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Phytochemical Profile and Antioxidant Activity of *Daemonorops draco* Resin Extract from Jambi, Indonesia

Fitra Wahyuni[1]*, Ade Adriadi[2], Anggari Linda Destiana[3], Ashif Irvan Yusuf[4], and Revis Asra[5]

[1,2,3,4,5] Universitas Jambi, Jambi, Indonesia
*Corresponding Author: fitra.wahyuni88@unja.ac.id

Abstract

Background: Jernang resin from Daemonorops draco (Willd.) Blume is traditionally used for wound care and is expected to contain antioxidant secondary metabolites. **Objective:** This study characterized the phytochemical constituents and antioxidant activity of 96% ethanol extract of jernang resin from Jambi, Indonesia. **Methods:** Resin powder was extracted by maceration using 96% ethanol, screened qualitatively for major metabolite groups, and evaluated using the DPPH radical scavenging assay. **Results:** The extract was dominated by flavonoid-type polyphenols. DPPH inhibition increased from 4.0% at 20 µg/mL to 28.3% at 100 µg/mL, with $R^2 \approx 0.96$ and an extrapolated IC50 of approximately 160 µg/mL. **Conclusion:** The jernang ethanol extract has moderate antioxidant activity and provides a basis for further anti-inflammatory and wound-healing studies.

Keywords: *Daemonorops draco*; jernang; phytochemical screening; antioxidant activity; DPPH assay; wound healing

Cite This Article

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INTRODUCTION

The proportion of elderly people aged 60 years or older in Indonesia reached approximately 11.8% in 2023 and is projected to increase substantially by 2045 [4]. A major health consequence of aging is the increase in chronic, non-healing wounds in older populations, often associated with diminished stem cell activity, persistent oxidative stress, prolonged inflammation, and altered skin-repair communication [1,15,16,20]. Such wounds are prone to infection, reduce quality of life, and burden healthcare systems. Therefore, new therapies that can accelerate wound healing in aged individuals are needed, especially by countering excessive oxidative stress and inflammation that impede the healing process [9,13].

One promising natural therapy is the red resin known as jernang or dragon's blood, obtained from the rattan palm Daemonorops draco, which is abundant in Jambi Province, Indonesia. Jernang resin has long been used empirically by local communities for treating wounds, headache, and fever, supporting its potential as a local natural wound-healing agent [17,22]. Scientifically, D. draco resin contains bioactive compounds such as polyphenols, flavonoid pigments, dracorhodin-related compounds, and triterpenoids that are associated with antioxidant, anti-inflammatory, antimicrobial, and tissue-repair activities [3,12,14,23,30,31]. These properties support its traditional use for wound care.

Despite these promising attributes, comprehensive preclinical data on how jernang resin extract facilitates wound healing remain limited, particularly in the context of aging. Most prior studies on jernang have focused on antioxidant activity or wound-healing efficacy in young and healthy animal models, whereas aged wounds are typically characterized by delayed repair, higher oxidative stress, and dysregulated inflammatory responses [5,10,11,16,20]. We hypothesize that the antioxidant and anti-inflammatory properties of jernang resin could be especially beneficial in an aged wound environment.

In this study, we present an initial investigation of the phytochemical profile and antioxidant activity of 96% ethanol extract of jernang resin from Jambi. These preliminary results serve as a scientific basis for ongoing research into its wound-healing potential. Subsequent stages of our research will evaluate the extract's anti-inflammatory effects using an in vitro human red blood cell (HRBC) membrane stabilization assay as a proxy for lysosomal membrane stabilization in inflammation [29], and an in vivo wound-healing model in D-galactose-induced aged rats. In that model, wound closure, histopathology, and macrophage activity via CD68 immunohistochemistry will be evaluated to understand the extract's impact on inflammatory-cell infiltration [5,10,11]. Ultimately, this integrated approach is expected to provide a comprehensive understanding of jernang resin's mechanism of action in wound healing under oxidative-stress conditions.

METHODS

Plant Material and Extraction

Dry jernang resin, obtained from the fruit of Daemonorops draco palms in Jambi, Indonesia, was used as the starting material. The resin, in the form of dried dark reddish-brown chunks, was cleaned and oven-dried to constant weight, then ground into a coarse powder or simplisia. For extraction, 96% ethanol was used as solvent to preferentially extract semi-polar and polar constituents. Approximately 100 g of jernang powder was macerated in 1 L of 96% ethanol at room temperature for 3 x 24 hours with periodic stirring. The extract was filtered, and the marc was re-macerated twice under the same conditions; all filtrates were combined. The solvent was removed under reduced pressure using a rotary evaporator at

<=50 °C, yielding a thick dark-red resinous extract that was further dried in vacuo to obtain a dry extract. The percentage yield of the ethanol extract was about 11% of the starting resin powder. The dried extract was stored in an airtight container at 4 °C until use.

Phytochemical Screening

Qualitative phytochemical tests were performed on both the jernang simplisia and the ethanol extract to identify major classes of secondary metabolites. Standard reagents and protocols were employed for each compound class: Dragendorff's and Mayer's reagents for alkaloids, the Shinoda test (Mg-HCl reduction) for flavonoids, foam test for saponins, FeCl3 test for tannins and general phenolics, Liebermann-Burchard test for terpenoids and steroids, and Bornträger's test for anthraquinones. A small sample of each material, approximately 2 g of simplisia or 0.5 g of extract, was used for each test. Formation of characteristic precipitates or color changes was observed as indicators of positive results, and the results were recorded as present (+) or absent (-) for each metabolite class.

Antioxidant Activity Assay (DPPH)

The free radical scavenging activity of the jernang resin extract was evaluated using the DPPH (2,2-diphenyl-1-picrylhydrazyl) assay, a widely used electron-transfer-based antioxidant assay [2,8,19,21]. A stock solution of DPPH (0.1 mM) in methanol was prepared freshly. The extract was dissolved in ethanol to create a series of concentrations ranging from 20 µg/mL to 100 µg/mL. In a 96-well plate or test tubes, 1 mL of each extract dilution was mixed with 1 mL of DPPH solution and incubated in the dark for 30 minutes at room temperature. Methanol plus DPPH without extract served as the negative control, and vitamin C was tested in parallel as a positive reference. After incubation, the decrease in absorbance was measured at 517 nm using a UV-Vis spectrophotometer because DPPH produces a purple color that fades upon reduction by an antioxidant.

$$\text{DPPH inhibition (\%)} = [(A_{control} - A_{sample}) / A_{control}] \times 100\%$$

Acontrol is the absorbance of the DPPH solution without extract, and Asample is the absorbance with extract. Each concentration was tested in triplicate, and results are reported as mean percentage inhibition ± standard deviation. A plot of percentage inhibition versus extract concentration was made to evaluate the dose-response. The data were further analyzed by linear regression to determine the correlation coefficient (R^2) and to estimate the IC50 value, defined as the concentration of extract required to inhibit 50% of DPPH radicals. Because the highest tested concentration produced less than 30% inhibition, the IC50 was extrapolated from the linear regression beyond the tested range.

RESULTS

Phytochemical Composition of Jernang Resin

Qualitative phytochemical screening revealed distinct profiles for the raw resin or simplisia and the 96% ethanol extract. Table 1 summarizes the presence (+) or absence (-) of major metabolite groups in each sample.

Table 1. Phytochemical screening results for jernang resin (simplisia versus 96% ethanol extract)

No.	Metabolite Class	Simplisia (raw resin)	Ethanol Extract
1	Alkaloids	-	-
2	Flavonoids	+	+
3	Saponins	+	-

4	Tannins/Phenolics	-	-
5	Terpenoids/Steroids	+	-

Note: "+" indicates detected; "-" indicates not detected.

The ethanol extract tested positive only for flavonoids and related polyphenols, evidenced by a characteristic color change in the Shinoda test. In contrast, alkaloids, tannins, saponins, and terpenoids/steroids were not detected in the extract, suggesting that these compounds were absent or present in negligible amounts after ethanol extraction. The raw resin powder showed the presence of saponins and terpenoid/steroid compounds prior to extraction, although they did not appear in the ethanol extract. This pattern suggests that the extraction solvent and resin matrix influenced the recovery of each metabolite group. The flavonoids appear to be the major constituents carried into the ethanol extract, consistent with reports that Daemonorops resin is rich in flavonoid pigments and phenolic compounds [3,7,17,22].

In summary, the ethanol extract of jernang resin contains flavonoid-type polyphenols as the dominant secondary metabolites, with negligible amounts of alkaloids, saponins, tannins, or steroids. The presence of abundant flavonoids provides a biochemical basis for the extract's expected bioactivities because flavonoids are known for antioxidant, antimicrobial, and wound-healing-related effects [12,14,17]. The absence of saponins and alkaloids in the extract also suggests that these classes likely do not contribute substantially to the measured antioxidant activity of the extract.

DPPH Free Radical Scavenging Activity

The jernang resin extract was evaluated for its ability to scavenge DPPH free radicals as a measure of antioxidant capacity. Table 2 shows the percentage inhibition of DPPH at extract concentrations from 20 to 100 µg/mL. Even at the highest tested concentration, the extract achieved approximately 28% radical inhibition, indicating a partial antioxidant effect. There was a clear dose-dependent trend, with inhibition increasing from 4.0% at 20 µg/mL to 28.3% at 100 µg/mL.

Table 2. DPPH radical scavenging (%) by D. draco resin extract at various concentrations

Extract Concentration (µg/mL)	% DPPH Inhibition (mean ± SD)
20	4.0 ± 0.1%
40	13.5 ± 0.2%
60	17.3 ± 0.1%
80	26.7 ± 0.3%
100	28.3 ± 0.2%

A linear regression analysis was performed on the inhibition data. Figure 1 illustrates the relationship between extract concentration and DPPH inhibition. The data showed a strong positive linear correlation ($R^2 \approx 0.96$) between concentration and percentage inhibition in the tested range. The regression line has an equation of approximately $y = 0.308x - 0.546$, where y is percentage inhibition and x is concentration in µg/mL. This slope indicates that every 10 µg/mL increase in concentration increased radical scavenging by approximately 3% within the tested range.

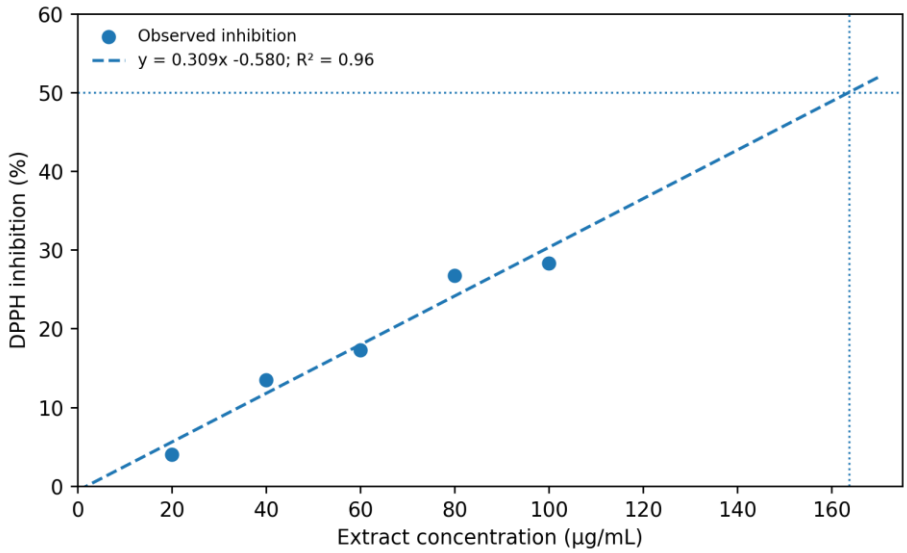

Figure 1. Linear regression of DPPH radical scavenging activity of the 96% ethanol extract of D. draco resin.

Because the experimental data did not reach 50% inhibition within the tested concentrations, the IC50 value was estimated by extrapolation of the linear plot. The extrapolated IC50 is roughly in the range of 160-170 µg/mL for this extract. This relatively high IC50 indicates that the antioxidant potency of the jernang extract is in the moderate-to-weak category compared with pure antioxidants such as vitamin C and with many highly active plant antioxidant extracts [8,19,21].

These findings are in line with several previous reports. Waluyo and Pasaribu found that methanol and ethyl acetate extracts of Daemonorops resin had antioxidant activity, with the best IC50 value reported for specific species and solvent systems [23]. Purwanti et al. reported that an ethyl acetate fraction of D. draco resin collected from Jambi had stronger antioxidant activity than crude extracts [17]. These comparisons suggest that solvent selection and fractionation can strongly affect antioxidant yield and potency. The antioxidant effect of the present extract is likely driven mostly by flavonoids, which are present in the ethanol extract but may occur in moderate quantity or moderate activity compared with more potent isolated polyphenols.

Despite being moderate, the antioxidant activity is biologically relevant. Achieving approximately 30% free-radical scavenging at about 0.1 mg/mL indicates that the extract can provide partial protection against oxidative stress. In the context of wound healing, even a moderate antioxidant effect could be beneficial by reducing local oxidative damage in the wound microenvironment. Flavonoids in the extract can donate electrons or hydrogen atoms to neutralize reactive oxygen species, potentially protecting wound-area cells from oxidative injury and creating a more favorable environment for tissue repair [6,9,13].

DISCUSSION

The results provide scientific validation of jernang resin's antioxidant content and lay the groundwork for understanding its wound-healing potential. The phytochemical analysis showed that the ethanol extract is dominated by flavonoids, which are well-known for antioxidant and anti-inflammatory properties [2,12,19]. In wound healing, flavonoid antioxidants can protect regenerating tissues from oxidative stress. Wounds, especially during

the inflammatory phase, generate high levels of reactive oxygen species from activated neutrophils and macrophages; if unchecked, these reactive species can cause cellular damage and impede healing [6,9,13]. The presence of flavonoids in jernang extract thus likely contributes significantly to its traditional efficacy in wound treatment.

The absence of certain compounds, including alkaloids, saponins, and tannins, in the ethanol extract has mixed implications. Tannins are strong antioxidants, so their absence could partly explain the moderate DPPH activity. However, tannins can also be astringent and may affect tissue response if present excessively. The 96% ethanol extraction appears to have selectively retrieved flavonoid-type phenolics while leaving behind very polar or high-molecular-weight constituents. This selectivity could be advantageous for topical use because excluding saponins may reduce detergent-like irritation on skin, while excluding alkaloids may reduce the possibility of introducing potentially toxic or vasoactive compounds.

The moderate antioxidant potency, with IC50 around 160 μg/mL, suggests that jernang extract can counteract oxidative stress but is not among the most powerful plant antioxidants. Fractionation can substantially improve the measured antioxidant activity of D. draco resin, as shown by stronger activity in ethyl acetate and enriched fractions reported previously [17]. The lower activity of the present crude ethanol extract may be due to dilution by non-antioxidant constituents or suboptimal extraction of selected antioxidant compounds. This finding points to a potential future strategy: the extract could be optimized or enriched through solvent partitioning if stronger antioxidant activity is required.

Nevertheless, wound healing in vivo involves a complex interplay of processes beyond antioxidant activity alone. Antioxidant activity is one part of the mechanism, while anti-inflammatory effects, stimulation of tissue regeneration, antimicrobial properties, fibroblast activity, and angiogenesis may also contribute to wound closure [5,10,11,25,30,31]. Prior local research reported that topical application of 5% jernang resin extract increased fibroblast numbers and epithelial thickness in rat excision wounds [25]. This aligns with the idea that jernang constituents may actively promote the proliferative phase of healing. The present findings of flavonoids and moderate antioxidant activity reinforce these observations.

Modern pharmacological studies have provided mechanistic insight into compounds from dragon's blood resin. Wu et al. isolated a flavan compound from D. draco and reported anti-inflammatory and skin-barrier repair effects in a UVB-induced skin-damage model through inhibition of intracellular reactive oxygen species and NF-kB-related inflammatory signaling, with effects on IL-1β, TNF-α, filaggrin, and claudin-1 [26]. Lu et al. reported that dracorhodin perchlorate enhanced wound closure by promoting keratinocyte migration through β-catenin, AKT, ERK, and p38 signaling in human HaCaT keratinocytes [27]. Chen et al. further reported that dragon blood from D. draco provided multifaceted therapeutic benefits for chronic diabetic wounds by influencing myoblast differentiation, PAI-1-mediated regulation, and stem-cell proliferation [28]. These molecular findings support the broader biological relevance of jernang resin beyond antioxidant activity.

The relevance of these mechanisms is particularly strong for aged wounds. Aging is associated with altered inflammatory resolution, impaired keratinocyte and fibroblast responses, delayed angiogenesis, and dysregulated macrophage activity [1,5,10,15,16,20]. Our ongoing work is designed to assess whether jernang extract can modulate macrophage responses in a D-galactose-induced aging rat model. CD68 immunostaining will be used to quantify macrophages in wound tissue. Although CD68 labels total macrophages rather than distinguishing M1 and M2 phenotypes, reduced macrophage persistence at later healing

stages, combined with improved tissue formation, may indicate faster inflammatory resolution. Future work may include markers such as iNOS, CD163, or cytokine panels to strengthen interpretation of macrophage polarization.

The HRBC membrane stabilization assay planned for the next stage is also relevant as an in vitro proxy for anti-inflammatory potential. Membrane-stabilizing activity reflects the ability of compounds to prevent erythrocyte or lysosomal membrane rupture under stress conditions. In inflammation, lysosomal rupture can release enzymes that exacerbate tissue injury. Yesmin et al. showed that the anti-inflammatory mechanism of Piper chaba root extract involved HRBC membrane stabilization [29]. If jernang extract shows significant HRBC protection, it will suggest that its constituents may stabilize cellular membranes or reduce oxidative damage in lipid bilayers, complementing its DPPH antioxidant activity.

Overall, jernang resin extract holds promise as a wound-healing agent, especially under challenging conditions such as aging or chronic wounds. Its moderate antioxidant activity and flavonoid-dominant phytochemical profile are consistent with anti-inflammatory and tissue-repair mechanisms documented for dragon's blood compounds [3,12,22,26-28]. Future experiments involving HRBC assays, aged wound models, histopathology, and macrophage immunostaining are necessary to translate the current phytochemical and antioxidant findings into mechanistic evidence for wound-healing efficacy.

CONCLUSIONS

The 96% ethanol extract of Daemonorops draco (jernang) resin from Jambi contains predominantly flavonoid and phenolic compounds and demonstrates moderate antioxidant activity, with an extrapolated DPPH IC50 of approximately 160 µg/mL. These findings support the traditional use of jernang resin as a wound remedy by confirming the presence of bioactive phytochemicals capable of scavenging free radicals and potentially protecting tissues from oxidative damage. Although the antioxidant potency is not extremely strong, it may contribute to wound healing when combined with the extract's other potential bioactivities, particularly anti-inflammatory and tissue-repair mechanisms.

Future work should evaluate the extract's anti-inflammatory and wound-healing properties through HRBC membrane stabilization, wound closure rate, histological tissue regeneration, and CD68-positive macrophage infiltration in aged wound models. Successful outcomes could lead to the formulation of an evidence-based herbal wound-healing remedy for elderly patients using a local Indonesian biological resource.

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AUTHOR CONTRIBUTIONS

Fitra Wahyuni (F.W.) conceptualized and designed the study, supervised the research implementation, curated the data, performed the primary analysis and interpretation, and wrote the original draft of the manuscript. Ade Adriadi (A.A.) contributed to methodology development, assisted with laboratory work and data acquisition, and reviewed the manuscript. Anggari Linda Destiana (A.L.D.) supported sample preparation and phytochemical screening, contributed to data validation, and reviewed the manuscript. Ashif Irvan Yusuf (A.I.Y.) assisted with antioxidant assay implementation, contributed to figure/table preparation, and reviewed the manuscript. Revis Asra (R.A.) contributed to project administration, documentation, and manuscript editing. All authors critically revised the manuscript, approved the final version, and agree to be accountable for all aspects of the work.

CONFLICT OF INTEREST

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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