

**DEVELOPMENT AND FORMULATION OF OMEGA-3
NANO- EMULSION SYRUP FROM CANDLENUT OIL**

By
Louisa Aileen
11904002

BACHELOR'S DEGREE

in

CHEMICAL ENGINEERING – PHARMACEUTICAL ENGINEERING
FACULTY OF LIFE SCIENCES AND TECHNOLOGY



SWISS GERMAN UNIVERSITY

The Prominence Tower

Jalan Jalur Sutera Barat No. 15, Alam Sutera

Tangerang, Banten 15143 - Indonesia

Revision after the Thesis Defense on 18 July 2023

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.



Louisa Aileen

Student

25 July 2023

Date

Approved by:

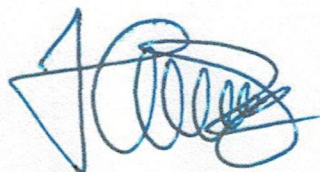


Silvy Yusri S.Si, M.Si

Thesis Advisor

25 July 2023

Date



Dr Hery Sutanto S Si, M Si

Thesis Co-Advisor

25 July 2023

Date



Dr Hery Sutanto S Si, M Si

Dean

25 July 2023

Date

Louisa Aileen

ABSTRACT

DEVELOPMENT AND FORMULATION OF OMEGA- 3 NANO EMULSION SYRUP FROM CANDLENUT OIL

By

Louisa Aileen

Silvya Yusri S.Si M.Si, Advisor

Dr Hery Sutanto S.Si, M.Si, Co-Advisor

SWISS GERMAN UNIVERSITY

The use of a cold expeller press machine led to the discovery of candlenut oil extract with a high concentration of essential unsaturated fatty acids, specifically omega 3. However, when heat-treated, the addition of candlenut oil to products caused a significant decrease in omega-3 content. Conversely, alternative studies explored the formulation of candlenut oil in emulsion syrup and found that the omega oil content did not show a significant decrease. Nevertheless, the syrup had an unpleasant taste and imparted a bitter flavor due to the presence of candlenut oil. Therefore, this research aims to investigate candlenut oil as a supplement and proposes incorporating it into an emulsion syrup formulation. To enhance the stability of the emulsion, formulation using the nano-emulsion method was developed to achieve smaller oil droplet sizes and improve the taste of the syrup. The stability of the candlenut oil emulsion syrup is evaluated over a 28-day period measuring, and observing various parameters such as pH, viscosity, lightness, creaming index, particle size diameter, omega content, and microbial contamination. This comprehensive evaluation allows for an assessment of the syrup's stability. The findings demonstrated that increasing the emulsifier ratio led to the formation of a nano-emulsion. Additionally, the stability test indicated that the emulsion remained stable without any creaming throughout the testing period. Slight alterations were observed in pH, viscosity, and lightness. Furthermore, the omega content of the syrup emulsion only experienced a decrease of approximately 29.39%.

Keywords: Candlenut Oil, Nano Emulsion, Omega Content, Stability Test



DEDICATION

I dedicate my work for my parents, friends, and my beloved country Indonesia.



ACKNOWLEDGEMENTS

First and foremost, I would like to express my sincerest gratitude to God that has blessed me with His guidance by giving me strength and patience in doing my thesis research. Additionally, I want to thank Him for His unending favor throughout the writing process of this paper, which has enabled me to overcome my obstacles and difficulties.

My deepest gratitude goes to my thesis advisor, Ms Silvy Yusri S.Si M.Si and my thesis co-advisor, Dr Hery Sutanto S.Si M.Si that always spared their time and knowledge in order to guide me through my research. I am also very thankful for their patience in dealing with all my questions and their innumerable helps. Additionally, I'd like to thank Kak Rizal Ramdhani, Kak Devita V. Senzas, and Kak Stacia A. Fortunata, and other laboratory assistants for the help during my experiment.

I would also like to thank to all of CE'19 friends. for the laughs and keeping my sane, and to all Life Science and Technology fellows for the togetherness and laughs during thesis work in laboratory. These last four years have been a wild ride with you all.

To my family, without their strong support and concern, this research might not have been finished on time. I sincerely appreciate your kindness and unending support.

Last but not least, I want to thank myself. I want to thank me for believing in me and for doing all this hard work. With your blood and tears you finally did it!

TABLE OF CONTENTS

	Page
STATEMENT BY THE AUTHOR	1
ABSTRACT	3
DEDICATION.....	5
ACKNOWLEDGEMENTS.....	6
TABLE OF CONTENTS	7
LIST OF FIGURES	10
LIST OF TABLES.....	12
LIST OF APPENDICES	13
CHAPTER 1 INTRODUCTION.....	14
1.1 Background	14
1.2 Research Objectives	16
1.3 Significance of Study	16
1.4 Research Questions	16
1.5 Hypothesis.....	17
CHAPTER 2 LITERATURE REVIEW.....	18
2.1 Candlenut and Candlenut oil.....	18
2.2 Oxidation of Unsaturated Fatty Acid	19
2.3.1 Omega 3	21
2.3.2 Omega 6	22
2.3.3 Omega 9	23
2.4 Omega Content in Candlenut oil.....	23
2.5 Nano – Emulsion.....	24
2.6 Supplement Syrup Emulsion.....	25
2.7 Microbial Contamination in Candlenut Oil.....	27
2.8 Previous Study	28

CHAPTER 3 RESEARCH METHODS.....	30
3.1 Venue and Time	30
3.2 Materials and Equipment	30
3.2.1 Materials.....	30
3.1.2 Equipment.....	30
3.3 Experimental Procedure	31
3.2 Preliminary Research	34
3.2.1 Extraction of Candlenut Oil	34
3.3 Design of Formulation	36
3.3.1 Nano – emulsion Preparation.....	37
3.3.2 Syrup Preparation.....	38
3.4 Analytical Procedure.....	38
3.4.1 Analysis of Omega Content	38
3.4.2 Stability Test	39
3.4.3 Microbial Analysis.....	40
3.5 Sensory Analysis.....	41
3.6 Statistical Analysis.....	41
CHAPTER 4 RESULTS AND DISCUSSIONS	42
4.1 Preliminary Research	42
4.1.1 Candlenut Oil Extraction	42
4.1.2 Omega Content Analysis of Candlenut Oil.....	44
4.1.3 Microbial Analysis of Candlenut Oil.....	47
4.2 Formulation of Candlenut Oil Nano- emulsion Syrup.....	48
4.3 Stability Test Analysis	51
4.3.1 pH Measurement.....	52
4.3.2 Colour Measurement.....	57
4.3.3 Viscosity Measurement.....	64
4.4 Microbial Analysis of Candlenut oil Nano Emulsion Syrup	70
4.5 Particle Size Diameter of Candlenut oil Nano Emulsion Syrup	71

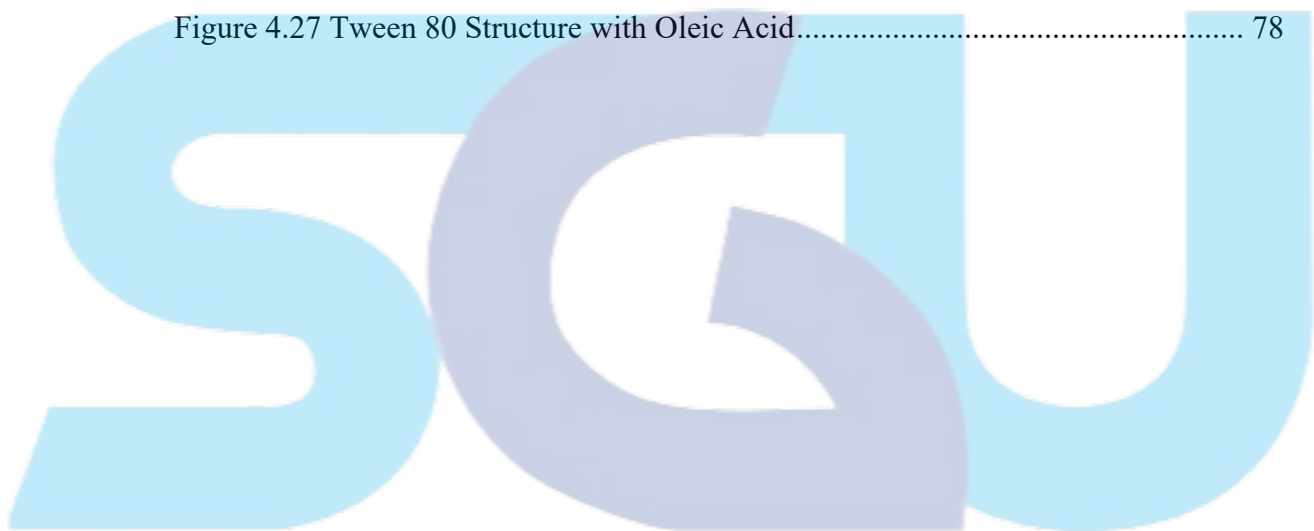
4.7	Sensory Analysis of Candlenut Oil Syrup Emulsion	76
4.7	Omega Content of Candlenut Oil Syrup Emulsion.....	77
	CHAPTER 5 CONCLUSIONS AND RECCOMENDATIONS.....	80
5.1	Conclusions	80
5.2	Recommendations	81
	REFERENCES	82
	APPENDICES	92
	CURRICULUM VITAE.....	133



LIST OF FIGURES

Figures	Page
Figure 2.1 Candlenut Oil	18
Figure 2.2 Oxidation Reaction.....	20
Figure 2.3 Omega- 3 Fatty Acids Structure.....	22
Figure 2.4 Omega- 6 Fatty Acids Structure.....	22
Figure 2.5 Omega- 9 Fatty Acids Structure.....	23
Figure 3.1 Experimental Block Diagram.....	33
Figure 3.2 Flowchart of Candlenut Oil Extraction	35
Figure 4.1 Schematic diagram of cold press expeller.....	42
Figure 4.2 Comparison omega content of Candlenut Oil.....	45
Figure 4.3 Omega content of Candlenut Oil After and Before Autoclave	46
Figure 4.4 Candlenut Oil Nano-emulsion Syrup	51
Figure 4.5 pH value of F1.....	54
Figure 4.6 pH value of F2.....	55
Figure 4.7 pH Value of F3.....	55
Figure 4.8 pH Value of F4.....	56
Figure 4.9 Candlenut oil Emulsion Syrup at 28 days	58
Figure 4.10 Chemical structure of Allura Red AC.....	59
Figure 4.11 The photochemical degradation of Allura Red AC.....	61
Figure 4.12 Lightness value of F1	62
Figure 4.13 Lightness value of F2	62
Figure 4.14 Lightness value of F3	63
Figure 4.15 Lightness value of F4	63
Figure 4.16 Conformation of Xanthan Gum	66
Figure 4.17 Conformation of Xanthan Gum under temperature and salinity.....	66

Figure 4.18 Viscosity of F1	67
Figure 4.19 Viscosity of F2	67
Figure 4.20 Viscosity of F3	68
Figure 4.21 Viscosity of F4	68
Figure 4.22 Creaming index at 30°C and 40°C	69
Figure 4.23 Size Distribution diameter of ratio 1:1:1	72
Figure 4.24 Size Distribution diameter of ratio 5:1:1	72
Figure 4.25 Size Distribution diameter of ratio 1:1:1 at 30°C.....	74
Figure 4.26 Size Distribution diameter of ratio 1:1:1 at 40°C.....	74
Figure 4.27 Tween 80 Structure with Oleic Acid.....	78



LIST OF TABLES

Table	Page
Table 2.1 Previous studies which were conducted in Swiss German University	28
Table 3.1 Formulation of Experiment	37
Table 3.2 Polydispersity Index	41
Table 4.1 Yield of Candlenut Oil	43
Table 4.2 Omega content of candlenut Oil.....	44
Table 4.3 TPC observations from candlenut oil	47
Table 4.4 Daily Recommendation Intake of Omega 3 Oil	48
Table 4.5 pH value at 30°C	52
Table 4.7 Lightness Value at 30°C.....	57
Table 4.8 Lightness Value at 40°C	58
Table 4.9 Viscosity at 30°C	64
Table 4.10 Viscosity at 40°C	65
Table 4.11 Microbial Analysis of Candlenut oil Nano emulsion syrup at day 7	70
Table 4.12 Particle size diameter and polydispersity in different ratios	72
Table 4.13 Particle size diameter and polydispersity ratio 1:1:1	74
Table 4.14 Hedonic Test for Candlenut Oil Syrup Emulsion.....	76
Table 4.15 Omega Content of Candlenut Oil Syrup Emulsion	77

LIST OF APPENDICES

Appendix	Page
Appendix 1. Modified Cold Pressed Expeller	92
Appendix 2. Cold Pressed Candlenut Oil	93
Appendix 3. Microbial Analysis for self-cold pressed Candlenut Oil	94
Appendix 4. Omega content for self-pressed candlenut oil.....	95
Appendix 5. Omega content for cold pressed candlenut oil from e-commerce	96
Appendix 6 Microbial Analysis Candlenut Oil after Autoclave	97
Appendix 7 Omega Content of Candlenut Oil after Autoclave.....	98
Appendix 7 Statistic Analysis for Omega Content.....	99
Appendix 8 Low Energy Method Nano Emulsion	100
Appendix 9 Statistical Analysis Regression Test for pH measurement	101
Appendix 10 Statistical Analysis Slope Test for pH measurement.....	105
Appendix 11 Trendline Extrapolating for pH measurement	107
Appendix 12 Statistical Analysis Regression Test for Lightness measurement	111
Appendix 13 Statistical Analysis Slope Test for Lightness measurement	115
Appendix 14 Statistical Analysis Regression Test for Viscosity	117
Appendix 15 Statistical Analysis Slope Test for Viscosity	121
Appendix 16 Microbial Analysis Candlenut Oil Syrup Emulsion Day 1.....	123
Appendix 17 Microbial Analysis Candlenut Oil Syrup Emulsion Day 28.....	124
Appendix 18 Consent Form for Parent of the panelists in Sensory Analysis.....	125
Appendix 19 Questioner for the panelists in Sensory Analysis	127
Appendix 20 Data Hedonic Acceptance Sensory Test.....	128
Appendix 21 Statistical Analysis (Wilcoxon Test) for Hedonic Test	129
Appendix 22 Omega Content Candlenut Oil Syrup Emulsion.....	132