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## Hydrogel Potential of Piper Crocatum (Piper Crocatum) Red Extract to Accelerate Perineum Wound Healing and Staphylococcus Aureus Bacteria Growth in Postpartum

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### ABSTRACT

The prevalence of perineal rupture increases every year, as a result, the greater the chance of puerperal infection in postpartum mothers. Factors that cause puerperal infection is the care of the perineal wound that is not paid attention to. One of the complementary treatments uses herbal plants made from red betel leaf (*Piper crocatum*) in the form of hydrogel preparations. Proving the potential of red betel leaf hydrogel (*Piper crocatum*) against accelerated perineal wound healing and staphylococcus aureus bacterial growth. This type of quantitative research uses a quasi-experimental method with purposive sampling, post-test design only with control group. Sampling was in accordance with the inclusion criteria with a sample size of 45 respondents, 15 control respondents, 15 respondents to intervention I with a dose of 2x1 a day and 15 respondents to intervention II with a dose of 3x1 a day. Data was obtained from the REEDA score assessment scale which was obtained from the assessment of Redness, Edema (Swelling), Eccymosis (Bleeding), Discharge (Extraction) and Approximation (Wound union) and vaginal swab samples carried out on days 3 and 7 for 7 days. The analysis used to assess variables is the Wilcoxon and Mann Whitney tests. The analysis used to assess the variables is the Wilcoxon and Mann Whitney test. Red betel leaf hydrogel intervention 2x1 a day and intervention 3x1 a day has the potential to accelerate perineal wound healing and decrease the growth of *S. aureus* bacteria with p-value <0.05, so it can be interpreted that there is a significant difference effect. The greatest decreasing value in reducing the REEDA score and the growth of *S. aureus* bacteria was the 3x1 a day intervention group, namely 4.60 and 8.74, so it can be concluded that the 3x1 intervention was more effective than the 2x1 a day intervention.

Keywords: perineal wound; REEDA score; staphylococcus aureus bacteria

### Introduction

Perineal wounds are tears that occur at the time a baby is born either spontaneously or by using tools or actions. Perineal tears generally occur in the midline and can become extensive if the fetal head is born too quickly. Perineal wound care in mothers after childbirth is useful for reducing discomfort, maintaining hygiene, preventing infection and accelerating healing. Perineal treatment generally coincides with vulvar care.

Things to note are preventing contamination with the rectum, gently handling wound tissue, cleaning the blood that is the source of infection and odor [1].

The genital tract is an area prone to infection, if treatment is not optimal it can lead to infection. Deteriorating wound conditions in the perineum can be caused by pathogenic bacteria (infectious bacteria) such as *the coccus* group, namely, *Staphylococcus epidermidis*, *Staphylococcus aureus*, *Enterococcus (Streptococcus group D)*, *group B Streptococcus*, low-virulence pathogenic

bacteria, but chronic wounds can arise due to poor wound care [2].

According to WHO, as many as 80% of postpartum mothers in the world suffer from perineal injuries. The figures show that perineal lesions are experienced by almost all puerperal mothers globally. When viewed from the degree of perineal injury, the highest prevalence is degree 2 (73.4%), then degree 1 (17.7%), degree 3 (8.4%), and degree 4 (0.5%). The incidence of *perineal* lacerations in the world in 2009 was 2.7 million cases. This figure is predicted to increase by 6.3 million cases by 2050. The rate of perineal lacerations in Indonesia in 2013 was 57% of 1951 vaginal deliveries.<sup>3</sup> Based on retrospective research, it is known that mothers who experience 3-4th degree lacerations in the UK increased from 1.8% in 2000 to 5.9% per 100 births in 2011 and 2nd degree lacerations increased by 23% [4]. Perineal suture wounds occur in 75% of mothers who deliver vaginally or vaginally. It is estimated that 1 – 8% of mothers will develop a postpartum infection. Lacerations are the second most common cause of primary *postpartum* hemorrhage after *uterine atony* [5].

The results of a preliminary study conducted at the Ngesrep Health Center in Semarang City obtained data on 225 normal births in January – November 2021, there were 52% or 117 cases of births with perineal laceration wounds which required a hecting or suturing process to help heal perineal wounds. Of the 117 who gave birth at the Ngesrep Health Center, around 90 mothers made good and regular postpartum visits. Then from the data from the Semarang Regency Health Profile report, it shows that the number of postpartum maternal deaths in 2020 was 48% or 12 cases of death out of the total number of maternal deaths of 25 cases. Of these, there was 1 case of maternal death due to puerperal infection. This requires re-monitoring of the case.

Perineal wounds occur spontaneously, the main causes of which are due to labor not being led as it should, labor by vacuum extraction, cunam extraction, embryotomy. Perineal lesions occur due to the sudden pressing of the head or body part of the fetus, so the skin and tissues of the perineum are torn. Parineal trauma is more common in circumstances such as the size of the fetus is too large, the long labor process, and the use of birth aids, such as forceps [7]. In addition, perineal wounds are also caused by deliberate actions, namely episiotomy [8]. Perineal wounds or *perineal ruptures* performed with the episiotomy itself must

be done on indications, among others: large babies, stiff perineum, delivery with location abnormalities, labor using both *forceps* and vacuum tools. Without an episiotomy in some of these circumstances will cause increased and severe damage to the *perineal region*. *Spontaneous perineal rupture* occurs due to tension in the vaginal area during childbirth, can also occur due to the psychological burden of facing the labor process and more importantly perineal rupture occurs due to mismatch between the birth canal and the fetus, because the effects caused by *perineal rupture* are very complex [9].

In general, all new wounds such as incision wounds or episiotomy areas require a healing time of about 6-7 days. Perineal infection will arise if improper perineal care results in moist conditions in the perineum due to lochea. This greatly supports the development of bacteria. Infection of the perineum can damage cell tissue and can inhibit the wound healing process. So that it will increase the length and depth of the wound and increase the size of the wound itself. Slow healing of wounds due to several problems including changes in vital signs caused by bleeding, infections such as skin redness, fever and pain, discomfort for activities, and rupture of suture wounds partially or completely due to trauma and protruding internal organs outwards due to wounds not immediately fused properly. Wounds in the perineum are declared to heal quickly when < 7 days and pronounced long healed when > 7 days. With the characteristics of wound healing, namely, no redness of fused tissues, dry wounds, no swelling, and no pain when walking, sitting and other activities. If the healing of the perineal wound is long, it will cause an increased risk of puerperal infection [10].

Although lacerations are local, proper treatment is required to avoid systemic spread of infection. Perineal infection will arise if improper perineal care results in moist conditions in the *perineum* due to lochea [11]. If *perineal* infection occurs, bacteria can enter through the birth canal during labor or after delivery can be a risk factor for *postpartum infection*. Organisms attacking the former implantation of the placenta or the presence of perineal lesions due to childbirth come from bacteria normal inhabitants of the cervix and birth canal or from the outside [12]. In addition to infection, the presence of perineal wounds in the mother also provides pain and discomfort during the postpartum period that the mother goes through. [13] Bacteria that often cause puerperal infections include *Staphylococcus aureus* which comes from gram-positive bacteria, *Escherichia coli* from gram-

negative bacteria, *Streptococcus hemolyticus*, and *Manit Salt Agar (MSA)*.

Prevention of infection can be done by maintaining the cleanliness of the suture wound, changing dressings and using topical drugs made from water that can absorb and reduce pain in the perineal wound. [14] In this increasingly advanced and sophisticated era, many drugs are offered for various diseases with various drug names and types that are sometimes not known for sure the content and benefits. Therefore, people must be more selective in choosing the right drug. One drug that must be chosen selectively is a drug to stop bleeding wounds on the skin. One of the medicinal preparations to stop wounds is *hydrogel*. Where with the main mixture is water, hydrogel is a type of primer dressing that can be directly applied to injured skin. *Hydrogel* can create a moist / rehydrating atmosphere in the wound as well as provide a cooling effect. [15] The use of this hydrogel is also a preventive effort to reduce the use of antibiotics and *povidone iodine 10%* which causes resistance if used for a long time. [16]

One complementary treatment using herbal plants that can reduce the use of medical drugs such as antiseptics is red betel leaf (*Piper crocatum*). [17] Red betel leaf has antiseptic power twice as great as green betel leaf. Various functions possessed by red betel leaf are caused by the content of secondary metabolites, such as *flavonoids*, *alkaloids*, and *tannins*. Red betel leaf contains essential oil, *karvakrol*, and *eugenol*. [8] This herbal plant has destructive properties and interferes with the growth of bacteria. In an earlier study, *Piper crocatum methanol* extract was examined on anti-allergic inflammatory effects with a kareagent-induced rat edema test. These studies make it clear that *Piper crocatum* has a strong anti-allergic inflammatory effect. [18] Red betel leaf contains active compounds such as *flavonoids*, *tannins*, *essential oils*, *alkaloids*, and *saponins*. *The flavonoid content contained in red betel has antibacterial and anti-inflammatory activities that can help prevent infection in wounds. The mechanism of flavonoids' antibacterial ability* is by disrupting the potassium concentration of gram-positive bacteria causing dysfunction of their cytoplasmic membrane. [19]

The results of previous studies showed that there was an influence of red betel leaf on accelerating perineal wound healing and had the ability to inhibit growth and kill *Staphylococcus aureus* (gram positive) at a concentration of 25%, while the ability to inhibit growth and kill *Escherichia coli* (gram negative) at a concentration

of 6.25%. [1,21] It can be known based on the explanation above, the effect of red betel leaf has a role in accordance with pathophysiology so that researchers develop research by making topical preparations in the form of *hydrogel* from red betel leaf extract (*Piper crocatum*), where *hydrogel* with the main mixture is water is also a type of primary dressing that can be directly applied to injured skin and can create a moist atmosphere / rehydrate the wound as well as provide a cold effect. The use of *hydrogel* has advantages over other topical drugs because it can absorb more optimally and has the lowest irritating effect, as well as the effectiveness of *hydrogel* in healing incision wounds, burns and several other diseases. The material for making *hydrogel* is water so that it reduces fluid loss in the wound area and is more comfortable if used by patients. [22]

The use of *hydrogel* can be used as a medium for preventing infection with the addition of herbal plant extracts such as red betel leaves which contain high antioxidants as anti-inflammatory, and antibacterial. In addition, this study also aims to make it easier for postpartum mothers to be more effective and practical in applying drugs, because preparations in the form of hydrogel are easy to apply topically or applied directly to the skin compared to the old way that still uses extracts, decoctions, or compresses and so on that require time for the manufacturing process, how to apply it is considered less effective.

## Methods

This research was conducted in the working area of Puskesmas Ngesrep, Puskesmas Sronдол and Puskesmas Bangetayu Semarang. The type of research used is quantitative with a *Quasi Experimental design of two groups post-test only with control group design*. The population in this study was *postpartum* primigravida and multigravida mothers on the first to 7th days in the working areas of the Ngesrep Health Center, Sronдол Health Center and Bangetayu Health Center in Semarang City, Central Java for the period February – May 2022 which amounted to 160 postpartum mothers. The sampling technique used was *purposive sampling* that met the inclusion criteria and exclusion criteria totaling 45 respondents. In this study, there were three groups, namely the dry cleaning technique group consisting of 15 respondents, the intervention group of *giving red betel leaf hydrogel 2x1 days* consisting of 15 respondents and the intervention group giving red

betel leaf hydrogel 3x1 days consisting of 15 respondents. The duration of this hydrogel intervention is carried out for 7 days postpartum. Assessment of *perineal* wound healing score by looking at REEDA score, while assessment of *growth of Staphylococcus aureus* bacteria by looking at gram-positive bacterial staining.

Statistical Analysis using *Wilcoxon* and *Mann Whitney*. The number of the Letter of Ethics by the Health Polytechnic Ethics Committee of the Ministry of Health Semarang is **No.97/EA/KEPK/2022**.

## Results and Discussion

**Table 1.**  
**Analysis of the Effect of Red Betel Leaf Hydrogel Administration of the Intervention Group and Control Group on REEDA Scores in Postpartum Mothers**

Variable	Data	Day 3	Day 7	P-value
		Mean ± SD	Mean ± SD	
REEDA	2x1 Intervention	5,87 ± 2,532	1,53 ± 1,767	0,01
	Control	7,53 ± 2,031	3,60 ± 2,131	0,00
	3x1 Intervensi	5,20 ± 2,624	0,60 ± 1,056	0,01
	3x1 Control	7,53 ± 2,031	3,60 ± 2,131	0,00

**Table 2.**  
**Analysis of the Effect of Red Betel Leaf Hydrogel Intervention Group and Control Group on the Growth of Staphylococcus aureus bacteria in postpartum mothers**

Variable	Data	Day 3	Day 7	P-value
		Mean ± SD	Mean ± SD	
Bakteri <i>S. aureus</i>	2x1 Intervention	11,20 ± 4,144	3,67 ± 2,024	0,01
	2x1 Control	11,33 ± 3,288	5,33 ± 4,467	0,01
	3x1 Intervention	9,27 ± 3,173	0,53 ± 0,990	0,01
	3x1 Control	11,33 ± 3,288	5,33 ± 4,467	0,01

**Table 3.**  
**Differences in the effect of Red Betel Leaf Hydrogel Administration of the 2x1 Intervention Group and the 3x1 Intervention Group on REEDA Scores and the growth of Staphylococcus aureus bacteria**

Variable	Intervention Group		p- value
	2x1	3x1	
	Mean ± SD	Mean ± SD	
REEDA score	4,34 ± 1,767	4,60 ± 1,056	0,032
Bakteri <i>S. aureus</i>	7,53 ± 2,024	8,74 ± 0,990	0,000

After conducting research on the effect of red betel leaf hydrogel (*Piper crocatum*) on the acceleration of perineal wound healing and the growth of *Staphylococcus aureus* bacteria obtained the following results:

The use of *red betel leaf hydrogel* reduces the inflammatory process better because saponin and flavonoid compounds act as anti-inflammatory. This is evidenced through research that states that these compounds can help reduce the number of *Polymorphonuclear* (PMN) consisting of *neutrophils*, *basophil* and *eosinophils*. The presence of *neutrophils* plays an important role in the immune system because it is the most abundant white blood type (40 – 75%) in the human body. The age of

*neutrophils* ranges from 4 - 5 days, but if it has moved to the tissue the age becomes 1 - 2 days so as to minimize the spread of pathogenic microorganisms and tissue damage during inflammation. [103] After the age of PMN dies, it will be replaced with *macrophages* as the main cells in wound healing because it plays a role in the process of *bacterial phagocytosis* and repairs damaged tissue. Unlike *neutrophils* which are short-lived, the presence of *macrophages* in tissues can persist for several months. Metabolic activity that occurs in the reepithelialization process will cause an increase in oxygen demand in injured tissue. The use of *hydrogel* is a topical drug that can

minimize the loss of oxygen and fluid in the tissue so that it can release *proteases* optimally. [104,105]

The results of this analysis are in line with previous research, on the treatment of incision wounds in rabbits that are no different from *perineal wounds* of the area and length of the wound. The observation time for *perineal* lesions is taken from day one to day 7 and at the end of observation of *perineal* lesions There are those who still have not closed the skin distance up to 1 mm with a score of 1 wound with a poor wound category. In the study, the first day was the beginning of the wound so there was no change, for example, with the *perineal* wound, the first day's REEDA score was still large because of the beginning of the wound so there was no change. After days 3, 5, and 7 the end of observation / observation of incision wounds given *intervention hydrogel* red betel leaf closed on day 14 or the last day for the control group still did not close 0.5 cm. Ratna Widawati also stated that it is believed that red betel leaf ointment with a concentration of 45% can increase the ability to attach to wounds, this is supported by an increase in the number of erythrocytes and hemoglobin due to incision wounds in rabbits. [106]

The spread of *Staphylococcus aureus* bacteria is an endemic bacteria found in health facilities and resistant to antibiotics so that it can cause *methicillin-resistant Staphylococcus aureus* (MRSA) infection. The bacterial infection is a positive group of bacteria that attacks the *integumentary* system, soft tissues, bones and cardiovascular system in the body. Infection in the wound caused by such bacteria is swelling and odorous discharge from the *perineal wound*. [109, 110]

The discussion of smears carried out on day 3 and day 7 refers to the theory of pathogenesis (the process of infection) of bacteria from the *first day coccus* group around 6.6%, on the second day 50% the most bacterial range on day 3 is 62% and day 7 is 88.8%. So that the examination of bacteria takes day 3 and day 7.<sup>93, 94</sup> The results of the research analysis are in line with Ika Buana, that the purified extract of *Piper crocatum* showed an IC50 value of 53.91 ppm. The results of the antibacterial potency test showed that there was inhibition of the growth of *Staphylococcus ATCC 12228* bacteria at extract concentrations of 50% and 100%. This activity comes from secondary metabolite compounds of *alkaloids, flavonoids, saponins*, and essential oils. Red betel is extracted purification to remove ballast substances that can affect the ability of secondary

metabolites to produce biological activity. The purpose of the study was to determine the antioxidant and antibacterial potential of purified extract of red betel leaf. The antioxidant potential was tested by the DPPH method (*1,1 diphenyl-2-picrylhydrazyl*) which yielded an IC50 value. The antibacterial potential is tested through the sumuran diffusion method. The result of this study was that the extract showed an IC50 value of 53.91 ppm. The results of the antibacterial potency test showed that there was inhibition of the growth of *Staphylococcus ATCC 12228* bacteria at extract concentrations of 50% and 100%. The conclusion of this research study is that the extract has strong antioxidant and antibacterial potential. [24]

The results of the analysis of the study found that there was a significant difference between the 2x1 intervention group and the 3x1 intervention with a *p-value* value on the REEDA score variable of 0.032. So it can be concluded that the *p-value* < 0.05 can be concluded that there is a difference in influence between the provision of interventions 2x1 days and 3x1 days. However, administration of red betel leaf hydrogel with a 3x1 intervention is more effective than a 2x1 intervention in accelerating *perineal* wound healing based on REEDA scores. This was also supported by a decrease in the average REEDA score in the 3x1 intervention group of 4.60 compared to the average decrease in the 2x1 intervention group of 4.34. So it can be concluded that the decrease was most in the 3x1 intervention group. The results of this research analysis are in accordance with previous research by Fina Ulvani, that variations in extract concentration have an influence on the acceleration of wound healing. Red betel leaf extract gel with a concentration of 3% which is the highest concentration among others has the greatest healing effect with a healing percentage of 85.81% compared to gel extracts with concentrations of 1% and 2% with percentages of 65.32% and 76.58%. Based on these results, it is necessary to test the isolation of the group of compounds in red betel that have effectiveness as anti-inflammatory, it is also necessary to formulate other topical preparations with the addition of extract concentration, because the greater the dose of administration and the concentration of red betel leaf extract (*Piper crocatum*) the greater the percentage of wound healing. [20]

Research on the administration of *red betel leaf hydrogel (Piper crocatum)* 2x1 day intervention and intervention to reduce the growth of *Staphylococcus aureus* bacteria showed a

significant difference with a *p*-value of 0.00. So that the *p*-value < 0.05 can be interpreted as there is a difference in influence between the provision of 2x1 days and 3x1 days intervention. However, giving red betel leaf hydrogel with a 3x1 intervention is more effective than a 2x1 intervention in reducing the growth of *Staphylococcus aureus* bacteria, this is supported by a decrease in the average growth of *Staphylococcus aureus* bacteria in the 3x1 intervention group of 8.74 greater than the average decrease in the 2x1 intervention group of 7.53. So it can be concluded that the decrease was most in the 3x1 intervention group. Previous research by Tunik Saptawati, also in line with this research, namely the preparation of red betel leaf gel (*Piper crocatum*) carried out antibacterial power tests showed the ability of antiseptic power with an extract level of

### Conclusion

Based on the results of research on the potential of red betel leaf extract hydrogel (*Piper crocatum*) to accelerate perineal wound healing based on REEDA scores and decrease in the growth of *Staphylococcus aureus* bacteria based on quantification of gram staining of vaginal swab results of perineal wounds in postpartum mothers, it can be concluded as follows:

The provision of perineal wound care dry cleaning technique affects the acceleration of perineal wound healing on day 3 and day 7.

Hydrogel extract of red betel leaf (*Piper crocatum*) intervention 2x1 day has the potential to accelerate perineal wound healing on day 3 and day 7 in postpartum mothers.

Hydrogel extract of red betel leaf (*Piper crocatum*) intervention 2x1 days has the potential to reduce the growth of *Staphylococcus aureus* bacteria on day 3 and day 7 in postpartum mothers.

Hydrogel extract of red betel leaf (*Piper crocatum*) intervention 3x1 day has the potential to accelerate perineal wound healing on day 3 and day 7 in postpartum mothers.

Hydrogel red betel leaf extract (*Piper crocatum*) 3x1 intervention has the potential to decrease the growth of *Staphylococcus aureus* bacteria in postpartum mothers.

Red betel leaf extract hydrogel in the 3x1 day intervention group to accelerate perineal wound healing based on day 3 and day 7 REEDA scores was more effective, compared to the 2x1 day intervention group in postpartum mothers.

25% (the highest concentration) able to inhibit the growth of gram-positive bacteria *Staphylococcus aureus* as much as approximately 45%. So the greater the concentration and large dose of administration, the greater the ability of bacterial inhibitory. *Piper crocatum* is one plant that is efficacious as an antiseptic as a mouthwash or cleans other body parts and some are crushed and attached to wounds. *Piper crocatum* is known to contain flavonoids, saponins, tannins, essential oils, consisting of hydroxycavicol, cavibetol, estargiol, eugenol, carvakrol, methylugenol and many more. Of these compounds are known to have antibacterial abilities. So it can be concluded that the preparation of red betel leaf extract gel (*Piper crocatum*) can be an alternative antiseptic that can be used to inhibit the growth of gram-positive bacteria, one of which is *Staphylococcus aureus* bacteria. [111]

Hydrogel administration of red betel leaf extract in the intervention group 3x1 days against and decreased the growth of *Staphyococcus aureus* bacteria based on quantification of gram staining results of vaginal swabs of perineal wounds day 3 and day 7 was more effective, compared to the intervention group 2x1 days in postpartum mothers.

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