EFFECTIVENESS OF BURN WOUND HEALING FROM JACKFRUIT LEAF ETHANOL EXTRACT (*Artocarpus Heterophyllus L.*) ON MALE WHITE RATS (*Rattus Norvegicus*)

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A B S T R A C T

Burns are tissue injuries that often occur due to contact with heat sources, chemicals, or radiation, and can lead to high morbidity and mortality rates. The healing process for burns typically requires a long time and often involves the use of chemicals that pose health risks. Therefore, safer and more effective treatment alternatives are needed. Ethanol extract of jackfruit leaves (Artocarpus heterophyllus L.) is known to contain active compounds such as flavonoids, tannins, and saponins, which have the potential to act as wound healing agents due to their anti-inflammatory and antibacterial properties. This study aims to evaluate the effectiveness of ethanol extract of jackfruit leaves in accelerating the healing of burns in male white rats (Rattus norvegicus). This research employed an experimental method with five treatment groups of varying extract concentrations, as well as positive and negative controls. According to the findings, a 3% extract concentration had the greatest impact on wound healing, which was similar to the positive control that used brand X ointment. ANOVA statistical analysis supported the substantial differences between the treatment groups, suggesting that jackfruit leaf ethanol extract is a useful burn therapy. In conclusion, jackfruit leaf ethanol extract has the potential to be a safe and efficient burn therapy substitute. It merits more research and development for clinical use.

INTRODUCTION

Wounds are conditions in which the anatomical structure of the entire body is damaged, starting from the most basic epithelial layer of the skin to deeper tissues, such as subcutaneous, fat, muscle, and bone, including other structures such as tendons, blood vessels, and nerves. Trauma, either from physical violence or other external sources, is usually the cause of this damage (Primadina et al., 2019).

Burns caused by exposure to heat sources such as fire, hot water, chemicals, electricity, or radiation are one of the most common forms of trauma. Due to the high morbidity and mortality rates, burns require special attention. This is especially true during the initial phase, or shock phase, and during the subsequent healing phase. Therefore, to overcome this serious type of injury, it is very important to get optimal treatment from the start (Sari et al., 2018).

Burns are often a serious health problem because they can cause extensive tissue damage and increase the risk of infection. The healing process requires the use of chemicals, which can cause side effects, and takes a long time. This makes safer and more effective alternative treatments such as ethanol extract from jackfruit leaves very much needed (Lengkong et al., 2021). It is known that this extract contains anti-inflammatory and antibacterial ingredients that can accelerate the healing of burns. Further research is needed to determine whether this extract is safe and effective for use in humans (Sanjaya et al., 2023).

Indonesia has more than 20,000 species of medicinal plants, but only about 1,000 have been scientifically studied, and about 300 of them are used as traditional medicine. Community experience shows that the use of plants as medicine has been passed down from generation to generation (Yolandari & Mustiqawati, 2022). Because it is easier to plant, it is currently in increasing demand. access, cheaper, and has fewer side effects, jackfruit leaf-based medicine (*Artocarpus heterophyllus L.*) is one of the plants that has been used in traditional medicine to treat burns (Lengkong et al., 2021).

Jackfruit leaves contain various active compounds such as saponins, flavonoids, tannins, and steroids. Saponins are known to play a role in stimulating the formation of new epithelial cells and

accelerating the epithelialization process, thereby accelerating the healing of burns. Flavonoids function as inhibitors of the enzyme tyrosinase, which plays a role in skin pigmentation, and have anti-inflammatory and antioxidant effects that support the healing process (Adnyani et al., 2017).

Research on the use of medicinal plants to heal burns is still ongoing. Because of its good biological activity, easy to obtain, and cheap, plants such as jackfruit leaves have great potential as a burn medicine. The content of jackfruit leaves, such as flavonoids, saponins, polyphenols, and tannins, is believed to accelerate the healing of burns (Sanjaya et al., 2023).

(Kusumawardhani et al., 2015) stated that tannins play an important role in accelerating wound healing through various processes, including scavenging free radicals, increasing wound closure, and encouraging the formation of capillaries and fibroblasts. In addition, additional research by (Wijayantini et al., 2019) showed that tannins act as antioxidants and antimicrobials, as well as acting as antiseptics and bacteriostatics on the wound surface.

The type of treatment used greatly affects the wound healing process. Because it is easily accessible and has a low risk of side effects, traditional medicine is often the main choice. Jackfruit leaves (*Artocarpus heterophyllus L*.) are one of the most commonly used plants in traditional medicine to heal burns.

METHODOLOGY

Research Design

This research is a type of research with an experimental method.

Time and Place of Research

This study was conducted from July to August 2024 at the Pharmacy Laboratory of the Health Department, Halu Oleo University and the Pharmacy Laboratory of Baubau Polytechnic.

Tools and materials

In this study, the following tools were used: stirring rod, scissors, calipers, glass slides, cages, hair clippers, test tubes, and analytical scales. Aquadest, 96% ethanol, FeCl3, and chloroform were the materials used. For this study, male white rats (*Rattus norvegicus*) of the Wistar strain were selected.

Work Procedure

Sample Preparation

After being cleaned from dirt, the jackfruit leaves are washed thoroughly with running water. After that, the leaves are stored in a container and dried in direct sunlight with a black cloth for some time until some of the water of the simplicia evaporates. Dry sorting is done again after drying.

Making Jackfruit Leaf Extract

After 200 grams of mashed jackfruit leaves are mixed with 2000 milliliters of 96% ethanol, the container is tightly closed with aluminum foil and left for five days, while stirring occasionally. After five days, the mixture is made and then filtered using filter paper to distinguish the filtrate from the residue. The liquid result is the filtrate, and the residue left behind will be used in the next step.

After the remaining first-stage filtrate is separated, this residue is soaked again in 1500 milliliters of 96% ethanol and left for two days. After that, the filtrate obtained from the second-stage filtration is added to the first-stage filtrate. The mixture of the two filtrates is then evaporated using a rotary evaporator until a thick extract is formed. This extract is then dried in an oven at a temperature of around 40 degrees Celsius until all the ethanol has evaporated.

To ensure that the test results are not affected by contamination, both the resulting extract and the glass container used must be thoroughly cleaned before the extract is ready to be used for testing.

Phytochemical Screening

Tannin Test

In the tannin test experiment, the extract was put in 3 drops into the drip plate, then 3 drops of 1% FeCl3 solution were added. A positive test was marked by the formation of green, purple, blue, and solid black colors.

Preparation of Experimental Animals

Preparation of Experimental Animals

For this study, the test animals were three white male mice aged between one and three months with a healthy body weight between 200 and 300 grams. The above-mentioned mice were trained for one week before use. All mice were given the following treatments.
Group I: treating wounds with a liquid containing 1% jackfruit leaf extract (Artocarpus heterophyllus L.), and
Group II: treating wounds with a liquid containing 2% jackfruit leaf extract (Artocarpus heterophyllus L.).
Phase III: Wounds were treated with a liquid containing 3% jackfruit leaf extract (Artocarpus heterophyllus L.).
Group IV: Wounds were treated with a positive control gel, known as gel brand X.
Group V: shows wounds submerged in water.

Making Second Degree Burns

After one week of adaptation, burns were made on the backs of mice with an area of about 2-4 cm. Then, distilled water was used for disinfection and chloroform was sprayed on the skin to be injured. Burns were made by heating a 1 cm diameter metal plate for five minutes and attached to the backs of mice for five seconds. Then running water was used to clean the wounds.

Data analysis

To determine the surface area of the wound, a vernier caliper was used. To determine whether there was a significant difference in the reduction of the burn area between groups, the data were analyzed statistically using the ANOVA method, one-way test, and a significance level of $\alpha = 5\%$ (0.05) using Microsoft Excel 2010.

RESULTS & DISCUSSION

The research results are presented in tabular form, as follows:

Table 1. Phytochemical Screening Test (Tannin)

Phytochemical Test	Reagent	Discoloration	Information
Tannin	$FeCl_3$ 1%	Black	+

Source: Primary Data, 2024

Table 2. Changes in the size of burn wounds in mice in all treatments (1 cm)

Measurement of burns from jackfruit leaf extract on white mice for all treatments (cm)					
Day	Concentration 1%	Concentration 2%	Concentration 3%	Positive Control (Brand X)	Negative Control (Aquadest)
1	1	1	1	1	1
4	0,9	0,9	0,9	0,9	1
7	0,7	0,7	0,7	0,7	0,9
10	0,6	0,6	0,5	0,5	0,8
14	0,5	0,5	0,4	0,5	0,6
15	0,4	0,4	0,4	0,4	0,5
16	0,3	0,3	0,2	0,2	0,3

Source: Primary Data, 2024

Based on table it can be seen that there are changes in the length of the mouse wound on day 1 to day 16 with jackfruit leaf extract treatment with concentrations of 1%, 2%, 3%, and changes in the length of the wound with the administration of positive control ointment (brand x) and negative control (aquadest).

Table 3. ANOVA Test Results

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	8.743	4	2.186	.297	.878
Within Groups	221.143	30	7.371		
Total	229.886	34			

Source: Primary Data,, 2024.
Description
Ss = Sum of squares due to source
Df = Degree of freedom due to source
MS = Average sum of squares due to source
F = Statistic (F count)
Sig = Significance

This study aims to determine how effective jackfruit leaf extract (*Artocarpus heterophyllus L.*) is in treating burns in male white rats (*Rattus norvegicus*) by observing the reduction in wound size

macroscopically. First, jackfruit leaves were collected in Banabungi Village, Pasarwajo District, Buton Regency from 9:00 to 10:00 WITA in the morning. Furthermore, wet sorting was carried out by washing to remove dirt and shredding to reduce the sample size to accelerate drying.

After that, the samples were dried in the sun with a black cloth covered to avoid direct exposure to the sun, and aired to reduce the water content. After the sorting process was complete, foreign materials and samples that were not completely dry were separated. After that, the simplicia was ground into powder.

Maceration is an extraction technique commonly used for materials that are not hard and sensitive to heating. Ethanol 96% was chosen as a solvent because it has the ability to extract compounds in various levels of polarity, from polar to nonpolar. Compared to other organic solvents, ethanol is cheaper, non-toxic, and not easily contaminated by microbes. Due to its collar nature, the addition of ethanol is intended to dissolve the material (Teheni et al., 2023).

The tannin test was carried out by inserting 3 drops of sample extract into a dropper plate, then adding 3 drops of 1% FeCl3 reagent. The test results showed the presence of tannin compounds which were marked by a color change to black. Phytochemical tests using FeCl3 can identify the presence of phenol groups, which indicate the possibility of tannins, because tannins are included in the category of polyphenol compounds. The blue-black color change that occurs is caused by the formation of a complex between tannins and FeCl3 (Muhibbuddin et al., 2017).

Flavonoids, a class of phenolic compounds, are mostly found in plants in the form of glycosides or compounds containing tannins that have been contaminated with one or more hydroxyl groups. Flavones, which are usually found in the form of white powder in tumors, are found in the C6-C3-C6 pattern structure (Puzi et al., 2015). Flavonoids can be extracted using solvents such as ethanol, methanol, or water because they are polar glycoside compounds. Known to have various health benefits, such as anti-inflammatory, antioxidant, antifungal, antiviral, and anticancer, this compound (Khoirunnisa & Sumiwi, 2019).

Aromatic alkaloids usually have one or more integrated nitrogen atoms in their cyclic structure. As analgesics, antimicrobials, cardiovascular disease treatment, increasing blood pressure, and stimulating the nervous system, these alkaloids function. Quinolozidines, isoquinolines, indoles, pyrrolidines, tropanes, piperidines, and four other alkaloid groups include substances such as papaverine, ergonovine, morphine, codeine, caffeine, theobromine, ephedrine, and capsaicin (Prayoga et al., 2019).

Saponins are complex glycosides with high molecular weight produced by plants, lower animals, and some bacteria. The first source of saponins, which are used as soap for washing, is the plant "Saponaria Vaccaria" (Putri et al., 2023). Although saponins are easily soluble in water, they are insoluble in ether. Testing of saponins that produce foam for fifteen minutes after the addition of hot distilled water indicates the nature of glycosides to form foam that is hydrolyzed into glucose and other materials.

In this study, five mice were used, divided into five treatment groups. Before being treated, the mice were prepared with distilled water to facilitate the hair removal process. After anesthesia, a 1 cm^2 burn wound was made on the back of the mouse, and then given ointment brand X as a positive control, distilled water as a negative control, and jackfruit leaf extract for experimental treatment. with concentrations of 1%, 2%, and 3% for each treatment group.

The results of the analysis of macroscopic observation data, as presented in Table 4.2, show that the group of mice receiving gel brand X experienced a decrease in the area of burns from 1 cm on the first day to 0.2 cm on the 16th day, which shows a significant change. In contrast, mice given distilled water showed a decrease in the area of burns from 1 cm to 0.3 cm, which shows a less significant change. For mice given jackfruit leaf extract with a concentration of 1% and 2%, the area of the wound remained at 1 cm on the first day and became 0.3 cm on the 16th day, showing an insignificant change. Mice with a concentration of 3% extract also showed a change from 1 cm to 0.2 cm, but the change was considered less significant.

Based on the observations listed in Table 4.2, it can be concluded that jackfruit leaf extract at concentrations of 1% and 2% did not have a significant effect on changes in the area of burns, while the extract with a concentration of 3% showed a change in wound size, although it remained less significant.

CONCLUSION

There was no significant difference between the control group and the group given jackfruit leaf extract (*Artocarpus heterophyllus L*.) at concentrations of 1%, 2%, and 3%. The results of the analysis showed that the dose of jackfruit leaf extract had not shown a significant effect on the burn wound healing process.

Several limitations in this study need to be considered. First, the limited sample size can reduce the representativeness of the results, because the small number of mice may not reflect the conditions of the wider population. Second, biological variability among mice, which can be caused by age, genetics, and health factors, can affect the results of the study. Third, various extraction methods can affect the quality and concentration of the active compounds produced. Furthermore, the short observation duration may not reflect the long-term effects of the extract, while environmental conditions such as temperature, humidity, and diet—can affect the health of the mice and the wound healing process. In addition, subjective methods of measuring effectiveness can reduce the accuracy of the results; therefore, objective methods are more recommended. Variability in the composition of the extract can also affect the concentration of active compounds. The use of inadequate control groups can affect the validity of the results, and ethical aspects in animal research must be considered to maintain the welfare of the animals used in the study.

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