bioactive compounds. Know a day the collagen sources from the aquatic animal have been a lot of advantages because of many reasons. Due to its biocompatibility, stability and bioactivity has been widely used as a biomaterial.

Therefore, collagen has become very useful in both biomedical and non-bio medical industries in this modern era, with an extended range of usage. Due to this reason, they contribute high value add product deliver for the consumer and the sector that involved to play a role in economic and social development. The sector that played a significant role in the health benefit such as pharmaceutical and medical care to resolve the problem like in corneal defects, urogenital problems, examine of neural migration, dental reason, bone grafting, arthritis, and obesity.

The result of population increment that create a high consumption of demand and this could be result to increase the by-product fish industry volume in different country. It may create the consequence of environmental impact on the world. So, the proper utilization of the fish industry by-product is one of the remedies to solve pollution through by-product processing into value addition product.

In general, the collagen from the aquatic animal by-product has been useful product impute for the benefit of health such as pharmaceutical, cosmetics, nutraceutical, biomedical, tissue engineering and for reconstructive of the different organ in the body. Leather industry and another research purpose in laboratory input also an indispensable contribution that have been made.

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