



Short Communication

Preparation of activated carbon by microwave heating of langsat (*Lansium domesticum*) empty fruit bunch waste

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ABSTRACT

The feasibility of langsat empty fruit bunch waste for preparation of activated carbon (EFBLAC) by microwave-induced activation was explored. Activation with NaOH at the IR ratio of 1.25, microwave power of 600 W for 6 min produced EFBLAC with a carbon yield of 81.31% and adsorption uptake for MB of 302.48 mg/g. Pore structural analysis, scanning electron microscopy and Fourier transform infrared spectroscopy demonstrated the physical and chemical characteristics of EFBLAC. Equilibrium data were best described by the Langmuir isotherm, with a monolayer adsorption capacity of 402.06 mg/g, and the adsorption kinetics was well fitted to the pseudo-second-order equation. The findings revealed the potential to prepare high quality activated carbon from langsat empty fruit bunch waste by microwave irradiation.

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1. Introduction

Langsat (*Lansium domesticum*) is a tropical plant species belonging to the family Meliaceae and genus of *Lansium*. The fruits are oval, 2.5–5 cm in diameter, and usually found in clusters of 2–30 fruits along the branches. Langsat fruit is encapsulated by yellowish, leathery skin, and underneath the skin are the translucent and juicy arils, which are sweet-acid to subacid in flavor (Morton, 1987).

The langsat tree is a multi-purpose plant. Apart from the use as table fruit, langsat fruit is popular in several culinary preparations as cooking dishes, jam, jelly, syrup (canned) and available as the ingredients of candies, desserts and beverages (Te-chato et al., 2005). The dried peel is a mosquito repellent, and the pulverized seed is employed as febrifuge and vermifuge. Langsat tree timber is a medium hardwood with desirable characteristics in the manufacture of household commodities, rafters, tool handles and small utensils. (Thompson, 2003).

The adhering fruit bunch, which constitutes 40% of the fruit is usually discarded as waste. According to the data reported by the Ministry of Agricultural and Agro-Based Industry Malaysia, the annual production of langsat fruit in 2010 was projected at 25,660 MT, translating to approximately 10,264 MT of empty fruit bunches waste (EFBL) (MAAIM, 2011). This work was undertaken to evaluate the viability of EFBL as an efficient raw precursor for preparation of activated carbon via microwave-assisted chemical

activation. The significant influences of activation agents, chemical impregnation ratio, microwave power, and radiation time on the carbon yield and adsorption uptake were investigated. Structural, functional and surface chemistry of the prepared adsorbent was performed. The adsorption equilibrium for methylene blue dye, the adsorption isotherms and kinetics were outlined.

2. Methods

2.1. Adsorbate

Methylene Blue (MB), a cationic pollutant difficult to be degraded in natural environment was selected as the model adsorbate. A standard stock solution of 1000 mg/L was prepared by dissolving an appropriate quantity of MB in double distilled water and diluted to the desired concentrations.

2.2. Preparation of activated carbon

Langsat empty fruit bunch waste (EFBL) was washed exhaustively with distilled water, cut, air-dried, ground and screened to obtain particles 1–2 mm in size. Char preparation was carried out as described by Foo and Hameed (2012a). The char produced was mixed with activation agents (H_2SO_4 , H_3PO_4 , HNO_3 , K_2CO_3 , NaOH and KOH) at impregnation ratio defined as the dry weight of activation agent (g) to char (g).

The activation was performed as described by Foo and Hameed (2012b) under nitrogen flow ($300\text{ cm}^3/\text{min}$). The resultant activated carbon (EFBLAC) was washed sequentially with 0.1 M

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