

**PHYSICAL AND CHEMICAL EVALUATION OF NATURAL LIP STAIN
USING DRAGON FRUIT (*Hylocereus polyrhizus*) PEEL**

By

Jovina Tiofanny
12104054

BACHELOR'S DEGREE
in

Pharmaceutical Chemical 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 30 June 2025

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.


Jovina Tiofanny

Student

Date 11 July 2015

Approved by:



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

Thesis Advisor

Date 11 July 2015


Silvy Yusri, S.Si, M.T.

Thesis Co-Advisor

Date 11 July 2015



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

Dean

Date 11 July 2015

Jovina Tiofanny

ABSTRACT

PHYSICAL AND CHEMICAL EVALUATION OF NATURAL LIP STAIN USING DRAGON FRUIT (*Hylocereus polyrhizus*) PEEL

By

Jovina Tiofanny

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

Silvy Yusri, S.Si, M.T., Co-Advisor

SWISS GERMAN UNIVERSITY

This study evaluates the physical and chemical stability of natural lip stain formulations using red dragon fruit (*Hylocereus polyrhizus*) peel extract as a natural colorant. The extract was obtained via Ultrasound-Assisted Extraction (UAE), followed by freeze-drying, and analyzed for Total Phenolic Content (18.38 mg GAE/L) and antioxidant activity (IC₅₀: 1588 ppm). Lip stains were formulated with varying concentrations of vitamin E (0.1% and 1%) and film-forming agents (Hydroxypropyl Methylcellulose/HPMC and Dimethicone). Stability tests (color, pH, viscosity, spreadability) were conducted over 28 days at 30 °C, alongside a sensory evaluation involving 23 young adult panelists. The formulation containing 1% vitamin E showed the best color stability, while the HPMC formulation demonstrated superior viscosity and pH stability, along with the highest sensory preference. Overall, all formulations were stable, except the dimethicone variant which showed reduced spreadability due to phase separation. The 1% vitamin E formulation had the best color stability, while HPMC provided superior texture and user acceptance.

Keywords: Red dragon fruit peel extract, natural lip stain, ultrasound-Assisted Extraction (UAE), stability test, sensory evaluation



© Copyright 2025
by Jovina Tiofanny
All rights reserved

DEDICATION

To my beloved family and friends, thank you for your endless support, love, and encouragement.

To Indonesia, my home, may this small work contribute to its growing future.

And to everyone who believed in me when I doubted myself, this is for you.



ACKNOWLEDGEMENTS

First, I would like to express my deepest gratitude to my parents for their unwavering support throughout my bachelor study journey. Your encouragement has been my strongest foundation.

My sincere appreciation goes to my advisor and co-advisor, Dr. Hery Sutanto, S.Si., M.Si., and Silvya Yusri, S.Si., M.T., for their invaluable guidance and support in completing this thesis.

I am also thankful to all lecturers and laboratory assistants, especially Kak Rizal, Kak Stacia, Kak Theo, and Kak Devita, for always being patient in answering all my questions and assisting me throughout the laboratory work.

To all my fellow PCE friends, especially Rifa Ayesha Januar, my closest companion since the first semester—thank you for always helping me and listening to all my worries during this long journey.

I would also like to express my gratitude to Carsteen Agrivina, my companion during our half-year stay in Germany. Thank you for going through the struggles together and always striving toward success with me.

Special thanks to Benedetta Yufita Buhani and Raphaella Melody for being such supportive friends during our time in PCE.

Last but not least, to D—thank you for being with me from the beginning until the end of this thesis journey. Thank you for your unwavering mental support and for believing in me when I couldn't believe in myself.

TABLE OF CONTENTS

	Page
STATEMENT BY THE AUTHOR.....	2
ABSTRACT.....	3
DEDICATION.....	5
ACKNOWLEDGEMENTS.....	6
TABLE OF CONTENTS.....	7
LIST OF FIGURES.....	10
LIST OF TABLES.....	12
CHAPTER 1 - INTRODUCTION.....	13
1.1 Background.....	13
1.2 Research Problems.....	14
1.3 Objectives.....	14
1.4 Significance of Study.....	15
1.5 Research Questions.....	15
1.6 Hypothesis.....	15
CHAPTER 2 - LITERATURE REVIEW.....	16
2.1 Lip Stain.....	16
2.2 Synthetic Colorants in Cosmetics.....	16
2.3 Natural Colorants in Cosmetics.....	17
2.4 Red Dragon Fruit Peel as a Potential Natural Colorant.....	18
2.5 Variables That Influence Betalain Stability.....	20
2.5.1 pH.....	21
2.5.2 Light.....	21
2.5.3 Oxygen.....	22
2.5.4 Temperature.....	22
2.6 Ultrasound-Assisted Extraction (UAE).....	22
2.7 Physical Properties of Lip Stain.....	24
2.7.1 Color stability.....	24
2.7.2 Texture and viscosity.....	25
2.7.3 Spreadability and transfer proof.....	25
2.8 Chemical Properties of Lip Stain.....	26
2.8.1 pH stability.....	26

2.8.2 Oxidation resistance.....	26
2.9 Total Phenolic Content (TPC).....	27
2.10 2,2-Diphenyl-1-picrylhydrazyl (DPPH) assay method and IC 50.....	28
2.11 Vitamin E.....	29
2.12 Film-Former.....	30
2.11.1 Hydroxypropyl Methylcellulose (HPMC).....	31
2.11.2 Dimethicone.....	32
2.13 Tween 80.....	33
2.14 Sensory Test.....	34
2.15 Microbiological on Lip Stain.....	35
2.16 State of The Art (SOTA).....	36
CHAPTER 3 – RESEARCH METHODS.....	38
3.1 Venue and Time.....	38
3.2 Materials and Equipment.....	39
3.2.1 Materials.....	39
3.2.2 Equipment.....	39
3.3 Design of Experiment.....	40
3.4 Dragon Fruit Peel Extraction.....	40
3.5 Total Phenolic Content.....	41
3.5.1 Standard curve preparation.....	41
3.5.2 Sample preparation for TPC analysis.....	41
3.6 Antioxidant Activity.....	41
3.7 Lip Stain Formulation.....	42
3.8 Stability Test.....	43
3.8.1 Color.....	43
3.8.2 Viscosity.....	44
3.8.3 pH.....	44
3.8.4 Spreadability.....	45
3.9 Sensory Test.....	45
3.10 Microbiological Analysis.....	46
3.10.1 Total Plate Count.....	46
3.10.2 Total Mold and Yeast Count.....	47
CHAPTER 4 – RESULTS AND DISCUSSIONS.....	48
4.1 Extraction Results of Red Dragon Fruit Peel.....	48
4.2 Dried Extract Analysis.....	50
4.2.1 Total Phenolic Content.....	50
4.2.2 Antioxidant Activity.....	52
4.3 Formulation.....	53
4.4 Sensory Test.....	57

4.5 Stability Analysis.....	58
4.5.1 Color Stability.....	58
4.5.2 pH Stability.....	60
4.5.3 Viscosity Stability.....	62
4.5.4 Spreadability Stability.....	64
4.6 Microbiology Analysis.....	65
4.6.1 Total Plate Count.....	65
4.6.2 Total Mold and Yeast Count.....	67
CHAPTER 5 – CONCLUSIONS AND RECOMMENDATIONS.....	70
5.1 Conclusions.....	70
5.2 Recommendations.....	70
REFERENCES.....	72
CURRICULUM VITAE.....	81



LIST OF FIGURES

Figures	Page
Figure 2.1 Water lip stain from Clarins (Clarins, C., 2024, November 26)	14
Figure 2.4.1 Red dragon fruit (Peppyflora, P., 2024, November 25)	17
Figure 2.6.1 Ultrasound-Assisted Extraction method (Ameer, K., Shahbaz, H. M., & Kwon, J.-H., 2017)	21
Figure 2.9.1 Reaction of DPPH• and antioxidant (Xiao et al., 2020)	27
Figure 2.10.1 Chemical structure of α -tocopherol (Demirkaya, F., & KADIOGLU, Y., 2007)	28
Figure 3.3.1 Research process flowchart	36
Figure 3.8.2.1 Ostwald viscometer (Generalic, E., 2022, June 29)	45
Figure 4.1.1 Red dragon fruit peel (<i>Hylocereus polyrhizus</i>) before drying process	42
Figure 4.1.2 Red dragon fruit peel (<i>Hylocereus polyrhizus</i>) after drying process	42
Figure 4.1.3 Dragon fruit extract after freeze drying process	43
Figure 4.2.1.1 Gallic acid standard curve	44
Figure 4.2.2.1 Extract antioxidant curve	46
Figure 4.3.1 Lip stain using dragon fruit peel extract, vitamin E, and film-formers	49
Figure 4.3.2 Swatches lip stain formulation	49
Figure 4.4.1 Sensory analysis result	51
Figure 4.5.1.1 Color stability result chart	52
Figure 4.5.2.1 pH stability result chart	54
Figure 4.5.3.1 Viscosity stability analysis chart	56
Figure 4.6.1.1 Fungal growth observed on PCA media for lip stain sample (Vitamin E + HPMC) at day 0	68

Figure 4.6.1.2 Fungal growth observed on PCA media for lip stain sample (Vitamin E + HPMC) at day 9	68
Figure 4.6.1.3 Fungal growth observed on PCA media for lip stain sample (Vitamin E + HPMC) at day 18	68
Figure 4.6.2.1 Fungal growth observed on PDA media for lip stain sample (Vitamin E + HPMC) at day 0	69
Figure 4.6.2.1 Fungal growth observed on PDA media for lip stain sample (Vitamin E + HPMC) at day 9	70
Figure 4.6.2.1 Fungal growth observed on PDA media for lip stain sample (Vitamin E + HPMC) at day 18	70



LIST OF TABLES

Table	Page
Table 2.3.1 Sources of natural colorant (Ansari, S., Ghildiyal, H., & Mukopadayay, S., 2022)	15
Table 2.13.1 BPOM regulation for microbial contamination limits in cosmetics (BPOM., 2019)	38
Table 2.14.1 Previous study about utilization of dragon fruit as natural cosmetic colorant	31
Table 3.1.1 Research timeline	33
Table 3.7.1. Lip stain formulation with different concentrations of vitamin E (tocopherol)	38
Table 3.7.2. Lip stain formulation with different film-forming ingredients	38
Table 3.9.1 Hedonic test scale	40
Table 4.2.1.1 Absorbance of Gallic Acid Standard Solutions	43
Table 4.2.1.2 Extract Total Phenolic Content analysis result	44
Table 4.2.1.3 Comparison of TPC result between this study and previous study	44
Table 4.2.2.1 Extract percentage inhibition result	45
Table 4.3.1 Vitamin E variation	47
Table 4.3.2 Film-former variation	47
Table 4.3.3 Formulation result	58
Table 4.5.1.1 Color stability analysis result	50
Table 4.5.2.1 pH stability analysis result	52
Table 4.5.3.1 Flow time to calculate viscosity	53
Table 4.5.3.2 Viscosity stability analysis result	54
Table 4.5.4.1 Spreadability stability analysis result	55

Appendix 1. Raw Data of Sensory Evaluation for Sample 862	81
Appendix 2. Raw Data of Sensory Evaluation for Sample 653	82
Appendix 3. Raw Data of Sensory Evaluation for Sample 742	83
Appendix 4. Raw Data of Sensory Evaluation for Sample 283	84
Appendix 5. Raw Data of Sensory Evaluation for Sample 975	85
Appendix 6. Friedman test result for sensory evaluation – Color appearance, odor, texture, longevity, stickiness, and overall preference	87
Appendix 7. Friedman test output – Color appearance	87
Appendix 8. Friedman test output – Odor	87
Appendix 9. Friedman test output – Texture	88
Appendix 10. Friedman test output – Longevity	88
Appendix 11. Friedman test output – Stickiness	89
Appendix 12. Friedman test output – Overall preference	89