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Conference Paper

Rajungan Shell (*Portunus pelagicus*) as Antitoxic Mask Coated with Chitosan Polymer Medium (CPM) For Nicotine Reduction Using Spray Coating Method

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ABSTRACT

Exposure to cigarette smoke in passive smokers has a bad impact because the substances inhaled are 4-6 times greater than the levels inhaled by active smokers. Nicotine is a dangerous substance in cigarettes that can cause respiratory disease. Crab shell waste in Indonesia is very abundant and has a chitin content of 50%-60%. Thus, the purpose of this study was to determine the effectiveness of Rajungan Shell (*Portunus pelagicus*) as an antitoxic mask coated with Chitosan Polymer Medium (CPM) for nicotine reduction using the spray coating method. Variations in CPM variables were concentrations of 10,000 ppm, 20,000 ppm, 30,000 ppm, 40,000 ppm, and 50,000 ppm with a total of 3 sprays, 5 sprays, and 7 sprays. The results obtained were the degree of deacetylation 69.45%, percent nicotine removal 80.73%, and adsorption capacity of 4,9993 mg/g.

Keywords: Rajungan shell, Chitosan Polymer Medium (CPM), spray, mask, and nicotine

Introduction

According to World Health Organization (WHO, 2020), there are 3.8 million fatalities from cigarette smoke pollution, with 60.8 million adult male smokers and 3.7 million adult female smokers in Indonesia. The main cigarette smoke is that created by smokers who are actively smoking and contains 25% of harmful substances, while the side cigarette smoke is that produced by smokers who are passively smoking and contains 75% of harmful substances (Nurjanah et al., 2014).

Nicotine (β-pyridil—N-methyl pyrrolidine), an organic chemical molecule that is a member of the alkaloid family, is present in cigarettes in hazardous amounts (Alegantina, 2018). Among other things, smoking has risks that can promote the growth of cancer (Schaal & Chellappan, 2014) and lung cancer development brought on by the CYP2B6 genetic variant (Wassenaar et al., 2013). In the liver, CYP2A6, UDP-glucuronosyltransferase, and flavin-containing monooxygenase metabolize more than 80% of the ingested nicotine (Alegantina, 2018). According to Government Regulation of the Republic of Indonesia Number 109 (2012), as much as 85-90% of nicotine is metabolized before elimination through renal excretion.

The waste from processing crabs is mostly in the form of hard shells (shells) 70-80% are often discarded or only used as a mixture of animal feed, flavorings in making crackers, and shrimp paste. If the waste is left unchecked, it will cause environmental pollution and endanger human

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health. This is because the waste increases biological oxygen demand (BOD) and chemical oxygen demand (COD).

In general, crab shells contain protein (15.60% - 23.90%), calcium carbonate (53.70% - 78.40%) and chitin (18.70% - 32.20%) (Focher et al., 1992). Das et al. (1996) observed that the chitin content was 16.7% (leg), 11.67% (carapace), and 10.42% (claw) in green crab (Scylla serrate) and blue crab (*Portunus pelagicus*) was 20.18% (legs), 13.51% (carapace), and 11.67% (paws) **(**Chakraborty et al., 2010).

Chitosan is a chitin derivative compound and has the same chemical structure as chitin, consisting of a long molecular chain and a high molecular weight. Chitosan is a biopolymer that is unique in that it is in an acidic solution and cannot be dissolved in neutral and alkaline solutions. A good solvent for chitosan is acetic acid. Chitosan Polymer Medium (CPM) is a derivative form of chitosan with a smaller polymer size when compared to large polymer chitosan. The manufacture of CPM comes from powdered chitosan which is dissolved using acetic acid and aquadest, then sizing is done using a magnetic stirrer so that the chitosan polymer becomes shorter (Mardani et al., 2015).

Based on the description of the problems above, it is very necessary to do further research on reducing the effect of exposure to cigarette smoke on passive smokers using modified masks and utilizing crab shell waste which has high chitin content as Chitosan Polymer Medium (CPM). The analysis used is Gas Chromatography Mass Spectrometry (GCMS) to test the adsorption gas content and functional groups (Wahyudi et al., 2020), Scanning Electron Microscope (SEM) to determine the surface morphology, shape and size of the Chitosan Polymer Medium (CPM) sample, and Fourier Transform Infrared (FTIR) to determine the structure and degree of deacetylation of Chitosan Polymer Medium (CPM) (Mardani, 2015). So the researchers took the initiative to conduct research on the Shell of the Crab (*Portunus pelagicus*) as an Antitoxic Mask Coated with Chitosan Polymer Medium (CPM) for Nicotine Reducing Using the Spray Coating Method.

Material and Methods

A sample of termite nests was collected in September 2016 from Pananjung Pangandaran Nature CPM solutions with concentrations of 1%, 2%, 3%, 4%, 5% were used to determine the effect of chitosan concentration in absorbing nicotine in cigarette smoke. The performance process of the CPM mask begins with placing a cloth mask that has received CPM spraying treatment, then inserting a cigarette that has been burned with 14.4 mg of nicotine contained in 6 cigarettes. Cigarette smoke will pass through the mask and will be accommodated in a chamber containing a methanol solution. Cigarette smoke gas in the chamber is then detected using mass spectrometry gas chromatography. The design of the CPM mask performance model and its application to the mask is shown in Figure 1.

Figure 1. Mask application process

Results and Discussion

Morphology and degree of deacetylation

The surface of the Chitosan Polymer Medium (CPM) of crab shells can be seen using Scanning Electron Microscopy (SEM) to determine the morphology which includes the shape and size of the Chitosan Polymer Medium (CPM) pores. Observation of SEM Chitosan Polymer Medium (CPM) of crab shells with a magnification of a thousand times can be seen in Figure 2.

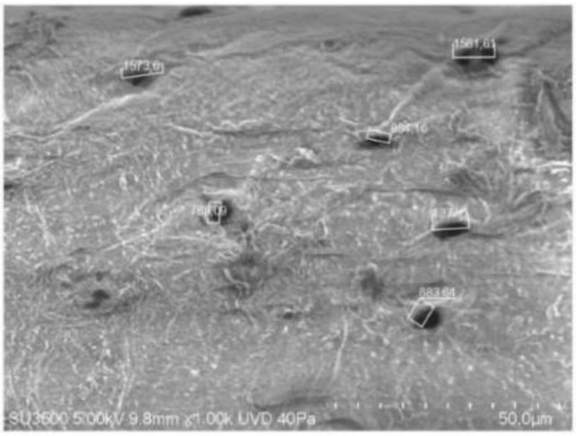

Figure 2. Results of Scanning Electron Microscopy (SEM) Chitosan Polymer Medium (CPM) crab shells

Based on Figure 2, the SEM test with a magnification of a thousand times the sample of Chitosan Polymer Medium (CPM) of crab shells has a pore diameter of ± 0.79 m – 1.57 m with medium porosity and spread pore locations. The formation and addition of new pores on the surface of Chitosan Polymer Medium (CPM) are caused by the use of acetic acid and NaOH in the CPM manufacturing process (Nurlaeli et al., 2014). Thus increasing the adsorption capacity or the entrapment ability of the adsorbent to the adsorbate. The chitin content in crab shells reaches 50%-60% (Dali et al., 2016).

The size reduction process occurs during the manufacture of CPM using a magnetic stirrer. The kinetic theory of gas molecules states that gas molecules often collide with each other and react with each other. The rate of the reaction will be directly proportional to the number of molecular collisions per second, or directly proportional to the frequency of molecular collisions. The faster the rotation, the greater the intensity of the solvent molecules to come into contact with the chitosan, so the greater the intensity of the rotational speed on the magnetic stirrer the smaller the particles produced (Suptijah et al., 2011)

Functional group analysis using Fourier Transform Infra-Red Spectrometry (FTIR) obtained the results of the IR Spectrum of Chitosan Polymer Medium (CPM) of crab shells in Figure 3.

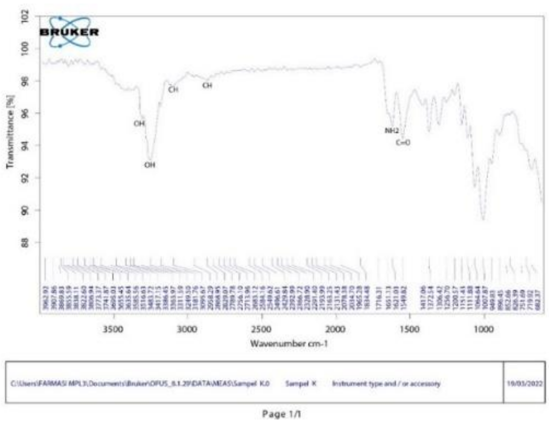

Figure 3. Results of the IR Spectrum of Chitosan Polymer Medium (CPM) of crab shells

The degree of deacetylation of CPM was determined using the infrared spectrum. The frequency used ranges from 4000 cm-1 to 400 cm-1. The degree of deacetylation of CPM was determined by the baseline method found by Moore and Robert. The formula used is:

$$DD = 100 - \left(\frac{A1655}{A3450} \times \frac{100}{1{,}33}\right)$$

Information
A1655 = amide group wave number (1650/cm – 1500/cm)
A3450 = primary amine group wave number (3500/cm – 3200/cm)
Based on the calculation of the baseline method the value of the degree of deacetylation of The Chitosan Polymer Medium (CPM) of crab shells was 69.45%.

Effect of concentration and total spraying of CPM in reducing nicotine

The effect of the concentration of Chitosan Polymer Medium (CPM) can be known by comparing the percent removal to the variation of spraying. The results of the comparison of the effect of concentration on the type of Chitosan Polymer Medium (CPM) of crab shells can be seen by comparing the percent removal to spraying variations according to Figure 4.

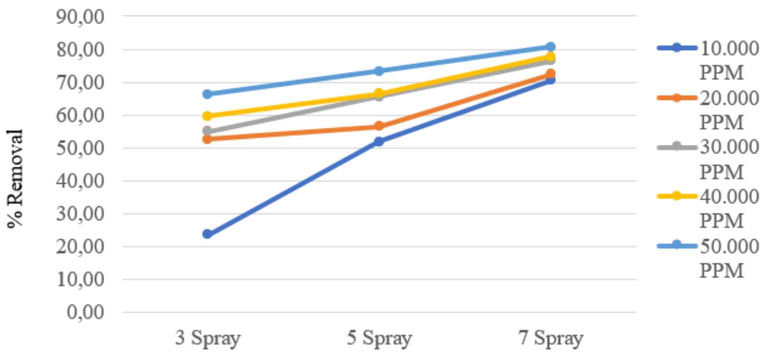

Figure 4. The relationship between percent nicotine removal and spraying quantity at various concentrations of crab shell CPM

The more the total spray and the higher the concentration of CPM, the more nicotine will be adsorbed because there are more opportunities for CPM particles to come into contact with nicotine. This causes more and more nicotine to bind to the CPM pores.

The graph above describes the use of Chitosan Polymer Medium (CPM) for crab shells with different total sprays and CPM concentrations. Optimal nicotine removal results in the Chitosan Polymer Medium (CPM) of crab shells were obtained with a total of 7 sprays and a concentration of 50,000 ppm with a nicotine removal of 80.73%.

Conclusion

Chitosan Polymer Medium (CPM) of crab shells has a pore diameter of ± 0.79 m – 1.57 m with medium porosity and spread out pore locations. The functional group and degree of deacetylation of Chitosan Polymer Medium (CPM) crab shells were 69.45%. The effectiveness of the mask coated with Chitosan Polymer Medium (CPM) in crab shells in reducing nicotine was 80.73%. So it can be concluded that the crab shell (*Portunus pelagicus.*) as an Antitoxic Mask with Chitosan Polymer Medium (CPM) Coating Using the Spray Coating Method is effective in reducing nicotine in cigarette smoke.

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