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BIOFILTER MANUFACTURE OF AZADIRACHTA INDICA LEAF POWDER AND ITS EFFECTIVENESS IN CAPTURING FREE RADICALS OF CIGARETTE SMOKE

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ABSTRACT

Free radicals from cigarette smoke are a dangerous part that must be found to counteract. This research aims to make a composite biofilter made from Azadirachta Indica to ward off/capture free radicals from cigarette smoke. This biofilter is made with Azadirachta Indica leaf powder added to polyethylene glycol as the matrix. The biofilter was then seen for its physical characteristics; the density and porosity were tested using SEM. Furthermore, a biofilter membrane is used to filter cigarette smoke. Cigarette smoke that passes through the biofilter is then analyzed using ESR for its free radical content. The results showed that the biofilter made from Azadirachta Indica leaves could absorb several types of suspected free radicals in cigarette smoke. Biofilters using PEG as a matrix with a mass of 0.9 and 1gr were the most effective in absorbing the suspected types of free radicals. SEM test showed an average pore size of 2-3 μm for a mass of 1gr with PEG as the matrix.

Keywords: biofilter, cigarette smoke, Azadirachta Indica, free radicals

INTRODUCTION

Cigarettes are a controversial product because of the pros and cons in society. The many adverse effects, such as the effects of addiction and health problems caused to the increasing death rate due to excessive cigarette consumption, are being challenged by people worldwide [1,2]. Every May 30, the world community celebrates No Tobacco Day as a form of protest against tobacco, the main ingredient of cigarettes. On the other hand, from an economic point of view, there is no doubt about the prospect of the cigarette industry because it is very promising, especially regarding the amount of foreign exchange income to the country and providing employment opportunities for many people [3].

Smoking can cause changes in the structure and function of the airways and lung tissue. Cigarette smoke will accelerate the decline in lung function and have a more significant effect than dust on the respiratory tract [4].

Oxidative stress/damage from cigarette smoke exposure plays an essential role in developing tobacco smoke-induced diseases. Carbonyls and free radicals are the two main classes of oxidants in tobacco smoke [5].

Cigarette smoke consists of a mixture of chemical substances in the form of gas and particles dispersed in it. To date, various chemical substances have been isolated, the number of which reaches 3000 compounds in the tobacco leaf itself and reaches more than 4000 compounds in cigarette smoke [6]. Most of these materials or compounds are toxic to various cells in our bodies. Toxic substances are in the form of gases, namely carbon monoxide (CO), hydrogen cyanide (HCN), and nitrogen oxides. Meanwhile, toxic substances in the form of volatile chemicals such as nitrosamines and formaldehyde are found in cigarette smoke. These substances can exert their toxic effects by specific mechanisms and on certain cells or macromolecular units of cells, especially in the respiratory system.

There have been many epidemiological studies on the effects of smoking, and it has been proven that smoking can increase the risk of developing COPD (Chronic Obstructive Pulmonary Disease), lung cancer, and cardiovascular diseases [7].

The presence of free radicals causes various diseases in the body—high amounts of free radicals in cigarette smoke. Free radicals are unpaired atoms or unstable molecules, so they will look for partners by binding to other molecules around them [8].

Azadirachta leaves have a relatively high antioxidant content [9,10], which can be used to make biofilters to capture free radicals in cigarette smoke. In this study, the leaves of the Azadirachta plant will be used as materials for making biofilter composites to ward off free radicals in cigarette smoke.

METHOD

Making Azadirachta indica leaf biofilter consists of several stages. The first step is to dry the leaves of Azadirachta indica using sunlight, then the material is ground and sieved using a 200 mesh sieve. The manufacture of this biofilter uses a solution of polyethylene glycol (PEG) as a matrix.

The powdered material was mixed with 0.3ml of PEG as a matrix and stirred until homogeneous. Each sample used variations in the composition of Azadirachta indica leaf powder 0.7, 0.8, 0.9, and 1gr with a matrix of 0.3ml.

A homogeneous mixture of filler and matrix was then printed using a 7cm hose and dried at room temperature. If the sample can be removed from the mold, it is heated using an oven at 105^0C for 20 minutes. This heating aims to remove the water content trapped in the biofilter. Then a biofilter is used to filter cigarette smoke. Next, the smoke of cigarettes was analyzed for the type of free radicals using the ESR tool, and the best results from the ESR were analyzed for the porosity and density values using the SEM tool.

Testing of free radicals in filter cigarette smoke uses ESR (Electron Spin Resonance), first, the instrument calibration is carried out using DPPH. The frequency value then determines the DPPH placed in the coil (f) and current value (I), which is then calculated for the g factor, and determined the type of suspected free radicals from cigarette smoke filters kretek cigarettes.

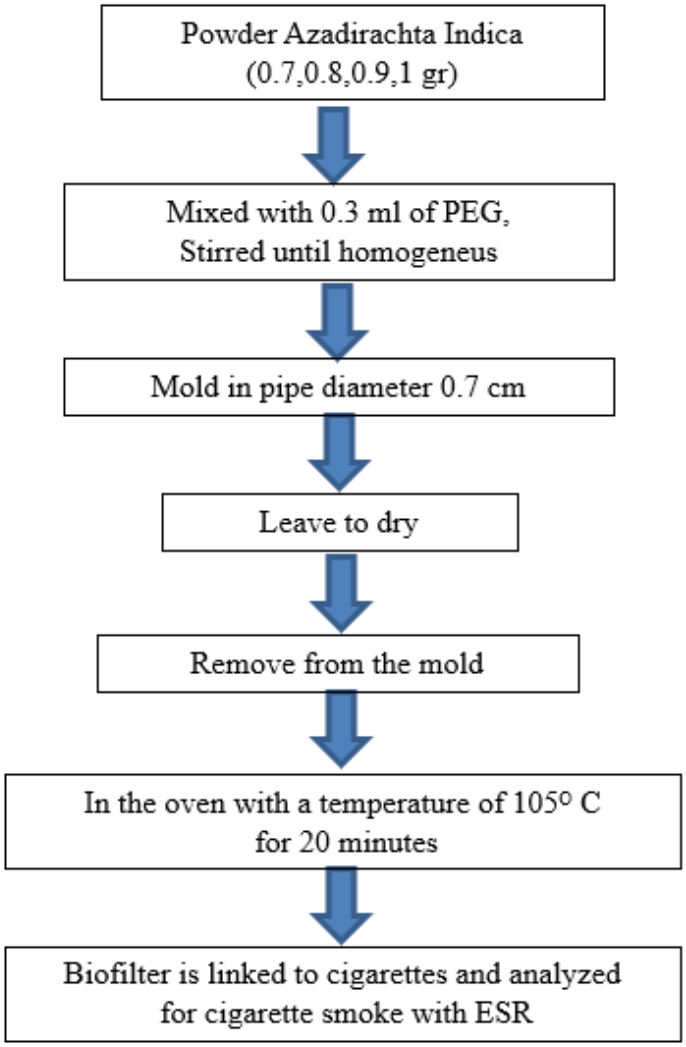

FIGURE 1. Rearch Flow

RESULT AND DISCUSSION

ESR detects 7 types of free radicals in non-filtered kretek cigarettes, namely Hydroperoxide, CO2-, C, Peroxy, O2-, CuOx, and $CuGeO_3$ as shown in TABLE 1. After the Azadirachta Indica leaf powder biofilter is installed, the types of free radicals are obtained as in TABLE 2.

TABLE 1. Types of Suspected Smoke Free Radicals Cigarettes Filter Clove Cigarettes

No	Types of Smoke-Free Radicals Kretek Cigarettes
1	Hydroperoxide
2	CO
3	C
4	Peroxy
5	O
6	CuOx
7	CuGeO

TABLE 2.Types of suspected free radicals found in kretek cigarette smoke with Dirachta Indica powder biofilter

Test	Azadirachta Indica Mass (g)	Types of Free Radical Hydroperoxide	CO_2^-	C	Peroxy	O	CuOx	$CuGeO_3$
I	0.7						Stand	Stand
	0.8						Stand	Stand
	0.9							Stand
	1							Stand
II	0.7						Stand	Stand
	0.8						Stand	Stand
	0.9							Stand
	1							Stand
III	0.7						Stand	Stand
	0.8						Stand	Stand
	0.9							Stand
	1							Stand

TABLE 3. Examples of calculations to estimate the type of free radicals

Powder Azadirachta indica	f (Hz)	I (A)	B (T)	Factor-g	Suspected types of free radicals
	33.0	0.273	0.00115514	2.0410038	CuOx
	33.1	0.273	0.00115514	2.0471887	CuOx
	33.2	0.273	0.00115514	2.0533735	CuOx
	33.3	0.273	0.00115514	2.0595584	CuOx
	33.4	0.273	0.00115514	2.0657432	CuOx
	33.5	0.273	0.00115514	2.0719281	CuOx
	33.6	0.273	0.00115514	2.078113	CuOx
	33.7	0.273	0.00115514	2.0842978	CuOx
	33.8	0.273	0.00115514	2.0904827	CuOx
	33.9	0.273	0.00115514	2.0966675	CuOx
	34.0	0.273	0.00115514	2.1028524	CuOx
	34.1	0.273	0.00115514	2.1090373	CuOx
	34.6	0.272	0.00115091	2.1478291	$CuGeO_3$
	34.7	0.272	0.00115091	2.1540367	$CuGeO_3$
	34.8	0.272	0.00115091	2.1602443	$CuGeO_3$

Biofilter characterization test to get the results of porosity and density. In this porosity test using SEM (Scanning Electron Microscope), the following results are obtained:

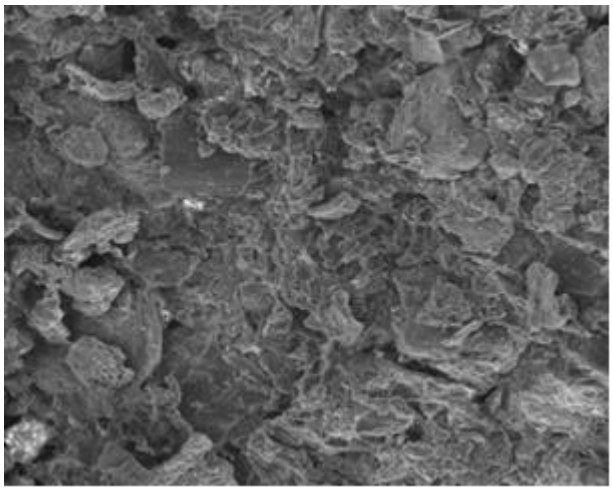

FIGURE 2. SEM results of Azadirachta Indica leaf powder biofilter 1gr

In the biofilter density test, mass and volume were measured and then the density value (ρ) was calculated, the following data were obtained:

TABLE 4. Porosity Biofilter leaf powder Azadirachta Indica

Azadirachta Indica Mass (g)	Dry Mass (g)	Fresh Mass (g)	Volume (ml)	Porosity (%)
0.7	1.10	1.17	1.035	6,763
0.8	1.15	1.23	1.046	7,648
0.9	1.19	1.28	1.055	8,530
1	1.23	1.33	1.058	9.451

TABLE 5. Azadirachta Indica leaf powder Biofilter density

Azadirachta Indica Mass (g)	m(g)	V (cm3)	(g/cm3)
0.7	1.10	1.035	1.068
0.8	1.15	1.046	1.099
0.9	1.19	1.055	1,128
1	1.23	1.058	1,162

Azadirachta Indica leaves can absorb free radicals in cigarette smoke, this is in line with several research results. Azadirachta Indica leaves have a high enough antioxidant content to catch free radicals [11,12,13,14].

Antioxidants from outside the body can be in the form of natural and synthetic antioxidants, but synthetic antioxidants are not good for health. Therefore natural antioxidant properties were chosen. Natural sources of antioxidants can be obtained from the neem plant. The flavonoid content in the ethanolic extract of neem leaves has a strong IC50 DPPH with a value of 88.1273 g/mL. Neem leaf is a strong antioxidant and can protect the body's cell damage from oxidation in a polluted environment [15,16]. Azadirachta Indica leaf extract contains various bioactive including anti-oxidant, anti-bacterial, anti-fungal functions [17].

Free radicals in cigarette smoke have two different populations, in the tar and gas phases [18]. The antioxidant content in the biofilter can capture free radicals in cigarette smoke.

From the SEM analysis, the pore size of the biofilter is between 2-3 μm, while the size of free radicals in cigarette smoke ranges from 20-430 nm [19]. The absorption of free radicals in

kretek cigarette smoke is not affected by the pores of the biofilter, but is influenced by the content of the biofilter. The higher the porosity value, the closer the distance between the particles so that the volume of the substance that flows will be less. In contrast, the low porosity indicates more volume of the substance that passes through the biofilter [20]. So the absorption of free radicals in cigarette smoke is influenced by the composition of an appropriate composite. Azadirachta Indica leaf powder contains antioxidants that can affect the absorption of free radicals in kretek cigarette smoke.

CONCLUSION

Biofilter from Azadirachta leaf powder can absorb several types of suspected free radicals in cigarette smoke. Variations influence the absorption of free radicals from cigarette smoke in the composition of the composite biofilter. Azadirachta leaf powder, as a filler that contains antioxidants, also affects the absorption of free radicals in kretek cigarette smoke. Azadirachta leaf powder biofilter with a mass of 0.9 and 1 g was more able to absorb free radicals in kretek cigarette smoke.

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