

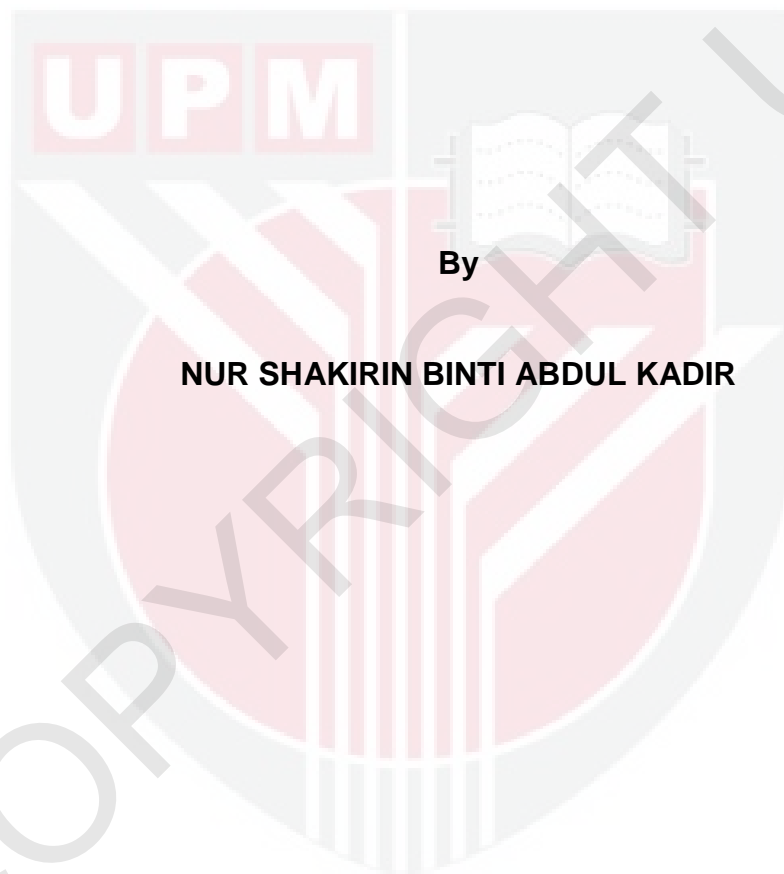


***PHYSICO-MECHANICAL PROPERTIES OF HEAT TREATED SESENDUK  
USING DIRECT CONTACT THERMAL METHOD***

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By

**NUR SHAKIRIN BINTI ABDUL KADIR**

**A Project Report Submitted In Partial Fulfilment of the Requirement  
for the Degree of Bachelor of Wood Science and Technology in the  
Faculty of Forestry  
Universiti Putra Malaysia**

**2019**

## DEDICATION

The thesis is dedicated to:

**My parents,**

Mazni Binti Ibrahim

Abdul Kadir Bin Othman

**My supervisor and adviser;**

Assoc. Prof. Dr. Edi Suhaimi Bakar

Assoc. Prof. Dr. Mojtaba Soltani

**Master students**

Rafsan, Nadzim and Hannafi

And all of my friends,

Thanks for being there during ups and downs

## ABSTRACT

The main purpose of this study is to improve the dimensional stability, increase biological durability, enhanced weather resistance and decrease shrinkage and swelling wood. The sample of Sesenduk with 200mm x 70mm x 10mm, 300mm x 70mm x 15mm and 400mm x 70mm x 20mm in a green condition are being treated with different temperature which is 160°C, 190°C and 220°C, also with the different time where 30 minutes, 45 minutes and 60 minutes are being tested on mechanical and physical properties to identify the physical properties changes (surface roughness, colour changes water absorption and thickness swelling). The sample that being tested shows those 45 minutes with 190°C and the thickness of 15mm are the most optimum treatment to produce Sesenduk with the best physico-mechanical properties.

## ABSTRAK

Tujuan utama kajian ini adalah untuk meningkatkan kestabilan dimensi, meningkatkan ketahanan biologi, meningkatkan rintangan cuaca dan mengurangkan pengecutan dan pembengkakan kayu. Sampel sesenduk bersaiz 200mm x 70mm x 10mm, 300mm x 70mm x 15mm dan 400mm x 70mm x 20mm dalam keadaan segar dirawat dengan suhu yang berbeza iaitu 160°C, 190°C dan 220°C serta berlainan masa iaitu 30 minit, 45 minit dan 60 minit diuji. Setelah itu, ujian dijalankan bagi mengenalpasti sifat mekanikal dan fizikal kayu (Kekasaran permukaan, perubahan warna, penyerapan air dan ketebalan bengkak kayu). Hasil ujian menunjukkan sampel 45 minit dengan suhu 190°C dan ketebalan 15mm adalah sampel yang berupaya menghasilkan kayu Sesenduk yang terbaik bagi ciri-ciri fizikal dan mekanikal.

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To become more prepared, endure the physical and emotional to finish this project my special gratitude to all my beloved friends who helped me during this project. Your help and support gave me passion to finish the project.

Thank you.

## APPROVAL SHEET

I clarify that this research report “Physico-Mechanical Properties of Heat Treated Sesenduk Using Direct Contact Thermal Method” by Nur Shakirin Binti Abdul Kadir has been examined and approved as a partial fulfilment of the requirement for the degree of Bachelor of Wood Science and Technology in the Faculty of Forestry, Universiti Putra Malaysia.

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Assoc. Prof. Dr. Edi Suhaimi Bakar  
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Prof. Dr. Mohamed Zakaria Hussin  
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Date: January 2019

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## LIST OF ABBREVIATIONS

ANOVA	Analysis of Variance
EMC	Equilibrium Moisture Content
FRIM	Forest Research Institute Malaysia
LKTS	Lesser Known Timber Species
MC	Moisture Content
MOE	Modulus of Elasticity
MOR	Modulus of Rupture
SPSS	Statistical Package for Social Science
TS2	Thickness swelling after 2 hours submerges
TS24	Thickness swelling after 24 hours submerges
WA2	Water absorption after 2 hours submerges
WA24	Water absorption after 24 hours submerges

# CHAPTER 1

## INTRODUCTION

### 1.1. Background

As the global demand for timber increasing, the lower density timber and those having a good appearance have a higher demand rather than common commercial hardwood (Ashaari, 2017). Also in wood modification there are two phase involved, which is active modification (Chemical, Thermal and Enzymatic modification) and passive modification that does not changes the natural properties of material.

According to Hill (2006) there are four types of wood modification have been used which is thermal modification, chemical modification, surface modification and impregnation modification. When the timber was treated by heat in the temperature above 200°C it will begins the process of thermal modification. Without the presence of oxygen, the heat bakes the sugar and tannins in the wood. This will make the wood is inedible to insects also make the wood becoming darken and hardening. Others than thermal modification, the second in wood modification are chemical modification, where the wood are under treatment of chemical. The advantages of this treatment are wood prevent decay also improve water resistance and reduce the effect of ultraviolet radiation also increase the fire resistance but the disadvantages for this modification because of it contain corrosive chemical that can harm the environment. Surface modifications are the treatment that modifies the surface material of wood that will bring the physical, chemical or biological characteristic of the wood to become a desire performance. Also

impregnation modification where this method is to filling the wood substance with an inert material which is impregnation to bring about a desired performance changes and make a performance better. Table 1.1 shows that the enhanced properties of wood after thermal treatment and Table 1.2 show the negative impact on wood after thermal treatment.

Table 1.1: Some of enhanced properties of wood from thermal modification

<b>Property</b>	<b>References</b>
Reduced equilibrium moisture content: swelling and shrinkage due to moisture	Kocaeffe et al. (2008) and Repellin & Guyonnet (2005)
Darkening of colour throughout entire thickness, often resembling the look of tropical hardwoods.	Kocaeffe et al. (2008) and Repellin & Guyonnet (2005)
Improved dimensional stability	Kocaeffe et al. (2008) and Rapp & Sailer (2000)

Table 1.2: Some of the negative impact on wood properties from thermal treatment

<b>Property</b>	<b>References</b>
Decreased mechanical strength, including resistance to bending in static and dynamic tests.	Esteves & Pereira (2009)
Low UV resistance of the heat-related brown hue during use	Rapp & Sailer (2000)

*Endospermum diadenum* were found in Thailand, Malaysia, Indonesia and Philippines. The habitat was easily to found along the roadside in logged forest and burned forests also the open places of undisturbed mixed dipterocarp and freshwater swamp. This species also as a fast growing species that had mean annual were incremented of 25mm of bole diameter. The tree flowers every year and in Malaysia it often even flowers twice a year. For 2 to 3 months matured fruits are presented after flowering. Usually the bark is used to cure dropsy and the roots are applied to injuries.

### **1.2. Problem Statement**

Sesenduk is one of the species of light hard wood with low density has low strength and that have the lower durability and easily susceptible to fungal decay and insect attacks. To enhancing the properties of low density of wood to serve as an alternative material as according to the needs of the industry, there are the efficient and practical heat treatment by direct contact thermal method can be used to improve the properties and producing the higher quality of Sesenduk timber. Also by this method it is in the low cost where there are no medium to use except for hot press machine, while it also the environmental friendly as can increase the dimensional stability by heat treated.

### **1.3. Objectives**

The objective of this study is;

#### 1.3.1. General objective

To identify the physical and surface properties of heat treated Sesenduk using direct contact thermal method

#### 1.3.2. Specific objective

To identify the effect of treatment of time, temperature and thickness of direct contact thermal method on the mechanical and physical properties (surface roughness, colour changes, water absorption and thickness swelling) of heat treated Sesenduk.



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