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Fabrication and Characterization of High Molecular Chitosan Film with Hydrogel Gelatin.

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Abstract. The research on fabrication and characterization of high molecular chitosan film with hydrogel gelatin has been successfully conducted. High molecular chitosan was dissolved in a solution of 1% acetic acid and gelatin was dissolved with aquadest at ± 60 ºC. The formed chitosan and gelatin solution was poured into the glass plate glass and then dried in an oven at ± 50ºC for 24 hours. Volume number variations of chitosan and gelatin solution were 25% : 75%, 50% : 50%, 75% : 25%, respectively.The formed chitosan was characterized using tensile test, SEM, and FT-IR analysis. The tensile test results showed that film chitosan with no gelatin was 1.280 Mpa compared to the ratio between chitosan solution and gelatin solution were 25%: 75, 50%: 50%, and 75%: 25% which tensile test results were 2.156, 2.840, and 9.604 Mpa, respectively. The FTIR test also showed the difference between chitosan and chitosan-gelatin film functional groups where the band at 3433.29 cm^{-1}, which indicated N-H groups of chitosan and changed to be OH groups in chitosan-gelatin film at 3653.18 cm^{-1} bands. This study also found that three films produced a relatively smooth surface and not rough.

Keywords: Chitosan, Gelatin, High Molecular

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1 Introduction

The use of films of polymers continues to increase and expand in various fields such as the biotechnology industry, pharmaceutical industry, medical, environmental, and agriculture (Majeti and Kumar, 2000; Shahidi and Abuzaytoun, 2005; Maggy, 2006; Honarkar and Barikani, 2009). This is due to the advantages of non-porous film coating which offers high permeability, mechanical strength, and selectivity, and can separate azeotrope solutions (Kanti et al., 2004).

Film material is one of the variables that greatly determine the performance of the film. Natural polymers are currently receiving the attention seriously researchers to be used as a material in

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film making due to their nontoxic, biodegradable, biocompatible, properties, low cost, and easier to be obtained.

Chitosan is a long-chain polymer contained by (2-amino-2-deoxy - D-glucose) glucosamine monomers. This biopolymer is composed of two types of amino sugars i.e glucosamine (2-amino - 2-deoxy-D - glucose, 70-80 %) and N-acetylglucosamine (2-acetamino-2-deoxy - D-glucose, 20 to 30%) (Goosen, 1997).

High molecular chitosan has been reported to form films that have good properties, as a result of the intra-and intermolecular bonds of hydrogen (Muzzarelli, 1973).

The formed chitosan film is a polymer that can harden to be a coefficient film. The chitosan film properties depend on its morphology influenced by the solvent system, molecular weight, degree of N-acetylation, and solvent evaporation (Kogras, 2003). Agusnar, et al (2013) said that the hydrolysis of the solvent in chitosan occurs every day if it is not stored in the freezer.

Gelatin has high hydrophilic properties that can be seen by its purposes, in food products gelatin serves as a stabilizer, gelling, binder, thickener, emulsifier, coating, etc. Gelatin is also biocompatible and has very high bio absorbtivity (Achet & Dia, 1995; Arvanitoyannis, Nakayama, & Aiba, 1998).

Furthermore (Gomez, 2010) said that based on the gelatin and chitosan properties, it is necessary to conduct more intensive research in discussing the physical and chemical properties of the combination of these two compounds. The combination of these two biopolymers will improve each other's weaknesses and improve the physicochemical properties of pure gelatin and pure chitosan.

However, most of the films that are compiled using the chitosan in acetic acid solution and gelatin solution (Jayakumar & Tamura, 2008; Nagahama, Higuchi, Jayakumar, Furuike, & Tamura, 2008a; Nagahama, et al, 2008b.; Nagahama, Nwe, Jayakumar, Furuike, & Tamura, 2008c; Tamura, Nagahama, & Tokura, 2006).

Based on the description above, the authors are interested to conduct about fabrication and characterization of high molecular chitosan film with gelatin hydrogel.

2 Materials and Methods

2.1 Equipments

In this study, the equipments used were analytical balance, hot plate, volumetric flask, beaker glass, graduated cylinder, dropper pipette, oven, rubber bulb, scoopula, magnetic stirrer, and a set of fourier transform infrared (FT-IR), scanning electron microscope (SEM), and tensile testing..

2.2 Materials

The main materials used were acetic acid glacial, distilled water, high molecular chitosan, and gelatin.

2.3 Preparation of 1% Acetic Acid Solution

As much as 5 mL acetic acid was taken by using the volumetric pipette and put into a 500 mL volumetric flask. Then, diluted with distilled water until the marked line and homogenized.

2.4 Preparation of 2% Gelatin Hydrogel Solution

As much as 2 g of gelatin was dissolved into 100 mL of distilled water. Then heated on a hot plate at ± 60ºC while stirring using a magnetic stirrer for ± 2 hours.

2.5 Preparation of 2% Chitosan Solution

As much as 2 g of chitosan dissolved into 100 mL of CH_3COOH 1% solution. Then, stirred using a magnetic stirrer at room temperature for ± 2 hours.

2.6 Fabrication of Chitosan-Hydrogel Gelatin Film

The chitosan and hydrogel gelatin solution was mechanically stirred and poured into a glass plate (17.5 cm x 8.5 cm) with a volume ratio of chitosan and gelatin which was 25%: 75%. Then dried in the oven at 50ºC for 24 hours. After the chitosan-gelatin film has dried, it was then released from the glass plate and characterized. Next. the same procedure was carried out with the ratio of chitosan-gelatin at 50%:50% and 75%:25%.

3 RESULT AND DISCUSSION

This resulted in chitosan-hydrogel gelatin film with the ratio of the total volume of chitosan solution: gelatin solution as shown in figure 1.

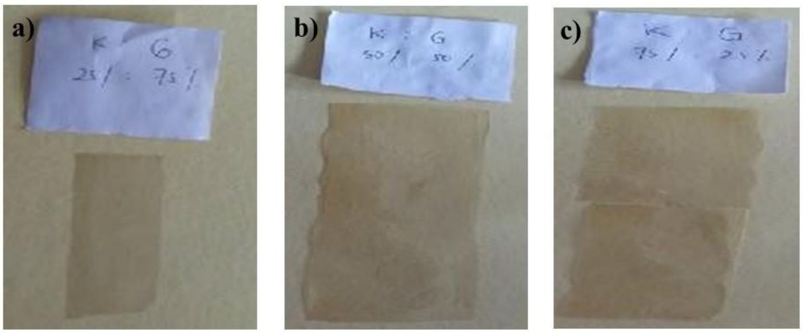

Figure 1. Chitosan-hydrogel gelatin film a). 25%:75%, b). 50%:50%, c). 25%:75%

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3.1 Fabrication of Chitosan-Hydrogel Gelatin Film

Fabrication of chitosan-hydrogel gelatin film can be seen in figure 1 above, where figure 1. a showed the surface of the film chitosan-hydrogel gelatin evenly distributed because the solution was mixed homogeneously. In addition, figure 1. b showed that the surface of the film chitosan-hydrogel gelatin is uneven because the solution was not mixed homogeneously, and figure 1. c showed that the surface of the chitosan-hydrogel gelatin film produced was not good because the mixture process is uneven.

3.2 Tensile Testing

Tensile test analysis was used to characterize the mechanical strength of chitosan-hydrogel gelatin film. The sample was cut in the form of a rectangle with a length of 70 mm and a width of 20 mm. The tensile test results are indicated in Table 1.

Tabel 1. The tensile test results

No	Sample	Tickness (mm)	Tensile strength (Mpa)
1	Chitosan Film	0.01	1,280
2	Chitosam-Gelatin Film (25%:75%)	0.02	2.156
3	Chitosam-Gelatin Film (50%:50%)	0.03	2.840
4	Chitosam-Gelatin Film (75%:25%)	0.04	9.640

Table 1 showed that film chitosan with no gelatin was 1.240 Mpa compared to the ratio between chitosan solution and gelatin solution were 25%: 75, 50%: 50%, and 75%: 25% which tensile test results were 2.156, 2.840, and 9.604 Mpa, respectively.

3.3 FT-IR (Fourier Transform-Infrared) Analysis

The FT-IR test results presented in figure 2 show that the chitosan and chitosan-gelatin film have the hydrogen bond interaction that occurs on mixing chitosan and gelatin, the band at 3433.29 cm^{-1}, which indicated the presence of N-H groups and changed to be OH groups at 3645.46 cm^{-1} on chitosan-gelatin film. However, there was no significant change in the band between the three films produced in the ratio of chitosan-gelatin film a, b, and c which the spectra produced from the three films almost showed the same cluster.

In addition, Darmanto et al (2011) explained that the gelatin blended with chitosan causes a shift in the chitosan spectra of the chitosan-gelatin film due to the presence of hydrogen bonds between chitosan with gelatin in the polyelectrolyte formations. According to Sionkowska, et al (2004) the hydrogen bond occurs between the OH groups of hydroxyproline in gelatin with the NH_2 groups in chitosan.

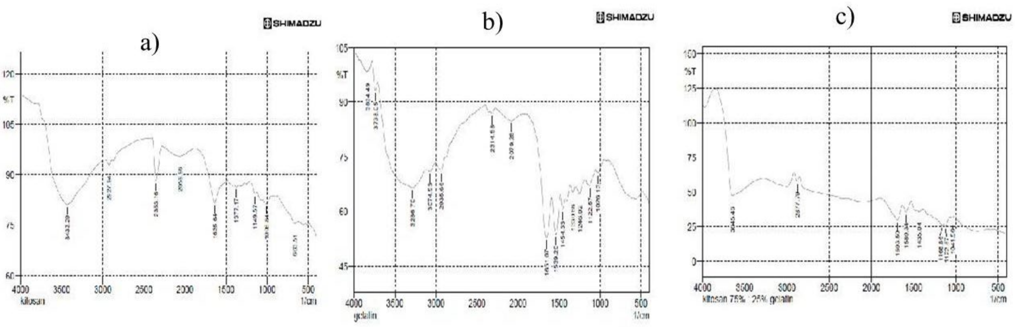

Figure 2. FT-IR spectra of a). high molecular chitosan, b). gelatin, and c). chitosan-gelatin film

3.4 SEM (Scanning Electron Microscope) Analysis

The formed film is also characterized by SEM as shown in figure 3. In order to see the morphology of the chitosan-gelatin film. The three films produced were relatively smooth and not rough surfaces due to the chitosan and gelatin dissolved perfectly (Meriatna, 2008).

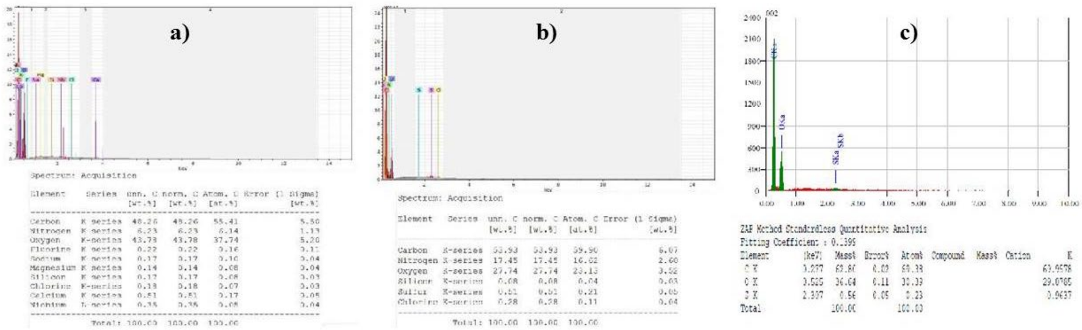

Figure 3. The surface morpology of a). chitosan, b). gelatin and c). Chitosan-gelatin film

4 Conclusion

In conclusion, chitosan-gelatin films were successfully fabricated. This is supported by the characterization results obtained from FT-IR, SEM, and tensile tests. In this study, tensile test results showed that the increase of chitosan volume increased the mechanical strength from 1.280 to 9.604. The FT-IR test also showed that the hydrogen bond interaction occurred in the mixing of chitosan and gelatin, the band at 3433.29 cm^{-1}, which assigned N-H groups in chitosan changed to the band at 3645.46 cm^{-1}, which indicated OH groups in the chitosan-gelatin film. The SEM test results showed that the three films produced were relatively smooth

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and not rough surfaces. This study also found the chitosan: gelatin film with a ratio volume of 75%:25% was the best characteristic film.

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