Chitosan-Alginat-Aloe Vera Biomembran for Wound Dressing Applications

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Abstract

Biomembran is one type of wound dressing. Wound dressing is usually used in healing wounds and can create good conditions in the process of wound healing. The raw materials used for making these biomembranes are chitosan, alginate, and aloe vera. This study aims to examine biomembrane processing and analyze the physical-chemical properties of biomembrane. The process of making this biomembrane is by mixing all the raw materials, namely chitosan: alginate: aloe vera with a ratio of 40:60:40; 50:50:40; 60:40:40; 70:30:40; and 80:20:40. Then proceed to the stage of printing using glass molds and then dried using an oven. Biomembranes produced were carried out several tests such as for absorption test the value obtained was 73%; 131%; 167%; 258%; and 267% for each of the above comparisons, and for membrane thickness the value obtained is 0.09 mm; 0.0867mm; 0.0833 mm; 0.07mm; 0.0667mm, and for the swelling test the value obtained is 100%; 122.2%; 140%; 200%; 225%, and for analysis of this biomembrane FTIR group contains alkyl halides, CH bonds, alkyl amine groups, NO2 bonds, CO/CH bending groups, NO2 bonds, alkene (C = C), alkaline compounds (C≡C), compounds alkanes (CH), and amine compounds, amides (NH).

Keywords
Chitosan, Alginat-Aloe Vera, Biomembran, Wound, Dressing Applications

1. Introduction

The skin is the elastic outermost layer of tissue that wraps around and protects the body. In the event of damage, homeostasis is the process by which the body defends itself against bleeding and invasion prevention is the method by which bacteria enter the tissues and spread throughout the body (Jayakumar, Prabaharan, Kumar, Nair & Tamura,

2011). Aloe Vera is a nutritious plant that can help heal wounds. Saponins and flavonoids have found in the leaves and stems of aloe Vera plants. Furthermore, the leaves contain tannins and polyphenols (Okuda & Ito, 2011). Chitosan has biocompatible, biodegradable, non-toxic, anti-microbial, hydrating agent properties (Rajoka, Zhao, Mehwish, Wu, & Mahmood, 2019). Because of its nature, chitosan used for the wound healing process(Patrulea, Ostafe, Borchard & Jordan, 2015). Chitosan is a chemical compound derived from the biological material chitin, an abundant organic compound after cellulose (El Knidri, Belaabed, Addaou, Laajeb & Lahsini, 2018). Chitin is a structural polysaccharide that is useful in composing exoskeletons from arthropod animals (Fabritius, Sachs, Raabe, Nikolov, Friák & Neugebauer, 2011).

Alginate is a naturally occurring carbohydrate derived from brown seaweed (Gomaa, Fawzy, Hifney & Abdel-Gawad, 2018). Previous research found that membrane alginate has high absorption, is anti-bacterial (Xing, Ma, Tan, Yuan, Li, Li, & Hu, 2019) and can speed up wound healing, but it does not contain antibiotics (Shi, Zhang, Song, Liu, Gao, Zhou & Li, 2019). So even though alginate is a linear molecule with a high molecular weight, it quickly absorbs water. Wound healing can do it by covering the injured part of the skin with a wound pad to avoid infection. The ideal wound dressing is a sanitary pad that does not damage the skin tissue during the wound healing process. The perfect feature of wound dressings is that they can help air circulation, control excess exudate, and not transmit bacteria and viruses. The condition can control the wet infection of the wound, maintain the body's stability to be stable, and microorganisms will not pass (Jayakumar et al., 2011).

1.1 Objectives

The purpose of this study is to examine biomembrane processing and analyze the physical-chemical properties of biomembrane. The process of making this biomembrane is by mixing all the raw materials, namely chitosan: alginate: aloe vera with a ratio of 40:60:40; 50:50:40; 60:40:40; 70:30:40; and 80:20:40.

2. Materials and Methods

Methods used in this study are ovens, FTIR spectrophotometers, freezers, blenders, glass molds, 5 ml and 25 ml glass, spatulas, digital balance sheets, funnels, beaker glasses 80 ml and 100 ml, measuring gourds 500 ml and rotary evaporators. Chitosan (shrimp skin), Alginate (Sargassum Sp), (Aloe Vera identification of specific Miller), and Glacial Acetic Acid are used in this study.

2.1 Preparation of Raw Materials

Aloe Vera is cleaned first, then mashed with a blender, then finely mixed with ethanol, silenced for 12 hours, and finally glued with a rotary evaporator. A Digital balance is used to measure the materials used in chitosan, alginate, and CaCl2. After all of the ingredients have been weighed, they are dissolved in glacial acetic acid using a blender. Alginate plus CaCl2 dissolved in acetic acid in a blender for 5 minutes with an alginate composition of 2 gr, CaCl2 1 gr, and acetic acid 100 ml. Chitosan 2 g dissolved in 100 mL acetic acid

2.2 The phase of Bio membrane Processing

After all the ingredients are dissolved, the ingredients are mixed with a predetermined composition using a blender. Next, the material is mold using a glass mold and left 24 hours at 30 0C—incineration in the oven for 48 hours. Biomembrane is ready to be put in plastic samples and stored in the freezer before the testing stage.

2.3 Testing Stage

1. Cluster analysis (FTIR)

The material to be tested at the testing stage is dissolved with KBr, then verified with the FTIR tool. Biomembrane tested with FTIR spectroscopy will produce a spectrum graph describing the value of the wavenumber and % transmittance value.

2. Swelling analysis (%)

1. Analisa gugus (FTIR)
   At the testing stage, the material to be tested is dissolved with KBr which is then tested with an FTIR tool. The biomembrane tested by FTIR spectroscopy will produce a spectrum graph that describes the wavenumber value and % transmittance.
2. Analisa *swelling* (%)
   Analysis of swelling biomembrane was tested using NaCl solution as an analogue of bodily fluids. The percentage size of the swelling can be calculated using the equation:

$$\%S = \frac{W_s - W_d}{W_d} x\ 10$$

W_s = Weight of the biomembrane after soaking from inside NaCl
W_d = Weight of the biomembrane before washing inside NaCl

3. Absorption test
   Biomembranes absorbance test is conducted by incubating biomembrane pH7.4 in PBS (phosphate buffer saline) solution at room temperature. The calculation of the wet weight of biomembrane is carried out several times by giving the paper filter membrane used to remove the absorption water on the surface, then immediately weighed with a digital scale.
4. Test membrane thickness
   Membrane thickness tests are performed using screw micrometres, as screw micrometres have precision up to 0.01 mm.

3. Results and Discussion

Several tests are carried out during the process of creating biomembrane from chitosan, alginate, and aloe vera to apply wound pads. As for the discussion of these tests are:

3.1 Analysis of Clusters (FTIR)

The goal of membrane group analysis (FTIR) is to determine whether the chitosan-alginate-aloe vera membrane has other functional groups. Figure 1 depicts the results of the cluster analysis (FTIR).

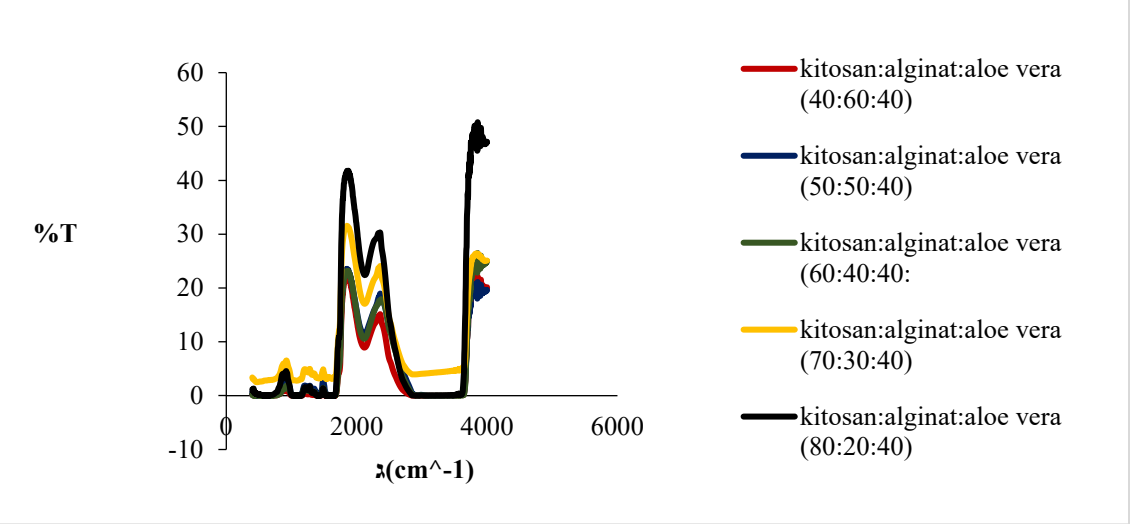

Figure 1. Cluster Analysis Graph (FTIR))

There is a shift in peaks and the addition of new heights that indicate the interaction between chitosan, alginate, aloe Vera, and CaCl2. The composition difference showed from Figure 1 with a comparison of chitosan: alginate: aloe Vera at the peak with a value of 500-650 containing alkyl halides group. The mountain with a value of 675-900 includes a C-H bond. At heights with a value of 1010-1200 containing the alkyl amine group. The peak with a value of 1300- 1370 has bond NO2. At the rise with a value of 1427.32, it includes a C-O/C-H bending cluster. Relationship Sulphur dioxide found in height with a weight of 1500-1570. The peak with a value of 1500-1570 contains NO2 bonds. Bond Sulphur dioxide found in height with a weight of 1500-1570. Alkene compounds (C=C) are present at the highest point with a value of 1610-1680. Akuna compounds (CC) were found in the measurement with a value of 2119.77. It contained a C-H cluster at the peak with a value of 2343.51. Alkyl components are considered the highest, with a value of 2890. (C-H). Hight with a value of 3300 includes amino compounds and amide. (N-H).

3.2 Test Absorbs

Absorbance tests conducted to determine the variation of chitosan, alginate, and aloe Vera variation in the membrane. %A against chitosan-alginate-aloe vera membrane. Graph of biomembrane variations of chitosan-alginate-aloe Vera against absorption tests displayed in Figure 2.

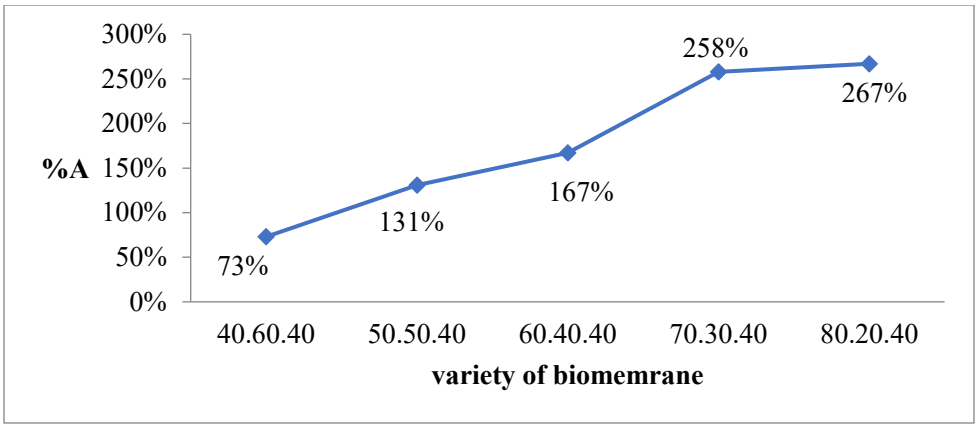

Figure 2. Graph of % Absorption of chitosan-alginate-aloe vera biomembrane

Figure 2 depicts the percentage A difference in each biomembrane.The material's hydrophilic properties heavily influence the difference in per cent A; chitosan and alginate are both hydrophilic. At comparable concentrations, chitosan and alginate will produce biomemlings that easily destroyed. The pores of alginate are larger than chitosan. The biomembranes containing alginate composition have more excellent soft biosecurity. When chitosan and alginate are combined, fibers form. A soft biomembrane will be produce d if the alginate composition will be increased due to the formation of fibers when chitosan and alginate are combined. If chitosan and alginate are combined, fibers will form. The large pores of alginate have fewer boundary walls when the fibrous biomembrane is creating. The larger composition cannot hold fluid well due to a lack of boundary walls that can support the fibers to store fluid biomembrane with higher alginate content and form a soft and brittle structure (Calvert, 2009).

3.3 Membrane Thickness Analysis

The membrane thickness test determines the composition of the membrane—layer measurement with such a micrometre screw with a 0.01 mm scale accuracy. The measurement has done by taking samples of the chitosan-alginate-aloe vera membrane from three sides: the top, middle, and bottom. Figure 3 depicts a graph of the variation in the chitosan-alginate-aloe vera membrane.

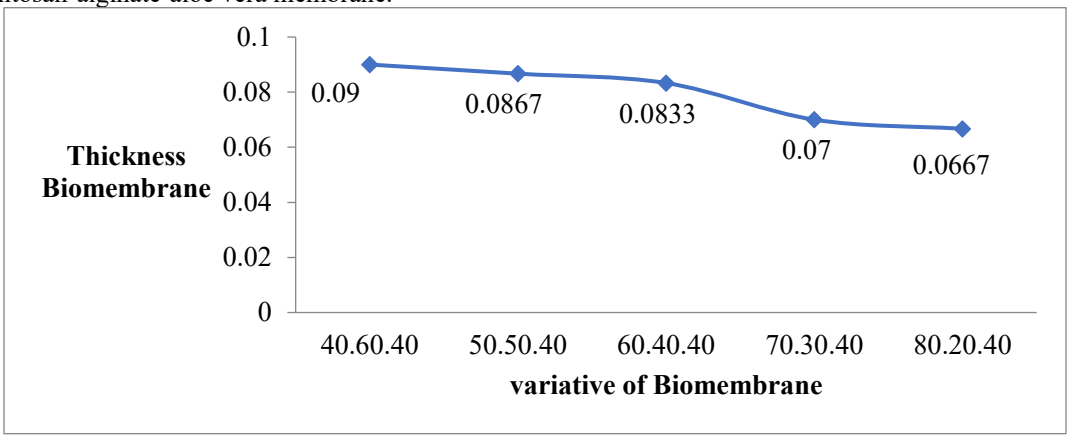

Figure 3. Graph of the average thickness of the chitosan-alginate-aloe vera biomembrane

Figure 3 shows the value of the thickness of the biomembrane is influenced by adding the composition of chitosan and alginate. Alginate I formed into gels, paste solutions, sponges, membrane fibers. At the same time, alginate used as a thickening agent and thickness material. The influence on the volume of alginate, the thicker biomembrane. The more it causes the solution to be more concentrated, Bio membrane's thickness increased (Rachik, Barthes-Biesel, Carin & Edwards-Levy, 2006).

3.4 Swelling evaluation

Determine variations in chitosan alginate in biomembrane, a water resistance test (swelling) performed. Percent S compared to chitosan-alginate-aloe Vera membrane Figure 4 depicts a graph of variations in chitosan-alginate-aloe Vera membrane versus swelling test.

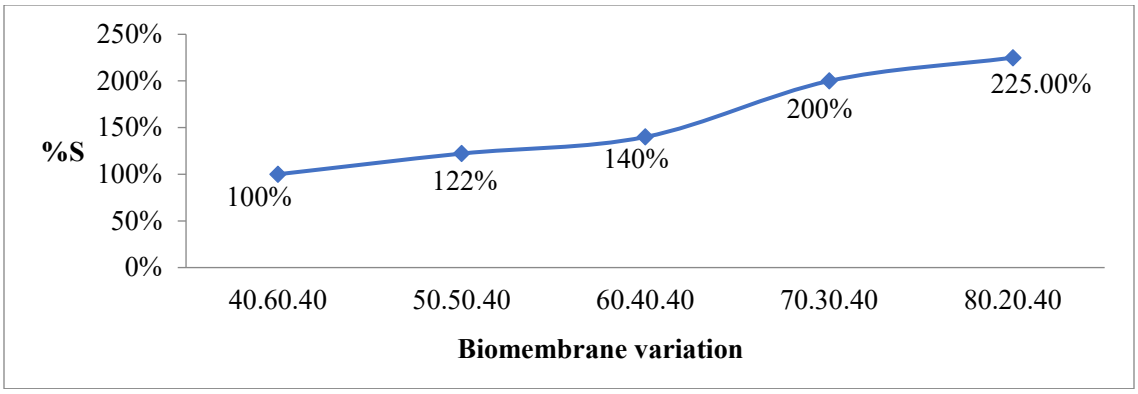

Figure 4. Percentage of Swelling biomembran chitosan-alginat-*aloe vera*

The percent S difference in each biomembrane showed in Figure 4. The percentage S of material is heavily reliant on its hydrophilic properties; chitosan and alginate are hydrophilic. Figure 4 depicts the increase in per cent S is due to the increased volume of chitosan. The volume of chitosan consumed, the greater the absorption. Suppose the chitosan and alginate are comparable. Biomembrane destroyed, whereas biometrics will produce flaccid biomembrane because it contains more composition than chitosan. The swelling value of the application of wound dressings is between 200%-500%. The results obtained show that the membrane chitosan-chitosan-aloe Vera is qualified, and some are not eligible for use as wound dressings. The longer the soaking time to a certain extent, the NaCl solution absorbed as much as biomembrane. The swelling value that can use for wound dressing application ranges from 200 to 500 per cent. The results show that some membrane chitosan-aloe Vera are qualified for use as wound dressings, but others aren't. To a certain extent, the longer the soaking time, the more NaCl solution was absorbed as biomembrane (Bontha & Pintauro, 1994).

5. Conclusion

The results of the research that has found several conclusions can be drawn, among others, the results of the study with a comparison of chitosan :alginate: aloe Vera 40:60:40; 50:50:40; 60:40:40; 70:30:40; and 80:20:40 for the absorbance test the value obtained is 73%; 131%; 167%; 258%; and 267%. The results study with a comparison of chitosan :alginate :aloe vera 40:60:40; 50:50:40; 60:40:40; 70:30:40; and 80:20:40 for membrane thickness the obtained value is 0.09mm; 0.0867mm; 0.0833mm; 0.07mm; 0.0667mm. Results of the study with a comparison chitosan alginate: aloe Vera 40:60:40; 50:50:40; 60:40:40; 70:30:40; and 80:20:40 for the swelling test the value obtained is 100%; 122,2%; 140%; 200%; and 225%. The results with a comparison of chitosan: alginat: aloe Vera 40:60:40; 50:50:40; 60:40:40; 70:30:40; and 80:20:40 for analysis of this bio membranous FTIR group contains alkyl halides, C-H bonds, alkyl amine groups, NO2 bonds, C-O/C-H bending groups, NO2 bonds, alkenes (C=C), alkuna compounds (C≡C), alkane compounds (C-H), and amine compounds, amide (N-H). Biomembrane the best produced in the comparison chitosan: alginate: aloe Vera 80:20:40.

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