

**THE EFFECT OF GLYCEROL AND CITRIC ACID DEEP  
EUTECTIC SOLVENT CONCENTRATION ON THE  
PROPERTIES OF CARBOXYMETHYL CELLULOSE (CMC)  
BIOPLASTIC**

**KAMAL NOR ARIFF BIN KAMAL NAZRY**

**BACHELOR OF SCIENCE (Hons.) APPLIED CHEMISTRY  
FACULTY OF APPLIED SCIENCES UNIVERSITI  
TEKNOLOGI MARA**

**AUGUST 2023**

**THE EFFECT OF GLYCEROL AND CITRIC ACID DEEP  
EUTECTIC SOLVENT CONCENTRATION ON THE  
PROPERTIES OF CARBOXYMETHYL CELLULOSE (CMC)  
BIOPLASTIC**

**KAMAL NOR ARIFF BIN KAMAL NAZRY**

**Final Year Project Proposal Submitted in  
Partial Fulfilment of the Requirements for the  
Degree of Bachelor of Science (Hons.) Applied Chemistry  
in the Faculty of Applied Sciences  
Universiti Teknologi MARA**

**AUGUST 2023**

This Final Year Project Report entitled “**The effect of glycerol and citric acid deep eutectic solvent concentration on the properties of carboxymethyl cellulose (CMC) bioplastic**” was submitted by Kamal Nor Ariff Bin Kamal Nazry in partial fulfillment of the requirement for the Degree of Bachelor of Science (Hons) Applied Chemistry, in the Faculty of Applied Sciences, and was approved by

---

**Dr. Rizana Binti Yusof**  
**Supervisor**  
**B. Sc. (Hons) Applied Chemistry**  
**Faculty of Applied Science**  
**Universiti Teknologi Mara**  
**02600 Arau**  
**Perlis**

---

**Dr. Siti Nurlia Binti Ali**  
**Project Coordinator**  
**B. Sc. (Hons) Applied Chemistry**  
**Faculty of Applied Sciences**  
**Universiti Teknologi MARA**  
**02600 Arau**  
**Perlis**

---

**Dr. Nur Nasulhah Binti Kasim**  
**Head of Programme**  
**B. Sc. (Hons) Applied Chemistry**  
**Faculty of Applied Sciences**  
**Universiti Teknologi MARA**  
**02600 Arau**  
**Perlis**

Date: \_\_\_\_\_

## TABLE OF CONTENTS

<b>ACKNOWLEDGEMENTS</b>	iv
<b>TABLE OF CONTENTS</b>	v
<b>LIST OF TABLES</b>	vii
<b>LIST OF FIGURES</b>	viii
<b>LIST OF ABBREVIATIONS</b>	ix
<b>ABSTRACT</b>	x
<b>ABSTRAK</b>	xi
<b>CHAPTER 1 INTRODUCTION</b>	
1.1 Background of Study	1
1.2 Problem Statement	2
1.3 Significance of Study	3
1.4 Objectives of Study	4
1.5 Research Question	4
<b>CHAPTER 2 LITERATURE REVIEW</b>	
2.1 Bioplastic	5
2.1.1 Cellulose-based bioplastic	6
2.2 Plasticizer	10
2.2.1 Deep eutectic solvent (DES)	10
2.3 Carboxymethyl cellulose (CMC)	15
<b>CHAPTER 3 METHODOLOGY</b>	
3.1 Materials	16
3.1.1 Apparatus	16
3.1.2 Chemicals	16
3.2 Methodology	16

## ABSTRACT

### **THE EFFECT OF GLYCEROL AND CITRIC ACID DEEP EUTECTIC SOLVENT CONCENTRATION ON THE PROPERTIES OF CARBOXYMETHYL CELLULOSE (CMC) BIOPLASTIC**

Petroleum-based plastics have been popular due to their strong and long-lasting properties. However, these plastics are not degrading easily, prompting researchers to develop bioplastics. Cellulose is one of the best choices for bioplastics production. Nevertheless, the created cellulose-based biodegradable films were stiffed due to the strong hydrogen bonds between cellulose chains and limits their use as a bioplastic. In this study, carboxymethyl cellulose (CMC) was used as an alternative source to synthetic plastic for the production bioplastics with glycerol/citric acid deep eutectic solvent (DES) as a plasticizer. Four bioplastic samples were prepared: CMC without plasticizer and CMC with glycerol: citric acid DES at different ratio (i.e., 100:1, 100: 2 and 100:3). The properties of these bioplastic samples were then investigated. Result shown that the tensile strength and Young's modulus decreased in the range of 41.19 to 0.25MPa and 2369 to 1.35MPa respectively, meanwhile elongation at break shows increasing trend from 4.75 to 19.00mm. The thickness bioplastics also in the range of 0.34 to 0.09mm. The water solubility was found in the range of 100 to 37.67%, whereas the moisture content and water absorption were 36.12 to 29.63% and 44.52 to 22.23% respectively. In addition, it was observed that using DES as a plasticizer had affected CMC biodegradability in soil by reducing the weight lost in range from 100% to 54.13% and slowed the degradability within 30 days. Therefore, these CMC bioplastics with DES could be a potential food packaging.