Cosmetic Potential of Freshwater Fish Skin Gelatin

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Abstract: Many cosmetic formulations have gelatin as a major constituent as widely used by various industries because of its functional and technological properties. Gelatin used in cosmetics for enhancing the elasticity, firmness and consistency of products. The aim of study was to extracts gelatin from the skin of the freshwater fish (*Cirrhinus reba*- Hamilton, 1822). The skin of fish yielded higher amount of gelatin. Gelatin extracted by acid treatment and UV-Vis**,** FT-IR analysis**,** pH, Viscosity, Foam Formation Capacity and Foam Stability, Melting point, Setting point and Setting time**,** Odour, and Moisture were studied. Results indicated that, the potential use of fish skin as an alternative source of gelatin in cosmetic application.

IndexTerms - Gelatin, *Cirrhinus reba*, UV-VIS, FTIR

I. INTRODUCTION

Gelatin is one of the most conventional biopolymers. Gelatin protein is obtained from collagen hydrolysis of animal origin, thus collagen-containing tissues are generally used as sources of gelatin (See *et al.*, 2010). Gelatin is widely used in food, pharmaceutical, cosmetic and photographic applications because of its unique functional and technological properties, furthermore, the major source for the world collagen is derived from pig skin which leads the highest about 46%, followed by bovine skin (29.4%), bones (23.1%), and other sources (1.5%) reported by Karim and Bhat, (2009). Gelatin contains 62% calories, 1.2% protein and 14% carbohydrates. Generally gelatin is used in cosmetic and health care products as a gelling ingredient in face creams, body lotions, shampoos, hair sprays, sun screens and bath salts and bubbles GMAAP, (2011); Sakr, (1997) in addition it also used in encapsulation of different drug products (Cascone and Lazzeri, 2002; Narang *et al.*, 2007). Collagen source for gelatin were obtained from mammals, birds, porcine and bovine from their body protein constituents of the skin, tendons, cartilage, bone and connective tissue. On consequences, gelatin from aquatic animals, especially from fish skins, could be a substitute for mammalian gelatin (Pranoto *et al*., 2007). So the development of alternative sources of gelatin is one of the issues that have been given much main concern. Thus researches into the used of some another source of gelatins are being pursued. Huda *et al.,* (1999) reported that fish and fish products has been found to be safe as it does not contain toxins and poisons. Fish gelatin, a partially hydrolysed form of collagen, can be obtained from the skin and bones of fish (Herpandi *et al.,* 2011) which is the principal protein (Mostafa *et al.,* 2015) widely used in foods to improve elasticity, consistency, and stability. Jamilah, *et al.,* (2011) also recommended the environmental friendly management of industrial wastes through innovative processing conditions as well as potential novel applications. The use of fish by- products for the production of gelatin has several advantages. In fish industry, fish skin is considered as a major by-product that causing pollution could provide a valuable source of gelatin (Badii and Howell, 2006). Fish skin is main product of fishery industries. For this reason, researchers may find the possibility of alternative gelatin by improve technique for fish processing wastes. Moreover, the utilization of by-catch and discards obtained from fishing and the wastes from fish industries for the production of gelatin fulfils the sustainable management policy of responsible fisheries (Sahoo *et al.*, 2015). There are high number of fish waste is rich in collagen, and can be used for gelatin processing materials. Gelatin quality is highly affected by physico-chemical characteristics, not only by species, selected tissue extract, but also by processing methods (Ida Ratnasari and Firlianty, 2016). Nevertheless, the quality of gelatin from fish skins and bones is dependent on the species and the habitat (Kharyeki *et al*., 2011).

Fisheries in India are a very important economic activity and a flourishing sector with varied resources and potentials which secured third global position in fisheries as well as the second largest country in aquaculture production. As far as brackish water aquaculture in India is concerned, it has a long history of traditional practices. India is home to more than 10 percent of the global fish diversity. Presently, the country ranks second in the world in total fish production. Fish and fish products have presently emerged as the largest group in agricultural exports from India (FAO, 2014; NFDB, 2018). Fish industry has increased steadily and has become economically significant but there were very inadequate researches in the field of collagen derived from fresh water fish as alternative gelatin sources were utilized in cosmetic purposes. Hence, in the present study aimed the extraction of gelatin from freshwater from freshwater fish *Cirrhinus reba*. Gelatin extracted by acid treatment and characterization UV-Vis, FTIR analysis**,** pH, Viscosity, Foam Formation Capacity and Foam Stability, Melting point, Setting point and Setting time**,** Odour, Moisture were studied. The problem with safety and efficacy of the cosmetic product will be explored throughout this research. These properties increase the demand of gelatin production in industries.

I. RESEARCH METHODOLOGY

A. Sample Preparation: The materials used for gelatin production were fresh fish skins of *Cirrhinus reba* (Hamilton, 1822), collected from local fish market of Jalgaon city. The fish was stored directly in the refrigerator. Fish skin was removed, clean and stored in freezer at -20 ^{0}C until use.

B. Gelatin Extraction: Gelatin extraction procedure was carried out as previously described Nagai and Suzuki, (2000) with little modification by Gomez-Guillen and Montero, (2001). Briefly, the method consist of a mild acid (50 mM acetic acid)

swelling step for 3 hr and subsequent overnight (16–18 hr) gelatin extraction in distilled water at moderate temperature (45 ^{0}C). The tissue samples were then rinsed with water and drained using cheesecloth. The acid treatment was also repeated two times. The treated samples were squeezed manually and remove water prior to the extraction. All reagents used were of analytical grade. Protein was estimated by Lowry's method (1951). For characterization following parameters such as UV-Vis absorption spectrum of ASC collagen was recorded using a Shimadzu spectrophotometer UV-240 in the range of 200-400 nm, Fourier transform infrared (FT-IR) spectroscopy of gelatin sample was performed using an FT-IR spectrophotometer (Shimadzu), yield, pH, Viscosity (Cho *et al.*, 2006), Foam Formation Capacity and Foam Stability (Cho *et al.*, 2004), Melting point (Wainewright, 1977), Setting point and Setting time described by Muyonga *et al.*, (2004), Odour (Muyonga *et. al.*, 2004), Determination of Moisture (Method 934.01: AOAC, 2000) were analyzed.

Yield of gelatin: Gelatin production was gained from the following calculation:

$$\% \text{ Yield (Wet weight basis} = \frac{\text{Dry weight of gelatin}}{\text{Wet weight of skin}} \times 100$$

IV. RESULTS AND DISCUSSION

Sr No.	Parameter	Values
1	Determination of yield (Yield of gelatin (%) = (weight of dried gelatin [g] / wet weight of fish skin[g]) × 100)	19.15 %
2	Determination of pH	5.2
3	Viscosity (Cho et. al., 2006)	3.5
4	Foam Formation Capacity and Foam Stability (Cho et. al., 2004)	1.75 and 1.5
5	Determination of Melting point (Wainewright, 1977)	30 ^{0} C
6	Determination of Setting point and Setting time described by Muyonga *et al.*, (2004).	19 ^{0} C and 100 Sec.
7	Determination of Odour (Muyonga et. al., 2004).	No Odour
8	Determination of Moisture (Method 934.01: AOAC, 2000)	12 %

Analytical Methods: Table No.1 Physico-chemical Parameters**.**

CHARACTERIZATION

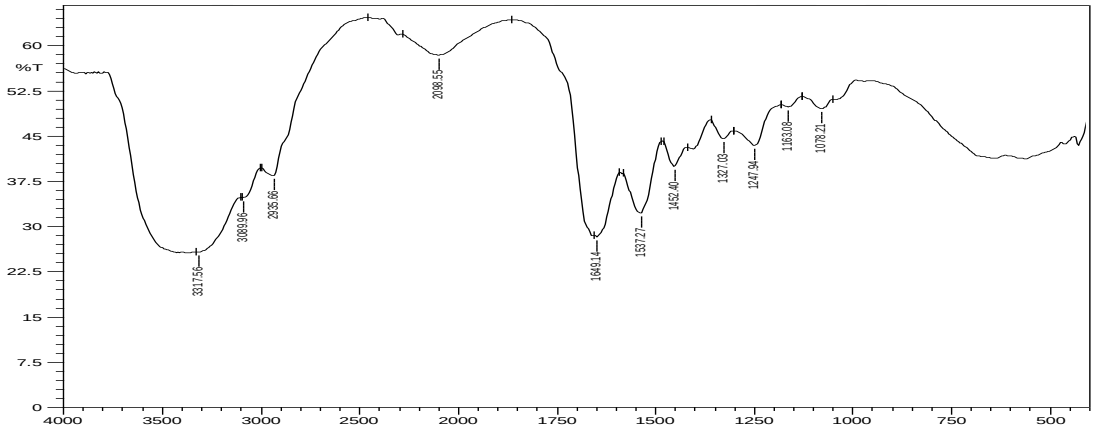

Figure 1. FTIR of Fish Skin Gelatin

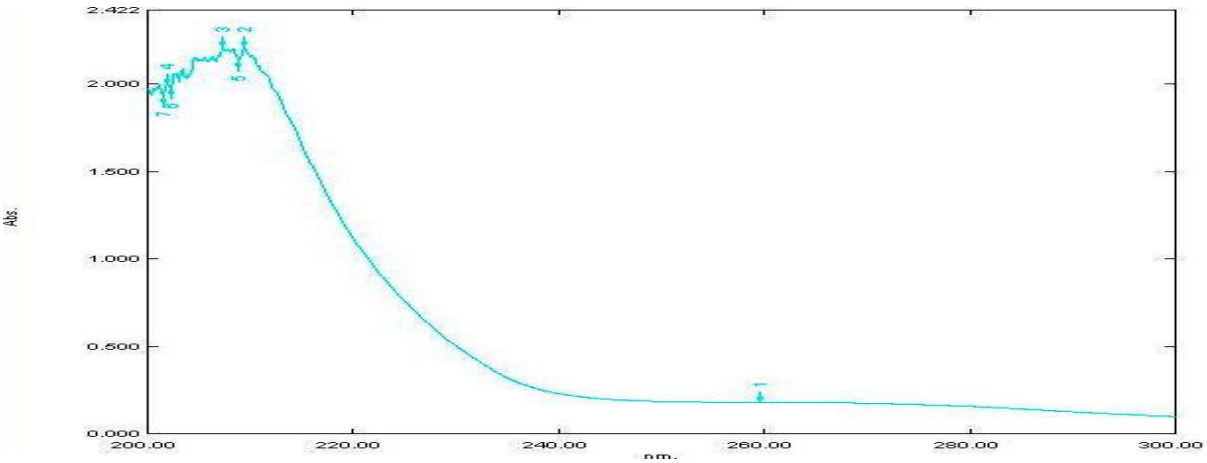

Figure 2. UV-Vis spectrum of Fish Skin Gelatin.

Analyses of gelatin with different parameters were mentioned freshwater fish species in this study (Table 1). The protein content of fish Skin gelatin was found 312.18 mg / ml.

FTIR Analysis: KBr IR spectroscopic results have confirmed the gelatin (Fig. 1). Result shows Amide-A, Amide-I, Amide-II and Amide-III band. Spectra seem to be similar with commercial gelatin. Amide bands of gelatins from Nike perch (*Lates nicoticus*) skin studied by Muyonga *et al.,* (2004) observed similar record. FTIR helped to improve sensitivity and the subtraction of spectra arising from solvents. From last two decade, there was considerable development in the interpretation of protein secondary structure from FTIR spectra (Pelton and Mclean, 2000). Proteins and peptides normally show absorption bands at around amide-A, amide-I, amide-II, amide-III were similar to Gelatin from fish waste by Chandra, (2012). Whereas Muyonga *et al*. (2004) noticed the FTIR spectra of ASC at higher degree of molecular order for collagen and gelatin from adult Nile perch than from young Nile perch. Rathod and Shirsath, (2018) observed that, the carp skin has high content of collagen and also recorded closer type I collagen whereas the FT-IR spectrum shows the differences in amide I band position.

UV-Vis Spectrum: In present study we successfully extracted gelatin from Skin of freshwater fish (*Cirrihnus reba*), by acid treatment, the UV-Vis absorption spectrum of sample was recorded using a Shimadzu spectrophotometer UV-240 in the range of 200 - 400 nm. The spectrum shows maximum absorption at 207 nm in figure 2, which shows characteristic of gelatin. For identification of the amino acids contributing to the specific of gelatin and chromophore groups which give absorption at 210-240 nm indicate the presence of characteristic peptide bond fragments from each of the gelatin similar report noticed by Hermanto *et al*., (2013).

Yield of Gelatins: The highest yield of 19.15% was obtained. It is in agreement with that variations in gelatin production could be caused by difference in collagen content noticed that the highest gelatin yield was found in *P. pangasius* (21.93 %) by Ida Ratnasari and Firlianty, (2016), and also followed in *C. batrachus* (20.57 %), *C. straiata* (20.17%), and *C. micropeltes* (20.76%) respectively, skin composition in the skin matrix, and extraction method (Gomez- Guillen *et al.,* 2002, 2011; Bakar *et al.,* 2002), 2011; Jongjareonrak *et al.,* 2006, 2010). Anchana Devi *et al.,* (2016) extracted gelatin from the different fish species of fresh water they reported yield of 8% obtained from the *Carcharhinus amblyrhyncho* and 6% from *Sphyraena barracuda* and cultured Amur sturgeon (9.4-12.5%) by Nikoo *et al*., (2013) and blue whiting (1.5-2.4%) by Khiari *et al*., (2015).

The pH Value of Gelatins: In this study extraction was carried out in the pH range of 5.2. The pH values probably reflect the differences in pretreatments used during the extraction involving both alkaline and acid treatments (Shyni *et al*., 2014) and Panga catfish (5.8), Asian Redtail Catfish (5.9), Nile Tilapia (5.7) and Striped Snakehead (5.8) by Ratnasari *et al.,* (2013).

Viscosity: The viscosity of gelatin obtained from the fish was 3.5. Viscosity of gelatin solution was lowest at pH 5.2 of the fish gelatin, Shyni *et al.,* (2014) similar record were noticed in Rohu gelatin compared to Shark and Tuna gelatins.

Foam Formation Capacity and Foam Stability: Foam formation ability of gelatin was 1.75 (the ratio of foam volume/liquid volume) and foam stability of 1.5, whereas significantly lower than Rohu (2.51) of Grass carp (2.83) gelatins noticed by George Ninan (2009). Cho *et al.,* (2004) reported foam formation ability of 2.6 and 2.9 and foam stability of 1.5 and 1.4 for gelatins from shark cartilage and porcine skin respectively. The foam formation ability of fish gelatin compared with bovine gelatin also noticed higher in red snapper and grouper bone gelatin (Jeya Shakila *et al.,* 2012). Although, foam formation ability of cuttlefish skin gelatin was lower than bovine gelatin (Aewsiri *et al.,* 2011).

Melting point: The melting point is also an indicator of gelatin quality. The lower melting point was observed. These values were similar to those of gelatins from Tuna (24.2^{0}C) by Shyni *et al*., (2014), Pacu (23.7-24.8 ^{0}C) by Sahoo *et al.,* (2015) but this value were higher than those reported for cold water fishes such as Hake Cole skin (8-10 ^{0}C) by Gudmundsson and Hafsteinsson, (1997). The difference in melting point could be related to fish species, amino acid composition, and fishing season along with the effect of the preparation.

Setting point and Setting time: The setting temperature observed for the gels from skins of *Cirrhinus reba* were 19 ^{0}C and setting time 100 seconds. Muyonga *et al.,* (2004) reported a setting temperature of 19.5 ° C and a setting time of 60 seconds for the gelatin from the skin of adult Nile perch extracted at 50 °C which is similar to the values observed. These values were higher than those of gelatins from many fish species previously reported although differences in method may have a major impact from shark skins noticed by Shyni *et al*., (2014); Rohu skins and Mrigal skins by Madhamuthanalli and Bangalore, (2014). Setting time and setting temperature of gelatin also depend on the age of the fish used for the extraction of gelatin (Muyonga *et al*., 2004).

Odour: The gelatins were found to be free of fishy odour and to have a mild putrid odour. It seems therefore that the activated carbon treatment eliminated the fishy odour from fish gelatins. Similar report was observed by Muyonga *et al.*, (2004) in Nile perch.

Moisture:

The skins of fish had highest moisture content balance of 12 % moisture when maintained at 30 ^{0}C room temperature. Many researchers noticed significant variations in moisture content, such as 11.04 % in catfish *Clarias batrachus* by See *et al.*, (2010); grass carp noticed 12.3% by Chandra, (2012). The results can be correlated with the moisture content in reverse order in the above species.

CONCLUSION

This study revealed the potential of skin of *Cirrhinus reba,* as a raw material for gelatin production, giving relatively high yield. In addition, fish skin could be applied source in product processing as substitute than other mammalian origin gelatin. In brief, fish skin is a cost effective and environmentally friendly source of gelatin which can be used in various cosmetics industrial purposes.

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