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Recent Advances in the Recovery and Improvement of Functional Chitosan from Fish Processing

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ABSTRACT

An increase in fish production as a consequence of a rise in require for fisheries products is expected during the next several years. This means that the volume of fish processing by-products will also increase. Therefore, that an improvement in the management of these by-products is urgently needed. Fishery waste was used for natural biopolymers such as chitin. The most widespread biopolymer is available in nature. Chitin has economic value because of its biological activities, industrial and biomedical applications. Chitosan is prepared by alkaline N-deacetylation process of fish chitin. The present work is mainly focused on chitosan preparation by tradition methods, improvement and also studies the properties of chitosan from fish scales.

Keywords: Membrane, chitosan, fish, shrimp and polyethersulfone.

I.INTRODUCTION

Fish processing generates solid wastes that can be as high as 50–80% of the original raw material But Fish wastes are an excellent raw material for preparation of high protein foods, fish gelatin , fish oils , proteins as well as other value added products [1]. The fish oil is generally used for products such as margarine, omega-3 fatty acids and biodiesel [2]. The fish protein concentrate is used as human food and animal feed. The Recent advances achieved in the recovery of fish proteins from processing and by-products [3]. Fishery waste is also excellent sources of chitin and chitosan. Chitosan has multiple advantages over other biopolymers such as cellulose, starch, galactomannans, etc [4]. Chitosan has used in different application such as biochemistry, biology, enzymology, ecology, chemical and physico-chemical properties, biological activities, medical and biomedical applications such as drug delivery systems, gene delivery, pharmaceuticals, tissue engineering, wound healing agents, antimicrobial activities, biotextiles, biocatalysis, food science, agriculture, water purification, environment and other areas of life sciences and materials science [5].

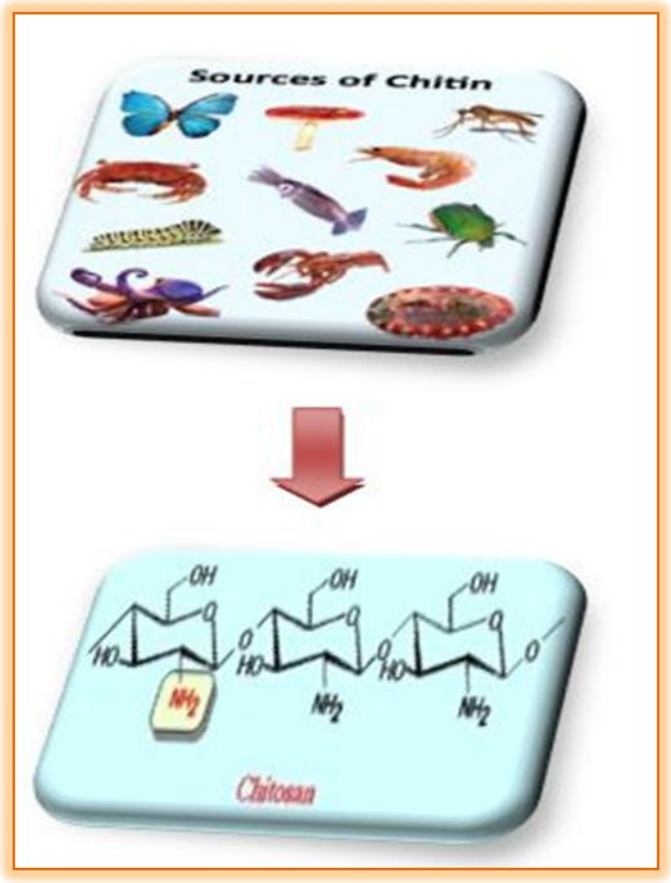

Figure.1 Sources of chitin and chitosan structure.

Chitosan was prepared by so many different methods but many problems still reaming. This needs to be change or modify according to the chitosan properties and application. In this research, chitosan was prepared by traditional methods with different temperature range and study physicochemical properties.

II.MATERIALS AND METHODS

Fish waste was obtained in the fresh conditions from a fish market. Hydrochloric acid (analytical reagents, Rankem,), acetic acid glacial 100 %(Merck), sodium hydroxides pellets (Rankem) were purchased from Rankem and Merck chemicals. Commercial chitosan (86% deacetylated) was purchased from India Sea Foods, Kerala in India.

2.1. Traditional method

All industries method for chitosan extraction was based on the chemical processes for the hydrolysis of protein and removal of inorganic matter. Many processes use a pigments removal step to improve the color of the extraction chitin, using solvent extraction or chemical oxidation. The Oldest method used for the preparation of chitin commercially from crustaceans shell waste consist of mechanical grinding , demineralization (DM) with strong acids followed by protein removals Deproteination (DP) with alkali at 90-100°C [6,7 and 8].

The Depolymerization of the product and which affects the properties of chitosan such as molecular weight, viscosity and degree of acetylation. Preparation of chitin is very hazardous, energy consuming and harmful to

the environment because of the use of highly concentration minerals acid and caustic soda. The removal of protein components can no longer make the source material suitable to be used as animal feed [9, 10, 11 and 12]. Due to this reason, it is very necessary to treat and utilize the chitin source material (Waste) in a more efficient manner. Therefore, there is a significant interest in the recycling of crustacean bio-waste.

2.2. Preparation of chitosan from fish scales

Chitosan was prepared consuming a combination of three methods.10 grams of fishery waste were treated with 1% NaOH at room temperature for 30min with 60°C temperature. The alkali was depleted from the scales and washed with refined water over and again till pH throw down to neutral. This procedure created deproteinization of scales. The deproteinized shells were treated with 1% HCl at room temperature for 30 min for demineralization to yield chitin. The corrosive was emptied off out of chitin, washed with refined water lastly dried at room temperature. Chitin was deacetylated to shape chitosan by treating with 40% KOH for 6 hours at 90°C at room temperature.

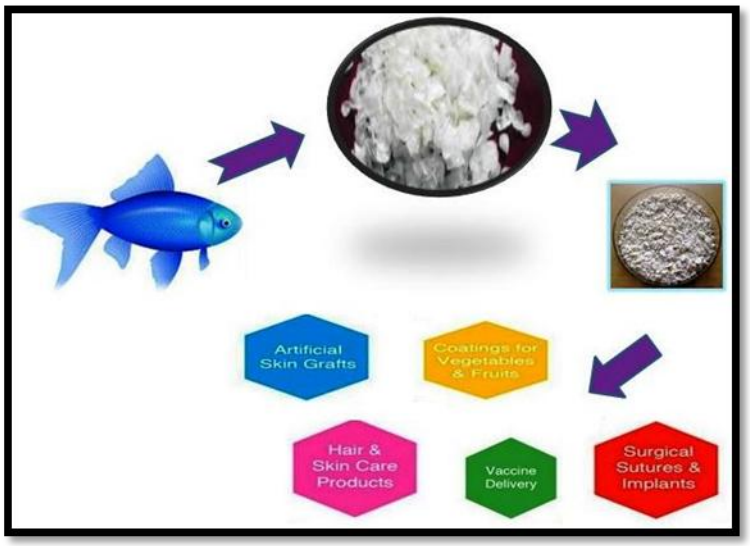

Figure.2.Fish chitosan preparation and application.

2.2.Physicochemical properties

Physicochemical Properties such as binding capacity, fat binding capacity, solubility, average molecular weight, moisture content, ash content and protein content are determined by standard method [13].

III.CHARACTERIZATION

3.1. X-ray powder diffraction (XRD)

The X-ray diffraction (XRD) powder patterns was recorded in transmission geometry with CuKα radiation in the 2θ range of 10° to 80° on a Rigaku D max 2000 machine at 40 kV, 30 mA.

3.2. Fourier transforms infrared spectroscopy (FTIR)

Infrared spectra were obtained using a Perkin-Elmer type FTIR 1000 spectrometer at room temperature and using KBr pellet scanning methods. Pellets were scanned at room temperature (25°C) in the spectral range of 400 – 4000 cm^{-1}.

IV.RESULTS AND DISCUSSION

4.1. Fourier transforms infrared spectroscopy (FTIR)

In the traditional method for extraction of chitin and chitosan from fishery waste three steps involve such as deproteinization, demineralization and deacetylation process. During the deproteinization process, all protein was removed by NaOH solution. In the same manner demineralization process was used for removed mineral in fish scales by HCL solution. During the preparation, there were two trials, first treatment was based on HCL and another was NaOH. In the FTIR analysis for two different treatment but final treatment process was same graph shown in the Figur.3.After the analysis by FTIR shown in the Figure.3. It was found that NH_2 peaks were sharper peak in the NaOH treatment. It was also cleared by physicochemical properties analysis shown in the Table.1. The chitin peaks was observed for the both process at different bandwidths such as 3430cm^{-1}, 2818cm^{-1}, 1603cm^{-1}, 1360cm^{-1}, 1039cm^{-1} and 767 cm^{-1} as shown in the Fig.3. In the similar manner 3441cm^{-1}, 2918cm^{-1}, 1603cm^{-1}, 1624cm^{-1}, 1593cm-1, 1420cm^{-1}, 1362 cm^{-1} and 1010cm^{-1} peak was observed in the both treatment methods shown in the Figure.3 [14].

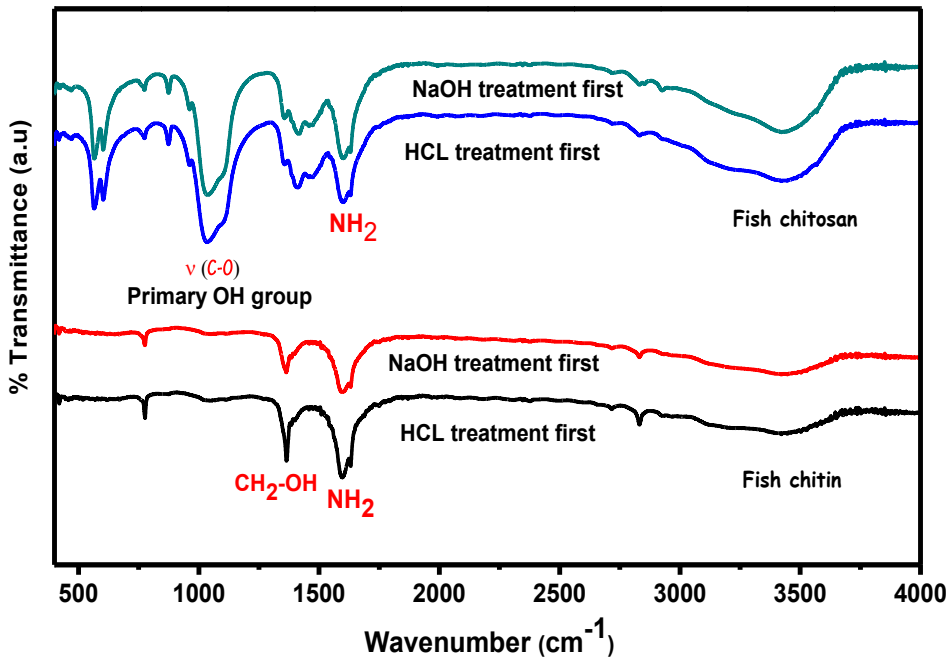

Figure.3. FTIR spectra of chitin and chitosan from fish scales.

1.2. X-ray powder diffraction (XRD)

The XRD analysis of fish scale chitin with HCL first treatment major peaks was at 20°,37°.96°,44.1°,64.66° and 77.63° shown in the Fig.4. In the same manner NaOH first treatment major peaks was at 22.14°, 31.92°, 37.72°, 64.54° and 77.9° shown in the Fig.4. There was some shifting in the peaks. It was also cleared by graphs amorphous peaks shown chitin spectra .But in the case of NaoH treatment some peaks more clearly due to more removal protein and minerals as compared to the HCL treatments. Fish chitosan, in the case of HCL major peaks was 26.38°, 32.7°, 40.4°, 50.12° and 53.6° and in case of NaOH treatment peaks was 26.02,31.94,39.88 and 53.54 shown in the Fig.4. It was clear that peaks were clearer in the case of NaOH treatment due to removal of all protein and minerals. In the both case, deacetylation process was same [14].

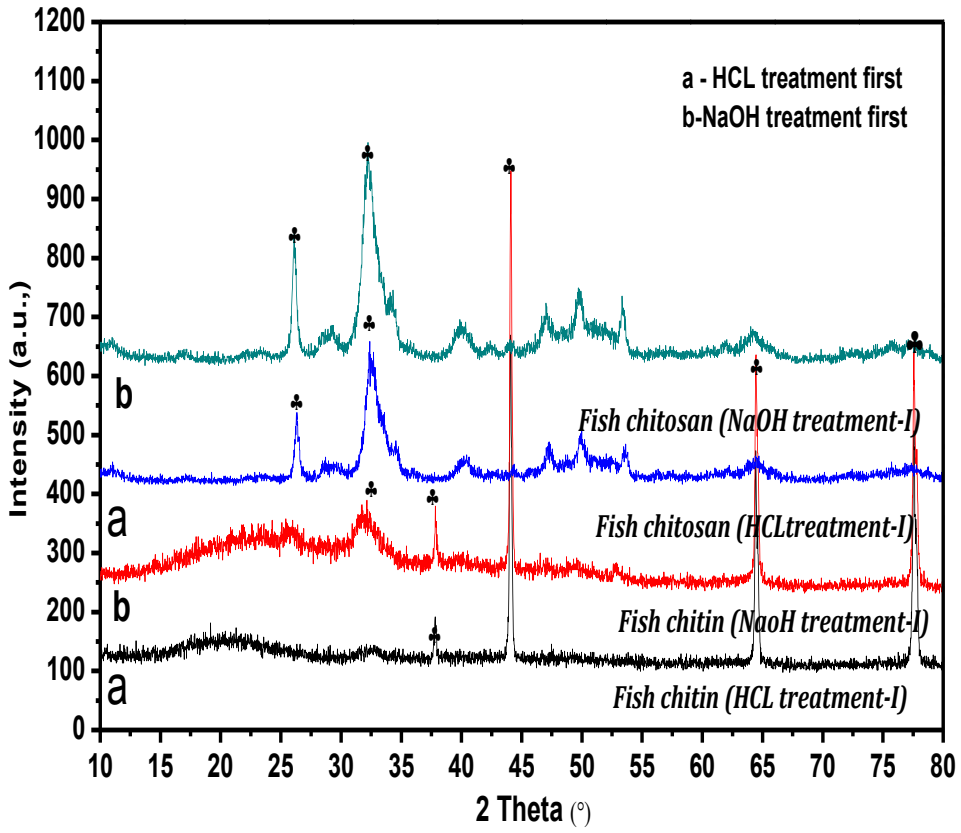

Fig.4. XRD analysis of fish chitosan.

2.3.Physicochemical properties of chitosan from fish scale with two different treatment was shown in the Table.1.It was found that fish chitosan with NaOH treatment first all properties was better as compared to HCL treatment [14].

Table.1. Physico-chemical properties of chitosan.

Sample	% solubility	% FBC	% WBC	Average molecular weight	Ash %	% moisture	% Protein	% C/N
Fish chitosan (HCL-1)	78	226	492	5201	2	0.009	10	7.62
Fish chitosan (NaOH-1)	79	223	496	52022	1.9	0.007	2	7.77

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