



IN SILICO DESIGN OF LAMP PRIMERS FOR THE IDENTIFICATION OF *Pongo abelii* AND *Pongo tapanuliensis*

GAETANIA FAZA ADHARA



DEPARTMENT OF BIOLOGY
FACULTY OF MATHEMATICS AND NATURAL SCIENCES
IPB UNIVERSITY
BOGOR
2025



@Hak cipta milik IPB University

Hak Cipta Dilindungi Undang-undang

1. Dilarang mengutip sebagian atau seluruh karya tulis ini tanpa mencantumkan dan menyebutkan sumber :
 - a. Pengutipan hanya untuk kepentingan pendidikan, penelitian, penulisan karya ilmiah, penyusunan laporan, penulisan kritik atau tinjauan suatu masalah
 - b. Pengutipan tidak merugikan kepentingan yang wajar IPB University.
2. Dilarang mengumumkan dan memperbanyak sebagian atau seluruh karya tulis ini dalam bentuk apapun tanpa izin IPB University.

STATEMENT ABOUT UNDERGRADUATE THESIS INFORMATION SOURCES AND ACT OF SPILLING OVER COPYRIGHTS

I hereby declare that the thesis with the title “In Silico Design of LAMP Primers for the Identification of *Pongo abelii* and *Pongo tapanuliensis*” is my work under the supervision of the advising committee and has not been proposed for any form of institution. Sources of information derived or quoted from published or unpublished works of other authors have been mentioned in the text and included in the references at the end of this thesis.

By this writing, I hereby assign the copyright of my writings to IPB University.

Bogor, August 2025

Gaetania Faza Adhara
G3401211065



ABSTRAK

GAETANIA FAZA ADHARA. In Silico Design of LAMP Primers for the Identification of *Pongo abelii* and *Pongo tapanuliensis*. Dibimbing oleh PUJI RIANTI dan ASADATUN ABDULLAH.

Orangutan Sumatra (*Pongo abelii*) dan orangutan Tapanuli (*Pongo tapanuliensis*) termasuk primata yang terancam punah akibat degradasi habitat dan kegiatan antropogenik. Identifikasi spesies yang akurat penting untuk konservasi, namun metode berbasis PCR kurang praktis untuk diterapkan di lapangan. Penelitian ini bertujuan merancang primer LAMP (*loop-mediated isothermal amplification*) yang menargetkan gen mitokondria *cytochrome b* (*cyt b*), dengan pendekatan in silico. Data sekuens *cyt b* dari GenBank disejajarkan untuk menemukan daerah konservatif sebagai lokasi penempelan primer. Primer dirancang menggunakan NEB LAMP Primer Design Tool dan dievaluasi berdasarkan karakteristik fisikokimia dan termodinamika. Hasil BLASTn menunjukkan spesifisitas tinggi terhadap spesies target. Pemetaan struktur juga menunjukkan jarak antar primer dan ukuran amplicon sesuai untuk amplifikasi LAMP. Temuan ini mendukung potensi penggunaan primer LAMP sebagai alat identifikasi spesies orangutan yang cepat dan dapat diterapkan di lapangan. Validasi laboratorium tetap diperlukan untuk memastikan efektivitasnya.

Kata kunci: DNA mitokondria, identifikasi genetik, orangutan sumatera, orangutan tapanuli.

ABSTRACT

GAETANIA FAZA ADHARA. In Silico Design of LAMP Primers for the Identification of *Pongo abelii* and *Pongo tapanuliensis*. Supervised by PUJI RIANTI and ASADATUN ABDULLAH.

Orangutans, especially the Sumatran (*Pongo abelii*) and Tapanuli (*Pongo tapanuliensis*) orangutans, are critically endangered due to habitat loss and other human-induced threats. Reliable species identification is crucial for conservation, but the limitations of PCR-based methods in field settings often hamper it. This study aimed to develop species-specific primers for loop-mediated isothermal amplification (LAMP) targeting the mitochondrial cytochrome b (*cyt b*) gene to distinguish between the two species using an in silico approach. *Cyt b* sequences from GenBank were aligned to identify conserved regions for primer binding. Candidate primers were designed using the NEB LAMP Primer Design Tool and evaluated based on physicochemical and thermodynamic characteristics. BLASTn analyses confirmed high sequence specificity. Structural mapping also indicated suitable inter-primer spacing and amplicon sizes compatible with LAMP reaction. These results support the potential of LAMP primers for rapid, field-deployable identification of orangutan species. Further laboratory validation is recommended to confirm their effectiveness in conservation efforts.

Keywords: genetic identification, mitochondrial DNA, Sumatran orangutans, Tapanuli orangutans.



@Hak cipta milik IPB University

Hak Cipta Dilindungi Undang-undang

1. Dilarang mengutip sebagian atau seluruh karya tulis ini tanpa mencantumkan dan menyebutkan sumber :
 - a. Pengutipan hanya untuk kepentingan pendidikan, penelitian, penulisan karya ilmiah, penyusunan laporan, penulisan kritik atau tinjauan suatu masalah
 - b. Pengutipan tidak merugikan kepentingan yang wajar IPB University.
2. Dilarang mengumumkan dan memperbanyak sebagian atau seluruh karya tulis ini dalam bentuk apapun tanpa izin IPB University.

IN SILICO DESIGN OF LAMP PRIMERS FOR THE IDENTIFICATION OF *Pongo abelii* AND *Pongo tapanuliensis*

GAETANIA FAZA ADHARA

An Undergraduate Thesis
Intended to Acquire Bachelor Degree in
Biology Study Program

**DEPARTMENT OF BIOLOGY
FACULTY OF MATHEMATICS AND NATURAL SCIENCES
IPB UNIVERSITY
BOGOR
2025**

@Hak cipta milik IPB University

IPB University





@Hak cipta milik IPB University

Hak Cipta Dilindungi Undang-undang

1. Dilarang mengutip sebagian atau seluruh karya tulis ini tanpa mencantumkan dan menyebutkan sumber :
 - a. Pengutipan hanya untuk kepentingan pendidikan, penelitian, penulisan karya ilmiah, penyusunan laporan, penulisan kritik atau tinjauan suatu masalah
 - b. Pengutipan tidak merugikan kepentingan yang wajar IPB University.
2. Dilarang mengumumkan dan memperbanyak sebagian atau seluruh karya tulis ini dalam bentuk apapun tanpa izin IPB University.

Examiner Team on Undergraduate Thesis Examination:
Prof. Dr. Ir. Hamim, M.Si.



@Hak cipta milik IPB University

Hak Cipta Dilindungi Undang-undang

1. Dilarang mengutip sebagian atau seluruh karya tulis ini tanpa mencantumkan dan menyebutkan sumber :
 - a. Pengutipan hanya untuk kepentingan pendidikan, penelitian, penulisan karya ilmiah, penyusunan laporan, penulisan kritik atau tinjauan suatu masalah
 - b. Pengutipan tidak merugikan kepentingan yang wajar IPB University.
2. Dilarang mengumumkan dan memperbanyak sebagian atau seluruh karya tulis ini dalam bentuk apapun tanpa izin IPB University.



Thesis Title : In Silico Design of LAMP Primers for the Identification of *Pongo abelii* and *Pongo tapanuliensis*
Name : Gaetania Faza Adhara
NIM : G3401211065

Approved by

Supervisor 1:

Dr. Puji Rianti, S.Si, M.Si

Supervisor 2:

Prof. Dr.rer.nat. Asadatun Abdullah

Acknowledged by

Head of Biology Department:

Prof. Dr. Ir. Iman Rusmana, M.Si.

NIP. 196507201991031002

Exam date:
25th June 2025

Pass date:



FOREWORDS

The highest praise and gratitude are due to Allah the Almighty for the countless blessings that enabled the completion of this study. This study was conducted in December 2025 and April 2025 with the title "In Silico Design of LAMP Primers for the Identification of *Pongo abelii* and *Pongo tapanuliensis*".

Working on and writing this undergraduate thesis certainly cannot be separated from the help and support of various parties. Therefore, the author expresses her sincere gratitude to those who have helped make this study possible. Under the guidance, warm support, and encouragement of outstanding supervisors, Dr. Puji Rianti and Prof. Dr.rer.nat. Asadatun Abdullah, the author, completed this paper well and without obstacles.

Best regards are also given to Prof. Dr. Ir. Hamim, M.Si., the academic supervisor, who accompanied the author during her studies. Gratitude is also extended to Dr. Ivan Permana Putra, S.Si., M.Si., for serving as the seminar moderator, and to all lecturers, assistants, and staff of the Biology Department for the knowledge and assistance provided.

Special appreciation to father, mother, and the author's entire family members for all the love, support, and prayers; to all Biology 58 comrades-in-arms, Peneliti Keceh, and others that cannot be mentioned one by one, who have accompanied, helped, entertained, and become a comfort place to charge. Ultimately, it is hoped that this scientific work will be beneficial to those in need and contribute to the advancement of science.

I hope this study will benefit the reader and scientific progress.

Bogor, August 2025

Gaetania Faza Adhara



TABLE OF CONTENTS

LIST OF TABLES	iii
LIST OF FIGURES	iii
I INTRODUCTION	1
1.1 Background	1
1.2 Study Questions	2
1.3 Study Objective	2
1.4 The Benefit of the Study	2
II METHODS	3
2.1 Time and Place	3
2.2 Materials and Tools	3
2.3 Procedures	3
III RESULT	5
3.1 Multiple Sequence Alignment	5
3.2 Target Region Characteristics	5
3.3 LAMP Primer Set Characteristics	5
3.4 LAMP Primer Set Specificity	7
3.5 Primer Binding Site Mapping and Inter-Primer Distances	8
IV DISCUSSION	9
V CONCLUSION AND SUGGESTION	13
5.1 Conclusion	13
5.2 Suggestion	13
REFERENCES	14
APPENDIXES	17
CURRICULUM VITAE	25

LIST OF TABLES

1	Recommended Characteristics of Optimal LAMP Primers	4
2	Summary of BLASTn Homology Parameters	5
3	Nucleotide sequences of the designed LAMP primer sets	5
4	Thermodynamic characteristics of the designed LAMP primers	6
5	Potential secondary structure of the designed LAMP primers	6
6	Number of BLASTn Hits for Each LAMP Primer Against <i>P. abelii</i> and Non-Target Species	7
7	Number of BLASTn Hits for Each LAMP Primer Against <i>P. tapanuliensis</i> and Non-Target Species	7

LIST OF FIGURES

1	Binding positions and orientations of the six LAMP primers on the target <i>cyt b</i> sequence of <i>P. abelii</i>	8
2	Binding positions and orientations of the six LAMP primers on the target <i>cyt b</i> sequence of <i>P. abelii</i>	8