



THE REPUBLIC OF INDONESIA DEFENSE UNIVERSITY

**THE CONCENTRATION OF GLYCEROL ON BIOPLASTIC
KOMBUCHA QUALITY DERIVED FROM KOMBUCHA
RED DRAGON FRUIT PEEL (*Hylocereus polyrhizus*)
FOR MILITARY RATION PACKAGING**

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**Undergraduate Thesis Written to Fulfill Part of the
Requirements in Obtaining the Bachelor Degree**

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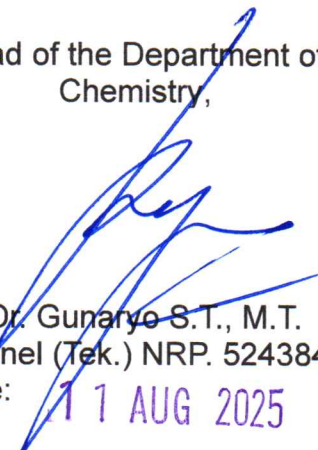
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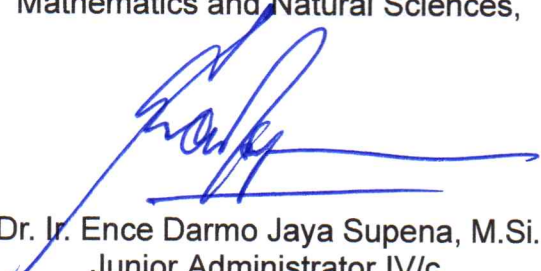


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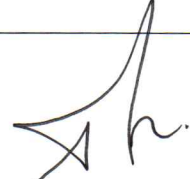


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PREFACE

With gratitude to the Almighty for His unstoppable blessings, mercy, and grace, I have completed my undergraduate thesis titled "The Concentration of Glycerol on Bioplastic Kombucha Quality Derived from Kombucha Red Dragon Fruit Peel (*Hylocereus polyrhizus*) for Military Ration Packaging". This undergraduate thesis completion fulfill one of the requirements for obtaining a Bachelor's degree at the Chemistry Study Program, Faculty of Mathematics and Natural Sciences, Republic of Indonesia Defense University.

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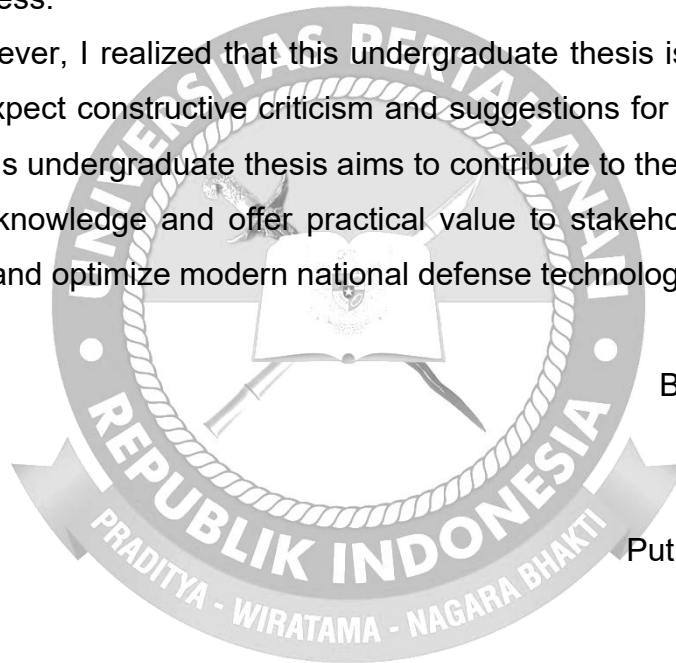
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However, I realized that this undergraduate thesis is imperfect and I humbly expect constructive criticism and suggestions for its improvement. Finally, this undergraduate thesis aims to contribute to the advancement of scientific knowledge and offer practical value to stakeholders working to enhance and optimize modern national defense technology.

Bogor, July 2025

Putry Wanda Azzida



ABSTRACT

THE CONCENTRATION OF GLYCEROL ON BIOPLASTIC KOMBUCHA QUALITY DERIVED FROM KOMBUCHA RED DRAGON FRUIT PEEL (*Hylocereus polyrhizus*) FOR MILITARY RATION PACKAGING

As an environmental big issue, plastic waste is still a concern in Indonesia. Bioplastic can solve the problem, which is more easily decomposed by nature. The aim of this research is to analyze the effect of glycerol concentration (5%, 10%, and 15%) on bioplastic kombucha from red dragon fruit peel (*Hylocereus polyrhizus*) quality with several parameters such as physical, chemical, and biodegradability. The bioplastic will synthesize in thermal condition. Varying glycerol concentrations significantly affect the physical characteristics, with higher glycerol concentrations causing increased elongation and biodegradation but reducing tensile strength. Universal Testing Machine (UTM) analysis shows the highest tensile value of 25.55 MPa at 5% glycerol concentration conditions meeting SNI 7818:2014 standards and the highest elongation of 31.48% at 15% glycerol concentration conditions meeting SNI 7188.7:2016 standards. Attenuated Total Reflectance-Fourier Transform Infrared (ATR-FTIR) analysis confirmed chemical changes due to the plasticization effect of glycerol with the weakening of hydrogen bonds and peak shifts to higher frequencies. The biodegradability test using Effective Microorganism 4 (EM4) showed the fastest biodegradation, 96.53% on glycerol at 15% concentration, fulfilling SNI 7188.7: 2022. This research is an initial study on developing bioplastic packaging for rations for the Indonesian National Army (TNI) to support food packaging technology in national defense.

Keywords: Bioplastic, Dragon Fruit Peel, Kombucha, Packaging

ABSTRAK

PENGARUH KONSENTRASI GLISEROL TERHADAP KUALITAS BIOPLASTIK KOMBUCHA YANG BERASAL DARI KOMBUCHA KULIT BUAH NAGA MERAH (*Hylocereus polyrhizus*) UNTUK KEMASAN RANSUM MILITER

Sampah plastik menjadi permasalahan lingkungan utama di Indonesia. Bioplastik merupakan solusi karena lebih mudah terurai oleh lingkungan secara alami. Penelitian ini bertujuan untuk menganalisis pengaruh konsentrasi gliserol (5%, 10%, dan 15%) terhadap kualitas bioplastik dari kombucha berbahan dasar kulit buah naga merah (*Hylocereus polyrhizus*) ditinjau dari parameter fisik, kimia, dan biodegradabilitas. Bioplastik disintesis dalam kondisi termal. Variasi konsentrasi gliserol memberikan pengaruh terhadap sifat fisik yaitu penambahan konsentrasi gliserol yang lebih tinggi menyebabkan peningkatan elongasi dan biodegradasi namun menurunkan kekuatan tarik. Analisis *Universal Testing Machine* (UTM) menunjukkan nilai kuat tarik tertinggi sebesar 25,55 MPa pada kondisi konsentrasi gliserol 5% sehingga memenuhi standar SNI 7818:2014 dan elongasi tertinggi sebesar 31,48% pada kondisi konsentrasi gliserol 15% memenuhi standar SNI 7188.7:2016. Analisis *Attenuated Total Reflectance-Fourier Transform Inframerah* (ATR-FTIR) mengkonfirmasi adanya perubahan kimia akibat efek plastisasi gliserol, ditandai dengan melemahnya ikatan hidrogen dan pergeseran puncak ke frekuensi yang lebih tinggi. Uji biodegradabilitas menggunakan *Effective Microorganism 4* (EM4) menunjukkan biodegradasi paling cepat yaitu 98,02% pada gliserol dengan konsentrasi 15% sehingga memenuhi SNI 7188.7:2022. Penelitian ini merupakan langkah awal dalam pengembangan kemasan ramah lingkungan untuk ransum Tentara Nasional Indonesia (TNI) guna mendukung teknologi kemasan makanan dalam pertahanan negara.

Kata Kunci: Bioplastik, Kombucha, Kulit Buah Naga, Kemasan

TABLE OF CONTENTS

APPROVAL SHEET OF UNDERGRADUATE THESIS.....	ii
VALIDATION SHEET OF UNDERGRADUATE THESIS.....	iii
ORIGINALITY STATEMENT	iv
STATEMENT OF APPROVAL FOR PUBLICATION	v
PREFACE	vi
ABSTRACT	viii
ABSTRAK	ix
TABLE OF CONTENTS	x
LIST OF FIGURES	xii
LIST OF TABLES	xiii
LIST OF ABBREVIATIONS	xiv
CHAPTER I INTRODUCTION	1
1.1 Research Background.....	1
1.2 Research Problem Statements	3
1.3 Research Purpose	3
1.4 Research Benefit.....	4
CHAPTER II LITERATURE REVIEW	5
2.1. Theoretical Background	5
2.1.1 Bioplastic	5
2.1.2 Bioplastic Manufacturing	6
2.1.3 SCOBY (Symbiotic Culture of Bacteria and Yeast)	7
2.1.4 Red Dragon Fruit (<i>Hylocereus polyrhizus</i>).....	9
2.1.5 Glycerol	10
2.1.6 Biodegradability	11
2.2. State of The Art.....	12
2.3. Theoretical Framework	16
2.4. Hypothesis	17
2.4.1 1 st Hypothesis.....	17

2.4.2 2 nd Hypothesis	17
CHAPTER III RESEARCH METHODOLOGY	18
3.1 Research Design	18
3.2 Research Timeline	18
3.3 Instrumentations and Materials	20
3.3.1 Instrumentations	20
3.3.2 Materials	20
3.4 Research Variables	20
3.5 Population and Sample	20
3.6 Procedures	21
3.6.1 Preparation of Red Dragon Fruit Peel Samples	21
3.6.2 Kombucha Fermentation from Red Dragon Fruit Peel	21
3.6.3 Synthesis of Bioplastic	21
3.7 Analysis Method	22
CHAPTER IV RESULT AND DISCUSSION	24
4.1 Physical Characteristics of Bioplastics	24
4.1.1 The General Appearance Bioplastics Kombucha from Red Dragon Fruit Peel (<i>Hylocereus polyrhizus</i>)	24
4.1.2 Characterization of Bioplastics Using Universal Testing Machine (UTM)	25
4.2 Chemical Characteristics of Bioplastics	29
4.2.1 Characterization of Bioplastics Using Attenuated Total Reflection- Fourier Transform Infrared Spectroscopy (ATR-FTIR)	29
4.3 Biodegradability of Bioplastic	32
CHAPTER V CONCLUSION	42
5.1 Conclusion	42
5.2 Suggestion	43
REFERENCES	44
APPENDIX	51

LIST OF FIGURES

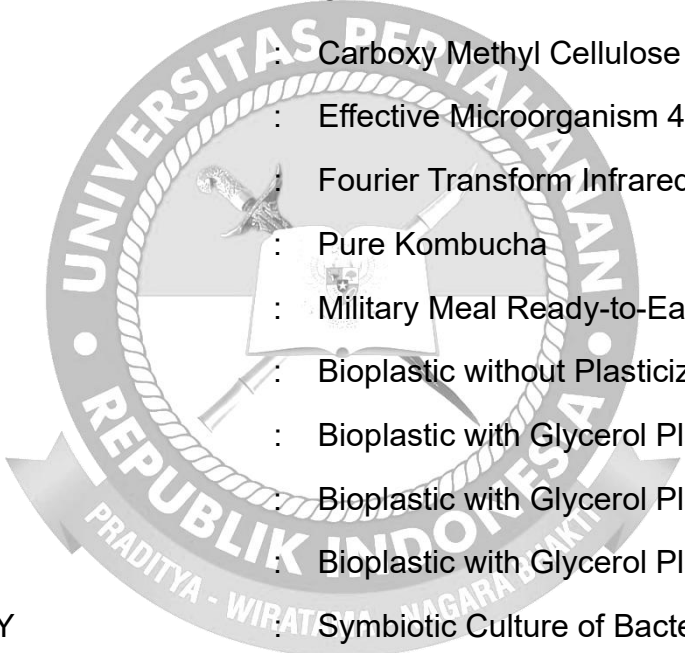
Figure 2.1 Interactions Between Materials in Bioplastics	7
Figure 2.2 Metabolism of SCOBY (Symbiotic Culture of Bacteria and Yeast)	8
Figure 2.3 Cellulose Polymerization Reaction	9
Figure 2.4 Chemical Structure of Glycerol	10
Figure 2.5 Theoretical Framework	16
Figure 3.1 Research Design	18
Figure 4.1 Bioplastic Ready for Testing (A. [K], B. [P], C. [PG5], D. [PG10], E. [PG15])	24
Figure 4.2 Tensile Test And Elongation Test Results of Bioplastics	26
Figure 4.3 ATR-FTIR Spectra of Bioplastics With Glycerol Plasticizer at Different Concentrations	29
Figure 4.4 Cellulose Chain Cutting Mechanism	34
Figure 4.5 Cellulose Hydrolysis Reaction by <i>Actinomyces</i> sp. and <i>Streptomyces</i> sp. in EM4.	34
Figure 4.6 Alcohol Fermentation Process by <i>Saccharomyces</i> sp. (Fungi) and Lactic Acid Fermentation Process By <i>Lactobacillus</i> sp. (Bacteria) in EM4.	35
Figure 4.7 Microbial Glycerol Oxidation Pathways	37
Figure 4.8 Bioplastic Degradation Rate at 2nd Order	39
Figure 4.9 Biodegradation Rate of Bioplastic Using EM4 in 180 days	40

LIST OF TABLES

Table 2.1 Bioplastic Quality Requirements According to SNI	6
Table 2.2 Microorganisms in EM4	11
Table 2.3 State of The Art.....	12
Table 3.1 Research Timeline.....	19
Table 3.2 Peak FTIR Spectra of Bioplastics Content	22
Table 4.1 The General Appearance of All Bioplastics Based On Visual ...	24
Table 4.2 Mechanical Characteristics of Bioplastics.....	26
Table 4.3 Peak ATR-FTIR Spectra of Bioplastics in Each Sample	30
Table 4.4 Biodegradation of Bioplastic using EM4	32
Table 4.5 Biodegradation of Bioplastic using Controlled pH 4.....	38



LIST OF ABBREVIATIONS



ASTM	: International Standard of The American Society for Testing Materials
ATR	: Attenuated Total Reflectance
BPS	: Central Statistics Agency
CB	: Cellulose Bacteria
CMC	: Carboxy Methyl Cellulose
EM4	: Effective Microorganism 4
FTIR	: Fourier Transform Infrared
K	: Pure Kombucha
MRE	: Military Meal Ready-to-Eat
P	: Bioplastic without Plasticizer
PG5	: Bioplastic with Glycerol Plasticizer 5%
PG10	: Bioplastic with Glycerol Plasticizer 10%
PG15	: Bioplastic with Glycerol Plasticizer 15%
SCOBY	: Symbiotic Culture of Bacteria and Yeast
SNI	: Indonesian National Standard
TNI	: Indonesian National Army
UTM	: Universal Testing Machine