

**CANDLENUT OIL ENCAPSULATION USING HYDROXYPROPYL  
METHYLCELLULOSE IN APPLICATION OF BREAD FORMULATION**

By

Meiriska Saga  
11405028

BACHELOR'S DEGREE  
in

FOOD TECHNOLOGY  
FACULTY OF LIFE SCIENCES AND TECHNOLOGY

SWISS GERMAN UNIVERSITY  


SWISS GERMAN UNIVERSITY  
The Prominence Tower  
Jalan Jalur Sutera Barat No. 15, Alam Sutera  
Tangerang, Banten 15143 - Indonesia

August 2018

**Revision after the Thesis Defense on July 26<sup>th</sup>, 2018**

## STATEMENT BY THE AUTHOR

I hereby declare that this submission is my own work and to the best of my knowledge, it contains no material previously published or written by another person, nor material which to a substantial extent has been accepted for the award of any other degree or diploma at any educational institution, except where due acknowledgement is made in the thesis.

Meiriska Saga

Student

Date

Revision after Thesis Defense on July 26<sup>th</sup>, 2018

Approved by:

Hery Sutanto, S.Si., M.Si.

Thesis Advisor

Date

Dr. Dipl.-Ing. Samuel P. Kusumocahyo

Dean

Date

Meiriska Saga

## ABSTRACT

### CANDLENUT OIL ENCAPSULATION USING HYDROXYPROPYL METHYLCELLULOSE IN APPLICATION OF BREAD FORMULATION

By

Meiriska Saga  
Hery Sutanto, S.Si., M.Si., Advisor  
Della Rahmawati, S.Si., M.Si., Co-Advisor

SWISS GERMAN UNIVERSITY

This study aims to preserve unsaturated fatty acids (UFAs) content of candlenut oil during food processing. Cold pressed extracted candlenut oil was encapsulated by spray drying using Hydroxypropyl Methylcellulose (HPMC) with three different ratio of wall material over oil (3:2, 1:1, and 2:3). Microencapsulation efficiencies of powders were ranged between 43.328-60.008%. Powder with high wall material ratio resulted a lower unsaturated fatty acid oxidation, thus was added to bread formulation. The concentration of omega-3, omega-6 and omega-9 in encapsulated candlenut oil for this research were 79.7 mg/100g, 4,204.8 mg/100g and 16,886.3 mg/100g respectively. The concentrations of encapsulated candlenut oil used for bread formulation were 1.0%, 1.5%, and 2.0% with baking temperature of 200°C. Bread with 1.0% encapsulated candlenut oil was the most preferred product based on sensory evaluation. The selected formula was preserved 95.48% omega-3, 5.23% omega-6, and 5.95% omega-9. The selected formula was qualified with the Indonesian National Standard (SNI) in proximate content (moisture, ash, fat, protein and carbohydrate).

*Keywords: Candlenut oil, Encapsulation, Hydroxypropyl Methylcellulose, Unsaturated Fatty Acids, Oxidation.*



**SWISS GERMAN UNIVERSITY**

## DEDICATION

This work is dedicated for my beloved parent, advisor and co-advisor.

Also, for everyone who are interested with this topic.



## ACKNOWLEDGEMENTS

The author would like to express the gratitude to Allah SWT for the chance to finished this thesis. Thanks to Mr. Hery Sutanto, S.Si., M.Si., as the advisor for his patience. From the beginning, he had entrusted to the author to do the research of this topic and gave the guidance and support. Also, thanks to Mrs. Della Rahmawati, S.Si., M.Si., as the co-advisor for the guidance and knowledge she gave during this research.

The author would like also to thank:

1. Beloved parents, for their support mentally and financially. Also, brother and sisters for their eternal love, support, and encourage so that this thesis could be complete.
2. All the staff of Faculty of Life Sciences and Technology, for the help and guidance during thesis work in laboratory.
3. All the fellow friends in Faculty of Life Sciences and Technology, for the joy, support and friendship.
4. All the staff in Laptiab BPPT, for the help and providing the author the place to done the research.
5. Tiffany Lie and Vania Velda Verianto, who help the author in candlenut oil extraction and share the knowledge during this research.
6. Diaz Marsya, Karissha Fritzi, Laurensia Christli, Nabila Putri, Mega Syahputri, Fadhila Amaliah, Elfrida Vanessa, and Putri Indes, for their support, listening to my problems, and encourage to finish on time.

## TABLE OF CONTENTS

	Page
<b>STATEMENT BY THE AUTHOR.....</b>	<b>2</b>
<b>ABSTRACT .....</b>	<b>3</b>
<b>DEDICATION .....</b>	<b>5</b>
<b>ACKNOWLEDGEMENTS.....</b>	<b>6</b>
<b>TABLE OF CONTENTS .....</b>	<b>7</b>
<b>LIST OF FIGURES.....</b>	<b>9</b>
<b>LIST OF TABLES.....</b>	<b>10</b>
<b>CHAPTER 1 - INTRODUCTION .....</b>	<b>11</b>
<b>1.1 Background.....</b>	<b>11</b>
<b>1.2 Research Problems .....</b>	<b>12</b>
<b>1.3 Research Objectives.....</b>	<b>13</b>
<b>1.4 Significance of Study .....</b>	<b>13</b>
<b>1.5 Research Questions.....</b>	<b>14</b>
<b>1.6 Hypothesis.....</b>	<b>14</b>
<b>CHAPTER 2 - LITERATURE REVIEW.....</b>	<b>15</b>
<b>2.1 State of the art.....</b>	<b>15</b>
<b>2.2 Candlenut.....</b>	<b>16</b>
2.2.1 Candlenut Oil .....	16
<b>2.3 Unsaturated Fatty Acids.....</b>	<b>17</b>
<b>2.4 Extraction of Candlenut.....</b>	<b>18</b>
2.4.1 Expeller Press.....	18
2.4.2 Cold Expeller Press .....	18
<b>2.5 Encapsulation.....</b>	<b>19</b>
2.5.1 Hydroxypropyl Methylcellulose (HPMC).....	20
2.5.2 Spray Drying.....	20
<b>2.6 Bread .....</b>	<b>21</b>
<b>CHAPTER 3 – RESEARCH METHODS .....</b>	<b>23</b>
<b>3.1 Venue and Time.....</b>	<b>23</b>
<b>3.2 Materials and Equipment.....</b>	<b>23</b>
3.2.1 Materials .....	23
3.2.2 Chemicals .....	23
3.2.3 Equipment.....	24
<b>3.3 Design of Experiment .....</b>	<b>24</b>
<b>3.4 Experimental Procedure.....</b>	<b>25</b>

3.4.1	Candlenut Oil Extraction .....	25
3.4.2	Candlenut Oil Encapsulation .....	26
3.4.3	Bread Formulation with Encapsulated Candlenut Oil.....	27
<b>3.5</b>	<b>Analytical Procedure .....</b>	<b>29</b>
3.5.1	Analysis of Unsaturated Fatty Acids (UFAs) of Candlenut Oil, Encapsulated Candlenut Oil, and Bread.....	29
3.5.2	Calculation of Expected Value of Unsaturated Fatty Acids .....	30
3.5.3	Analysis of Encapsulated Candlenut Oil .....	31
3.5.4	Analysis of Saponification in Encapsulated Candlenut Oil.....	33
3.5.5	Analysis of Encapsulated Candlenut Oil Bread.....	33
3.5.6	Data Analysis .....	34
<b>CHAPTER 4</b>	<b>– RESULTS AND DISCUSSIONS .....</b>	<b>35</b>
<b>4.1</b>	<b>Preliminary Experiment.....</b>	<b>35</b>
4.1.1	Candlenut Extraction .....	35
4.1.2	Unsaturated Fatty Acids (UFAs) of Candlenut Oil.....	37
<b>4.2</b>	<b>Candlenut Oil Encapsulation .....</b>	<b>38</b>
<b>4.3</b>	<b>Characterization of Encapsulated Candlenut Oil .....</b>	<b>40</b>
4.3.1	Moisture Content.....	40
4.3.2	Wettability .....	42
4.3.3	Microencapsulation efficiency .....	43
4.3.4	Thermal Oxidative Stability.....	45
4.3.5	The Best Ratio of Candlenut Oil Encapsulation Based on Powder Analysis .....	47
<b>4.4</b>	<b>Saponin Content .....</b>	<b>47</b>
<b>4.5</b>	<b>Unsaturated Fatty Acids (UFAs) of Encapsulated Candlenut Oil.....</b>	<b>48</b>
<b>4.6</b>	<b>Encapsulated Candlenut Oil Bread .....</b>	<b>51</b>
4.6.1	Bread Formulation.....	51
4.6.2	Bread Production.....	51
4.6.3	Organoleptic Test.....	52
<b>4.7</b>	<b>Unsaturated Fatty Acids (UFAs) of Encapsulated Candlenut Oil Bread</b>	<b>53</b>
<b>4.8</b>	<b>Proximate Analysis of Encapsulated Candlenut Oil Bread .....</b>	<b>57</b>
4.8.1	Moisture Content.....	57
4.8.2	Ash Content .....	58
4.8.3	Fat Content.....	58
4.8.4	Protein Content .....	58
4.8.5	Carbohydrate Content.....	59
4.8.6	Energy Content .....	59
<b>CHAPTER 5</b>	<b>– CONCLUSIONS AND RECCOMENDATIONS.....</b>	<b>60</b>
<b>5.1</b>	<b>Conclusions .....</b>	<b>60</b>
<b>5.2</b>	<b>Recommendations.....</b>	<b>60</b>
<b>REFERENCES</b>	<b>.....</b>	<b>62</b>
<b>APPENDICES</b>	<b>.....</b>	<b>66</b>
<b>CURRICULUM VITAE</b>	<b>.....</b>	<b>77</b>