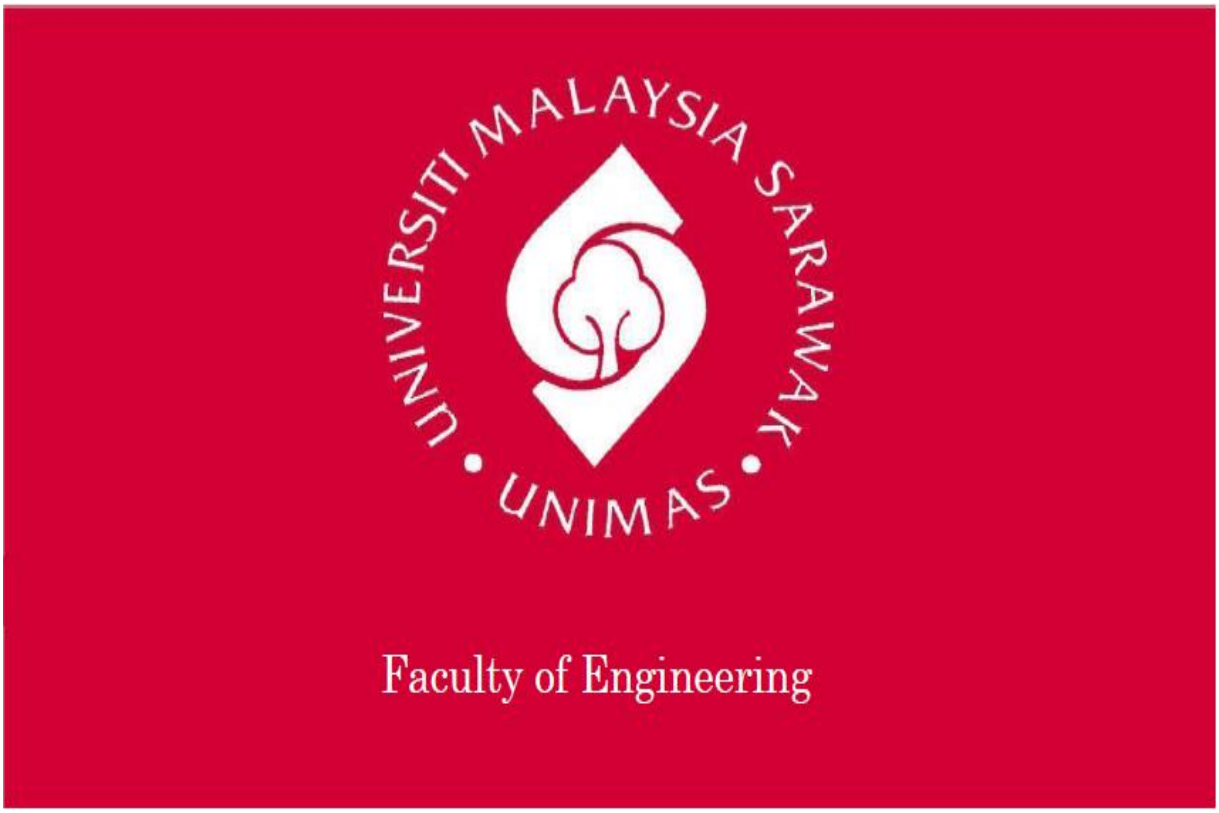

COOLING PATCH FROM HIBISCUS *ROSA SINENSIS* LEAVES EXTRACT

BENEDICT BASKI ANAK JATIM

Bachelor of Engineering with Honours

(Mechanical and Manufacturing Engineering)

2018

Faculty of Engineering

UNIVERSITI MALAYSIA SARAWAK

Grade: _____

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Final Year Project Report	√
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_____ _____

Mdm. Mahshuri Binti Yusof (Supervisor)

Date

This thesis is specially dedicated to both of my beloved parents;

JATIM SANGIN & RIWIN JUPA

COOLING PATCH FROM ROSA SINENSIS LEAVES EXTRACT

BENEDICT BASKI ANAK JATIM

A dissertation submitted in partial fulfilment

of the requirement for the degree of

Bachelor of Engineering with Honours

(Mechanical and Manufacturing Engineering)

Faculty of Engineering

Universiti Malaysia Sarawak

2018

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ABSTRACT

Cooling patch has been used for decades to lower down body temperature during fever. Malaysians on the other hand rely more on natural and organic approach by using hibiscus leaves, specifically its extract from ground leaves. The current cooling patch in the Malaysian market are of chemical composition and may result in side effects especially among children. In this paper, research was made to determine whether the extract from hibiscus *rosa sinensis* leaves were able to produce a new type of cooling patch and its density and thermal conductivity is compared to the available cooling patch in the Malaysian market; "KoolFever". The most crucial component in the cooling patch is the hydrogel. In this research, the hydrogel is fabricated from extract of *rosa sinensis* leaves, gelatin, glycerin and water. The hydrogels are also fabricated with different weight of *rosa sinensis* (10g-50g). The hydrogels are then tested for its thermal conductivity by using the PA Hiton H112A Linar Heat Conduction Unit. The thermal conductivity of all the *rosa sinensis* leaves hydrogels are compared with that of a pure gelatin-glycerin and "KoolFever" hydrogel. The density of all hydrogels' sample are also being measured. It is found out that the amount of *rosa sinensis* leaves can in fact enhance the thermal conductivity of the hydrogels. All the data obtained are recorded and the surface characterization of the hydrogels are being done using the microscope of the Shimadzu HMV-G21 Series Micro Hardness Tester with a 10x objective lens.

ABSTRAK

Tampalan pendingin telah lama digunakan untuk menurunkn suhu badan ketika menghidap demam panas. Penduduk tempatan sebaliknya beralih ke cara yang lebih semulajadi dan organik dengan menggunakan perahan air daun bunga raya *rosa sinensis*. Tampalan pendingin semasa yang terdapat dalam pasaran Malaysia mengandungi kandungan kimia dan berkemungkinan akan menyebabkan kesan sampingan terutama dalam kalangan kanak-kanak. Dalam kertas kajian ini, penyelidikan telah dibuat untuk mengenal pasti sama ada ekstrak daun bunga raya boleh diaplikasikan dalam pembuatan tampalan pendingin jenis baharu. Ketumpatan dan daya pengaliran haba turut dikaji dan dibandingkan dengan tampalan pendingin yang sedia ada; "KoolFever". Komponen yang paling penting di dalam tampalan ini adalah hidrogel. Hidrogel yang digunakan di dalam kajian ini diperbuat daripada daun bunga raya *rosa sinensis*, gelatin, gliserin dan air suling. Berat daun yang berbeza (10g-50g) digunakan untuk membuat hidrogel tersebut dan seterusnya daya pengalir haba diuji dengan menggunakan "PA Hiton H112A Linar Heat Conduction Unit". Daya pengalir haba bagi kesemua sampel hidrogel telah dibandingkan dan diketahui bahawa kandungan atau berat daun *rosa sinensis* boleh member kesan meningkatkan daya pengalir haba hidrogel. Kesemua data telah direkod dan morfologi permukaan hidrogel diimbas menggunakan mikroskop "Shimadzu HMV-G21 Series Micro Hardness Tester" dengan pembesaran sepuluh kali ganda.

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V	-	Volume
ρ	-	Density
t	-	Time
T_1 - T_6	-	Thermocouple reading
x_{int}	-	Length hot region form cold region, (30mm)
T_{hot}	-	Heat flow in the hot zone
T_{cold}	-	Heat flow in the cold zone
T_{int}	-	Internal temperature (space between T_3 &T_6)
A	-	Sample area
K_c	-	Thermal conductivity of sample
s	-	Standard deviation
x	-	Data (thermal conductivity)
$\bar{x}$	-	Average of the data
n	-	Number of data

LIST OF ABBREVIATIONS

AA	-	Ascorbic acid
AAP	-	American Academy of Paediatric
OH	-	Hydroxide group
COOH	-	Carboxylic group
MAPS	-	Medicinal and Aromatic Plants
NH_2	-	Amine group
pH	-	Potential of hydrogen

CHAPTER 1

INTRODUCTION

1.1 Background Study

Fever is a common sickness that adults and children experience along their life journey. It occurs when body temperature mediated by the hypothalamus elevates, as a result of prostaglandin E_2 synthesis-induced exogenous pyrogens and pyrogenic cytokines (Fletcher et al., 2013). To prevent the condition from getting any worse, our body temperature must be lowered down.

Figure 1.1: Cooling patch

Hydrogels are substance that are able to contain huge quantities of water. There are hydrophilic groups in the polymeric network, which become hydrated in aqueous media thus forming hydrogel structure (Akhtar et al.,2015). This polymer is often used in the production of cooling patches that is mostly available on the Malaysian market such as “Kool Fever”.

Hydrogel used in cooling patch exhibits good thermal properties; diffusivity and conductivity. This is crucial for the hydrogel to absorb heat at a certain rate from the body and reduce the temperature of our body.

Hibiscus *rosa sinensis,* commonly known as “Bunga Raya” in Malay, is the national flower of Malaysia as shown in Figure 1.2. Its usage dates back to our ancestral age whereby the leaves of *rosa sinensis* are utilized as a remedy to cure certain illnesses such as fever and seizure among children.

Figure 1.2 : Hibiscus *rosa sinensis* shrubs

1.2 Problem Statement

Most of the cooling patch available on the market are the product of Japan ingenuity and none comes from our local company. In order to do so, the medicinal and cooling effect of hibiscus *rosa sinensis* are to be utilized. The conventional cooling patch are made from synthetic materials and chemical that may be harmful to our skin.

Children nowadays tend to develop fever more easily than adults. Older children are still in risk of seizure because these illness corresponds with the background in which febrile seizure is at peak which is during 16-18 month (Rowhani-Rahbar et al, 2013) The medicinal properties and cooling effect of *rosa sinensis* leaves might serve useful in this matter due to the fact that its application as medicinal needs has been dated back since decades ago.

Therefore, approach of using hibiscus *rosa sinensis* extract to develop a hydrogel at different percentage to produce a new kind of cooling patch is studied. The thermal properties of the hydrogel are also studied. Furthermore, the research on the amount of *rosa sinensis* leaves relative to water content to produce hydrogel with the best thermal conductivity is also being done. The method of measuring the thermal conductivity of the hydrogel for the cooling pad is based on (ASTM) E1225-99.

1.3 Scope and Objective

The main objective of this research is to determine the thermal conductivity of a cooling patch from the liquid extract of hibiscus r*osa sinensis* leaves. In order to do so, the hydrogel is produced from hibiscus leaves with different weight relatives to water content. This is to determine the best option of how much percentage of *rosa sinensis* is needed to produce the most efficient hydrogel.

The importance of this research is to compare the thermal conductivity of the cooling patches produced with different amount of hibiscus leaves. The comparison on the thermal conductivity between the hibiscus *rosa sinensis* leaves and the available cooling patch; "KoolFever' will also be analyzed in this research. The equipment that will be used in this research is the thermal conductivity machine, PA Hilton H112A Linear Heat Conduction Unit. This conductivity measurement will be made based on the American Society for Testing and Material (ASTM) E1225-99 Standard test method for thermal conductivity of solids by means of the guarded comparative longitudinal heat flow technique. The methods to produce the hydrogel are also being identified whether it is the same as any conventional method that is being used now.

CHAPTER 2

LITERATURE REVIEW

2.1 Cooling Patch

Cooling patch is a patch that contains a type of gel with high heat absorbent rate. It will help in reducing our body temperature especially in an elevated body temperature. This gel is commonly known as hydrogel as its main constituent is water. Hydrogel used in cooling patch are mainly made out of water, glycerin and polyacrylic acid. Glycerin functions as a humectant to contain water inside the gel so that the moisture of gel is preserved. Polyacrylic acid on the other hand act as a thickening agent for the gel. It gives the gel its solid structure. These information regarding the material is crucial in this report in order to know what should be used for each purpose.

2.2 Hydrogel

Hydrogels are chains of polymer that can store huge amount of water. There are hydrophilic groups in the polymeric network, which become hydrous in aqueous media thus forming hydrogel structure (Akhtar et al.,2015). It has been utilized worldwide especially in biomedical application. Hydrogels are stimulus sensitive

meaning that it responds to external stimuli by altering their chemical or physical properties.

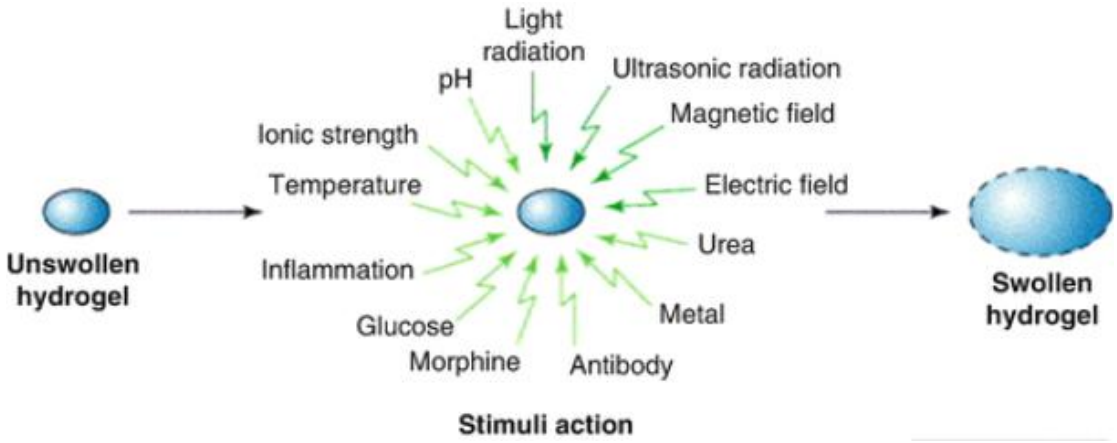

Figure 2.1 : Stimuli that affect the swelling of hydrogel (Vashist et al., 2017)

Figure 2.1 shows the numbers of stimuli changing the size of the hydrogel. There are various stimuli that affect the size. This shows that there are still many ways to utilize the ability of hydrogel especially for our benefits. Its special characteristic of adapting and responding towards surrounding environment in the human body makes it very suitable to be utilized as biomaterial.

2.2.1 Types of Hydrogels

There are various types of hydrogels being produced nowadays. Each with its own characteristic and properties. The most used type of hydrogels is thermo sensitive, electro-sensitive and pH sensitive. All of these hydrogels are environment sensitive hydrogel due to the face that the environment affect their properties and characteristic.

Electro-responsive hydrogel is the most latest advanced in the development of hydrogels. This kind of hydrogel is sometimes called smart hydrogel or smart biomaterials. These materials hold great potential when it comes to its application in the medicinal field especially in regenerative medicine.

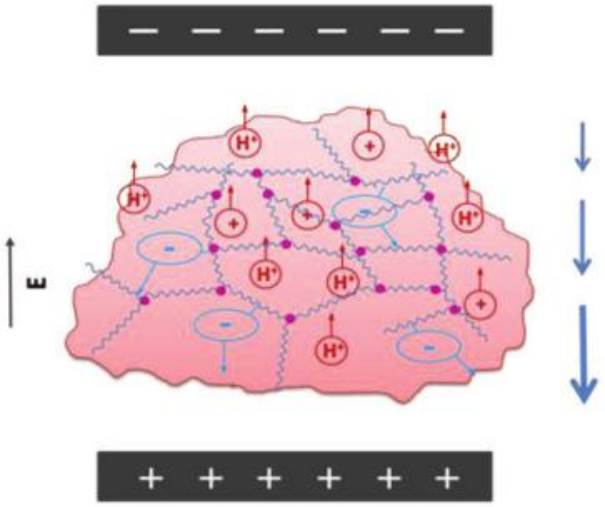

Figure 2.2**:** The conversion of electrical energy in the electro-responsive hydrogel (Rahimi et al., 2015)

According to Rahimi et al. (2015), in their research in Electro-Responsive Hydrogels for Biomedical Applications, it is stated that their aim is to develop a novel electro-responsive PolyPhosphoEster based hydrogel that can convert electrical energy into conformational changes in the structure when exposed to an electrical field as shown in Figure 2.2. The properties of the electro-responsive hydrogel might have the potential for a further development of smart gel-based devices capable of doing tissue engineering.

A pH-sensitive hydrogel is a pH dependent hydrogel. The swelling effect depends thoroughly with the pH level of the stimulus (Biewenga, 2014). If the pH level of solution meaning that a few hydrogen ions are present, the gel will hardly swell. Too many of ions present in a solution is also problematic for the hydrogel to swell due to the fact that the ambient solution outside the gel has very high osmotic pressure and is similar to that of the hydrogel. Both the solution and the hydrogel are nearly isotonic to each other meaning that the movement of water in and out of the hydrogel will be very significant. This characteristic of the pH-sensitive hydrogel makes it possible for it to be used as a pH control device or a pH sensor.