Adsorption of β-Carotene Contained in Crude Palm Oil (CPO) Using Pineapple Peel Activated Carbon

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Abstract

This research aims to adsorb β-carotene which gives CPO (Crude Palm Oil) an orange-red color using activated carbon. Activated carbon is activated carbon activated by a chemical substance so that it has a higher absorption capacity compared to ordinary carbon. Pineapple skin contains 10% active carbon which can be used as a material for absorption. One material that can be used as carbon is pineapple skin. Pineapple peel is also a type of waste that is underutilized by society. Pineapple peel contains 5.80% crude protein, 26.00% crude fiber, 4.70% lignin and 31.14% cellulose. The cellulose compound contained in pineapple skin has the potential to be used as an alternative adsorbent. Pineapple peel carbon was made by carbonizing for 1 hour at 300^{o}C and activated using NaOH 1 M for 1.5 hours. The results showed that activation time had a significant effect on the adsorption capacity of CPO (Crude Palm Oil).

Keyword: adsorption, β-carotene, activated carbon

INTRODUCTION

Indonesia is one of the largest crude palm oil (CPO) producing countries in the world. In 2022, the total production of palm oil plantations in Indonesia will be 45.58 million tons. This number increased by 1.02% from the previous year where in 2021 the total production of oil palm plantations was 45.12 million tons

(BPS, 2022). This increase in production is due to the increasing area of oil palm plantations in Indonesia.

One of the ingredients contained in CPO is beta carotene. Beta carotene is one of the carotenoid products. Carotenoids that give crude palm oil its orange-red color. The color of unprocessed palm oil is not liked by consumers. Various methods of extracting carotenoids from coconut oil have been used. Including saponification, adsorption processes, selective solvent extraction, and transesterification processes followed by distillation. A process that is cheap and easy to do is the adsorption method. This process uses an absorbent substance (adsorbent) which has high surface activity to absorb beta carotene in CPO.

The adsorbent most widely used in the oil and fat bleaching process is bleaching earth such as pillared clay, bentonite, activated carbon, alumina, silica and others (Hasibuan et al, 2017). Among several types of simple, economical adsorbents is activated carbon. Many people have made or developed active carbon raw materials, for example making active carbon from coconut shells, various kinds of wood and bamboo, coal, and also materials that have a fairly high carbon content (Miranti, 2012). One ingredient that can be used is pineapple peel.

The cellulose, hemicellulose and lignin compounds contained in pineapple skin have the potential to be used as natural adsorbents. Cellulose is a compound that has been widely developed as an adsorbent to bind or reduce heavy metal levels, purify water, absorb color and odor (Sofyan et al, 2020). Based on the study above, the author chose the title Adsorption of β-Carotene Contained in Crude Palm Oil (CPO) Using Pineapple Peel Activated Carbon.

2. RESEARCH METHOD

2.1 Materials and Tools

The tools used in this research Furnace, Magnetic stirer, Funnel buncher, Erlemeyer, Measuring cup, Hot plate, Vacuum pump, Beaker glass, Oven, Blender, Analytical balance, Burette, Stative, pH indicator, Porcelain dish, Volume pipet, Desiccator, Trya pan, Filter paper, Sieve 100 mesh, Stirring rod, Stop watch.

The materials used in this reseacrh Crude palm oil (CPO), NaOH, Aquades, and Pineapple peel.

2.2 Research Procedure

This research procedure begins with the preparation of raw materials to be used by separating them from the dirt attached to the pineapple weevil. Then proceed with the manufacture of activated carbon, namely by carbonizing pineapple weevils to get activated carbon after which pineapple peel carbon activation is carried out using activators, namely NaOH (Sodium Hydroxide), and CPO adsorption is carried out with activated pineapple weevil activated carbon that has been activated.

2.2.1 Preparation of Raw Materials

Preparation of raw materials begins with the sampling of Pineapple peel waste. Then carry out the washing process on the Pineapple peel sample and Pineapple peel cutting which aims to remove dirt attached to the Pineapple peel. After the Pineapple peel waste sample is clean, drying is carried out first using sunlight and continued with the drying process using an oven at 105^{o}C to ensure the Pineapple peel has dried.

2.2.2 Pineapple Peel Carbonization

The stages of carbonization are carried out by means of a dried Pineapple peel weighed as much as 100 grams. The Pineapple peel sample is filled into the rector and put into *the furnace* for carbonization process at a temperature of 300^{o}C with a time of 1 hour. The results of the carbonization process are cooled and smoothed using a *chopper*.

2.2.3 Carbon Activation

The activation carried out in this study is chemical activation. Performing chemical activation, 2 grams of carbon or Pineapple peel charcoal were soaked in 20 ml of NaOH solution with a concentration of 1M (ratio 1 : 10) with time variations of 1.5 hours. Pineapple crown is put into NaOH (Nartrium Hydroxide) solution and continued with stirring using a *hot plate* and *magnetic stirrer* for 1.5 hours. Stirring is carried out so that the solution becomes homogeneous. Then the washing process is carried out using filter paper and aquades solution with the help of a vacuum pump until the washing pH 7 (neutral) is obtained. After

washing, proceed with the drying process using an oven at a temperature of 105^{o}C with a time of 12 hours so that it becomes activated carbon.

2.2.4 Adsorption Test

For the first step, prepare activated carbon and Crude Palm Oil (CPO) in a ratio of 1: 5 in a beaker glass. After that, the mixture is heated using a hot plate to reach a temperature of 60^{o}C and then homogenized using an electric motor at a constant speed of 12 rpm. After reaching the desired temperature and homogenization, the mixture is taken periodically every 2 minutes until it reaches an equilibrium state. The last step, the sample is filtered using filter paper.

In β-carotene, the adsorption process is carried out in a beaker glass with a weight ratio between activated carbon and palm oil of 1:3. Next, the mixture is heated using a hot plate to reach a temperature of 40^{o}C and homogenized by using an electric motor at a speed of 120 rpm for 2 hours. After that, the mixture is filtered using filter paper. After the filtering process is complete, the mixture is transferred into a container for analysis.

3. RESULTS

The quality of edible oil is determined by several factors, among others, peroxide number, free fatty acid content and oil color. Therefore, the analysis carried out is the analysis of free fatty acid levels, peroxide number and oil color.

3.1 Carbon Activated

Activated carbon is activated for 1.5 hours, 2 hours, and 3 hours with a drying time of 12 hours. Activation using 1M NaOH solution.

Figure 1. Activated Carbon

3.2 Adsorption

The adsorption test was carried out using a hot plate and glass beaker with a ratio of 1: 3 for 2 hours at a speed of 120 rpm at a temperature of 40^{o}C.

Figure 2. Adsorption

4. CONCLUSION

This research includes physical and chemical characterization of the activated carbon produced, as well as assessing the ability of the activated carbon to absorb CPO. The results showed that activation time had a significant effect on the properties of activated carbon, including surface area and adsorption strength on CPO. This research makes a positive contribution in managing pineapple crown waste and reducing environmental pollution due to CPO, while also opening up opportunities for the development of environmentally friendly adsorbents in the palm oil processing industry.

5. REFERENCE

[1] H. A. Hasibuan, L. Afriana and D. Tamba, "Pengaruh Dosis Bleaching Earth Dan Waktu Pemucatan Crude Palm Oil yang Bervariasi *Deterioration Of Bleachability Index* (Dobi) Terhadap Mutu Produk," Jurnal Teknologi Industri Pertanian, vol. 27, no. 1, pp. 69-75, 2017. DOI: 10.24961/j.tek.ind.pert.2017.27.1.69.

[2] Miranti, S., T., Sudibandriyo, M., (2012). Pembuatan Karbon Aktif Dari Bambu Dengan Metode Aktivasi Terkontrol Menggunakan Activating

Agent H3PO4 Dan KOH, Laporan Penelitian, Jurusan Teknik Kimia, Fakultas Teknik, Universitas Indonesia.

[3] Sofyan, A., Kurniaty, N., & Wisnuwardhani, H. A. (2020). Pembuatan dan Karakterisasi Karbon Aktif dari Kulit Nanas (*Ananas comosus* (L.) *Merr*) Menggunakan Aktivator H2SO4. *Prosiding Farmasi*, *6*(2), 768-773.