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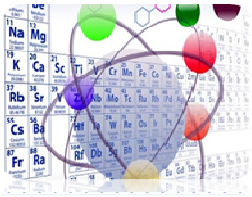

Characterization of Molecularly Imprinted Polymers (MIPs) as Cholesterol-Absorbing Materials

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ABSTRACT

Molecularly Imprinted Polymer (MIP) membranes as cholesterol absorbers have been successfully synthesized. MIP membranes can absorb cholesterol molecules because they have cavite (pores) and active groups that are selective and sensitive to cholesterol molecules. MIP membranes are synthesized from butyl acrylate monomers, cross-linkers, ethylene glycol dimethacrilate (EGDMA), initiators of 2-2-dimethoxy-2-phenylacetophenone (DMPP, sodium dodecyl sulfate (SDS) as surfactants, and cholesterol as templates. MIP membranes are synthesized using photopolymerization irradiated with UV light. The results obtained in the form of powder solids can be characterized using UV-Vis spectrophotometry. The results obtained by UV-Vis spectrophotometry showed that the MIP membrane prepared a standard curve with a linear regression equation y = 0.0054x-0.007 with a value of R2 = 0.9982. This suggests that MIP membranes are selective and sensitive to analytes. At optimum absorption of the MIP-cholesterol membrane can absorb cholesterol molecules in the amount of 0.020 grams of cholesterol composition within 20 minutes

Keywords: MIPs cholesterol, photopolymerization, UV-Vis spectrophotometry, cholesterol.

1. INTRODUCTION

Cholesterol is a steroid compound found in animals and humans. Normally cholesterol is produced by itself in the human body at the right amount.[1] Cholesterol present in animals and humans comes from the body's cholesterol synthesis and dietary intake. Cholesterol can also harm the body depending on how much cholesterol levels are present in the body. One example of a disease caused by cholesterol is Hypercholesterol (excessive cholesterol levels).

Physical and chemical properties of cholesterol that can dissolve in fat solvents, such as ether, chloroform, benzene, hot alcohol, acetonitrile, and slightly soluble in cold water. The form of cholesterol is colorless, tasteless and odorless when in high concentrations. The chemical properties of cholesterol such as having a melting point of 150°C - 151°C and a boiling point of 360°C.[2] In the blood the desired blood

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cholesterol ≤ 200 mg/dl).[3] If the cholesterol in the blood exceeds 200 mg/dl it can cause most cardiovascular diseases such as atherosclerosis, heart disease and others.[4]

MIPs (Moleculary Imprinted Polymers) are polymeric compounds in which functional monomers and crosslinkers print bonding sites to bind analytes, bound analytes have the same characteristics and properties as templetes that have been synthesized.[5] To have MIPs that are selective of template molecules, there are several things that need to be reviewed, namely the use of functional monomers, solvents and the appropriate ratio of template or functional monomers in their synthesis.

MIPs are considered necessary in various chemical analyses, especially food and health. In the field of analytical chemistry is a major development area for MIPs that have been well-known in several countries, there are many nooks or gaps for the development of MIPs applications. The ease of preparation makes MIPs one of the research fields that deserve to be developed.

Based on this, researchers are interested in conducting research with the title Molecularly Imprinted Polymers (MIPs) based on butyl acrylate as a cholesterol absorbing ingredient. MIPs are made by reacting cholesterol templates with monomers, crosslinkers, initiators by the potopolymerization method.[6]

2. EXPERIMENTAL

2.1. Chemicals, Equipment and Instrumentation

The tools used are photopolymer, sonication (ultra sound), UV-Vis spectrophotometer. The ingredients used are cholesterol, photoinitiator 2-2-dimethoxy-2-phenylacetophenone (DMPP), normal Butyl Acrylate (nBA), cross linker ethylene glycolmethacrylate (EGDMA) Sigma-Aldich, acetonitrile (C2H3N) and sodium dodecyl sulfate (SDS).

2.2. Research Procedure

2.2.1. The effect of MIP absorption on cholesterol

1.Synthesis of MIPs (Molecularly Imprinted Polymers)

MIP was synthesized following a method conducted by Dedi et al., 2013 with a slight modification where the templete molecule 17b- Estradiol was replaced with cholesterol. Mixing cholesterol as much as 0.1508 grams, normal Butyl Acrylate 112.3 µL, ethylene glycol dimethacrylate (EGDMA) as cross linker as much as 146.5 µL, 2-2-dimethoxy-2-phenylacetophenone (DMPP) 0.006 grams, 0.1125 grams of sodium dodecyl sulfate, and 5 ml aquades, this mixture was sonicated for 20 min, until a milky white emulsion was obtained. Furthermore, polymerization uses ultraviolet light for 600 seconds under a continuous stream of nitrogen gas. MIP microspheres were collected using 13,000 rpm centrifugation for 30 minutes, carefully washed using aquades three times and allowed to dry at room temperature.

2.Preparation of cholesterol standard curves using UV-Vis spectrophotometry

Standard curves are made with concentration variations (40, 60, 80, 100, 120, 140), then cholesterol regaen is added. Absorbance is measured using a UV-Vis spectrophotometer. After the absorbance is obtained it is entered into the calibration curve equation as the y value and x value for the solution concentration. Create a linear regression equation with the formula y = ax + b.

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3.The effect of MIP time on cholesterol absorption

A total of 6 ml of cholesterol solution with various MIP masses (0.005; 0.010; 0.015; 0.020) grams was soaked for 24 hours, then MIP was collected by centrifugation. The filtrate portion is taken to determine the amount of cholesterol left with a UV-Vis spectrophotometer instrument.

4. The effect of the length of MIP absorption time on cholesterol

The maximum mass obtained is put into each 6 ml of cholesterol solution with varying soaking times (10, 20, 30, and 40) minutes. After adsorption at that time, the solution is centrifuged, then taken filtrate added with reagents, cholesterol levels are analyzed using a UV-Vis spectrophotometer.

3. RESULTS AND DISCUSSION

3.1. Analysis of MIPs synthesis results

The synthesis of MIPs was carried out following the method of Dedi et al., 2013 with a slight modification where the templete molecule 17b-Estradiol was replaced with cholesterol and methacrylic acid was replaced with butyl acrylate. In this study, cholesterol was used as a template molecule synthesized with butyl acrylate monomers, EGDMA crosslinkers, and DMPP initiators. The resulting synthesis of MIPs is shaped like a solid powder.

3.2 Standard cholesterol curve preparation using UV-Vis spectrophotometry

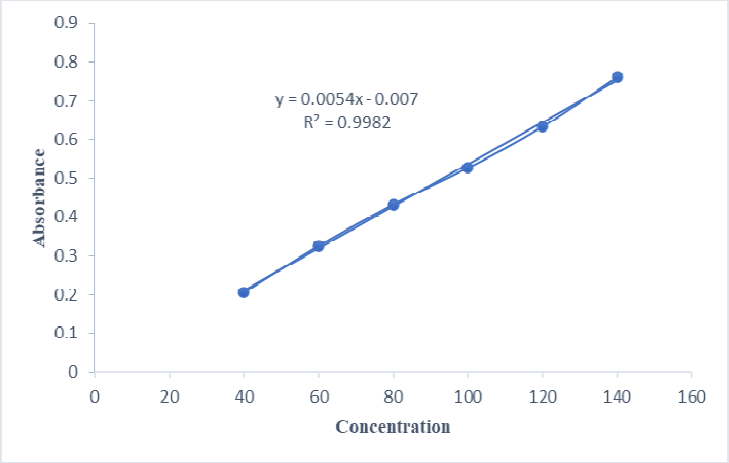

Figure 1. Stanndar cholesterol curve

According to the Lambert-Beer law, that is, if the concentration increases then the number of molecules through which a beam of light passes increases, so the absorption will also increase. This is similar to the results of the calibration curve below showing that the greater the increase in concentration, the absorbance will increase.[7] From the results of the calibration curve, the linear regression equation y = 0.0054x - 0.007

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with the value of R2 = 0.9982. This regression equation is used to determine the concentration of cholesterol left in solution after soaking with MIPs by calculating the x value of the regression equation.

3.3 Effect of MIP period on cholesterol absorption

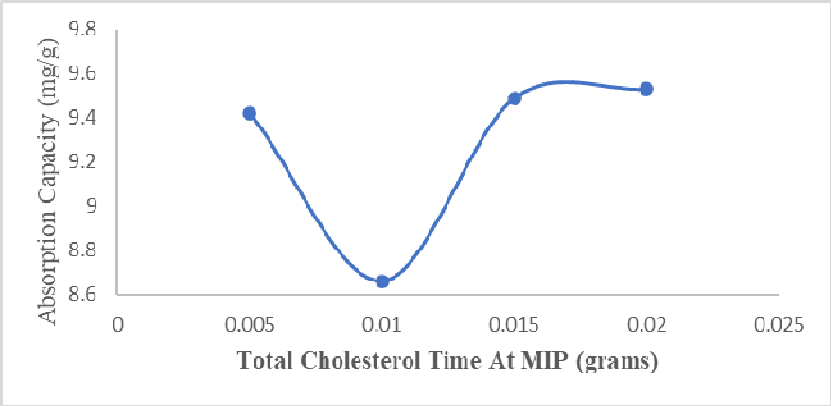

Figure 2. MIPs membrane absorbency efficiency curve over time

The picture above proves that the greater the amount of MIP-cholesterol mass, the greater the concentration and percentage of absorption of cholesterol molecules, this is caused when the MIP-extraction process is formed Kavita (cavity) or pore so that MIP-cholesterol binds more to absorption. Based on the picture above, 0.020 grams is the maximum absorption time of MIP-cholesterol. The amount of cholesterol composition of 0.005 grams decreases, this is because the absorption concentration in the MIPs cholesterol membrane is greater than the concentration of cholesterol remaining in the solution. This difference causes it to be desorbed back into solution.[8] The optimum adsorption condition was achieved at the use of 0.020 grams of cholesterol so that in this study a mass of 0.020 grams was used for the manufacture of MIPs.

3.4 Effect of absorption time of MIPs on cholesterol

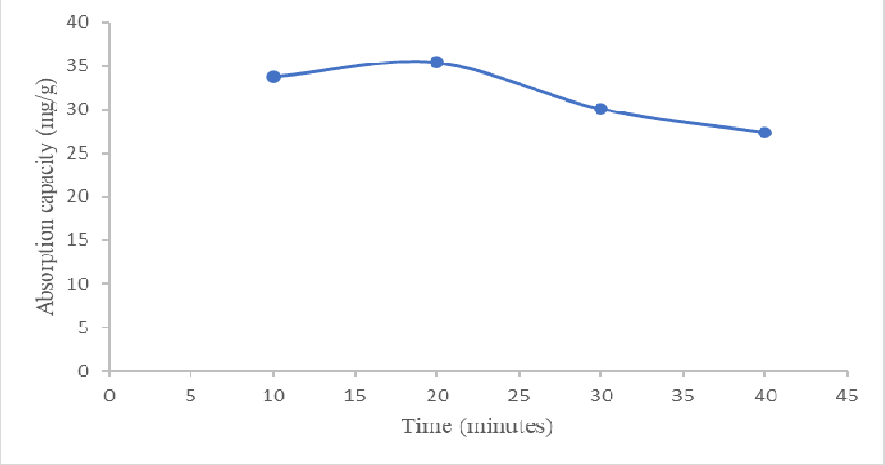

Figure 3. MIPs membrane absorbency efficiency curve over time

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The figure above shows that with increasing time, the concentration of cholesterol adsorbed by MIP also increases so that the maximum time for the highest adsorption is obtained at 20 minutes. This occurs because cholesterol interacts to form hydrogen bonds with functional groups of butyl acrylate monomers forming MIPs.[9] The longer the absorption time, the more cholesterol that interacts to form hydrogen bonds with the functional groups of the monomers forming MIPs, so that the higher the absorption power produced.[10] The decrease that occurs is because MIPs are not able to adsorb cholesterol in solution anymore so that cholesterol that has been bound to MIPs will be desorbed back into solution.

4. CONCLUSION

In membrane absorption, MIPs can optimally absorb cholesterol molecules with an optimum cholesterol period of 0.005 grams with a soaking time of 20 minutes.

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