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Autolytic Isolation of Chitin from White Shrimp (*Penaues vannamei)* Waste

Achmad Sjaifullah*, Agung Budi Santoso

Jurusan Kimia FMIPA, Universitas Jember, Jember 68121, Indonesia

Abstract

White shrimp waste comprised of shrimp head, tail and shell contains valuable materials such as chitin, protein, enzymes, minerals, natural pigments, etc. Isolation of chitin from white shrimp waste through an autolysis enzymatic deproteination is described in this paper. The deproteination rate was estimated by measuring nitrogen content during the autolysis and the structure was analyzed by FTIR. The results show that autolysis of white shrimp waste was effectively performed at pH 2 with the highest rate observed in the first two days of autolysis, showing it contains 13.0% protein and 14.7% chitin. The chitin produced after a 9-day autolysis indicated a less clean result than chitin which is chemically digested.

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Keywords: chitin; autolysis; white shrimp; waste

* Corresponding author. Tel.: -; fax: -.
E-mail address: sjaiful.fmipa@unej.ac.id

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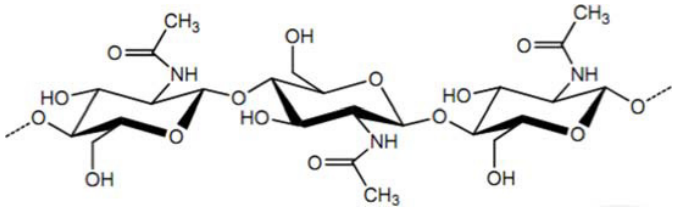
1. Introduction

Chitin is a polysaccharide of $[\beta\text{-}(1\rightarrow4)\text{-}2\text{-acetamido-}2\text{-deoxy-D-glucopyranose}]_n$ which normally has 1,000–3,000 monomer units. Its structure is very similar to cellulose, except that the C(2)-hydroxyl group is replaced by an acetamide group. Chitin may be regarded as the second most abundant biological material in the world after cellulose. It can be found ubiquitous naturally in shells of crustaceans, shells and skeletons of molluscs, krill and insects, and within the cell walls as well. However, generally chitin is produced industrially in most countries like USA, Japan, India, Canada, China, South Korea, Russia and Norway only from crustacean wastes, especially waste from marine product related industries, whereas other sources of chitineous biomaterials are commonly not available at the amount commercially feaseble[1]. In some places in East Java, such as in Banyuwangi, Gresik, Probolinggo and Pasuruan, there are quite a number of big shrimp industries which produce frozen shrimp for the global market and also for domestic consumption. The frozen shrimp industry normally generates waste that comprises nearly 50% of the weight of the raw material, fresh white shrimp. The white shrimp waste produced is comprised of shrimp head, tail and shell. It contains valuable materials such as chitin, protein, enzymes, minerals, natural pigments, etc. All the white shrimp waste from the frozen shrimp industry in East Java, so far are transported to the fish food industry and processed as a low cost raw material together with low quality fish product for fish food manufacturing. During the collection and transportation of the shrimp waste from the frozen shrimp industry to the fish food processing facility, which takes time, a strong foul smell of rotten shrimp waste is produced and spread along the way. Therefore, isolation of chitin from the shrimp waste may be considered as one technology or a process to solve the problem with shrimp waste in the frozen shrimp industry.



Chitin chemical structure

In biological matrices like white shrimp waste, chitin is tightly bound in complexes with other organic substances such as protein, lipids and also salts. So, isolation of chitin from biological matrices may involve a harsh chemical treatment using strong acid and strong base. Isolation of chitin normally will include a process of deproteination to remove protein, demineralisation to remove salts and decolourisation by oxidation. The deproteination may be done chemically using strong base such as sodium hydroxide at high temperature or by enzymatic degradation using proteinases. Chemical deproteination using sodium hydroxide may be considered as a quick and common industrial process to solubilise protein but it produces a basic solution of soluble protein that is easily degraded, producing a very rotten odour that can heavily pollute the environment. On the other hand, a deproteination process in chitin isolation from shrimp waste by enzymatic degradation, which promises a more environmentally acceptable result, has been reported in many places. Enzymatic degradation for the deproteination process in chitin isolation uses protease enzymes that may come from various sources. The enzyme may be generated during fermentation of the shrimp waste by *Bacillus subtilis*[2], and the chemical compositions of the hydrolysis product have been studied[3]. Enzymatic degradation by autolysis using proteases present or contained in the shrimp waste itself have been reported at various temperatures[4] during four days incubation, and the valuable compounds produced during hydrolysis were recovered[5]. Hydrolysis by commercial enzyme alcalase for chitin isolation from shrimp waste was also aimed to produce a nutritional protein extract[6]. Reports of chitin isolation by autolysis from the shrimp waste used incubation for less than four days,[4] and the remaining protein present after autolysis was then completely deproteinated chemically, which means that the process was only partly autolytic. Autolytic chitin isolation from shrimp waste reported in this paper was performed for 10 days incubation would be expected to complete the autolytic deproteination, and the produced chitin samples were evaluated based on their IR spectra.