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UTILIZATION OF SHRIMP SHELLS FOR FOOD

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Abstract

This article aims to review the use of shrimp shells for food products as an alternative to waste handling in Indonesia. Based on the literature study, information was obtained that the use of shrimp shells, waste from the fish processing industry can be used as food products. These products are 1) made shrimp shell flour for calcium fortification ingredients in ice cream cones, biscuits and cookies. 2) made flavoring or flavoring products. 3) Extraski chitosan from shrimp shells and its use for edible coating ingredients in sausage products.
Keywords : edible coating, fortification, chitosan, flour, extraction

INTRODUCTION

Waste is the residue of an activity or from a production process, both industrial and domestic. Based on its nature, waste has two types, namely organic waste and inorganic waste. Organic waste is waste that comes from living things and is easily decomposed and easily decomposed, for example from tree leaves, animal waste, human waste, and animal bones. Inorganic waste is waste that comes from activities that are difficult to decompose, for example such as plastic bottles, plastic bags, cans, glass and others.

Industrial activities, especially in the field of fisheries, are very important to increase the country's economic growth. However, apart from these positive impacts, fishing industry activities also produce negative impacts.

Along with the development of the fishing industry, the waste generated from the production of enterprises has also increased. For this reason, the Indonesian people have enormous potential to overcome this problem. The impact is that the environment becomes very polluted because the waste generated every day develops so quickly and the process to recycle or any activity to reduce the waste does not go hand in hand with the development of waste

The use of waste into a product that can be used by humans to be eaten back by humans and traded is a very important discussion. Shrimp shells are an example of organic waste that is developing very quickly. Shrimp shells can be used as nutritious food because shrimp shells contain protein and collagen which are useful for complementing human components.

Shrimp is one of the export commodities of fishery products that is rich in nutrients and is very popular with the community. Shrimp is one of Indonesia's commodities that is in demand in the international market. The export value of this seafood commodity has even increased rapidly during the pandemic. According to a report by the Ministry of Marine Affairs

and Fisheries (MMAF). In 2017 the export value of Indonesian shrimp only reached US$ 1.75 billion or around Rp25.97 trillion (exchange rate of Rp14,840/US$). This figure then fell to US$1.74 billion in 2018 and US$1.71 billion in 2019. Along with the emergence of the Covid-19 pandemic, the value of national shrimp exports then increased rapidly to US$ 2.04 billion in 2020, and continued to rise to US$ 2.2 billion in 2021. Shrimp meat itself can be processed into very delicious food products, but shrimp also has waste, one of which is shrimp shells. This waste, if not used, will have a negative impact on the fisheries sector. Currently, the processing of shrimp shell waste in Indonesia is still not optimal, because its use is only limited as a mixture in animal feed, even though shrimp shell waste can be a product of high economic value (Mawarda *et al.* 2011).

The main components in shrimp shells are protein (30 - 40%), calcium carbonate (CaCO" 40 - 50%) and poly-N-acetyl glucosamine, known by the name of chitin (15 - 20%). The compound is a biopolymer such as sellulosis but the -OH group in C-2 is replaced by N-acetyl (N-acetyl-Dglucosarnin), which forms a beta bond of 1-4. Chitin can be acetylated into chitosan. This article aims to review the use of shrimp shells for food products as an alternative to waste handling in Indonesia.

Processing of Shrimp Shells into Flour as Fortification Ingredients in Food Products

Flour is a food ingredient that is generally made from wheat or rice. Other ingredients that flour can make can come from shrimp shells. Research on making flour from shrimp shells has been carried out by Permana *et al*. 2012. The procedure for making shrimp shell flour begins with washing the shrimp shells under running water until clean. The shrimp shells that have been cleaned and then cut into pieces until they have a size of 0.5-1 cm. Then the shrimp shells are boiled with boiling water for 12 hours, in the first 4 hours a water change is carried out 8 times once every 30 minutes, then the next 8 hours the water change is carried out 8 times once every 1 hour. The boiled shell is then removed and drained. After that it is dried in the oven with a temperature of 121 ^{o}C for 60 minutes. After drying the shrimp shells are mashed using a blender, then sifted using a Tyler sieve. The part that does not escape is blended again until smooth and then sifted until it becomes flour.

Shrimp shells that have become flour can be processed into various products, such as ice cream cones, biscuits, cookies and so on (Mandiri, *et al*. 2022; Lestari, *et al*. 2021; and Olivia, *et al*. 2013) to increase calcium levels from these foodstuffs.

Application of shrimp flour in ice cream cone products

Making ice cream cones with the addition of shrimp shell flour, the stages are as follows:

- The shrimp shell flour that has been made is mixed with a dough consisting of wheat flour, tapioca flour, baking soda, and water.
- Shrimp shell flour is added as much as 2.5% of the total flour used.
- After the dough is formed, the cone printer is dipped in the dough and then pressed.
- The dough is baked at a temperature of 98^{0}C until an ice cream cone is obtained for ± 10 seconds.

Application of shrimp shell flour to biscuit products

Making biscuits with the addition of shrimp shell flour, the stages of which are as follows:

- Infuse all ingredients (low protein wheat flour, shrimp flour, liquid milk, eggs, sugar, and margarine) directly after weighing them accurately.
- Mix all the ingredients until homogeneous.
- After all the ingredients are mixed, the dough is stirred until smooth, grind the dough until the thickness reaches 1 cm. Print using a flower-shaped ring cutter with a diameter of 4 cm. Molding until the dough runs out, take some of the molded dough and give it a hole using a straw. Make sure the amount of dough is pitted and not the same.
- Bake the dough for 20 minutes at 180°C.
- Once cooked, let it cool. After cooling, spread dragon fruit jam between the perforated and non-perforated dough, store in a sealed container.

Application of shrimp shell flour in cookies products

Making cookies with the addition of shrimp shell flour, the stages are as follows:

- It begins with the mixing of refined sugar (15%), margarine (25%), egg yolk (6%), and vanilla (0.5%),
- Stirred (using a mixer) for 5 minutes, so that a homogeneous dough is obtained.
- Next is added little by little shrimp shell flour (7.5%) and tapioca flour (30%),
- Then added cornstarch (2%), milk powder (10%), baking soda (0.3 %), and salt (0.2 %).
- Before molding the dough is mixed with wheat flour (3.5%).
- The dough is molded in a circle (4cm diameter) and baked using an oven (150ºC) for 20-25 minutes, until it is light brown and smells of aroma.
- Before packing cookies are refrigerated (±25 minutes). Further packaged in sealed jars.

Utilization of Shrimp Jackfruit into Flavoring Powder

MonoSodium Glutamate (MSG) is an additive used in processed foods or beverages aimed at flavoring or flavoring. Although in certain amounts of MSG is said to be safe to consume, but over time it will trigger cancer. Therefore, it is necessary to look for alternatives to natural pirisa ingredients.

According to Baskoro (2016), shrimp shells can be processed into broth that can cause savory flavors to processed foods. Besides being able to be used as a flavor enhancer, shrimp shells have ten times better benefits against free radicals than fruits and vegetables because they contain the antioxidant astaxanthin.

In the research of Hermanto and Nengseh (2020) making flavoring powder from shrimp shells requires tools such as blenders, pans, and stoves and other ingredients such as garlic, onion, carrots, coriander, celery, leeks, and salt.

The procedure for making flavoring powder from shrimp shells is: First, all ingredients are washed thoroughly under running water. After that, puree all the ingredients using a blender, then roast using a pan over low heat until it dries. The flavoring powder obtained is cooled packed in plastic packaging and ready for use.

Chitosan Extraski from Shrimp Shells and Their Use for Edible Coating Ingredients in Sausages.

Edible coating is a thin layer made of edible material, formed to coat food (coating) or placed between food components (film). The function of edible coating as a barrier to mass transfer and to increase the appearance of a food (Harris, 2011). Edible coatings are commonly made from cellulose and its derivatives, starch and its derivatives, gum arabic, pectin extract of marine algae, and chitosan.

Chitosan is generally insoluble in water but slightly soluble in hydrochloric acid and nitric acid and soluble in both weak acids such as formic acid and acetic acid. Chitosan extraction from shrimp shells can be done as follows:

Deproteination Process

Shrimp Shells are washed with water and dried in the sun for 30 minutes. Next, the dried ingredients are blended until they become powder and sifted. The powder is mixed with a 1 M NaOH solution with a weight ratio between NaOH and shrimp shell powder of 10: 1 (v/b). Next stirred with a shaker for 1 hour, then heated on a hotplate to a temperature of 80-90ºC for 1 hour and cooled. The mixture is then filtered, there are residues and filtrates. The filthrates are removed while the residue is washed with aquades until the pH is neutral and oven-dried for 30 minutes, then weighed in weight for use in the demineralization process.

Demineralization Process

The demineralization process can be carried out in two ways, namely using a solution of acetic acid (weak acid) and a solution of hydrochloric acid (strong acid).

a) Demineralization Process with CH_3COOH 1 M solution

White shrimp shell powder (*Penaeus merguiensis*) from the deproteination process is mixed with a solution of CH_3COOH 1 M with a ratio of 700 mL: 70 g (solvent: deproteination result). The mixture is then stirred using a shaker for 1 hour, then heated on a hotplate to a temperature of 80-90ºC for 1 hour, and cooled. The mixture is then filtered, there are residues and filtrates. The filthrates are removed while the residue is washed with aquadest until the pH is neutral. It is then dried in the oven for 30 minutes then weighed in weight for use in the process of deacetylating chitin into chitosan.

b) Demineralization process with 1 M HCl solution

Deproteinated shrimp shells mixed with HCl 1 M in a ratio of 10: 1 (v / b). The mixture is then stirred using a shaker for 1 hour, then heated on a hotplate to a temperature of 80-90^{0}C for 1 hour, and cooled. The mixture is then filtered, there are residues and filtrates. The filthrates are removed while the residue is washed with aquadest until the pH is neutral. It is

then dried in the oven for 30 minutes, then weighed in weight for use in the process of deacetylating chitin into chitosan.

c) Deacetylation process

The process of deacetylation of chitin into chitosan can use acetic acid (CH_3COOH) 1 M and hydrochloric acid (HCL) 1 M. demineralized chitin results are soaked in a solution of acetic acid or hydrochloric acid in a ratio of 10 : 1 (v / b) The mixture is then stirred with a shaker for 1 hour, then heated on a hotplate to a temperature of 80-90ºC for 1 hour, and cooled. The mixture is then filtered, there are residues and filtrates. The filthrates are removed while the residue is washed with aquadest until the pH is neutral. Next dried in the oven for 30 minutes. The chitosan obtained can be starched, then packaged and ready for use.

The yield of chitosan extracted from shrimp shells is highly dependent on the type of shrimp, reagent concentration, temperature, reaction time, and particle size. A high NaOH concentration will increase the number of acetyl groups detached from chitin thereby increasing the degree of chitosan deacetylation. Low temperatures will slow down the reaction rate. Based on research according to Partia (2013) the influence of temperature and heating time on the deacetylation process of chitin will reduce chitosan yield. This is because the high temperature will cause the molecular chain in chitosan to be depolymerized and result in a decrease in molecular weight and chitosan yield. The yield of chitosan from tiger shrimp shells is 14% (Cahyono, 2018).

The results of Cahyono (2018) research inform the characteristics of chitosan extracted from tiger shrimp shells as shown in Table 1. Based on Table 1, the chitosan obtained is very suitable as an edible coating material because its viscosity is very high. This range of values has entered the chitosan viscosity standard between 25-5,000 cPs (GRAS 2012). The high viscosity value is influenced by the distribution of chitosan molecules in the solution as well as the molecular weight of chitosan.

Table 1. Characterisik Chitosan Extraction Results from Windu Shrimp Shells

Characteristic	Analysis Results
Color	brownish white
Smell	Odorless
Shape	Flakes
Moisture content	12,29 %
Ash content	0,99 %
Fat content	3,13 %
Total nitrogen	2,20
Carbohydrates (by difference)	81,39
Viscosity	1713.04 cPs
Degree of deacetylation	98.65

Chitosan is applied to sausage products as an edible coating. The first step is to make a chitosan solution, which is as follows: Chitosan is dissolved in a 1% dilute acetic acid solution

with a ratio of 1: 100 (w/v). Next, the sausage to be coated is soaked in chitosan solution for 30 minutes. After that, the sausages are removed and hung so that the sausages are dry. Furthermore, the sausages are put in polypropylene plastic packaging and frozen stored ready for market.

Conclusion

Based on the literature study, information was obtained that the use of shrimp shells, waste from the fish processing industry can be used as food products. These products are 1) made shrimp shell flour for calcium fortification ingredients in ice cream cones, biscuits and cookies. 2) made flavoring or flavoring products. 3) Extraski chitosan from shrimp shells and its use for edible coating ingredients in sausage products.

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