

## THE EFFECTIVENESS OF KEY LIME (*Citrus Aurantifolia*) AND SLAKED LIME (*Calcium Hydroxide*) IN REDUCING STRETCH MARKS IN POSTPARTUM WOMEN

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### ABSTRACT

Key lime (*Citrus aurantifolia*) contains vitamin C and bioactive compounds that promote tissue repair and skin regeneration. The combination of key lime and slaked lime may help reduce stretch marks in postpartum women. Vitamin C in key lime and hydroxide compounds in slaked lime are thought to accelerate skin regeneration while exfoliating dead skin cells. This study aimed to analyze the effectiveness of the combination of key lime and slaked lime in reducing stretch marks among postpartum women. The research employed a pre-experimental design with a one-group pretest–posttest approach. The sample consisted of twenty postpartum women (6 hours to 7 days after delivery) selected through purposive sampling, conducted from September to December 2024 at Paradise Mother and Child Hospital, Tanah Bumbu Regency. Inclusion and exclusion criteria were applied to determine eligible participants. The results of the study showed that the Sign Test yielded a *p*-value (Exact Sig. 2-tailed) of 0.002 (<0.05), indicating a significant effect of the treatment. Therefore, it can be concluded that the combination of key lime (*Citrus aurantifolia*) and slaked lime (calcium hydroxide) is effective in reducing stretch marks in postpartum women. It is recommended that this natural combination be used as an alternative treatment for postpartum stretch marks.

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### ABSTRAK

Jeruk nipis (*Citrus aurantifolia*) adalah buah-buahan yang berguna bagi kesehatan dan pencegahan penyakit serta banyak mengandung vitamin C yang berguna untuk pertumbuhan dan perbaikan jaringan yang rusak salah satunya untuk mengatasi stretch mark. Kombinasi jeruk nipis dan kapur sirih dapat menghilangkan stretch mark setelah melahirkan, kandungan vitamin C dalam jeruk nipis dan hidroksida pada kapur sirih membantu mempercepat regenerasi kulit baru dan menghilangkan sel kulit mati. Penelitian ini bertujuan untuk mengetahui efektivitas kombinasi jeruk nipis dan kapur sirih dalam mengurangi stretch mark pada wanita pasca melahirkan. Desain penelitian ini adalah desain pra-eksperimental dengan desain one group pretest-post test. Sampel penelitian ini adalah 20 orang postpartum 6 jam-7 hari postpartum dengan teknik purposive sampling dan sudah mendapatkan persetujuan etik No.344.04.A/VII-24/STIKES-DA. Hasil penelitian ini (uji tanda) didapatkan nilai *p* < 0.05 (0,002) yang berarti terdapat efektivitas kombinasi jeruk nipis dan kapur sirih dalam mengurangi stretch mark selama 6 jam sampai 7 hari. Kesimpulan dari penelitian ini adalah terdapat pengaruh kombinasi jeruk nipis dan kapur sirih terhadap pengurangan stretch mark selama 6 jam hingga 7 hari. Disarankan agar kombinasi jeruk nipis dan kapur sirih dapat digunakan untuk mengurangi stretch mark pada ibu pasca melahirkan.

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#### Kata Kunci:

Strechmark;

Jeruk Nipis;

Kapur Sirih;

Pasca Persalinan;

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## INTRODUCTION

Stretch mark problems in Indonesia often occur among women and teenagers due to hormonal factors and rapid growth. This common skin condition is caused by extreme skin stretching and frequently affects pregnant women, pubescent teenagers, and individuals experiencing drastic weight changes. The traditional treatment approach, which includes the use of herbal medicines, acupuncture, and ritual therapies, often coexists with modern medical practices, creating dynamic integration and challenges in health care. This pluralism not only reflects cultural richness but also influences how society understands and manages health and illness according to local cultural values.

The postpartum period (puerperium) begins after the placenta is expelled from the body until a woman's reproductive organs return to their pre-pregnancy condition. During this recovery stage, postpartum mothers experience various physical and psychological changes (Fatsena et al., 2023). The postpartum period is often accompanied by several physical and psychological discomforts, including the emergence of stretch marks or *striae gravidarum*, which are lines on the skin caused by excessive stretching during pregnancy. Stretch marks may cause aesthetic discomfort and sensations such as itchiness or skin tension, which can affect the psychological well-being of postpartum mothers. This discomfort is often exacerbated by hormonal changes and social pressure related to body image. Therefore, a holistic approach is needed to address it (Fernanda & Yuliaswati, 2023; Handayani et al., 2024; Situngkir et al., 2024).

In 2015, it was estimated that 60% or 598,000 women suffered from stretch marks during the postpartum period. In 2016, the proportion of postpartum women reached 80% or 860,000, and 73% of them experienced stretch marks. Meanwhile, in 2017, the number of postpartum women increased by 5% from the previous year, reaching 928,000, with a prevalence of 79% suffering from stretch marks (Nurwendah et al., 2025). Based on a preliminary survey conducted by the authors at the beginning of this research at Paradise Mothers' and Children's Hospital, South Kalimantan Province, Indonesia, from January to March 2024, there were 345 postpartum women, of whom 317 (91.88%) suffered from stretch marks. The number of women who gave birth through vaginal delivery was 290 (84.05%), while 55 (15.9%) delivered through cesarean section.

Stretch marks are caused by the stretching of the skin. Many efforts have been made to reduce and fade stretch marks. One natural method is by using a mixture of key lime (*Citrus aurantifolia*) and slaked lime (calcium hydroxide), which is applied to the affected area twice a day after bathing. Stretch marks may lead to skin problems such as thin or easily bruised skin and may also affect psychological aspects, causing discomfort or lack of confidence. Each individual has different levels of stretch mark severity (Bertin, 2018).

*Citrus* is a category of fruit with many health benefits, including disease prevention. It contains vitamin C, which functions to maintain the body's immunity. The chemical compounds related to the pharmacological effects of key lime include flavonoids, saponins, citric acid, and essential oils. *In vitro* research shows that squeezed key lime juice with an 8% effective concentration has antibiofilm activity against *Staphylococcus aureus* bacteria (Khanifah, 2015). Citrus also acts as an antioxidant, which helps prevent premature aging. During the postpartum period, abdominal flabbiness and *striae gravidarum* that appear during pregnancy often become concerns for mothers. With proper and regular application, key lime topical gel has been found to be effective in reducing *striae gravidarum* and tightening the abdominal skin of postpartum women (Puspadewi & Chasanah, 2014).

An alternative approach to using key lime for treating *striae gravidarum* is to combine it with slaked lime and eucalyptus oil. This mixture should be evenly applied to the skin after bathing (Rusmini et al., 2021). In general, key lime (*Citrus aurantifolia*) and slaked lime (calcium hydroxide) are believed to reduce wrinkles after childbirth and decrease abdominal circumference, contributing to weight reduction. The hydroxide content in key lime is beneficial for accelerating new skin cell regeneration while eliminating dead skin cells. Meanwhile, slaked lime contains several substances, including cadinene, cineole, carvacrol, and tannins, which provide benefits for skin health (Bainuan & Juaria, 2018).

Based on the discussion about stretch marks in postpartum women and the facts observed in society, many women complain about the condition of their skin after childbirth, which makes them feel uncomfortable and lose confidence (Haq et al., 2025). Various methods can be used to overcome this problem, including the use of natural ingredients available in the surrounding environment, such as key lime (*Citrus aurantifolia*) and slaked lime (calcium hydroxide), both of which have numerous benefits for the skin. This combination may help clear the skin and reduce stretch marks in postpartum women. Therefore, the authors are interested in conducting a study on the effectiveness of the combination of key lime (*Citrus aurantifolia*) and slaked lime (calcium hydroxide) in reducing stretch marks among women 6 hours to 1 week postpartum at Paradise Mothers' and Children's Hospital in 2024. This study aims to provide an alternative effort to minimize stretch marks in postpartum women.

## METHOD

### Type of Research

This research employed a pre-experimental design with a one-group pretest–posttest approach. The population of this study consisted of all postpartum women with stretch marks at Paradise Mothers' and Children's Hospital, totaling 317 individuals. The level of stretch marks was measured using an observation sheet. The data analysis consisted of univariate and bivariate analyses. To test the hypothesis, the authors used the Sign Test. A total of 20 samples were selected using the purposive sampling method based on the inclusion and exclusion criteria.

The instrument used was a topical gel consisting of a combination of key lime and slaked lime, which was applied to reduce stretch marks in postpartum women. The gel was prepared by mixing freshly squeezed key lime juice and slaked lime powder. The citric acid in key lime helps to clear the skin and tighten body tissues, while slaked lime has antiseptic properties and assists in healing small wounds caused by stretch marks. The steps for making the topical gel were as follows:

Ingredients: 50 ml of fresh key lime juice and 1 teaspoon of slaked lime powder.

#### Preparation method:

1. Grind the slaked lime until it becomes a fine powder.
2. Mix the freshly squeezed key lime juice with the slaked lime powder in a clean container. Stir thoroughly until the mixture thickens into a gel.
3. Place the topical gel in an airtight container and store it in a cool, dry place.

#### Preparation method:

1. Clean the area of the skin affected by stretch marks.
2. Apply the topical gel evenly to the affected area.
3. Leave it on for 15–20 minutes.
4. Rinse with warm water.
5. Perform this treatment regularly, twice a day for seven days.

### Place and Time of Research

This research was conducted at Paradise Mothers' and Children's Hospital, South Kalimantan Province, Indonesia, from August to September 2024.

### Population and Sample

The study population consisted of all postpartum women experiencing stretch marks at Paradise Mothers' and Children's Hospital, South Kalimantan Province, Indonesia, from August to September 2024. The number of samples in the intervention group receiving the combination of key lime (*Citrus aurantifolia*) and slaked lime was 20 people. The inclusion criteria were postpartum women at Paradise Mothers' and Children's Hospital who had normal deliveries, had visible stretch marks, were willing to participate in this study, and followed all stages of the research. The exclusion criteria were postpartum women who experienced emergency conditions, were not compliant with the intervention procedures using the key lime and slaked lime combination, or lived outside the researchers' reachable area.

### Data Collection

Data collection was conducted through several systematic steps. First, the authors submitted a proposal to the Director of Paradise Mothers' and Children's Hospital, Tanah Bumbu Regency, South Kalimantan Province, Indonesia, to obtain research permission. After approval, the researchers coordinated with treatment staff to conduct the study within the determined schedule.

Next, the researchers met with potential respondents—postpartum mothers who had given birth at least six hours earlier—to explain the objectives and benefits of the study and to obtain informed consent. Those who agreed to participate signed an informed consent form as a statement of approval. A pretest was then conducted to assess the stretch mark severity among respondents classified as having a medium level. Following that, the researchers provided the intervention using the combination of key lime (*Citrus aurantifolia*) and slaked lime (calcium hydroxide), applied with the assistance of an enumerator through a door-to-door approach. The observation sheet was used to measure the degree of stretch marks before treatment, categorized as severe, moderate, or mild. After one week, a post-test was carried out using the

same observation sheet to evaluate changes in the respondents' stretch marks. This study obtained ethical approval No. 344.04.A/VII-24/STIKES-DA.

### Data Analysis and Processing

Univariate analysis was conducted to describe the level of stretch marks after treatment with the combination of key lime (*Citrus aurantifolia*) and slaked lime (calcium hydroxide). The collected data were processed and presented in tables. Bivariate analysis was carried out to assess the effectiveness of the combination of key lime and slaked lime in reducing the severity of stretch marks in postpartum women. The Sign Test was used to compare paired samples before and after treatment. The Sign Test examines the mean difference between two related samples, labeled as  $X_a$  and  $X_b$ , with a significance level of  $\alpha = 0.05$ . The decision-making principle was as follows: (1) If  $p > 0.05$ , then  $H_0$  is accepted, indicating that the combination of key lime and slaked lime was not effective in reducing stretch marks. (2) If  $p < 0.05$ , then  $H_0$  is rejected, indicating that the combination of key lime and slaked lime was effective in reducing stretch marks among postpartum women.

### RESULT

This research was conducted at Paradise Mothers' and Children's Hospital, South Kalimantan Province, Indonesia, involving postpartum women suffering from stretch marks. Data were collected before and after the intervention, in which a combination of key lime (*Citrus aurantifolia*) and slaked lime (calcium hydroxide) was administered. The participants consisted of twenty individuals. To provide comprehensive information on the demographic characteristics of the sample, including age group, occupation, and education, the data are presented in the table below:

**Table 1.** Characteristics of Postpartum Women Based on Age Group, Occupation, and Education

Characteristics of Postpartum Women	Frequency (n)	Percentage (%)
<b>Age Group</b>		
$\leq 20$ years	1	5.0
21 – 35 years	18	90.0
$> 35$ years	1	5.0
<b>Education</b>		
Elementary School	6	30.0
Junior High School	3	15.0
Senior High School	2	10.0
Vocational High School	7	35.0
Bachelor's Degree	2	10.0
<b>Occupation</b>		
Stay-at-Home Mother	14	70.0
Private Company Employee	3	15.0
Teacher	1	5.0
State Civil Servant	1	5.0
Entrepreneur	1	5.0
<b>Total</b>	<b>20</b>	<b>100</b>

Table 1 illustrates the characteristics of postpartum women based on age group, occupation, and education. The majority of participants belonged to the 21–35-year-old age group, consisting of 18 individuals (90%), while only a small number were aged  $\leq 20$  years and  $> 35$  years, each represented by one person (5%). In terms of education, most had a Vocational High School background (35%), followed by Elementary School (30%), Junior High School (15%), Senior High School (10%), and Bachelor's Degree (10%). Regarding occupation, the majority were stay-at-home mothers (70%), while the remainder worked as private company employees (15%), teachers (5%), state civil servants (5%), and entrepreneurs (5%). Overall, these data indicate that most participants were of productive age, had a Vocational High School education, and were occupied as stay-at-home mothers.

**Table 2.** The Severity Level of Postpartum Women's Stretch Marks Before Treatment with Key Lime (*Citrus aurantifolia*) and Slaked Lime (Calcium Hydroxide)

Severity Level of Stretch Marks	Frequency (n)	Percentage (%)
Severe	7	35.0
Medium	13	65.0
Light	0	0.0
<b>Total</b>	<b>20</b>	<b>100</b>

Table 2 presents the data distribution before treatment. It shows that prior to the intervention, most respondents (65%) experienced medium-level stretch marks.

**Table 3.** The Severity Level of Postpartum Women's Stretch Marks After Treatment with Key Lime (*Citrus aurantifolia*) and Slaked Lime (Calcium Hydroxide)

Severity Level of Stretch Marks	Frequency (n)	Percentage (%)
Severe	4	20.0
Medium	9	45.0
Light	7	35.0
<b>Total</b>	<b>20</b>	<b>100</b>

Table 3 presents the data distribution after treatment. It shows that following the application of the combination, nearly half of the respondents (45%) still experienced medium-level stretch marks, while 35% improved to light-level stretch marks.

**Table 4.** Analysis of Research Results on the Combination of Key Lime (*Citrus aurantifolia*) and Slaked Lime (Calcium Hydroxide) to Decrease Stretch Marks in Postpartum Women (6 Hours to 7 Days After Delivery)

Level of Stretch Marks	Before		After		P value
	Frequency (n)	Percentage (%)	Frequency (n)	Percentage (%)	
Severe	7	35.0	4	20.0	
Medium	13	65.0	9	45.0	0.002
Light	0	0.0	7	35.0	(<0.05)
<b>Total</b>	<b>20</b>	<b>100</b>	<b>20</b>	<b>100</b>	

Table 4 shows that before treatment, most respondents (65%) had medium-level stretch marks. After being treated with a combination of key lime (*Citrus aurantifolia*) and slaked lime (calcium hydroxide), the number of respondents with medium-level stretch marks decreased to 45%, while those with light-level stretch marks increased to 35%. The analysis used the sign test, resulting in a *p*-value of 0.002 (Exact Sig./2-tailed) < 0.05, indicating a significant difference between the severity levels before and after treatment. Therefore, the null hypothesis ( $H_0$ ) was rejected, and the alternative hypothesis ( $H_1$ ) was accepted, confirming that the combination of key lime and slaked lime is effective in reducing stretch marks among postpartum women. The sign test was applied to assess the average difference between two paired sample groups ( $X_a$  and  $X_b$ ).

## DISCUSSION

Based on the results of research conducted at Paradise Mothers' and Children's Hospital, Simpang Empat District, Tanah Bumbu Regency, South Kalimantan Province, Indonesia, it was found that before being administered with the combination of key lime (*Citrus aurantifolia*) and slaked lime (calcium hydroxide), a small number of respondents suffered from severe-level stretch marks, while most (65%) had

medium-level stretch marks. No respondents experienced light-level stretch marks prior to treatment. Stretch marks are scar-like marks in the form of irregular white lines. These are formed due to excessive stretching of the skin, which causes the elastic tissues beneath the skin to tear. Postpartum women are highly vulnerable to stretch marks as they experience skin stretching due to body expansion during pregnancy from month to month (Amelia, 2016; Pratami, 2020).

In several cases, stretch marks may be associated with Cushing's syndrome or adrenal gland disorders, which lead to hormonal imbalances and skin problems. This condition is rare, occurring in approximately 1.6 cases per one million people. The resulting skin problems include easy bruising, redness, and thinning of the skin, making it appear unhealthy. Furthermore, stretch marks can also affect psychological well-being, causing discomfort and decreasing self-confidence (Anwar, 2016).

Regarding their causes, it should be noted that stretch marks are not a sign of aging. Medically, they do not affect one's physical health, but aesthetically, their early appearance can cause concern. Factors contributing to stretch marks include: (1) skin stretching during pregnancy; (2) the use of steroid-containing medications often prescribed for allergies, asthma, and rheumatoid arthritis; (3) obesity, as a rapid increase in body weight stretches the skin, potentially leading to stretch marks; and (4) excessive consumption of high-calorie foods. High-calorie diets can increase glucocorticoid hormone formation, which reduces physical activity and accelerates weight gain, further promoting the development of stretch marks (Amelia, 2016).

*Striae distensae*, or stretch marks, are classified as atrophic skin lesions caused by excessive stretching. Over time, stretch marks may fade to white as damaged blood vessels heal. Although painless, they can affect one's comfort and self-esteem. The prevalence of stretch marks reaches approximately 80% among postpartum women. Stretch marks result from the inability of the dermis, containing elastic fibers such as elastin and collagen, to adapt to rapid skin expansion. The damage in these tissues leads to the formation of visible striae (Anwar, 2016).

After childbirth, the abdomen typically becomes flabby due to increased body weight and the prolonged expansion of the womb, which causes changes in the navel's position. This enlargement increases abdominal circumference during pregnancy. Moreover, the rising levels of estrogen and progesterone hormones during pregnancy also increase the number of cells in the affected areas. According to a study by Hernández et al. (2012) entitled "Use of a Specific Anti-Stretch Mark Cream for Preventing or Reducing the Severity of *Striae Gravidarum*", most respondents reported using products to prevent or reduce the development of stretch marks during pregnancy. A wide range of products was used, and more than one-third of the women applied two or more products.

*Citrus aurantifolia* is rich in vitamin C, flavonoids, and alpha hydroxy acid (AHA). Vitamin C stimulates collagen synthesis, thereby increasing skin elasticity and helping to fade scars, including stretch marks. Pullar et al. (2017) found that vitamin C plays a crucial role in collagen biosynthesis through the activation of prolyl and lysyl hydroxylase enzymes, which enhance collagen stability and production. The topical application of vitamin C, such as that contained in key lime, can improve the damaged dermis structure caused by stretch marks, even though this study did not directly test the effect of *Citrus aurantifolia* on stretch marks. Research indicates that vitamin C in key lime promotes collagen formation, which is essential for skin tissue repair and reducing the appearance of stretch marks (Khanifah, 2015; Pullar et al., 2017). It also aids in removing dead skin cells and accelerating the skin regeneration process.

Citric acid functions as a natural exfoliant. The citric acid in key lime has exfoliating properties that help fade stretch marks by stimulating new skin cell formation (Tang & Yang, 2018). Tang and Yang (2018) reported that AHA compounds, such as citric acid in key lime, are effective in exfoliating the skin and promoting new cell formation. This process may reduce the depth and pigmentation of stretch marks, particularly during the early stages (striae rubra) when they appear red or purple. Furthermore, Pazyar et al. (2013) highlighted that flavonoids in *Citrus aurantifolia* have antioxidant effects that protect the skin from free radical damage, which can worsen stretch marks. Their findings suggest that citric acid also shows promise in repairing skin tissues damaged by stretch marks.

Calcium hydroxide is an inorganic compound with the chemical formula  $\text{Ca(OH)}_2$ , produced through the reaction of calcium oxide ( $\text{CaO}$ ) and water. This compound is a strong base (pH 11–12.5) with antimicrobial properties and the ability to bind water, making it useful in various applications such as food processing and wound treatment. In dermatological contexts, calcium hydroxide is believed to have mild exfoliating effects and can promote skin tissue recovery due to its alkaline nature (Pratami et al., 2014).

The combination of key lime (*Citrus aurantifolia*) and slaked lime (calcium hydroxide) has been proven effective in reducing stretch marks among postpartum women.

The administration of this gel was performed on postpartum women who had given birth between six hours and seven days earlier, applied twice daily after bathing. The findings suggest that the combination of key lime (*Citrus aurantifolia*) and slaked lime (calcium hydroxide) is effective in decreasing stretch mark severity among postpartum women. After seven days of treatment with twice-daily application, most respondents experienced improvement from medium-level to light-level stretch marks. Some respondents with severe stretch marks improved to medium level after treatment. Participants also reported feeling more comfortable with their abdominal skin condition, even though the stretch marks did not completely disappear. Therefore, the administration of a topical gel formulated from a combination of key lime (*Citrus aurantifolia*) and slaked lime (calcium hydroxide) can be considered a viable alternative for treating stretch marks (Pratami et al., 2014).

## CONCLUSION

Based on the research results, it can be concluded that before being given an intervention in the form of a combination of key lime (*Citrus aurantifolia*) and slaked lime (calcium hydroxide), most postpartum women (65%) experienced medium-level stretch marks. After the intervention, the percentage of postpartum women with medium-level stretch marks decreased from 65% to 45%, while the percentage of those suffering from severe stretch marks decreased from 35% to 20%. Meanwhile, the proportion of respondents experiencing light-level stretch marks increased from 0% to 35%.

It is expected that Paradise Mothers' and Children's Hospital may apply the use of the combination of key lime and slaked lime as a topical treatment to help reduce stretch marks in postpartum women. Furthermore, it is suggested that future researchers conduct studies with a larger sample size and a longer duration of application, ideally beginning from the third trimester of pregnancy, to assess the preventive and therapeutic effects more comprehensively. Lastly, it is hoped that this study can enhance readers' understanding of the potential benefits of the combination of key lime (*Citrus aurantifolia*) and slaked lime (calcium hydroxide) in reducing stretch marks among postpartum and pregnant women.

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