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Filtration of Uric Acid Using Ultra Filtration Membrane Chitosan-Glutaraldehyde-Alginate.

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ABSTRACT

The viability of using ultra fitration membranes made by blending 85% deacetylated chitosan and sodium alginate biopolymers with glutaraldehyde crosslink agent for separation uric acid was investigated. The membranes were characterized by FTIR to verify the polyion complex formation, SEM for observe morphology, tensile testing for mechanical stability and the ability of membrane in filtering uric acid. The results showed that surface and pore size that membrane in range of ultra filtration membrane and did not reveal any new functional groups so that the membrane formation occurred only electrostatic interaction. This membrane was able to filter out uric acid concentration of 90 mg/l, with the amount of uric acid filtered 48.23 mg/l.
Key words: Uric acid, ultra filtration, chitosan glutaraldehyde alginate

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INTRODUCTION

At the moment research about exploiting of natural polymer as membrane has used many, specially membrane of hemodialysis is developing. During the time which used as by many membrane of hemodialysis is to cellulose membrane and this generation like acetate cellulose, cellulose methyl, gelatin, cellophane, alginate and chitosan. Chitosan, a copolymer of glucosamine and n-acetyl glucosamine units linked by 1-4 glucosidal bonds, is obtained by n-deacetylation of chitin, which is one of the most abundant natural amino polysaccharide, and has been reported to have a variety of applications in pharmacy industry, metal ion uptake and biotechnology [1]. Chitosan has free amino and hydroxyl sites which enhance chelating and cross linking ability [2]. Cross linked chitosan derivatives still retain the advantages of chitin and chitosan, which include biocompatibility, antibacterial activity, nontoxicity, adsorptive activity [1-8]. Therefore, cross linked chitosan derivatives might be good candidates for application in various biomedical fields [9]. Alginate represent polymer of anionic of acid β-D-Manuronat and α L-Guluronat able to insulation of brown algae (*Phaeophytaceae*). Among the hydrophilic polysaccharide type polymers, alginate membrane has gained special interest because it showed the highest flux and separation factor among the hydrophilic materials tested for the pervaporation dehydration [10-15]. The performance of a pure sodium alginate membrane was still not satisfactory because of a large free volume between the molecular chains [16-17]. Its membrane performance has been improved by modifying alginate with different methods such as blending [18], grafting [19] and cross-linking [20].Alginate which representing polyanionic and chitosan is poly cationic, when dissolved at correct condition can have interaction one another carboxyl functional groups of alginate and amine fuctional group of chitosan [10]. At the moment research concerning exploitation of natural polymer (chitosan and alginate) as membrane is expanding, specially membrane of hemodialysis. At this process is used by membrane made in semipermeable with elementary principle apply dialysis process and ultra filtration. Structure membrane characteristic ultra filtration is to have pore size measure among 0,005-0,1 µm [21-22]. This membrane operates on pressure 1-5 bar.

MATERIALS AND METHODS

Chitosan with minimum 85% deacetylated and sodium alginate purchase from BrataChem Indonesia. Acetic acid, glutaraldehide, NaOH and other chemicals were used as analytical grade and purchase from Merck Company. Reagent uric acid HUMAN purchase from PT Kalbe Farma Indonesia.

Preparation of chitosan-alginate membrane

Ultrafiltration chitosan- alginate membranes were prepared by solution casting technique and were cross linked with cross linkers glutaraldehyde. In a typical synthetic procedure chitosan powder (1g) was dispersed in 25 mL of 2% acetic acid. A 3 g alginate g dissolved in aquades 100 ml. Both of condensation let one night. The solution of chitosan and alginate mixed with comparison of composition and chitosan of alginate equal to 3:1 (v/v). Hereinafter added 2 ml HCL 1% (v/ v) and 3 added NaOH 10% (b/v) and stirrer homogeneous

until. The condensation of chitosan formed to be alginate to be hushed during 1 hour is later then printed.

Preparation of glutaraldehyde cross linked chitosan alginate membrane.

The chitosan alginate membrane was immersed in a 50 ml glutaraldehyde 1% (v/v) at room temperature for 24 h. The membrane was washed and rinsed repeatedly with demineralization water and then dried at room temperature for 24 h.

Interaction functional groups membrane study using FT-IR

Spectra were recorded with a FT-IR Shimadzu FTIR 8400S spectrometer in range 400–4000 cm-1 using a resolution of 4 cm-1 and 10. Membrane 3mg was mixed with 15 mg of potassium bromide. The mixture was taken and compressed under 10-ton pressure in a hydraulic press to form a transparent pellet. To evaluate the functional groups of chitosan, glutaraldehide and membrane for the interaction study of them.

Mechanical Properties

The equipment used for glutaraldehyderrying out the test was Universal Testing Machine (UTM) with an operating head load of 5 kN. Cross-sectional area of the sample of known width and thickness was glutaraldehydelculated. The films were then placed between the grips of the testing machine. The grip length was 5 cm and the speed of testing was set at the rate of 12.5 mm/min. Tensile strength was glutaraldehydelculated using the equation

$$tensilestrength = \frac{\max imumload}{scross-sectorial}(\frac{N}{mm2}).$$

Swelling ratio

The swelling properties of the membrane were determined by following this procedure: membranes were placed in a glass vial containing of swelling solution. The swollen membrane were periodically removed and weighed. The wet weight of the swollen membrane was determined by blotting them with filter paper to remove moisture adhering to the surface, immediately followed by weighing on an electronic balance.

$$\%Swelling = \frac{Wa-Wb}{Wb} X100$$

Where, Wa and Wb represent the weight of swollen and dry samples, respectively.

Separation Uric Acid Using membrane

Ability of chitosan glutaraldehyde alginate as membrane of ultrafiltration tested to use appliance of dead-end. Membrane of citosan-glutaraldehyde-alginate be put down by in

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previous tester appliance underside have been arranged in layers with paper filter. This membrane hereinafter conducted by application of demineral water at membrane by plunged at demineral water, so that membrane pore can work more effective. Uric acid solution with various concentration entered into appliance one by one, called a meeting to order, and later then into that conducted by pressure 1 bar. Volume of permeate yielded to be to be accommodated in chemical glass. Concentration uric acid that analysis with spectrophotometer UV Vis at 546 nm with HUMAN uric acid reagent.

RESULTS AND DISCUSSION

Fourier transmission infra red study

Some peaks were observed which shows a broad-OH stretching absorption band between 3450 and 3100cm-1. Another major absorption band is between1220 and 1020 cm-1 which represents the free amino group (-NH2) at C_2 position of glucosamine, a major peak present in chitosan new bands at 1736 cm^{-1} and 1242 cm^{-1} were observed due to the asymmetric and symmetric stretching of –COO groups respectively. The band appearing at 1639 cm^{-1} in the spectrum of membrane glutaraldehyden be assigned to a symmetric $–NH_3C$ deformation, and broad bands appearing at 2500 cm^{-1} and 1900 cm^{-1} confirm the presence of $–NH_3C$ group in the membrane. The spectra confirmed that the glutaraldehyderboxylate groups of sodium alginate were dissociated to COO^- groups which complexed with protonated amino groups of chitosan through electrostatic interaction. Moreover, as the membrane formation proceeds, the O–H bonding would also be expected beglutaraldehydeuse of an increase in inter interaction such as hydrogen bonding between sodium alginate and chitosan.

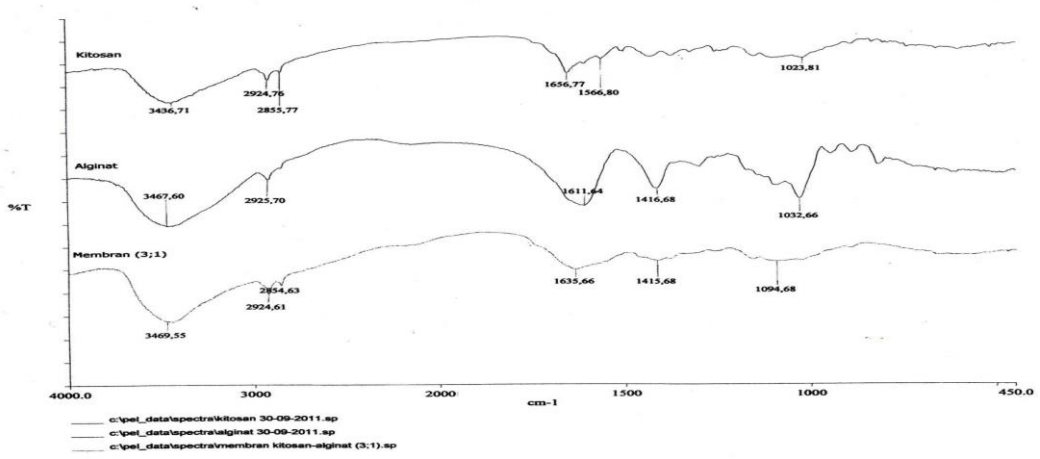

Figure 1: Spectra IR chitosan; alginate and chitosan glutaraldehyde alginate membrane

Membrane morphology of chitosan glutaraldehyde alginate membrane softer hard and flatten. Pore size measure able to identify by that is among 0.005-0.10 µm. membrane of chitosan glutaraldehyde alginate included in spanning membrane of ultra filtration where membrane characteristic of ultra filtration. Nature mechanic of membrane progressively with

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addition of crosslink agent glutaraldehyde at membrane of chitosan alginate in mixture like. The mentioned because glutaraldehyde of its structure which is meeting glutaraldehyd caeuse distance among molecule in membrane progressively meeting. Ever greater of modulus value of young hence having better ability to prevent the happening of damage which because glutaraldehyde of style coming from outside so that produce strong membrane.

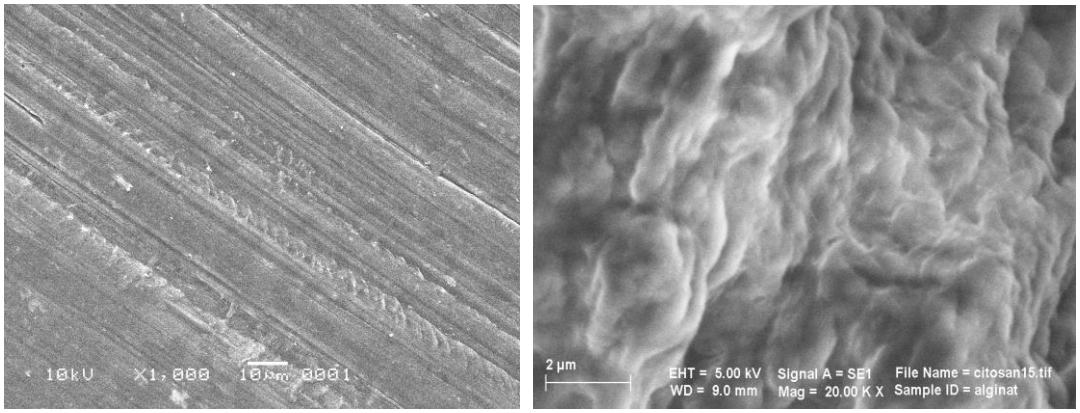

Figure 2: SEM study of chitosan glutaraldehyde alginate membrane

Addition of glutaraldehyde as crosslink agent to influence morphology structure of membrane, strengthening tying between molecule of chitosan and alginate so that its of softer membrane and this matter meeting differ from previous research which do not use crosslink agent at produce of membrane [19].

Swelling ratio

Data at tables 1 indicating glutaraldehyde that longer soaked of ability of swollen ratio of membrane ever greater, but membrane remain to be strong and glutaraldehyden be used. Existence of functioning glutaraldehyde as crosslink agent will form glutaraldehyde ion and form khelat with oxygen of guluronat of alginate. Tying is important in forming of strength of membrane of chitosan alginate. This matter is glutaraldehyde caused by distance between molecule in membrane will progressively and meeting formed pore at membrane will progressively small so that diffusion water difficult to into membrane glutaraldehyde causing ability small swollen.

Table1: Swelling ratio of chitosan glutaraldehyde alginate membrane

Time (minute)	0	10	20	30	40	50	60
Swelling (%)	0	15	27	43	54	65	87

Separation uric acid using membrane

Process filtered of sample at one particular membrane very influenced by structure, pore size measure, composition of polymer, nature of and molecules size measure and also its

concentration. Data at this research indicate glutaraldehyde that membrane of chitosan glutaraldehyde alginate have pore size measure at range membrane of ultafiltration, so that uric acid glutaraldehyde can be filtered better, while albumin representing a macromolecules glutaraldehyde cannot be filtered. Membrane chitosan glutaraldehyde alginate glutaraldehyde can filter uric acid until concentration 90 mg/l with amount of filtered uric acid 48.23 mg/l. At concentration above 100 mg/l ability of membrane in filtering uric acid start to decrease, because membrane pore have saturated by difficult to uric acid so that filter uric acid at concentration above 100 mg/l. At we previous research showed that membrane chitosan alginate glutaraldehyde can be used to filter of potassium ion [19]. So that this membrane glutaraldehyde can be used for the process of hemodialysis.

Table 2: Concentration of uric acid that was filtered with membrane

Initial concentration (mg/L)	Filtered concentration (mg/L)
0	0
5	2.34
10	6.52
20	11.09
30	17.12
40	23.45
50	33.78
60	34.89
70	38.67
80	41.89
90	48.23
100	42.02
110	37.51
120	32.32

CONCLUSIONS

Addition of glutaraldehyde as crosslink agent to influence morphology structure of membrane, strengthening tying between molecule of chitosan and alginate so that its of softer membrane. Ever greater of modulus value of young hence having better ability to prevent the happening of damage which because glutaraldehyde of style coming from outside so that produce strong membrane. Analysis of surface and pore size showed membrane in range of ultra filtration membrane and did not reveal any new functional groups so that the membrane formation occurred only electrostatic interaction. This membrane was able to filter out uric acid concentration of 90 mg/l, with the amount of uric acid filtered 48.23 mg/l.

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