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ARTICLE REVIEW: THE UTILIZATION OF CHITOSAN EXTRACTED FROM FISH SCALES FOR BIOPLASTIK

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Biodegradable, mixing, waste, chitin.

ABSTRACT

Waste from the fish fillet industry includes fish scales. One of the compounds contained in fish scales is chitin which can be acetylated into chitosan. This article aims to examine the manufacture of bioplastics from chitosan extracted from fish scales. Based on the results of the literature study above, it can be concluded that the manufacture of bioplastics from chitosan extracted from fish scales is through the stages of mixing (chitosan, acetic acid and sorbitol), molding and drying.

INTRODUCTION

The potential of the fishery processing industry in Indonesia is very high, seen from the number of fish processing factories. The by-products of fish processing have the potential to cause environmental damage. According to Ifa et al (2018), the fish processing industry only uses the meat, which is 40-50%. The rest becomes waste such as scales, skin, bones, gills and also internal organs. Environmental damage that occurs can be in the form of the emergence of unpleasant odors that can interfere with activities and also the health of the surrounding community, reduce beauty and reduce water quality in the waste disposal environment. One way to reduce pollution and make fishery waste has economic value is to process and utilize it, one of which is fishery waste in the form of fish scales which can be made into additional materials in the manufacture of bioplastics.

Bioplastics (Biodegradable plastics) are environmentally friendly plastics that can be made from starch, cellulose in plants and PLA (Polylactic Acids) (Ramadhani and Firdhausi 2021). In addition, bioplastics can also be made from chitosan. This chitosan is used as an additional material in the manufacture of bioplastics that can improve the characteristics of these bioplastics and chitosan has non-toxic and biodegradable hydrophobic properties (Ramadhani and Firdausi 2021). Chitosan is a biopolymer derived from chitin which has the molecular formula (C6H9NO3)n.

One source of raw material for making chitosan from fish waste is fish scales because the material contains chitin. The isolation process of chitosan from chitin is generally carried out in three processes, namely deproteination, demineralization and deacetylation (Fadli et al 2018). The physical properties of bioplastics can be seen from the thickness and water absorption (swelling) which affect whether or not the bioplastics from

fish scale waste chitosan are used. This article aims to examine the manufacture of bioplastics from chitosan extracted from fish scales.

Fish scales

Fish scales are part of the integumentary system which has a function as the outermost defense of the fish's body. Fish scales can be divided into 5 types, namely placoid, ganoid, cycloid, cosmoid and ctenoid (Fitriana 2021). The placoid type has a tapered shape resembling fine spines coated with enamel, this type is owned by stingrays and sharks, ganoid scales have a rhombus-like shape and are owned by alligator fish, cycloid scales have a slightly oval shape with growth lines for example carp and type Ctenoids are slightly oval in shape and have teeth on one side, for example, tilapia.

Fish scale content

Fish scales have nutritional components, namely 70% water content, 27% protein, 2% ash content and 1% fat (Fadilla et al 2019). Fish scales are also reported to contain calcium, alkaloids, steroids, chitin, saponins and phenols. Wibowo (2016) also reported that the proximate content of fish scales is 33.4% water content, 0.55% protein, 22.5% ash and 35.35% fat. Talumepa et al (2016) also reported that the content of dried marine fish scales generally had 11% water content, 30% protein, 39% ash, 5% fat, and 15% carbohydrates. The chemical content of fish scales is influenced by the type, habitat and size of the fish (Ramadhani and Firdhausi 2021).

Use of fish scales

Fish scales are part of the waste generated from the fish fillet industry. Fish scale waste that continues to accumulate without any processing will create an unpleasant odor and can eliminate the beauty of an environment.

Several uses of fish scales have been reported by several researchers. According to Dewantoro et al, (2019), fish scales can be used as gelatin which is applied to thicken syrup. Setyowati (2015) informed the manufacture of cosmeceutical from fish scale collagen. Other information also states that chitosan from fish scales can be used as an additional material in the manufacture of bioplastics. According to Ramdhani and Firdhausi (2021), chitosan can be used to reduce metal levels in water, as a preservative, in the fields of food, health and agriculture.

Chitosan

Chitosan has a yellowish white color produced from chitin and has the same chemical structure as chitin. In the manufacture of chitosan, it is divided into two stages, namely isolation of chitin in the form of deproteination, demineralization and depigmentation, then followed by the process of chitin deacetylation by reacting it with a high concentration of alkali for a long time and high temperature to become chitosan (Setha 2019).

Chitosan can be obtained with various morphological forms including irregular structures, crystalline or semicrystalline forms. In addition, it can also be in the form of a white amorphous solid with a fixed crystal structure from the initial form of pure chitin. Chitin has high biological and mechanical properties including biorenewable, biodegradable, and biofunctional. Chitosan has shorter chains than chitin chains. Chitosan solubility in acid solution and viscosity (Pratiwi 2014).

Bioplastic

Plastic is a packaging material used for household needs, wrapping food and drinks and other necessities, because plastic is light and the price is affordable, but in its use, plastic has a negative impact on environmental sustainability because plastic is difficult to degrade. Several studies have been carried out to reduce the use of plastic or replace it with environmentally friendly packaging, namely biodegradable plastic or bioplastic. Bioplastics are plastics that can be degraded in a short time made of natural polymer materials such as starch, cellulose and fat and the main ingredients that are often used in the manufacture of biodegradable plastics are starch and Poly Lactic Acid (PLA) (Kamsiati 2017). In addition, as one of the uses in processing fish waste, bioplastics can also be made from fish scales (Aziz 2017).

Bioplastic Manufacturing Process

How to make chitosan from fish scales for bioplastics according to Aziz et al (2017)

a) Sample Preparation

The fish scale waste is cleaned and dried until the fish scales become brittle to facilitate the flouring process. Drying is done using an oven to produce a fine powder of fish scales

b) Chitin isolation

Isolation of chitin from fish scale powder consisted of two stages, namely deproteination and demineralization. Fish scales powder that has been deproteinized is mixed and stirred in a 3.5% NaOH solution with a ratio of fish scales to NaOH 1:10 (m/v) at 100oC for 2 hours. The results obtained were filtered and washed with distilled water until the pH was neutral and then dried in an oven at 50°C for 3 until the precipitate was dry enough. The deproteination product was then demineralized by reacting the deproteination product in 1 N HCl solution with a ratio of 1:6 (m/v) at room temperature for 30 minutes. The results obtained were filtered and washed with distilled water until the pH was neutral and then dried in an oven at 50°C for 3 hours or until the precipitate was dry enough.

c) Chitosan Preparation

Chitosan preparation was carried out by breaking the acetyl group contained in the chitin extract from fish scales. The deacetylation process was carried out by dissolving chitin in 50% NaOH for 1 hour at a temperature of 100^{o}C with a ratio of 1:10 (m/v). The results obtained were filtered and washed with distilled water until the pH was neutral and then dried in an oven at 50°C for 3 hours or until the precipitate was dry enough.

d) Production of bioplastics

Bioplastics were made by dissolving 2 grams of chitosan in 25 mL of 1% acetic acid at 60oC for 1 hour while stirring constantly. The solution was then given 1 mL of sorbitol and stirred again at 60^{o}C for 15 minutes or until quite thick. The solution is then printed on aluminum foil, a glass container, and a cement mold which is then baked at a temperature of 60^{o}C until the plastic solidifies.

Figure 1. Bioplastic made from chitosan from fish scales

(Source: Aziz et al 2017)

Bioplastic Marketing

Bioplastics have been marketed in various e-commerce but there are not many types (Figure 2)

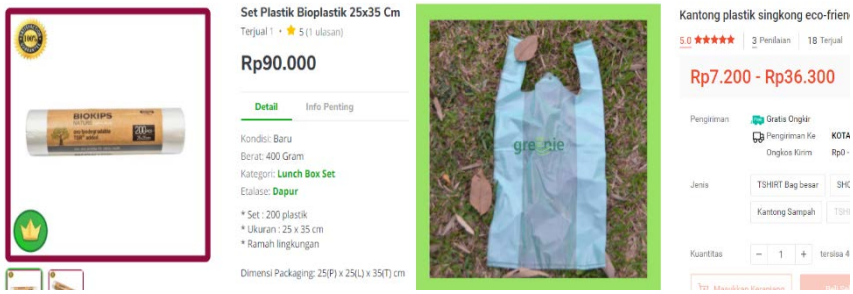

Figure 2. Bioplastic products

Bioplastic Physical Properties of Fish Scales

The physical properties of bioplastics from fish scale chitosan are seen from the water absorption (swelling) and thickness

a) Swelling test

The swelling test was carried out to determine the ability and resistance of bioplastics to water (Maladi 2019). The test method is to immerse the plastic in water so that the percentage of plastic development can be determined after being soaked in water. The value of this test can determine the physical properties of the plastic whether it is waterproof or not. The higher the swelling test value, the more difficult it is for bioplastics to disintegrate in water even though the absorption capacity is high and vice versa when the swelling value is low, the bioplastics are more easily destroyed in water due to the presence of H2O that diffuses into it (Augustin et al 2016). According to Coniwanti et al (2014) the higher the water resistance value in bioplastics, the higher the water resistance value in bioplastics will indicate that the bioplastics have good water holding capabilities, and if the water resistance values are lower, the bioplastic properties are bad.

b) Thickness of bioplastic

Thickness is a characteristic in determining a bioplastic film to the speed of transfer of water vapor, gas and other volatile compounds, the thickness of bioplastics is influenced by several factors, one of which is the addition of chitosan, a high concentration of chitosan will affect the thickness of the bioplastic, the thickness of the bioplastic is measured using a micrometer screw (Ramadhani 2021)

Conclusion

Based on the results of the literature study above, it can be concluded that the manufacture of bioplastics from chitosan extracted from fish scales is through the stages of mixing (chitosan, acetic acid and sorbitol), molding and drying.

References

Augustin and Karsono. 2016. Sintesis Bioplastik dari Kitosan-Pati Kulit Pisang Kepok dengan Penambahan Zat Aditif. *Jurnal Teknik kimia ,* 10 (2).

Aziz, N., M. F. B. Gufran., W. U. Pitoyo and Suhandi. 2017. Pemanfaatan Ekstrak Kitosan dari Limbah Sisik Ikan Bandeng di Selat Makassar pada Pembuatan Bioplastik Ramah Lingkungan. *Hasanuddin Student Journal*, 1(1): 56-61.

Coniwanti, P., Laila, L., and Alfira, M. R. 2014. Pembuatan Film Plastik Biodegredabel dari Pati Jagung dengan Penambahan Kitosan dan Pemplastis Gliserol.*jurnal Teknik kimia*, 20(4): 22–30.

Dewantoro, A. A., R. A. Kurniasih and S. Suharto. 2019. Aplikasi Gelatin Sisik Ikan Nila (*Oreochromis nilot icus*) sebagai Pengental Sirup Nanas. *Jurnal Ilmu dan Teknologi Perikanan*, 1 (1): 37-46.

Fadilla, E. N., Y. S. Darmanto and L. Purnamayati. 2019. Karakteristik Mi Kering dengan Penambahan Gelatin Sisik Ikan yang Berbeda.*jurnal perikanan*. Gadjah Mada University, 21 (2): 119-126.

Fadli, D. Drastinawati, O. Alexander, and F. Huda. 2018. Pengaruh Rasio Massa Kitin/NAOH dan Waktu Reaksi terhadap Karakteristik Kitosan yang Disintesis dari Limbah Industri Udang Kering. *Journal of Sains Mater. Indonesia*, 18(2): 61.

Fitriana. 2021. Identifikasi Tipe Sisik Ikan Laut pada Pelabuhan Perikanan Lampulo Kecamatan Kuta Alam Ko ta Banda Aceh sebagai Penunjang Referensi Praktikum Struktur Hewan. *Skripsi*. Fakultas Tarbiyah dan Keguruan Universitas Islam Negeri Ar-Raniry Darussalam. Banda Aceh.

Ifa, L., A. Artiningsih., Julniar and Suhaldin. 2018. Pembuatan Kitosan dari Sisik Ikan Kakap Merah. *Journal of chemical process engineering*, 3 (1): 47-50.

Kamsiati, E., H. Herawati dan E. Y. Purwani. 2017. Potensi Pengembangan Plastik Biodegradable Berbasis Pati Sagu dan Ubikayu di Indonesia. Journal of Agricultural Research and Development,36 (2): 67-76.

Maladi, I. 2019. Potensi Pengembangan Plastik Biodegradable Berbasis Pati Sagu dan Ubikayu di Indonesia. *Skripsi*. Program Studi Kimia Fakultas Sains dan Teknologi Universitas Islam Negeri Syarif Hidayatullah. Jakarta.

Nur, M. R and Asy'ari. 2020. Pemanfaatan Limbah Sisik Ikan Sebagai Kitosan. *Journal of Fisheries Agribusiness*, 13 (2): 269-273.

Pratiwi, R. 2014. Manfaat Kitin dan kitosan bagi kehidupan manusia. *Journal of Oseana*, 39 (1): 35-43.
Ramadhani, A and N. F. Firdhausi. 2021. Potensi Limbah Sisik Ikan sebagai Kitosan dalam Pembuatan Bioplastik. *Journal of Al Azhar Indonesia science and technology series*, 6 (2): 90-94.

Ramadhani, A. A. 2021. Karakterisasi Bioplastik Umbi Porang (*Amorphophallus muelleri*) dengan Penambahan Kitosan Sisik Bandeng. *Skripsi*. Uin Sunan Gunung Ampel. Surabaya

Setha, B., F. Rumata and B. Silaban. 2019. Karakteristik Kitosan dari Kulit Udang Vaname dengan Menggunakan Suhu dan Waktu yang Berbeda dalam Proses Deasetilasi. *JPHPI*, 22 (3): 498-507.

Setyowati, H dan W. Setyani. 2015. Potensi Nanokolagen Limbah Sisik Ikan sebagai *Cosmeceutical*. *Journal of Pharmacy Science and Community*, 12 (1): 30-40.

Talumepa., P. Suptijah, S. Wullur, dan I. F. M. Rumengan. 2016. Kandungan Kimia dari Sisik Beberapa Jenis Ikan Laut. *J. LPPM Bid. Sains dan Teknol, (*3) 1: 27–33.

Wibowo., S. Syamdidi, L. Assadad, Dwiyitno dan Darmawan. 2016. *Kandungan Gizi Ikan*. Penebar swadaya. Jakarta.