

**PREPARATION AND CHARACTERIZATION OF MEDICAL  
GRADE ACTIVATED CARBON FROM BANANA  
FRUIT (*MUSA ACCUMINATA*)**

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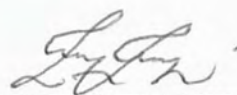
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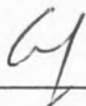


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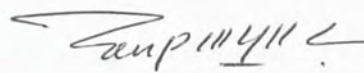
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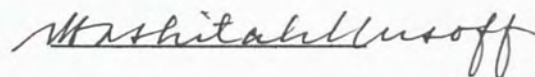
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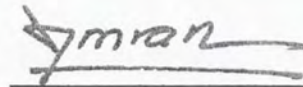
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## ABSTRACT

It is known that the porosity and adsorption capacity in a carbon that depended on the nature of precursors, pyrolysis and activation conditions, and the ash content. Porous carbons have been prepared from banana fruit (*Musa Accuminata*) in different temperature and time limits. The banana fruit has gone through carbonization before activation process occurs. Yield percentages shows that they were not many differences as moisture and ash gave higher percentages as temperature and time activation increase. Iodine number gives a low adsorption value, which is different in time and temperature in comparison. Methylene blue adsorption value shows the same configuration as iodine number. The SEM micrographs taken, proved the porosity of samples, which shows majority of mesopores and macropores volume. All the analyses have been compared with the Pharmaceutical activated carbon standards for medical grade activated carbon.



## ABSTRAK

Diketahui bahawa keliangan dan kapasiti jerapan bagi sesuatu karbon aktif bergantung kepada kandungan bahan semulajadi, proses aktivasi dan kandungan debu karbon tersebut. Karbon aktif ini telah disediakan daripada buah pisang yang dijalankan aktivasi dengan masa dan suhu yang berbeza. Buah pisang telah dijalankan proses karbonisasi sebelum aktivasi dijalankan. Peratusan air hilang tidak menunjukkan banyak perubahan ketara diantara sampel bagi masa dan suhu yang berbeza. Manakala ujian kelembapan dan debu memberikan peratusan yang tinggi apabila suhu dan masa aktivasi meningkat. Nombor iodine memberikan nilai jerapan yang rendah yang mana ia berbeza dari segi masa dan suhu, dan begitu juga bagi proses jerapan metalene biru. Daripada mikrograf SEM yang diambil, adalah terbukti wujudnya liang-liang pada sampel terbabit yang menunjukkan kebanyakan liang yang terhasil adalah berbentuk 'mesopores' dan 'macropores'. Semua keputusan analisa yang dijalankan adalah dibandingkan dengan nilai dalam 'Pharmaceutical Activated Carbon Standards'.



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## CHAPTER 1

### INTRODUCTION

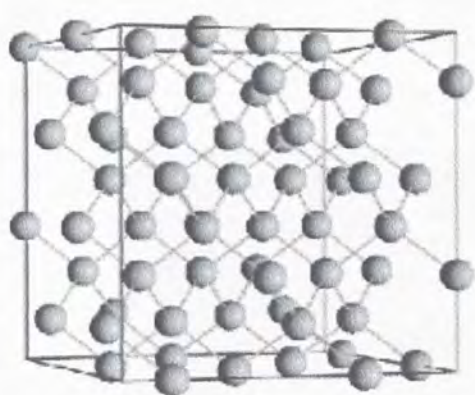
#### 1.1 BACKGROUND

Carbon is an important chemical element, there is 9.5% of Carbon in the human body and 80-90% of our body is water and other elements. Carbon material is use in various fields especially in modern industrial practice and everyday life. Carbon can exist in a number of forms with either crystalline (i.e. diamonds and graphite) (Figure 1.1) or amorphous (without a regular shape) structures (charcoal). One of the carbon formations that is important to our life is activated carbon which has an amorphous structure. The amorphous forms of charcoal are generally obtained by heating or burning under controlled conditions carbonaceous materials such as coal, oil, wood, oil palm shells, nutshells, peat, lignite etc. The amorphous forms of carbon are carbon black, carbon fibers and porous carbons. Charcoal is a porous black amorphous impure form of carbon. It is made by heating organic material in the absence of air.

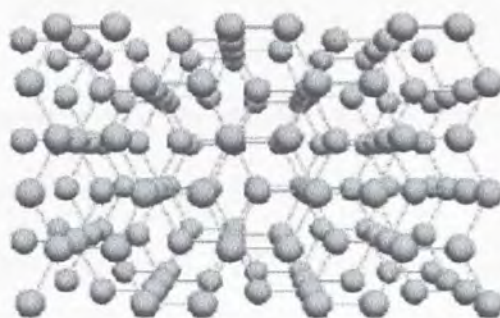
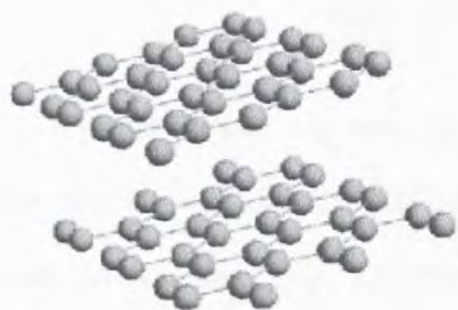
Activated carbon (Photo 1.1) is a processed carbon material with a highly developed porous structure and a large internal specific surface area. Activated carbon contain carbon compound the most and various other compounds which depends on



the raw material. Activated carbon has the ability to absorb any kind of substances either from the gas or liquid phase. Activated carbon act as an adsorbent to the substances it adsorbed from. The ability for the activated carbon to adsorb depends on the surface structure (Photo 1.2) of the activated carbon itself (Helena *et al.*, 1991).



***Diamond lattice***



***Graphite lattice***

Figure 1.1 View of Diamond lattice and Graphite lattice

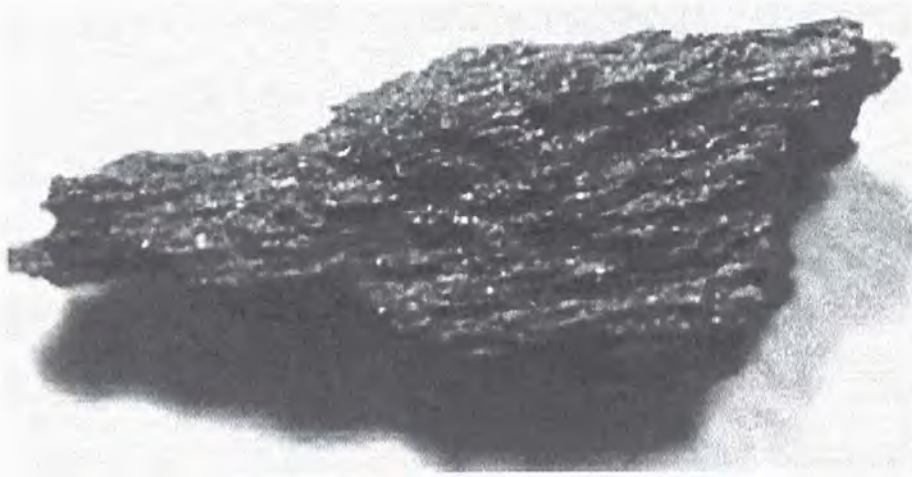


Photo 1.1 Activated carbon



Photo 1.2 Activated carbon surface

Activated carbon has been used since ancient time to purify air and water. However, the commercial use of activated carbon began at the end of the 18<sup>th</sup> century when the Swedish chemist Karl Wilhelm Scheele discovered (1773) the phenomenon of adsorption of gases on charcoal. Then soon after that the activated carbon when immersed in tartaric acid solution, decolorizes it by adsorbing the organic contaminant presents. This lead to the first industrial application of charcoal in the sugar industry in England in 1794 used as a decolorizing agent for sugar syrup. Since then there are many more discoveries made by chemist to use activated carbons (Richard, 1999).

Granular activated carbon was first developed as a consequence of WWI for gas masks and has been used subsequently for water treatment, solvent recovery and air purification. It is being used when the German armies introduced chemical warfare for the first time against the British and French in the West and against Russian soldiers in the East. This kind of mask, which is used to protect the soldiers' respiratory tracts throughout the world to the present day. During that time, coconut shell is the famous raw material for the production of activated carbon. Led from the accident brought researchers which conducted in the 1930's developed new technologies for obtaining granulated active carbons of supersorbent and benzosorbent type (Helena *et al.*, 1991).

From that time, activated carbon has been an effective substance for any adsorbing material and research for industry has conducted and from time to time found many uses of activated carbon such as water treatment, odor removal, color removal, medical and pharmaceutical grade, solvent recovery, and much more industrial applications uses.

## 1.2 RESEARCH OBJECTIVES

The objectives of this research are:

- i. To prepare the medical grade activated carbon prepared from banana fruit.
- ii. To characterize the prepared activated carbons using Iodine Number and Methylene Blue identification.



### 1.3 SCOPE OF STUDY

These projects is focus on the study of banana fruit as a raw material of the activated carbon and go through physical activation process with a different of times and without any chemical activation involved. Prepared activated carbon then characterize using iodine adsorption and methylene blue adsorption for the performance of the activated carbon.



## **CHAPTER 2**

### **LITERATURE REVIEW**

Activated carbon is used extensively in many fields and most carbon materials can be used to make activated carbon. The academic literature contains many references to activated carbon derived from many agricultural and industrial high-carbon waste products. Commercial activated carbon however is manufactured from only a few carbon sources such as wood and sawdust, oil palm shells, peat, coal, coke, and some other material used.

#### **2.1 ACTIVATED CARBON**

Activated carbon is an effective absorbent primarily due to its extensive porosity (Photo 1.3) and has a very large surface area. You can imagine activated carbon as a magnet that will attract the metals (adsorbate) around it. The high effectiveness of activated carbon is all depending on the surface structure of the activated carbon that consist of the surface area and porosity of the activated carbon (Figure 1.2).



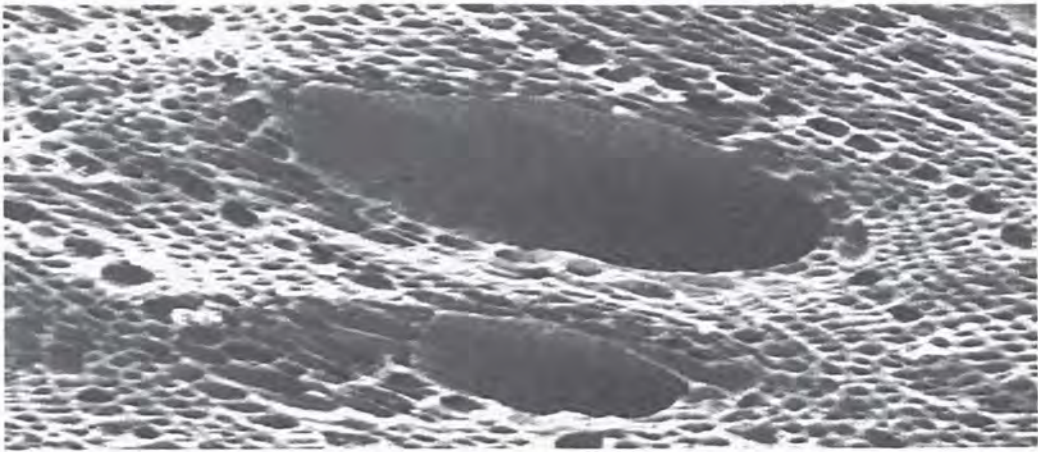


Photo 1.3 Porosity of the activated carbon

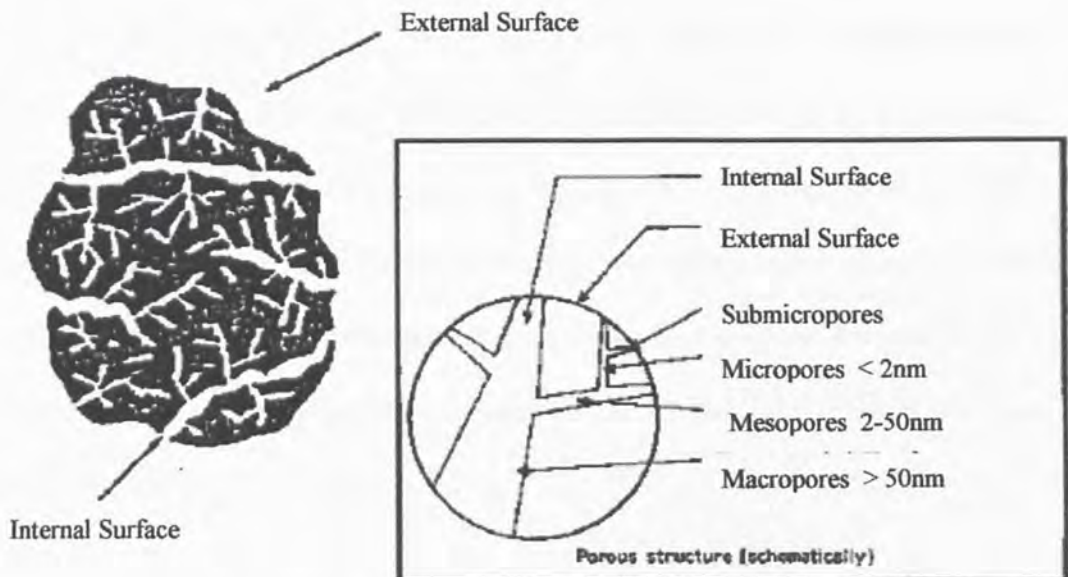


Figure 1.2 Schematic activated carbon model

The surface area of the activated carbon is where the adsorption will occur. Surface area and adsorption properties are related. It is because if the surface area of the activated carbon is large, the adsorption properties will be more effective. The interesting part of activated carbon surface structure is when 1 teaspoon of activated carbon would exhibit a surface area equivalent to a football field. These are happen when we realize that the activated carbon looks granular and exist in a small size. But because of the activated carbon itself have many pores inside, the activated carbon

makes it look smaller but if we count the surface area including the porosity it made, it has a very high surface area that can cover a football field. So from here, we know that surface area and porosity are related where if the porosity of the activated carbon is higher, the surface area of the activated carbon will be larger (Helena *et al.*, 1991).

Activated carbon has the ability to adsorb well because of its porosity structure. There are 3 main types of pores that are cover micropores, mesopores and macropores. Every type of this pores play different roles in any of the adsorption process for vapour and gases. The classification of the pores type is usually based on their linear dimensions. According to the IUPAC classification of pores in adsorbents, pores with the radii below 2nm are called as micropores, radii lying between 2-50nm called as mesopores and radii greater than 50nm are called macropores. The total number of pores and their volume distribution depends mainly on the nature of the raw material used and on the physico-chemical parameters of activation processes (Helena *et al.*, 1991).

The important of both porosity and surface area are no doubt for its ability to adsorb and the adsorption properties. So to understand the activated carbon, we firstly need to know how the surface structure of the activated carbon and it is all depending on the raw material used for making the activated carbon. This is because different raw material gives a different surface area and porosity of the activated carbon (eMedicine, 2004).





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