



**CHARACTERISTICS OF THE COAT COLOR AND ITS
RELATIONSHIP WITH MELANOCORTIN 1 RECEPTOR (MC1R)
IN THE PAPUAN BANDICOOT (*Echymipera kalubu*)**

@Hak cipta milik IPB University

URSULA PAULAWATI MAKER



**STUDY PROGRAM OF ANIMAL BIOSCIENCES
FACULTY OF MATHEMATICS AND NATURAL SCIENCES
IPB UNIVERSITY
BOGOR
2025**

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.
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.



@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.
 - 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 REGARDING DISSERTATION AND SOURCES OF INFORMATION AND COPYRIGHT ASSIGNMENT

I hereby declare that the dissertation with the title “Characteristics of the Coat Color and Its Relationship with Melanocortin 1 Receptor (MC1R) in the Papuan Bandicoot (*Echymipera kalubu*)” is my written work with instruction from the supervisor and has not been submitted in any form to any college. Sources of information derived from or cited from published or unpublished works from other authors have been mentioned in the text and listed in the Bibliography at the end of this dissertation.

I hereby delegate the copyright of my written work to IPB University.

Bogor, October 21, 2025

Ursula Paulawati Maker
G362190011



SUMMARY

URSULA PAULAWATI MAKER. Characteristics of the Coat Color and Its Relationship with Melanocortin 1 Receptor (MC1R) in the Papuan Bandicoot (*Echymipera kalubu*). Supervised by TRI ATMOWIDI, KANTHI ARUM WIDAYATI, BAMBANG SURYOBROTO, and HIROO IMAI.

Coat color is a highly variable morphological trait in animals and plays a crucial role in various adaptive functions such as camouflage, communication, sexual selection, and thermoregulation. In many mammalian species, color variation is influenced by the expression and mutation of multiple pigmentation-related genes, one of which is the *Melanocortin 1 Receptor* (MC1R). MC1R encodes a receptor protein that regulates the production of two primary types of melanin: eumelanin (black/brown) and pheomelanin (red/yellow). Activation of MC1R by the α -MSH hormone enhances eumelanin production via the cAMP signaling pathway. Research on MC1R has largely focused on placental mammals, while information on marsupials remains scarce. The Papuan bandicoot (*Echymipera kalubu*), a marsupial endemic to Papua, exhibits striking intraspecific variation in ventral hair color. Some individuals display reddish-yellow ventral hair, while others have white-grey coloration. This study aims to identify phenotypic hair color variation and hair color banding patterns, analyze the genetic characteristics of MC1R in the two-color morphs, and evaluate the functional association between MC1R variants and hair color through cAMP signaling assays. A total of 20 *E. kalubu* individuals were collected from Manokwari, West Papua. Hair color was analysed quantitatively using the CIE Lab* method and calibrated photography across three body regions (dorsal, lateral, ventral), while hair shafts were examined microscopically to identify seven banding types based on eumelanin and pheomelanin distribution. Habitat soil color was measured to assess body-background color matching. Results revealed two distinct phenotypic groups, red-ventral and white-ventral, with significant differences in Lab* and Chroma values, particularly in the ventral area. Red-ventral individuals had higher a* and b* values and lower L* values, indicating darker, redder coloration; they also exhibited a greater diversity of hair banding types (T3–T5) and were found in darker, reddish habitats. In contrast, white-ventral individuals displayed predominantly light-colored banding (T6–T7) and inhabited more open areas with lighter soil substrates, supporting the hypotheses of countershading and background matching. Genetic characterisation showed that the *E. kalubu* MC1R gene consists of a single exon spanning 951 bp, encoding a 317 amino acid protein. Three nucleotide polymorphisms were identified, including two synonymous mutations (T201C and C471T) and one non-synonymous substitution (G668A), resulting in an R223Q amino acid change. The R223 variant was found only in red ventral individuals, while Q223 occurred exclusively in white ventral individuals. Functional analysis showed that cAMP signaling upon α -MSH stimulation occurred in a dose-dependent manner response was weak, but significantly in haplotype A (R223) than haplotype C (Q223) displaying a relatively flat response curve. Basal activity was higher and significant in haplotype A than in haplotype C. Maximum activity and EC₅₀ values did not differ significantly between the haplotypes. The R223Q mutation is located at the end of TM5, near IL3, a key region for interaction with

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.
2. Dilarang mengumumkan dan memperbanyak sebagian atau seluruh karya tulis ini dalam bentuk apapun tanpa izin IPB University.



the Gs protein. This position contributes to receptor conformation stability through interactions with the G β subunit and Ca²⁺ ions, both essential for efficient hormone recognition and signal transduction. These findings indicate that the location of the mutation combined with basal activity may underlie the observed variation in ventral coat color in *E. kalubu*. These findings imply that ventral color differences are not solely determined by MC1R function and may involve downstream ERK/MAPK and other pathways and other genes such as ASIP. Overall, *E. kalubu* represents a promising animal model for studying the evolution of hair coloration, pigmentation mechanisms, and ecological adaptation in nonplacental mammals.

@Hak cipta milik IPB University
Keywords: cAMP signaling, hair color banding, marsupial, MC1R, pigmentation

@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
 - 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.



RINGKASAN

URSULA PAULAWATI MAKER. Karakteristik Warna Rambut dan Hubungannya dengan Gen Melanocortin 1 Receptor (MC1R) pada Bandikut Papua (*Echymipera kalubu*). Dibimbing oleh TRI ATMOWIDI, BAMBANG SURYOBROTO, KANTHI ARUM WIDAYATI, dan HIROO IMAI.

Warna rambut merupakan salah satu sifat morfologis yang sangat bervariasi pada hewan dan memainkan peran penting dalam berbagai fungsi adaptif seperti kamuflase, komunikasi, seleksi seksual, dan termoregulasi. Pada banyak spesies mamalia, variasi warna ini dipengaruhi oleh ekspresi dan mutasi pada berbagai gen pigmentasi, salah satunya adalah *Melanocortin 1 Receptor* (MC1R), yang mengkode reseptor protein pengatur produksi dua tipe utama pigmen melanin: eumelanin (hitam/coklat) dan feomelanin (merah/kuning). Aktivasi MC1R oleh hormon α -MSH meningkatkan produksi eumelanin melalui jalur pensinyalan cAMP. Hingga kini, studi mengenai MC1R sebagian besar terbatas pada mamalia plasental, sementara informasi pada marsupial masih minim. Bandikut Papua (*E. kalubu*), marsupial endemik dari Papua, menunjukkan variasi warna ventral yang mencolok beberapa individu berwarna merah kekuningan dan lainnya putih keabu-abuan. Penelitian ini bertujuan untuk mengidentifikasi variasi fenotip warna rambut dan pola pita warna rambut, menganalisis karakter genetik MC1R pada dua kelompok warna tersebut, serta mengevaluasi keterkaitan fungsional antara varian MC1R dengan warna rambut melalui uji pensinyalan cAMP. Sebanyak 20 individu *E. kalubu* dikoleksi dari Manokwari, Papua Barat. Warna rambut dianalisis secara kuantitatif menggunakan metode CIE Lab* dan fotografi terkalibrasi pada tiga area tubuh (dorsal, lateral, ventral), sementara rambut diamati secara mikroskopis untuk mengidentifikasi tujuh tipe pita warna berdasarkan distribusi eumelanin dan feomelanin. Pengukuran warna substrat tanah habitat dilakukan untuk mengevaluasi kesesuaian warna tubuh dengan latar belakang (*background matching*). Hasil menunjukkan dua kelompok fenotipe yang jelas, yaitu ventral-merah dan ventral-putih, dengan perbedaan signifikan pada nilai Lab*, dan Chroma, terutama di area ventral. Kelompok ventral-merah memiliki nilai a^* dan b^* lebih tinggi, serta L^* lebih rendah, mencerminkan warna lebih merah dan gelap; mereka juga menunjukkan keragaman pita warna rambut lebih banyak (T3–T5), dan hidup di habitat dengan tanah lebih gelap dan kemerahan. Sebaliknya, kelompok ventral-putih menunjukkan dominasi pita rambut terang (T6–T7) dan menghuni area lebih terbuka dengan substrat tanah yang lebih cerah, mendukung hipotesis countershading dan *background matching*. Karakterisasi genetik menunjukkan bahwa gen MC1R pada *E. kalubu* terdiri atas satu ekson sepanjang 951 bp yang menyandi 317 asam amino. Ditemukan tiga polimorfisme nukleotida, dua bersifat sinonim (T201C dan C471T), dan satu non-sinonim (G668A), yang menyebabkan substitusi asam amino R223Q. Varian R223 hanya ditemukan pada individu ventral-merah, sementara Q223 hanya pada ventral-putih, menunjukkan asosiasi kuat dengan fenotipe warna. Analisis fungsional menunjukkan bahwa sinyal cAMP akibat stimulasi α -MSH terjadi secara tergantung dosis pada haplotipe A (R223), meskipun keduanya responsnya lemah namun Haplotipe A (R223) berbeda signifikan dibandingkan haplotipe C (Q223), dengan kurva respons yang relatif datar. Aktivitas basal lebih tinggi pada haplotipe A dibandingkan haplotipe C,

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.
- 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.

secara signifikan. Aktivitas maksimum dan nilai EC_{50} tidak berbeda secara signifikan antara kedua haplotipe. Lokasi mutasi R223Q di ujung TM5, dekat IL3 situs kritis untuk interaksi protein G menunjukkan bahwa mutasi ini mungkin berperan dalam regulasi alternatif atau interaksi protein lainnya. Temuan ini menunjukkan bahwa lokasi mutasi, dikombinasikan dengan produksi basal cAMP, dapat menjadi dasar variasi warna bulu ventral yang diamati pada *E. kalubu*. Selain itu perbedaan warna ventral tidak sepenuhnya dijelaskan oleh fungsi MC1R, dan kemungkinan melibatkan gen atau jalur pensinyalan *downstream* ERK/MAPK dan lainnya serta keterlibatan gen lain seperti ASIP. Secara keseluruhan, *E. kalubu* merupakan model hewan yang potensial untuk mempelajari mekanisme evolusi warna rambut, pigmentasi, dan adaptasi ekologis pada mamalia non-plasental.

Kata kunci: cAMP signaling, marsupial, MC1R, pigmentasi, pola warna rambut

@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
 - 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.



@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.
 - 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.

© Copyright belongs to IPB University, the year 2025
All Rights Reserved

It is forbidden to cite part or all of this paper without including or citing the source. Citations are only for education, research, writing scientific papers, preparing reports, writing criticisms, or reviewing a problem, and the citation does not harm the interests of IPB University.

It is prohibited to publish and reproduce part or all of this paper without IPB University's permission



**CHARACTERISTICS OF THE COAT COLOR AND ITS
RELATIONSHIP WITH MELANOCORTIN 1 RECEPTOR (MC1R)
IN THE PAPUAN BANDICOOT (*Echymipera kalubu*)**

@Hak cipta milik IPB University

URSULA PAULAWATI MAKER

Dissertation
as one of the requirements for obtaining
the Doctoral degree
in the Study Program of Animal Biosciences

**STUDY PROGRAM OF ANIMAL BIOSCIENCES
FACULTY OF MATHEMATICS AND NATURAL SCIENCES
IPB UNIVERSITY
BOGOR
2025**

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.
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.



@Hak cipta milik IPB University

Hak Cipta Dilindungi Undang-undang

1. Dilarang mengutip sebagian atau seluruh karya tulis ini tanpa mencarumkan dan menyebutkan sumber :
- a. Pengutipan hanya untuk kepentingan pendidikan, penelitian, penulisan karya ilmiah, penyusunan laporan, penulisan kritik atau tinjauan.
- 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.

Advisory Committee External Examiner on Dissertation Closed Examination:

- 1 Dr. Ir. Achmad Farajallah, M.Si.
(Animal Biosciences, Faculty of Mathematics and Science, IPB University)
- 2 Dr. Keliopas Krey, S.Pd. M.Si.
(Department of Biology, Faculty of Mathematics and Science, Papua University)

Advisory Committee External Examiner on Dissertation Promotion Examination:

- 1 Dr. Ir. Achmad Farajallah, M.Si.
(Animal Biosciences, Faculty of Mathematics and Science, IPB University)
- 2 Dr. Keliopas Krey, S.Pd. M.Si.
(Department of Biology, Faculty of Mathematics and Science, Papua University)



Name
NIM

@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.
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.

Dissertation Title : Characteristics of the Coat Color and Its Relationship With Melanocortin 1 Receptor (MC1R) In the Papuan Bandicoot (*Echymipera kalubu*)
Name : Ursula Paulawati Maker
NIM : G362190011

Approved by,

Advisor 1:
Prof. Dr. Drs. Tri Atmowidi, M.Si.

Advisor 2:
Dr. Drs. Bambang Suryobroto

Advisor 3:
Dr. Kanthi Arum Widayati, S.Si., M.Si.

Advisor 4:
Prof. Hiroo Imai, Ph.D



Verified by

Head of Animal Biosciences Study Program:
Prof. Dr. Drs. Tri Atmowidi, M.Si.
NIP 196708271993031003

Dean of Faculty of Mathematics and Natural Sciences:
Dr. Berry Juliandi, S.Si., M.Si.
NIP 197807232007011001



The Dissertation Examination Date: October 10, 2025
The Doctoral Promotion Examination Date: October 21, 2025

Graduate Date:



PREFACE

In the name of God Almighty, the omnipotent, the omnipresent, the Most Gracious and the Most Merciful, who always blesses me with sound health, realistic thinking, and opportunity for higher study. Grace, all praises and gratitude to Jesus for the strength and His blessing in my life, so that this scientific work was completed. This research was conducted from January 2021 until December 2024 with the title “Characteristics of the Coat Color and Its Relationship with Melanocortin 1 Receptor (MC1R) Gene in the Papuan Bandicoot (*Echymipera kalubu*)”. This dissertation is submitted in partial fulfillment of the requirements for a Doctoral Degree for the author in the Graduate School of Bogor Agricultural University. This work could only have succeeded thanks to the invaluable contributions of many people. Therefore, on this occasion, the author would present a deepest acknowledgement and highest appreciation to:

1. Prof. Dr. Drs. Tri Atmowidi, M.Si, is the Head of the Animal Biosciences Study Program.
2. Dr. Kanthi Arum Widayati, S.Si, M.Si, Dr. Drs. Bambang Suryobroto, Prof. Hiroo Imai, and Prof. Dr. Drs. Tri Atmowidi, M.Si, as the supervisor for all the wise advice and guidance. Thank you for their kindness, patience, and all their hard work in correcting my dissertation.
3. Xiaochan Yan, PhD., Akihiro Itoigawa, PhD., Prof. Yohei Terai, and Mrs. Mihoko Umemura.
4. Ministry of Education and Culture, Research and Technology of Indonesia, for generously funding this study under the Doctoral Dissertation Research Grant Implementation for the year 2021-2022.
5. KAKENHI (21KK0130) and bilateral research (JPJSBP120259923) from the Japan Society for Promotion of Science supported this research.
6. Molecular Biology Section, Center for the Evolutionary Origins of Human Behavior (EHUB), Kyoto University, Japan, and all laboratory assistants and staff for support.
7. Ir. Ismail Jitmau, M.Si., as head of Yayasan Cinta Kasih Manokwari, for assistance with living costs in Bogor.
8. Dr. Alfian, S.Si, Dr. Fina, S.Si and staff of the Animal Biosciences Study Program, the Laboratorium of BEH FMIPA IPB University.
9. Dr. Aksamina M. Yohanita, S.Pd, M.Si, Dr. Rouland Ibnudarda, S.Si, M.Si, Dr. Siti Nurjanah, S.Si, M.Si, Dr. Lora Purnamasari, S.Si, M.Si for support.
10. My beloved family: my dad (†), my mother, my husband, my children, my sisters, and brothers for their inspiration, motivation, and encouragement.
11. To those who indirectly contributed to this research, your kindness means a lot to me.

Hopefully, this scientific work is useful for those who need it and for the advancement of science. Thank you very much.

Bogor, October 21, 2025

Ursula Paulawati Maker



TABLE OF CONTENTS

LIST OF TABLES	15
LIST OF FIGURES	15
I INTRODUCTION	Error! Bookmark not defined.
1.1 Background	1
1.2 Research Problem	Error! Bookmark not defined.
1.3 Research Aims	3
1.4 Benefits of This Research	3
1.5 Novelty of This Research	3
1.6 Research Stage	4
II LITERATURE REVIEW	5
2.1 Functions and Significance of Coat Color in Mammals	5
2.2 Coat Color Variation in Mammals and Marsupials	6
2.3 Genetic Basis of Mammalian Pigmentation	7
2.4 Coat Color in Marsupials: Previous Studies and Knowledge Gaps	8
2.5 Biological Profile of the Papuan Bandicoot (<i>E. kalubu</i>)	9
2.5.1 Taxonomy and Nomenclature	9
2.5.2 Distribution and Habitat	10
2.5.3 Diet and Activity Patterns	10
2.5.4 Social Behaviour and Reproduction	10
2.5.5 Morphology and Pelage Characteristics	11
2.5.6 Conservation status and threats	11
III Coat Color Variation and Hair Color Banding in the Papuan Bandicoot (<i>Echymipera kalubu</i> , Marsupialia: Peramelidae)	13
3.1 Introduction	13
3.2 Material and Methods	14
3.2.1 Animals	14
3.2.2 Coat Color Phenotype in the Body Area	15
3.2.3 Hair Color Bands	15
3.2.4 Color Substrate Measurement	17
3.2.5 Statistical Analysis	18
3.3 Results	18
3.3.1 Coat Color Variation Between Red-Ventral and White-Ventral Groups	18
3.3.2 Differences in Coat Color Values (Lab*) Between Body Areas in the Red Ventral and White Ventral Groups	21
3.3.3 Variation of Seven Hair Color Band Types	23
3.3.4 Differences in Hair Color Banding Between Red-Ventral and White-Ventral Groups	24
3.3.5 Result of Color Substrate	28
3.4 Discussion	29
3.4.1 Differences in Coat Color Value (Lab*) Between Red Ventral and White-Ventral Groups in Relation to Habitat	29
3.4.2 The Differences in Coat Color Values (Lab*) Between Body	



3.4.3	Areas in the Red-Ventral and White-Ventral Group Correlated with Countershading	30
3.5	Variations of Hair Color Banding Between Body Areas in Red Ventral and White-Ventral Group	30
3.5	Conclusion	31
IV	Characteristics of MC1R in New Guinea Spiny Bandicoot <i>Echymipera kalubu</i> Fischer, 1829 (Marsupialia: Peramelidae) from Papua	32
4.1	Introduction	32
4.2	Material and Methods	33
4.2.1	Animals	33
4.2.2	MC1R Genotyping	33
4.2.3	Functional Assay of MC1R	34
4.2.4	Genetic Variation and Haplotypes	34
4.3	Result	34
4.3.1	Genetic Variation and Haplotypes	34
4.3.2	Functional Assay	36
4.4	Discussion	38
4.5	Conclusions	40
V	GENERAL DISCUSSION	41
VI	CONCLUSIONS AND SUGGESTIONS	44
6.1	Conclusions	44
6.2	Suggestions	44
	REFERENCE	46
	BIOGRAPHY	52

LIST OF TABLES

1	Description of hair color banding types in <i>E. kalubu</i>	16
2	Coat color of body areas: dorsal, lateral, and ventral of each individual in the red-ventral group <i>E. kalubu</i>	18
3	Coat color of body areas: dorsal, lateral, and ventral of each individual in the red-ventral group <i>E. kalubu</i>	20
4	Mean ($\pm$ SD) values of lightness (L), redness (a), yellowness (b), and chroma (Ch) in the dorsal, lateral, and ventral areas of red-ventral and white-ventral <i>E. kalubu</i>	21
5	Mean ($\pm$ SD) values of lightness (L), redness (a), and yellowness (b) across the dorsal, lateral, and ventral areas of red-ventral and white-ventral <i>E. kalubu</i>	22
6	Description and phenotype of diagrammatic hair color band types (T1–T7) representation in <i>E. kalubu</i>	24
7	Distribution of hair color banding types (T1–T5) in the body areas: dorsal, lateral, and ventral of the red-ventral group of <i>E. kalubu</i> individuals	25
8	Distribution of hair color banding types (T1–T2; T6–T7) in body areas: dorsal, lateral, and ventral of the white-ventral group of <i>E. kalubu</i> individuals	27
9	Distribution of hair color banding types in body areas: dorsal, lateral, and ventral between the red and white-ventral groups of <i>E. kalubu</i>	28
10	CIE Lab color values (L, a, b) of soil substrates collected from habitats of red-ventral and white-ventral <i>E. kalubu</i> individuals	29
11	Amino Acid and Nucleotide Haplotypes of MC1R in <i>E. kalubu</i>	36
12	Mean ($\pm$ SD) values of basal activity, maximum activity, and EC ₅₀	37

LIST OF FIGURES

1	Research flow diagram: the covariation between the MC1R gene polymorphism and coat color in bandicoots Papua	4
2	Geographic sampling locations of the Papuan bandicoot (<i>E. kalubu</i>) in Manokwari City, West Papua, Indonesia	15
3	Photographs of <i>E. kalubu</i> illustrating body areas and color sampling areas	16
4	Habitat types and substrate color at the location where <i>E. kalubu</i> individuals were found	18
5	Hair color banding observed under a VHX-7000 digital microscope (magnification: 100 $\times$ to <500 $\times$)	23
6	Schematic transmembrane topology for the MC1R receptor between The reddish-ventral color group and the white-ventral color group bandicoot	35
	Dose-response curve for MC1R variants of <i>E. kalubu</i> . Each point represents the mean $\pm$ standard error of the mean (SEM) determined from at least four independent measurements	37