TELANG FLOWER EXTRACT IN OBESE WHITE MALE WISTAR RAT MODEL DERMAPEN WOUND HEALING: HAIR GROWTH AND HISTOPATHOLOGICAL SKIN TISSUE CHARACTERISTICS

Silvia Fransisca[1*], Riva Nita Harmila[2], Widyaningsih Oentari[3]
Master Study Program in Biomedical Sciences, Faculty of Medicine, Dentistry and Health Sciences, Prima Indonesia University, Medan [1,2,3]
[*]*Corresponding Author :* silviafransisca@unprimdn.ac.id

ABSTRAK
Rambut dan kulit berperan sebagai proteksi terhadap lingkungan yang merugikan. Bunga Telang dikatahui sebagai antioksidan mengandung flavonoid, dan peptida yang dapat meningkatkan kesehatan dan sebagai obat alami untuk berbagai keluhan penyakit. Tujuan penelitian menguji dan menganalisis efektivitas pemberian krim ekstrak bunga telang (Clitoria ternatea) terhadap pertumbuhan rambut dan penyembuhan luka bekas dermapen pada tikus putih (Rattus norvegicus) galur wistar jantan obesitas serta bagaimana perubahan histopatologinya. Penelitian dilaksanakan bulan Oktober - Desember 2023, dilaboratorium Farmakologi dan Terapi Departemen Fakultas Kedokteran Universitas Sumatera Utara dengan jenis penelitian True Experimental dengan rancangan *Post Test Only Control Group*. Sampel adalah 24 ekor tikus Wistar dalam 4 kelompok. Kelompok perlakuan 1 (kontrol), sedangkan kelompok 2, 3, dan 4 mendapat ekstrak bunga telang sebesar 2,5%, 5%, dan 7% per kg per berat badan. Data penelitian diolah menggunakan SPSS 25.0 for Windows. Hasil penelitian menunjukkan pertumbuhan rambut paling besar ada pada kelompok perlakuan 3 yang diberi ekstrak bunga telang dengan konsentrasi 7%. Hasil penyembuhan luka yang diberikan ekstrak bunga Telang pada konsentrasi 2.5%, 5%, dan 7% berpengaruh signifikan terhadap proses penyembuhan luka dan memiliki kolagen terisi penuh dan padat. Sehingga disimpulkan bunga Telang dapat mempercepat penyembuhan luka serta merangsang pertumbuhan rambut yang mengalami obesitas.

Kata kunci : bunga telang, pertumbuhan rambut, kulit, obesity

ABSTRACT
Hair and skin defend against environmental hazards. Antioxidants like flavonoids and peptides in Telang flowers can improve health and treat many diseases. Telang flower extract cream (Clitoria ternatea) was tested for its effects on hair development, dermapen scar healing, and histopathology in obese male Wistar strain white rats (Rattus norvegicus). The Pharmacology and Therapy Laboratory, Department of Medicine, University of North Sumatra, conducted a true experimental research study with a post-test-only control group design from October to December 2023. The samples were 24 Wistar rats in 4 groups. Telang flower extract was given to groups 1, 2, 3, and 4 at 2.5%, 5%, and 7% per kg per body weight. Research data was handled with SPSS 25.0 for Windows. Treatment group 3 received 7% Telang flower extract and had the most hair growth. Telang flower extract at 2.5%, 5%, and 7% concentrations improves wound healing and has dense collagen. Thus, Telang flowers accelerate wound healing and hair development in fat persons.

Keywords *: telang flower, hair growth, skin, obesity*

INTRODUCTION

Hair has an essential role in humans. This hair protects against adverse environments, namely cold temperatures or ultraviolet rays (Egambaram et al., 2020). Hair also functions as a temperature regulator, encouraging sweat evaporation and as a sensitive sense of touch (Wu et al., 2022).

In addition to its obvious social and aesthetic value, hair serves various physiological purposes. Having good hair may do wonders for one's self-esteem. A person's overall self-

perception and physical attractiveness are profoundly affected by their hair's care, coloring, and style. In addition to its apparent aesthetic value, hair serves a practical purpose by shielding the scalp from the weather and regulating core body temperature (Kutlubay & Serdaroglu, 2017).

There are two parts to hair: the roots and the shafts (Erdoğan, 2017). Blood nourishes the hair follicles via the nervous system. Hence, weather, chemicals used in hairstyling, and the environment can all impact hair. A person's hair develops out of roots buried in their skin. The follicles in the scalp undergo biological changes that control the development and fall of the hair. There are metabolic events that affect hair growth that take place at the roots' base (Lemasters et al., 2017). There are two primary human hair varieties: terminal and vellus. Coarse, heavily pigmented hair is known as terminal hair. The external genitalia, armpits, eyelashes, eyebrows, and head are all potential locations. The subcutis layer is home to the big hair follicles producing terminal hair. The standard for terminal hair diameter is more excellent than 0.03 mm. Vellus hair, which is light-colored and thin, is made of tiny hair follicles in the dermis layer that are less than 0.03 mm in diameter (El-Domyati et al., 2017).

Proper nourishment and oxygen are essential for the proliferation and differentiation of hair follicles. According to Guo & Katta, the hair development cycle might be interrupted when the necessary nutrients are not provided (Guo & Katta, 2017). Nutrients required by the metabolism are in short supply in an undernourished organism. This means the body's nutritional reserves are going toward supporting its most vital organs. Hair thinning and loss occur because the scalp does not get enough nutrients due to this disorder (Muscogiuri et al., 2019).

Stoffel et al. found that adipose tissue increases the production of inflammatory cytokines, including interleukin 6 (IL-6), in conditions of overweight and obesity (Stoffel et al., 2020). Many variables contribute to the development of obesity, making it a complicated disease. Epidemiological studies employ body mass index (BMI) to categorize overweight and obesity, a condition associated with hair loss (Chooi et al., 2019).

In particular, young women, those with inadequate serum levels of ferritin, folic acid, and zinc, and those undergoing metabolic or patriarchal surgeries are at increased risk for hair loss (Zhang et al., 2021). Furthermore, iron deficiency causes hair loss because it reduces the ability of red blood cells (RBCs) to carry enough oxygen. The anagen phase, when the hair follicles require enough oxygen and nutrients to proliferate and differentiate, becomes problematic when the amount of oxygen provided to the matrix cells of the follicles diminishes (Kareem et al., 2020).

Humans naturally experience a steady stream of hair loss, with an average of 50–150 strands of telogen hair falling off daily. Telogen effluvium can be caused by several factors, including hormonal changes (as might occur with androgen hormones or certain medications), an imbalanced diet, scalp inflammation, systemic illness, psychological stress, and events such as childbirth or surgery (Rebora, 2019).

Most individuals, regardless of gender, attribute a person's sense of self-worth to their hair. A person's hairstyle can have a significant impact on their self-esteem and the way others see them. Having good hair may do wonders for one's self-esteem. A person's physical appearance and sense of self-worth are significantly impacted by their hair care routine, including the style, color, and cut. Vitamin and mineral supplements help reverse hair loss. Inadequate intake of vitamins and minerals necessary for healthy cell development and function can lead to hair thinning. Knowing which vitamins and minerals effectively treat hair loss is crucial, even though supplements are commonly accessible and relatively inexpensive (Almohanna et al., 2019). Extreme heat, a typical result of Indonesia's tropical climate, can damage hair. A blister on the scalp can result from excessive perspiration

brought on by hot weather. The hair roots may become weaker and more prone to loss due to this limp and filthy scalp state (Amelia et al., 2017). In addition, the skin, the body's largest organ, is vulnerable to the harmful effects of this climate (Balato et al., 2014). Among the skin's several roles is maintaining a constant internal temperature (Parker, 2021). Cuts and scrapes are one way the skin can be damaged. Disease, injury, or changes in the body's chemistry or physical makeup are pathological situations that can lead to wounds. According to their cause and length, wounds are classified as acute or chronic (Farahani & Shafiee, 2021).

Telang flower or butterfly pea, also known by the scientific name *Clitoria ternatea*, is a type of plant widely used for therapeutic purposes, as a functional food, natural dye, and as an ingredient in herbal drinks. Telang flowers contain abundant secondary metabolites (Pertiwi et al., 2022). This Telang flower has the potential to be a source of antimicrobials (Suganda & Adhi, 2017), antioxidants, anti-cancer (Marpaung, 2020), improving hair health, maintaining brain health, and so on (Suryawati & Santika, 2023).

One indigenous plant with development potential in Indonesia is the Telang flower (*Clitoria ternatea*). As a decorative plant, a natural dye, a food colorant, and a cancer preventive due to their high antioxidant content, Telang flowers have many uses. In 2023, Ginting et al. According to animal research, there is much hope that the antioxidants, flavonoids, and peptides found in Telang flowers will help alleviate a wide range of health issues (Ginting et al., 2022). The properties of the flavonoid quercetin on skin and hair have led to the usage of Telang flowers in numerous beauty products (Gaytos & Lumagbas, 2020).

In light of this finding, scientists are keen to study the anti-inflammatory properties of this plant's constituents. The researchers examined the effects of a cream containing Talang flower extract (*Clitoria ternatea*) on the histological image of dermapen scar healing, hair development, and the rats' overall health.

METHOD

This true experimental study uses a post-test-only control group design. This research observes a control and treatment group following specified acts or treatments. The University of North Sumatra Faculty of Medicine Department of Pharmacology and Therapeutics Laboratory will conduct this research. The research will run from October until December 2023. The researchers sampled 24 Wistar rats. An influential and valuable research variable is the center of attention. Talang flower extract (*Clitoria ternatea*) cream was the independent variable. Dermapen scar healing and histopathology. Dietary fat and Dermapen wounds precondition variables.

The treatment group of mice was given Talang flower extract (*Clitoria ternatea*) cream at different doses for 14 days. Treatment Group 1 was given distilled water, and Treatment Groups 2, 3, and 4 were given butterfly pea flower extract with concentrations of 2.5%, 5%, and 7% per kg per body weight, respectively.

The research data was analyzed using SPSS 25.0 for Windows. The Kolmogorov-Smirnov test ($p > 0.05$) assessed data normality. The significance between groups was tested using a one-way analysis of variance (One-way ANOVA) with a 95% confidence level ($p < 0.05$). The Post Hoc Test with LSD was used for further analysis.

RESULT

This research was conducted from October to December 2023 at the University of North Sumatra Faculty of Medicine Department of Pharmacology and Therapeutics

Laboratory. Male Wistar white rats (*Rattus norvegicus*) weighing 200–300g were used in this study. The test animals were placed into four groups: the control group received base cream, and treatment group 1 received Telang flower extract (*Clitoria ternatea*) cream at 2.5%, 5%, and 7%.

Table 1. Characteristics Test Animals

Component	Group			
	Control	P1	P2	P3
Types of Rats	*Rattus norvegicus* White Wistar Strains			
Gender	Male			
General circumstances	The coat color is white, healthy, and active.			
Average Initial Weight	243gr	239gr	245gr	263gr
Average Final Weight Loss	325gr	312gr	329gr	321gr

On average, the mice in this study were healthy before and after therapy. Without quitting, 24 test animals completed this study. Twenty-four experimental animals were weighed. Table 2 shows the average body weight of each group before and after 14 days of treatment.

Table 2. Mouse Body Weight

Parameter	Group	Average a high-fat diet	
		Before	After
Weight (gr)	Control	243	325
	P1	239	312
	P2	245	329
	P3	263	321
Naso-length (mm)	Control	211	215
	P1	212	218
	P2	217	220
	P3	209	213
Lee Index	Control	0.29	0.31
	P1	0.29	0.31
	P2	0.28	0.31
	P3	0.29	0.32

Data shows that before the high-fat diet, the Lee index value in test animals was <0.3, indicating no obesity (Lee et al., 2011). Mice on a high-fat diet had Lee index scores of 0.31 and 0.32, indicating obesity. Researchers found that all test animals were fat before dermapen wound formation. This study employs a dermapen to injure the rat's shaved back.

On days 7 and 14, 6 of the longest mouse hair strands were removed, straightened, and attached to an adhesive tape to observe growth. Use a caliper to measure hair length.

The average mouse hair length shows that each group grew hair over 14 days. On the last day, control group hair length was 0.39 cm, treatment group 1 1.03cm, group 2 1.12cm, and group 3 1.49 cm. Based on this average difference, the researchers found that treatment group 3, with 7% Telang flower extract, had the most hair growth. With 0.39 cm hair length, the control group had the slightest hair growth. Control received simply base cream.

Table 4 shows that rats in treatment groups 1, 2, and 3 had flawless wound closure on the 14th day, while the control group had the most extended wound length at 0.58cm. Daily wound length measurements were taken in each treatment group to compare dermapen

wound healing rates. All research groups had the same wound healing percentage before treatment because the starting wound was 0.00%. Treatment and control groups had different average healing rates. Treatment group 1 had 100% dermapen wound healing on the 14th day, treatment group 2 on the 13th, and treatment group 3 on the 12th. The control group had 71%. Thus, treatment group 3 healed faster than treatments 1 and 2, but the control group did not.

Table 3. Rat Hair Length (cm)

No	Group	Repetition	Rat Hair Length Day 7	Rat Hair Length Day 14
1	Control	1st	0,31	0,50
2		2nd	0,25	0,42
3		3rd	0,00	0,29
4		4th	0,30	0,39
5		5th	0,21	0,32
6		6th	0,00	0,44
Average			0,18	0,39
7	Treatment I (2,5% Telang flower extract cream)	1st	0,58	0,82
8		2nd	0,63	1,09
9		3rd	0,57	1,02
10		4th	0,65	1,11
11		5th	0,72	1,20
12		6th	0,52	0,98
Average			0,61	1,04
13	Treatment II (5% Telang flower extract cream)	1st	0,77	1,12
14		2nd	0,73	1,37
15		3rd	0,79	1,09
16		4th	0,67	0,95
17		5th	0,65	1,22
18		6th	0,71	1,02
Average			0,72	1,13
19	Treatment III (7% Telang flower extract cream)	1st	0,83	1,40
20		2nd	0,88	1,45
21		3rd	0,83	1,51
22		4th	0,91	1,52
23		5th	0,81	1,46
24		6th	0,92	1,60
Average			0,86	1,49

Phytochemical investigations show that Telang flower extract (*Clitoria ternatea*) includes flavonoids, saponins, tannins, and triterpenoids. These findings match Cahyaningsih et al., the 80% ethanol Telang flower extract contains flavonoids, saponins, triterpenoids, and tannins, according to this study (Cahyaningsih et al., 2019).

Histopathological investigations were made with a 400x light microscope. This study found that obese male Wistar white rats (*Rattus norvegicus*) can repair dermapen scars with collagen density after receiving Telang flower extract cream (*Clitoria ternatea*). Collagen density differences between the control and treatment groups prove this. The microscopic

appearance of treated histopathological skin tissue is shown in Table 6. The control group receiving only base cream had minimal collagen formation (<25%) due to inflammation in the skin tissue.

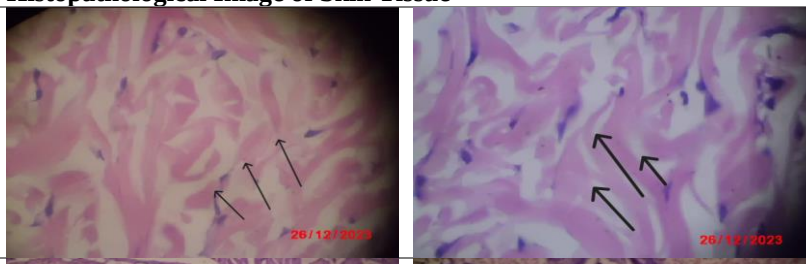
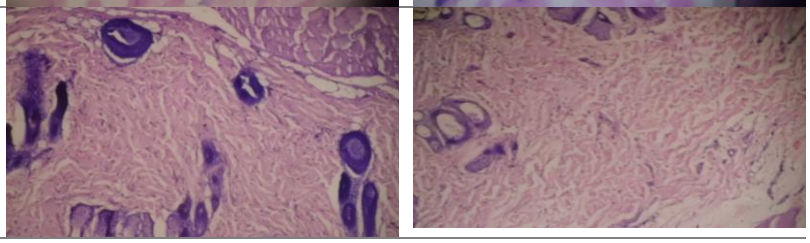
Table 4. Average Wound Healing

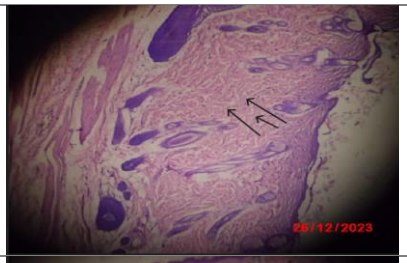
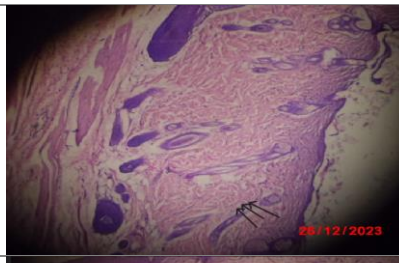
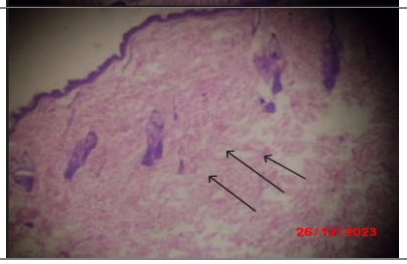
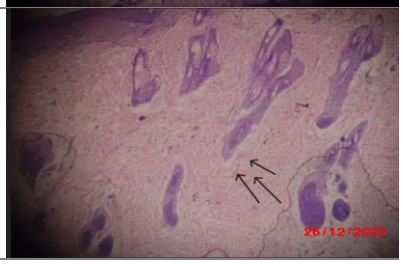
Day	Average Wound Healing							
	Control		Treatment I		Treatment I		Treatment III	
	Cm	%	Cm	%	Cm	%	Cm	%
1	2.00	0	2.00	0	2.00	0	2.00	0
2	1.98	1	1.94	3	1.92	4	1.90	5
3	1.91	4.5	1.83	8.5	1.79	10.5	1.81	9.5
4	1.87	6.5	1.75	12.5	1.69	15.5	1.62	19
5	1.74	13	1.63	18.5	1.55	22.5	1.32	34
6	1.55	22.5	1.44	28	1.32	34	1.03	48.5
7	1.45	27.5	1.15	42.5	1.11	44.5	0.90	55
8	1.35	32.5	1.05	47.5	0.93	53.5	0.72	64
9	1.24	38	0.87	56.5	0.73	63.5	0.52	74
10	1.11	44.5	0.76	62	0.55	72.5	0.33	83.5
11	0.95	52.5	0.66	67	0.42	79	0.16	92
12	0.85	57.5	0.52	74	0.22	89	0	100
13	0.67	66.5	0.28	86	0	100	0	100
14	0.58	71	0	100	0	100	0	100

Table 5. Phytochemical Test

Secondary Metabolites	Testing	Color	Results
Flavonoid	Wilstater	Red	+
Saponin	Forth	Blue and bubbly	+
Tannin	FeCl3	Blackish green	+
Alkaloid	Wagner	Red	-
Triterpenoid	Lieberman – Burchard	Red	+

Table 6. Histopathological Image of Skin Tissue

No	Groups	Histopathological Image of Skin Tissue
1	Control	
2	Treatment I (2,5% Telang flower extract cream)	

3	Treatment II (5% Telang flower extract cream)		
4	Treatment III (7% Telang flower extract cream)		

A close inspection of the micrograph after administering the Telang flower extract (*Clitoria ternatea*) treatment revealed thick and dense development. Groups 1, 2, and 3 all saw thick collagen development ranging from 75% to 100%. Compared to groups 1 and 2, the histopathological picture in treatment group 3, which was applied with a cream containing a 7% concentration of Telang flower extract, revealed the densest collagen composition. In histopathology, the collagen density could not be distinguished in obese male white rats (*Rattus norvegicus*) of the Wistar strain extracted from the blossoms of the Telang plant (*Clitoria ternatea*), which contain several compounds.

Hair Growth Data Analysis Results

Table 7. Normality Test

Group Extract Dose	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Control (C)	.160	6	.200*	.968	6	.879
Treatment P1	.166	6	.200*	.965	6	.859
Treatment P2	.189	6	.200*	.966	6	.868
Treatment P3	.167	6	.200*	.971	6	.899

The findings from the Kolmogorov-Smirnov test were used to check for normalcy. Normally distributed data is indicated by a p-value greater than 0.05, and non-normally distributed data is indicated by a p-value less than 0.05 (Ghozali, 2018). All groups show a significance level of 0.200 in the research results shown in Table 7. If the p-value exceeds 0.05, we say the data follows a normal distribution. The data is thus assumed to follow a normal distribution. Once we know the data follows a normal distribution, we can continue checking for homogeneity by using the Levene test for each subset of our study population to see if they are all the same.

Table 8. Homogeneity Test Results

	Levene Statistical	df1	df2	Sig.
Base on Mean	1.139	3	20	.357
Base on Median	.946	3	20	.437
Based on the Median, the adjusted df	.946	3	13.752	.445
Based on trimmed mean	1.083	3	20	.379

Final verdict on homogeneity Using the Levene test, as shown in the table above, data is considered homogenous if the significance value is more significant than 0.05 and non-

homogeneous if the value is less than 0.05 (Ghozali, 2018). The significant column in Table 8 displays the findings of the probability value, which is 0.357. We can conclude that the control and treatment groups 1, 2, and 3 come from homogeneous populations or have the same variance because the resulting significant probability value is greater than 0.05.

Table 9. One-Way ANOVA Test Results

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	3.752	3	1.251	99.443	.000
Within Groups	.252	20	.013		
Total	4.004	23			

The resulting significant value is 0.000 or less than 0.05 (Ghozali, 2018), as shown in Table 9, which contains the results of the One-Way ANOVA test. It is clear from these numbers that the treatment group differs significantly from the control group.

Table 10. Post-Hoc LSD Test Results

Experimental Group (I)	Experimental Group (J)	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Control	Treatment P1	-.64333*	.06475	.000	-.7784	-.5083
	Treatment P2	-.73500*	.06475	.000	-.8701	-.5999
	Treatment P3	-1.09667*	.06475	.000	-1.2317	-.9616
Treatment 1	Control (C)	.64333*	.06475	.000	.5083	.7784
	Treatment P2	-.09167	.06475	.172	-.2267	.0434
	Treatment P3	-.45333*	.06475	.000	-.5884	-.3183
Treatment 2	Control (C)	.73500*	.06475	.000	.5999	.8701
	Treatment P1	.09167	.06475	.172	-.0434	.2267
	Treatment P3	-.36167*	.06475	.000	-.4967	-.2266
Treatment 3	Control (C)	1.09667*	.06475	.000	.9616	1.2317
	Treatment P1	.45333*	.06475	.000	.3183	.5884
	Treatment P2	.36167*	.06475	.000	.2266	.4967

When looking for statistically significant differences between groups, the LSD Post Hoc Test is an excellent tool to use. Table 10 displays the results of the Post Hoc LSD test analysis, which indicates that the group differs significantly from other groups with a significance value of 0.000, which is less than 0.05. However, the significant value between treatments 1 and 2 is 0.172, which is higher than the threshold of 0.05. So, there is no statistically significant difference between the first and second treatment groups.

Wound Healing Data Analysis Results

The findings from the Kolmogorov-Smirnov test were used to check for normalcy. There is a statistically significant difference of 0.200 across all categories, as shown in Table 11. If the p-value exceeds 0.05, we say the data follows a normal distribution. The data is thus assumed to follow a normal distribution.

Table 11. Normality Test

Group Extract Dose	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Control (C)	.180	6	.200*	.920	6	.505
Treatment P1	.122	6	.200*	.982	6	.961
Treatment P2	.252	6	.200*	.916	6	.480
Treatment P3	.228	6	.200*	.847	6	.148

In Table 12, the significance column shows the resultant probability value of 0.769. We can conclude that the control and treatment groups 1, 2, and 3 come from homogeneous populations or have the same variance because the resulting significant probability value is greater than 0.05.

Table 13. Homogeneity Test Results

	Levene Statistical	df1	df2	Sig.
Base on Mean	1.139	3	20	.357
Base on Median	.946	3	20	.437
Based on the Median, the adjusted df	.946	3	13.752	.445
Based on trimmed mean	1.083	3	20	.379

Table 13 displays the outcomes of the Levene test for homogeneity. There is a significance column value of 0.769 for the likelihood. We can conclude that the control and treatment groups 1, 2, and 3 come from homogeneous populations or have the same variance because the resulting significant probability value is greater than 0.05.

The significance value produced by the One-Way A test is 0.000, less than 0.05, as shown in Table 14. It is clear from these numbers that the treatment group differs significantly from the control group.

Table 14. One-Way ANOVA Test Results

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	.797	3	.266	703.352	.000
Within Groups	.008	20	.000		
Total	.804	23			

There are statistically significant differences between the groups, as shown in Table 15, where the Post Hoc LSD test analysis yielded a significance value of 0.000, less than 0.05.

Table 15. Post-Hoc LSD Test Results

Experimental Group (I)	Experimental Group (J)	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Control	Treatment P1	.23833*	.01122	.000	.2149	.2617
	Treatment P2	.35667*	.01122	.000	.3333	.3801
	Treatment P3	.49667*	.01122	.000	.4733	.5201
Treatment 1	Control (C)	-.23833*	.01122	.000	-.2617	-.2149
	Treatment P2	.11833*	.01122	.000	.0949	.1417
	Treatment P3	.25833*	.01122	.000	.2349	.2817
Treatment 2	Control (C)	-.35667*	.01122	.000	-.3801	-.3333
	Treatment P1	-.11833*	.01122	.000	-.1417	-.0949
	Treatment P3	.14000*	.01122	.000	.1166	.1634
Treatment 3	Control (C)	-.49667*	.01122	.000	-.5201	-.4733
	Treatment P1	-.25833*	.01122	.000	-.2817	-.2349
	Treatment P2	-.14000*	.01122	.000	-.1634	-.1166

DISCUSSION

This study aimed to examine the effects of a cream made from Telang flowers (*Clitoria ternatea*) on the dermapen wound healing process in male Wistar rats, an obese model of the white rat species (*Rattus norvegicus*). This research used male Wistar white rats (Rattus

norvegicus) weighing 200-300 g and two to three months old as samples. A total of 24 mice were used, with each group split into four equal halves, to determine the samples using the Ferderer formula. The first set of mice served as a control and received nothing more than base cream. The experimental group received a cream containing 2.5%, 5%, and 7% Telang flower extract (*Clitoria ternatea*).

An essential function of hair was described in the first phenomenon: to shield the scalp from the elements. Also, hair acts as a sensitive sense of touch and a temperature regulator by promoting the evaporation of perspiration (Egambaram et al., 2020; Erdoğan, 2017; Kutlubay & Serdaroglu, 2017; Wu et al., 2022). According to Stoffel et al., adipose tissue in obese people produces more inflammatory cytokines, including interleukin 6 (IL-6), which can lead to hair loss (Stoffel et al., 2020). Extremely unhealthy scalp conditions brought on by being overweight can damage hair roots, making them more prone to issues with hair loss (Amelia et al., 2017).

The skin, like hair, is an organ that acts as a barrier between the inside and outside world. According to Herrero-Fernandez et al., skin plays a role in maintaining a constant internal temperature (Herrero-Fernandez et al., 2022). The skin must be protected from harm because of its vital role in the body. Cuts and scrapes are one way the skin can be damaged. Injuries, diseases, and other pathological circumstances can cause physical and chemical changes to the skin, leading to the development of wounds (Farahani & Shafiee, 2021).

Infection, pollution, age, stress, oxygen, nutrition, drugs, sex hormones, obesity, diabetes, venous or arterial disease, and other factors can easily interrupt the intricate process of wound healing, resulting in chronic, non-healing wounds. The researchers found that the healing process of wounds can be slowed or even halted by obesity (Caballero, 2019; Libby, 2021). The Telang flower, or *Crucita ternatea*, is one of the natural substances that can be used to heal wounds associated with obesity.

Secondary metabolites are abundant in Telang blossoms. The anti-cancer, antioxidant, and antibacterial properties of Telang flowers are intriguing. The antioxidants, flavonoids, and peptides found in Telang blossoms have demonstrated outstanding potential in animal trials as a non-invasive treatment for various medical conditions. Because of the flavonoid quercetin's effects on hair and skin, Telang blooms are also a source of many cosmetics. Scientists believe that administering an extract from the Telang flower (*Clitoria ternatea*) to overweight male Wistar white rats (*Rattus norvegicus*) might promote hair development and the healing of dermapen scars.

A high-fat meal was used as a preconditioning treatment to generate obesity in the investigation. Quail egg yolks are the source of fat in the diet. The Lee Index is utilized to confirm that mice are overweight. It was determined that the mice were obese because after being fed a high-fat diet, all test animals had a Lee Index score of 0.33 or higher than 0.3. Dermapen was administered to the wound after a high-fat diet.

To start, the test animal is given a mixture of ketamine (80 ml/kg BW) and xylazine (5 ml/kg BW) to make it unconscious. This will ensure that the rat does not experience discomfort and prevent it from making excessive movements caused by the dermapen. Using a dermapen tool, the needles are moved perpendicular to the stretched skin as part of the treatment. Applying pressure to each scar begins when the blood first flows (needle depth 2.5 mm). Following the formation of wounds, either the control group or the treatment group applied a base cream or a cream containing Telang flower extract *(Clitoria ternatea*) for 14 days. Data needed processing and testing, so various normality, homogeneity, and significance tests were performed.

The data used to conduct the normality test were acquired with the assistance of SPSS and the Kolmogorov-Smirnov test. All test groups' hair growth and wound healing data followed a normal distribution, with a significance value of 0.200. Therefore, the data can

follow a normal distribution or represent the population. In order to determine if normally distributed data is representative of a population with a constant variance, the Levene test is used.

The obtained significance value from the hair growth data homogeneity test was 0.357. It may be inferred that the control and treatment groups 1, 2, and 3 represent the same population, as the resulting significant probability value is greater than 0.05. All test groups were likely drawn from the same or very similar population since the collected wound healing data demonstrated a significance value 0.769 in the homogeneity test.

The effectiveness and significance of this data set, which was normally distributed and homogeneous, was next assessed using the One-Way ANOVA test. The significant value of the One-way ANOVA test on the hair growth and wound healing data was 0.000, more significant than 0.05. These results suggest that the control, treatment 1, and treatment three groups differ significantly from one another, necessitating a post hoc LSD test for further analysis. To compare the groups' average total cholesterol levels, researchers used a post hoc LSD test. All groups differed significantly from one another, according to the study's Post Hoc LSD test results, which had a significance value of 0.000, which is less than 0.05.

Hair growth on the back area left by the dermapen scar was first noticed. Results showed that treatment group 3, which received a 7% concentration of Telang flower extract, had the most significant increase in hair length relative to the other groups. At the same time, the control group had the shortest hair, measuring only 0.39 cm in length. One thing that the control group did get was some foundation cream.

Wound healing was the subject of the second finding. The observational results showed that the control and treatment groups had different average healing percentages. By the end of the trial, dermapen wounds in the control group had healed at an average rate of 71%, while in treatment groups 1, 2, and 3, the rates were 100% on days 13, 14, and 12, respectively. Therefore, it is safe to say that neither the control group nor treatment 3 took their time to recover fully, but treatments 1 and 2 took longer. Free radical carriers in Telang flower extract—saponins, tannins, triterpenoids, and flavonoids—led to hair growth and quicker wound healing. These circumstances are associated with dermapen scars and obesity. Consistent with earlier studies, this one discovered that a cream made from Telang flower extract sped up the healing process of wounds in Wistar white rats (Cahyaningsih et al., 2019; Marpaung, 2020; Subchan et al., 2022; Suganda & Adhi, 2017; Suryawati & Santika, 2023).

CONCLUSION

According to the research, a cream containing Telang flower extract (Clitoria ternatea) influences hair development. The difference in average hair length between the three groups allowed the researchers to determine that treatment group 3, which received a 7% concentration of butterfly pea flower extract, had the highest rate of hair growth. In contrast, the group that received simply base cream—the control group—saw the lowest rate of hair growth.

White rats (*Rattus norvegicus*) Wistar strain that are overweight were found to have a delayed dermapen scar healing time after receiving cream containing Telang flower extract (*Clitoria ternatea*) at doses of 2.5%, 5%, and 7%, respectively, in this study. In contrast to the control group that received base cream, the treatment group underwent full recovery.

Histopathological analysis revealed that whereas the control group's collagen growth was fragile, the groups treated with 2.5%, 5%, and 7% butterfly pea flower extract (Clitoria ternatea) were dense and filled. The phytochemical testing of Telang flower extract (*Clitoria ternatea*) revealed the presence of secondary metabolites such as triterpenoids, tannins, saponins, and flavonoids. In obese mice, these chemicals promote hair development

and dermapen wound healing.

The participants in this research sought more information about the effects of applying a cream containing Telang or butterfly pea flower extract (Clitoria ternatea) on hair growth and dermapen scar healing speed. Additional studies are required to determine whether cream-containing extract from Telang flowers (Clitoria ternatea) speeds up the healing of derma pen scars in humans. In order to advance the field, additional research should focus on other elements that impact hair growth and wound healing, as well as other microscopic parameters. You can test it on other kinds of wounds to determine if it works better for additional research.

ACKNOWLEDGEMENT

The researcher would like to extend his sincere appreciation to everyone who played a role in enabling him to carry out this research, especially the supervisors at the Study Program in Biomedical Sciences, Faculty of Medicine, Dentistry and Health Sciences, Prima Indonesia University.

REFERENCES

Almohanna, H. M., Ahmed, A. A., Tsatalis, J. P., & Tosti, A. (2019). The Role of Vitamins and Minerals in Hair Loss: A Review. *Dermatology and Therapy*, *9*(1), 51–70. https://doi.org/10.1007/s13555-018-0278-6

Amelia, Y., Rostamailis, & Rosalina, L. (2017). Pemanfaatan kecambah tauge untuk mengatasi kerontokan rambut wanita berjilbab. *E-Journal Home Economic and Tourism*, *14*(1), 1–14. http://ejournal.unp.ac.id/index.php/jhet/article/view/7211

Balato, N., Megna, M., Ayala, F., Balato, A., Napolitano, M., & Patruno, C. (2014). Effects of climate changes on skin diseases. *Expert Review of Anti-Infective Therapy*, *12*(2), 171–181. https://doi.org/10.1586/14787210.2014.875855

Caballero, B. (2019). Humans against Obesity: Who Will Win? *Advances in Nutrition*, *10*, S4–S9. https://doi.org/10.1093/advances/nmy055

Cahyaningsih, E., Yuda, P. E. S. K., & Santoso, P. (2019). (Phytochemical Screening And Antioxidant Activity Of Telang Flower Extract (Clitoria Ternatea L.) Using UV-VIS Spectrophotometry). *Jurnal Ilmiah Medicamento*, *5*(1), 51–57. https://doi.org/10.36733/medicamento.v5i1.851

Chooi, Y. C., Ding, C., & Magkos, F. (2019). The epidemiology of obesity. *Metabolism: Clinical and Experimental*, *92*, 6–10. https://doi.org/10.1016/j.metabol.2018.09.005

Egambaram, O. P., Kesavan Pillai, S., & Ray, S. S. (2020). Materials Science Challenges in Skin UV Protection: A Review. *Photochemistry and Photobiology*, *96*(4), 779–797. https://doi.org/10.1111/php.13208

El-Domyati, M., Hosam, W., Moftah, N. H., Abdel Raouf, H., & Saad, S. M. (2017). Hair follicle changes following intense pulsed light axillary hair reduction: histometrical, histological and immunohistochemical evaluation. *Archives of Dermatological Research*, *309*(3), 191–202. https://doi.org/10.1007/s00403-017-1714-7

Erdoğan, B. (2017). Anatomy and Physiology of Hair. In Z. Kutlubay & S. Serdaroglu (Eds.), *Hair and Scalp Disorders* (pp. 13–27). IntechOpen. https://doi.org/10.1016/B0-44-306557-8/50208-2

Farahani, M., & Shafiee, A. (2021). Wound Healing: From Passive to Smart Dressings. *Advanced Healthcare Materials*, *10*(16), 1–32. https://doi.org/10.1002/adhm.202100477

Gaytos, C. E. G., & Lumagbas, N. A. A. (2020). Acceptability of Asian Blue Pea Flower (Clitoria Ternatea) Ice Cream. *SSRN Electronic Journal*, *December*.

https://doi.org/10.2139/ssrn.3517731

Ghozali, I. (2018). Aplikasi Analisis Multivariate dengan Program IBM SPSS 25. In *Badan Penerbit Universitas Diponegoro*.

Ginting, E. E., Rumanti, R. M., Savira, D., Ginting, P., Marbun, N., & Leny, L. (2022). In Vivo study of Antidiabetic Activity from Ethanol Extract of Clitoria ternatea L. Flower. *Journal of Drug Delivery and Therapeutics*, *12*(6), 4–9. https://doi.org/10.22270/jddt.v12i6.5759

Guo, E. L., & Katta, R. (2017). Diet and hair loss: effects of nutrient deficiency and supplement use. *Dermatology Practical & Conceptual*, *7*(1), 1–10. https://doi.org/10.5826/dpc.0701a01

Herrero-Fernandez, M., Montero-Vilchez, T., Diaz-Calvillo, P., Romera-Vilchez, M., Buendia-Eisman, A., & Arias-Santiago, S. (2022). Impact of Water Exposure and Temperature Changes on Skin Barrier Function. *Journal of Clinical Medicine*, *11*(2). https://doi.org/10.3390/jcm11020298

Kareem, J. B., Yser, H. T., Turab, M. K. A., & Makki, U. M. (2020). Effect of Malnutrition, Hormones Disturbance and Malondialdehyde on Hair Loss in Women: Patients At Al-Sader Educational Hospital, Basrah Governorate, Iraq - a Case Study. *Biochemical and Cellular Archives*, *20*(2), 5701–5708.

Kutlubay, Z., & Serdaroglu, S. (2017). Introductory Chapter: Hair Loss Chapter. In *Hair and Scalp Disorders* (pp. 3–10). IntechOpen. https://doi.org/http://dx.doi.org/10.5772/66984

Lee, S.-I., Kim, J.-W., Lee, Y.-K., Yang, S.-H., Lee, I.-A., Suh, J.-W., & Kim, S.-D. (2011). Anti-obesity Effect of Monascus pilosus Mycelial Extract in High Fat Diet-induced Obese Rats. *Journal of Applied Biological Chemistry*, *54*(3), 197–205. https://doi.org/10.3839/jabc.2011.033

Lemasters, J. J., Ramshesh, V. K., Lovelace, G. L., Lim, J., Wright, G. D., Harland, D., & Dawson, T. L. (2017). Compartmentation of Mitochondrial and Oxidative Metabolism in Growing Hair Follicles: A Ring of Fire. *Journal of Investigative Dermatology*, *137*(7), 1434–1444. https://doi.org/10.1016/j.jid.2017.02.983

Libby, P. (2021). The changing landscape of atherosclerosis. *Nature*, *592*(7855), 524–533. https://doi.org/10.1038/s41586-021-03392-8

Marpaung, A. M. (2020). Tinjauan manfaat bunga telang (clitoria ternatea l.) bagi kesehatan manusia. *Journal of Functional Food and Nutraceutical*, *1*(2), 63–85. https://doi.org/10.33555/jffn.v1i2.30

Muscogiuri, G., Barrea, L., Laudisio, D., Pugliese, G., Salzano, C., Savastano, S., & Colao, A. (2019). The management of very low-calorie ketogenic diet in obesity outpatient clinic: A practical guide. *Journal of Translational Medicine*, *17*(1), 1–9. https://doi.org/10.1186/s12967-019-2104-z

Notoatmodjo, S. (2022). *Metodologi Penelitian Kesehatan* (3rd ed.). Jakarta: Rineka Cipta.

Parker, E. R. (2021). The influence of climate change on skin cancer incidence – A review of the evidence. *International Journal of Women's Dermatology*, *7*(1), 17–27. https://doi.org/10.1016/j.ijwd.2020.07.003

Pertiwi, F. D., Rezaldi, F., & Puspitasari, R. (2022). Uji Aktivitas Antibakteri Ekstrak Etanol Bunga Telang (Clitoria ternatea L.) Terhadap Bakteri Staphylococcus epidermidis. *Biosaintropis (Bioscience-Tropic)*, *7*(2), 57–68. https://doi.org/10.33474/e-jbst.v7i2.471

Rebora, A. (2019). Telogen effluvium: A comprehensive review. *Clinical, Cosmetic and Investigational Dermatology*, *12*(2019), 583–590. https://doi.org/10.2147/CCID.S200471

Stoffel, N. U., El-Mallah, C., Herter-Aeberli, I., Bissani, N., Wehbe, N., Obeid, O., & Zimmermann, M. B. (2020). The effect of central obesity on inflammation, hepcidin, and iron metabolism in young women. *International Journal of Obesity*, *44*(6), 1291–1300. https://doi.org/10.1038/s41366-020-0522-x

Subchan, P., Sofyanti Putri, R., Itsnal Muna, N., Magdalena Hutapea, C., Cahyani, E., & Hidayah, N. (2022). Ekstrak Bunga Telang (Clitoria ternatea L.) Menghambat Peningkatan Ekspresi Gen MMP-1 pada Kulit Tikus Wistar yang Terpapar Sinar Ultraviolet B. *Journal of Midwifery and Health Science of Sultan Agung*, *2*, 13–21. https://doi.org/10.30659/jmhsa.v1i2.22

Suganda, T., & Adhi, S. R. (2017). Uji Pendahuluan Efek Fungisida Bunga Kembang Telang (Clitoria ternatea L.) terhadap Jamur Fusarium oxysporum f.sp. cepae Penyebab Penyakit Moler pada Bawang Merah. *Agrikultura*, *28*(3), 136–140. https://doi.org/10.24198/agrikultura.v28i3.15746

Suryawati, A. A. M. A., & Santika, I. W. M. (2023). Potensi dan Efektivitas Farmakologi Ekstrak Kembang Telang (Clitoria ternatea L.) sebagai Suplemen Antidiabetes: A Systematic Review. *Prosiding Workshop Dan Seminar Nasional Farmasi*, *2*(Dm), 61–76. https://doi.org/10.24843/wsnf.2022.v02.p05

Suwarno, B., & Nugroho, A. (2023). *Kumpulan Variabel-Variabel Penelitian Manajemen Pemasaran (Definisi & Artikel Publikasi)* (1st ed.). Bogor: Halaman Moeka Publishing.

Wu, W., Yang, J., Tao, H., & Lei, M. (2022). Environmental Regulation of Skin Pigmentation and Hair Regeneration. *Stem Cells and Development*, *31*(5–6), 91–96. https://doi.org/10.1089/scd.2022.29011.wwu

Zhang, W., Fan, M., Wang, C., Mahawar, K., Parmar, C., Chen, W., & Yang, W. (2021). Hair Loss After Metabolic and Bariatric Surgery: a Systematic Review and Meta-analysis. *Obesity Surgery*, *31*(6), 2649–2659. https://doi.org/10.1007/s11695-021-05311-2