***Pharmacy Education*** (2022) 22(2) 109 - 112
https://doi.org/10.46542/pe.2022.222.109112

IAI SPECIAL EDITION

RESEARCH ARTICLE

# Formulation and effectivity testing of pining fruit extract gel (*Hornstedtia alliacea*) for healing burns

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**Keywords**
Burn
Gel
*Hornstedtia alliacea*
Pining fruit

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## Abstract

**Background:** Pining fruit is a traditional medicinal plant employed to treat burns for its content of active natural ingredients such as flavonoids, tannins, and saponins acting as antioxidants and anti-inflammatory. **Objective:** The objective of this study was to formulate the best formula for gel preparations and test the effectiveness of pining fruit extract gel preparations for healing burns. **Methods:** Evaluation tests of the gel preparations included organoleptic, homogeneity, pH, spreadability, and viscosity tests. The gel effectiveness test was conducted in five treatment groups for 14 days. The data were analysed statistically using the one-way ANOVA method followed by the LSD (Least Significant Different) test. **Results:** The physical evaluation of pining fruit gel preparations, i.e. organoleptic, homogeneity, pH, dispersion, and viscosity tests on all three formulas (F1, F2, and F3), met the requirements. The results of the one-way ANOVA analysis revealed a significant difference in the experimental group with a score of 0.022 ($p < 0.05$). Hence, the most effective formula for curing burns was F3, with a 1.5% extract concentration and a healing percentage of 19.175%.

## Introduction

As a protector, the skin is frequently damaged due to external interference, such as burns described as tissue loss caused by contact with heat sources such as water, fire, chemicals, electricity and radiation (Dantas *et al.,* 2016). National data regarding mortality rates or the incidence of burns throughout Indonesia is not available (Kemenkes RI, 2019). Many people in Indonesia have employed various plant types as natural remedies to treat different diseases and injuries. Traditional medicine treatment has advantages over synthetic chemical therapy because it can be obtained without a doctor's prescription. Pining fruit *(Hornstedtia alliacea)* is one of the traditional medicinal plants used to treat burns. Its active compounds from the flavonoid group, such as bioflavonoids, isoflavones, flavonols, and dihydrochalcones, have antioxidants and anti-inflammatory properties to treat skin burns (Gustaman *et al.,* 2020).

Gel preparations have the advantage of cooling and moisturising the skin. They are easy to apply, easy to penetrate the skin, and have a high-water content. This preparation is preferred due to its transparent appearance, good drug release, and the fact it does not leave an oil layer on the skin, thereby reducing the risk of inflammation (Prasongko *et al.,* 2020).

## Methods

The materials used were pineapple extract, Carbopol 940, triethanolamine (TEA), glycerin, propylene glycol, methylparaben, propylparaben, Aqua dest. Formula preparation formulas can be seen in Table I. The gelling process started with mixing a gelling agent (Carbopol 940) with hot water in a mortar. After the base expanded, TEA was added and stirred. Then glycerine was added and stirred until a homogeneous and clear gel mass was formed. Then, methylparaben and propylparaben were added after being dissolved in propylene glycol. Finally, the pining fruit extract was added and stirred until homogeneous.

**Table I: Preparation formula**

| Material name | Negative control (%) | F1 (%) | F2 (%) | F3 (%) | Utility | Range |
|---|---|---|---|---|---|---|
| Pineapple extract | - | 0.5 | 1 | 1.5 | Active substance | - |
| Carbobol 940 | 0.5 | 0.5 | 0.5 | 0.5 | Gelling agent | 0.5-2.0% |
| TEA | 0.5 | 0.5 | 0.5 | 0.5 | Alkali | 0.5-4% |
| Glycerin | 10 | 10 | 10 | 10 | Humectants | 30% |
| Propylene glycol | 5 | 5 | 5 | 5 | Humectants | 5-9% |
| Methyl paraben | 0.2 | 0.2 | 0.2 | 0.2 | Preservative | 0.02-0.3% |
| Paraben profile | 0.2 | 0.2 | 0.2 | 0.2 | Preservative | 0.01-0.6% |
| Aquadest ad | Ad 100 | Ad 100 | Ad 100 | Ad 100 | Solvent | - |

***Experimental animals***

The experimental animals used in this study were male white Wistar rats aged 2-3 months (growth age), weighing 200-300 grams, and healthy. A coin plate of ±2.2 cm diameter was used to make burns on the backs of rats. It was heated on a fire for three minutes and then affixed to the backs of rats for 5 seconds until a second-degree burn was formed. Rats were divided into five intervention groups: three treatment groups, one positive control, and one negative control. In groups A, B, and C, pining fruit extract gel was applied on burns at the concentrations of 0.5%, 1%, and 1.5%, respectively. Rats in group D received a known product (positive control), and those in group E were administered the basis gel (negative control). All five groups received the treatment three times a day. The wound diameter was measured with a calliper every morning for 14 days, applying the Morton method. The data obtained were then analysed statistically, employing the one-way ANOVA method and least significant difference (LSD).

## Results

The amount of water in Simplicia should not exceed 10%. In this study, the water content was 2.66% and the average ash content (after the test was conducted three times) was 17.91%. The extract and Simplicia of pining fruit indicate the presence of secondary metabolites, i.e., flavonoids, saponins, quinones, tannins, polyphenols, and alkaloids (Kilungga *et al.,* 2019). The pining fruit extract gel formulas F1, F2, and F3 were semi-solid and brown with different tones. The brown colour of F3 was darker than in F2 and F1 due to the higher concentration. Table II shows the results of organoleptic tests. All three formulas remained homogeneous before and after storage (Table III).

Figure 1 shows the results of pH value tests. The pH of the preparation referred to the pH of the skin, which was in the range of 4.5–6.5 (Andhini, 2017).

**Table II: Organoleptic test**

| Formula | Observation | | |
|---|---|---|---|
| | Form | Color | Smell |
| Control (-) | Semi solid | Clear, clear | No smell |
| F1 | Semi solid | Brownish red | Extract characteristic smell |
| F2 | Semi solid | Brownish red | Extract characteristic smell |
| F3 | Semi solid | Dark brown | Extract characteristic smell |

**Table III: Homogeneity observation results**

| Formula | Results | |
|---|---|---|
| | Before storage | After storage |
| Control (-) | Homogeneous, no coarse grain | Homogeneous, no coarse grain |
| F1 | Homogeneous, no coarse grain | Homogeneous, no coarse grain |
| F2 | Homogeneous, no coarse grain | Homogeneous, no coarse grain |
| F3 | Homogeneous, no coarse grain | Homogeneous, no coarse grain |

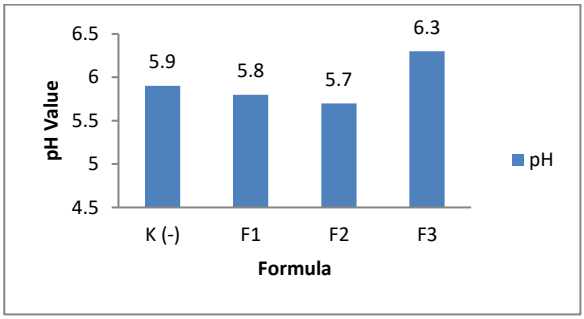


**Figure 1: pH value test results**

The spreadability is shown in Figure 2 and gel viscosity test is shown in Figure 3. The average burn diameters can be seen in Table IV & Figure 4. The results of the one-way ANOVA on the percentage of burn healing revealed an average difference in the experimental group with a significance score of 0.022 ($p < 0.05$), indicating a significant difference in the average percentage of burn healing based on the provided

treatment. The results of the LSD test analysis displayed a significant difference between the positive control group and the negative control group, with a significance value of 0.003 ($p < 0.05$).

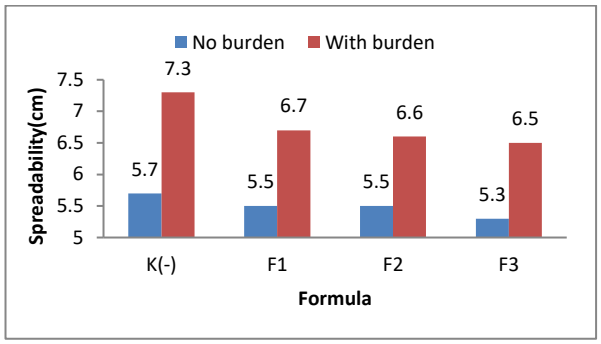


**Figure 2: Spreadability test results**

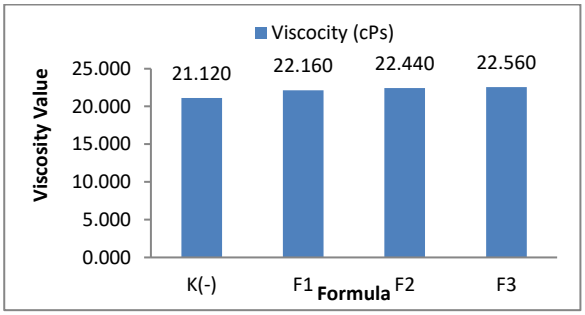


**Figure 3: Viscosity test results**

**Table IV: Results of the average diameter of burns**

| Day | Results of the average diameter of the burn on the treatment (mm) | | | | |
|---|---|---|---|---|---|
| | Control (-) | Control (+) | F1 (0.5 %) | F2 (1%) | F3 (1.5%) |
| 1 | 20,960 | 20.165 | 21,556 | 21,140 | 20,650 |
| 2 | 20,960 | 20.165 | 21,556 | 21,140 | 20,650 |
| 3 | 20,960 | 18,750 | 21,556 | 21,140 | 20,650 |
| 4 | 20,960 | 18,750 | 21,556 | 21,140 | 19,850 |
| 5 | 20,960 | 18,750 | 21,556 | 21,140 | 19,850 |
| 6 | 20,960 | 18,750 | 21,436 | 21,140 | 19,850 |
| 7 | 19,938 | 17,266 | 20,773 | 20,480 | 18,590 |
| 8 | 19,938 | 17,266 | 20,773 | 20,450 | 18,491 |
| 9 | 19,938 | 17,265 | 20,773 | 20,450 | 18,491 |
| 10 | 19,938 | 16,716 | 20,773 | 18,400 | 16,690 |
| 11 | 19,938 | 16,716 | 20,773 | 18,400 | 16,690 |
| 12 | 19,938 | 16,716 | 18,880 | 18,400 | 16,690 |
| 13 | 19,938 | 16,716 | 18,880 | 18,400 | 16,690 |
| 14 | 19,938 | 13,908 | 18,880 | 18,400 | 16,690 |
| Aver age | 20.345± 0.564 | 17,707± 1,590 | 20.694± 1.044 | 20.016± 1.278 | 18,609± 1,654 |
| P% | 4.87% | 31.02% | 13.81% | 17.65% | 19,175 |

Information: **Control (-):** Formula base negative control**; Control (+):** Bioplacenton gel positive control; **F1** : Pining fruit extract gel 0.5%; **F2** : Pining fruit extract gel 1%; **F3** : Gel Pineapple extract 1.5%; **P%** : Burn wound healing percentage

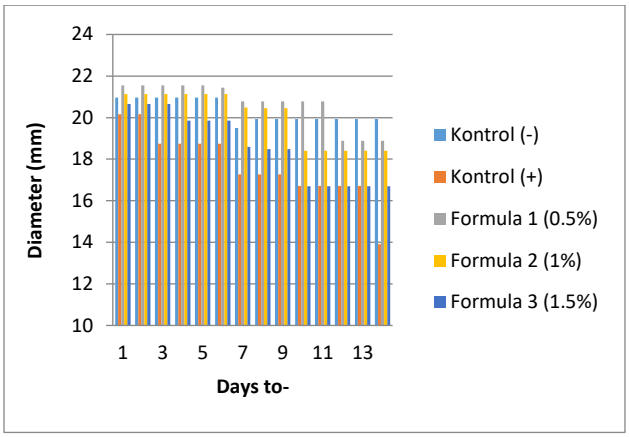


**Figure 4: Burn diameter measurement chart**

## Discussion

The results of pH testing performed on gel preparations met the requirements with skin pH based on SNI.06-2588, which was 4.5-6.5. The dispersion test was performed to determine the ability of the gel preparation to spread when applied on the skin, where it was expected to spread smoothly (Simatupang, 2018). Based on the table of dispersive power test results, all three formulas fulfilled physical quality requirements or good dispersibility parameters of the gel preparation, ranging between 5-7 cm. The viscosity test results of all formulas were consistent with the viscosity requirements of the gel preparation for the skin of 2,000-50,000 cP, based on SNI 16-4399-1996. Flavonoids act as antioxidants, which could ward off free radicals during the wound healing process. Their astringent effect shrank skin tissue, allowing burns to dry up quickly (Megawati *et al.,* 2020). Flavonoids could inhibit bacteria growth by damaging bacteria walls, microsomes, and lysosomes, after interacting with bacteria DNA. Furthermore, flavonoids could also release energy transduction to the cytoplasmic membrane of bacteria in burns (Agitya Resti Erwiyani, 2020).

## Conclusion

The pining fruit *(Hornstedtia alliacea)* extract can be formulated as a gel dosage form. Physical evaluation of the three formulas of pining fruit gel preparations, including organoleptic, homogeneity, pH, dispersion, and viscosity tests, met the requirements. The most effective formula for curing burns was F3, as it had the higher extract concentration (1.5%), with a healing percentage of 19.175%.

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