

The medicinal properties of *Borassus flabellifer* L

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GSC Biological and Pharmaceutical Sciences, 2025, 30(03), 141-145

Publication history: Received on 30 January 2025; revised on 06 March 2025; accepted on 08 March 2025

Article DOI: <https://doi.org/10.30574/gscbps.2025.30.3.0103>

Abstract

Background: Herbal medicine is increasingly being developed and widely used to prevent and treat chronic, degenerative and cancerous diseases with minimal side effects. Medicinal plants such as *Borassus flabellifer* L. hold an important role in human health as it is believed to be safer, more efficient, and have less side effects.

Objective: A comprehensive review of *Borassus flabellifer* L. medicinal properties.

Method: This comprehensive review on the medicinal properties and the usage of *Borassus flabellifer* L. in dental and medical field is done by collecting, reviewing, correlating, integrating, interpreting, and finally concluding several studies done using the *Borassus flabellifer* L. plant.

Results: *Borassus flabellifer* L. fruit contain several natural antioxidants that can neutralize the toxic effects of free radicals and fight DNA damage due to exposure to oxidative stress and malignancy. Its seed coat extract has cytotoxic effects towards Human Dermal Fibroblasts and Vero cell lines that is categorized as mild toxic, anticancer effects towards cancer cell lines such as HeLa and HSC-3 cell lines by inhibiting cancer cell proliferation, and having antidiabetic capabilities. Its seed coat, root, and sap could also inhibit the growth of bacteria and fungi such as *Streptococcus mutans*, *Staphylococcus aureus*, *Candida albicans*, *Klebsiella pneumoniae*, *Escherichia coli*, *Bacillus subtilis* and *Staphylococcus aureus*. Its fruit juice eliminates halitosis and inflammation by antioxidant properties within the seed coat.

Conclusion: It can be concluded that *Borassus flabellifer* L. could be used for medical health purposes.

Keywords: *Borassus flabellifer* L; Herbal medicine; Antioxidant; cytotoxic; Cancer cell; Human diseases

1. Introduction

Medicinal plants and herbal medicine are increasingly being developed and widely used by the community. Herbal based treatment is a new alternative that is expected to minimize the side effects of modern therapies. These days, medicinal plants are beneficial to humans to provide better health due to their bioactive compounds.¹ Medicinal plants such as tamarillo (*Cyphomandra betacea* Sendtn.), palasa (*Butea monosperma*), papaya (*Carica papaya* L.) with their phytochemicals are able to inhibit cancer growth.^{2,3,4} Medicinal plants such as *Borassus flabellifer* L. (Figure 1), more commonly known as Siwalan, lontar, in Indonesia, is the most popular type of palm trees that hold an important role in human health and is believed to be more safe, efficient, and with the least side effects. According to previous studies, the *Borassus flabellifer* L. seed coat ethanol extract contains very strong natural antioxidants such as flavonoids, phenols, and tannins.⁵ The ethanol extract of *Borassus flabellifer* L. seed coat also has antibacterial, antifungal, and antiproliferative properties towards cancer cells.^{5,6,7} The objective of this review is to give a comprehensive review of the medicinal properties of the *Borassus flabellifer* L. plant.

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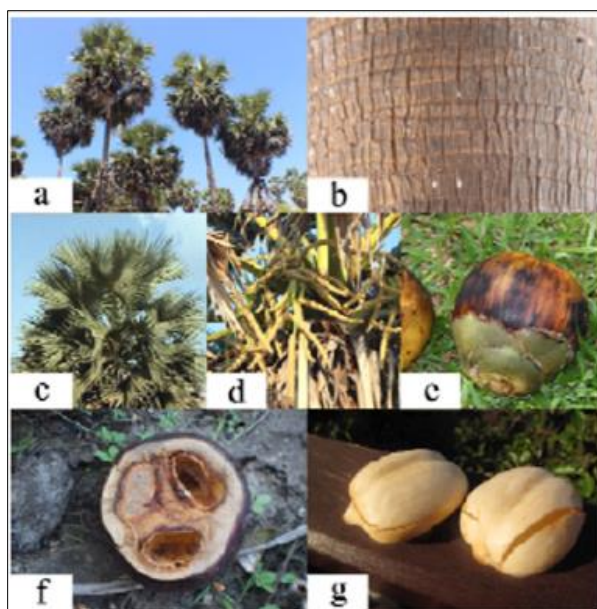


Figure 1 a. *B. flabellifer* tree, b. *B. flabellifer* trunk, c. *B. flabellifer* leaves, d. *B. flabellifer* flowers, e. *B. flabellifer* fruit, f. Inner part of *B. flabellifer* fruit, g. Seed coat (endocarp) of *B. flabellifer* fruit. ⁵

2. Methods

This comprehensive review on the medicinal properties and the usage of *Borassus flabellifer* L. in dental and medical field done by collecting, reviewing, correlating, integrating, interpreting, and finally concluding several studies using the *Borassus flabellifer* L. plant

3. Results

The main findings showed that palm fruit contains natural antioxidants especially xanthophylls and phenols groups. Ethanol extract of the plant can be derived from its various parts with different strength intensity. For example, the ethanol extract of *B. flabellifer* L seed coat can outperform the inhibition percentage of *B. flabellifer* L. leaves and young *B. flabellifer* L. pulp. Indonesians tend to only consume the fruit and throw away its seed coat, which then becomes trash. In a study by Sudiono J. and Susanto G. R., 2021, *Borassus flabellifer* L. seed coat ethanol extracts is found to contain flavonoid, phenol, tannins (25 µg/mL of ethanol extract for flavonoid and phenol, 5 µg/mL for tannin) which is shown on Table 1 and has a very strong antioxidant characteristic that can neutralize the toxic effects of free radicals and can fight DNA damage due to exposure to oxidative stress and malignancy.⁵

Table 1 Total Flavonoids, Phenols, and Tannins in the Ethanol Extract of *B. flabellifer* Seed Coat. ⁵

Sample	Parameter	Result	Unit	Technique Analyze
Ethanol extract of <i>B. flabellifer</i> seed coat	Flavonoid	112.14 ± 0.31	mg RE/g extract	Colorimetry and Spectrophotometry
	Phenol	163.90 ± 0.51	mg GAE/g extract	
	Tannins	134.62 ± 2.76	mg TAE/g extract	

The toxicity level of a substrate can be classified based on the number of living cells. If the percentage of cell viability is more than 90% then the substrate is classified as non-toxic, 60-90% is classified as slightly toxic / mild toxic (mild), 30-59% is classified as moderately toxic, and less than 30% is classified as severe.⁸

In a study by Tyatana R. N. and Sudiono J., 2021, *Borassus flabellifer* L. seed coat ethanol extract has cytotoxicity effect towards the HDF-line fibroblast as normal human cells with IC₅₀ value (12.29 ± 0.44) that is categorized as mild toxic started at a concentration of 1,56%. *B. flabellifer* L. seed coat extract with a concentration of 1.56% - 50% was toxic to fibroblast cells with increasing intensity according to the increase in extract concentration, with 50% being the highest concentration (Figure 2).⁹ Thus, it can be said that *B. flabellifer* L. seed coat extract is not biocompatible with normal

body cells or is cytotoxic. Therefore, it is necessary to know more about the cytotoxicity of the extract against other body cells, like immune cells during inflammation or allergic reactions. This is due to the toxicity of bioactive compounds at higher doses.¹⁰ Flavonoids, one of the bioactive compounds found in this plant, can be toxic to cells due to its ability to perform cell rupture or lysis if used in excessive amounts.¹¹ Alkaloids, another bioactive compound found in the plant, have a cytotoxic effect that can result in fibroblast cell membrane leakage. Tannin, another bioactive compound found in the plant, can cause cell mutation at a high concentration, as well as the breakdown of fat and hoarding compounds caused by cell lipoproteins and tannin polar compound bonds, which results in the disruption of fibroblast permeability that leads to necrosis.¹²

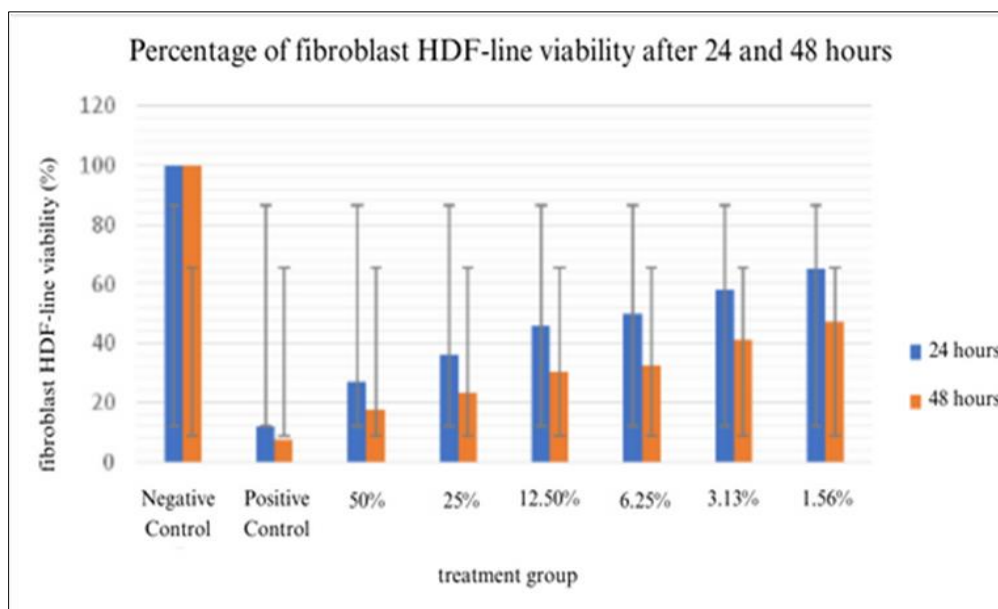


Figure 2 Fibroblast HDF-line Viability Percentage after 24 and 48 hours.⁹

In a study by Banu S. M. et al, 2020, the extract of *B. flabellifer* L. seed powder is proven to have antibacterial effects as shown by maximum inhibition of *Klebsiella pneumoniae* and *Escherichia coli* as well as minimum inhibition of *Bacillus subtilis* and *Staphylococcus aureus* while anticancer effects by inhibiting the growth of several types of cancer cells such as HeLa cell lines. The study of Banu S. M. et al, 2020 also shows that the extract of *B. flabellifer* L. seed powder give a cytotoxic effect towards the Vero cell line (monkey renal epithelial cells) with an IC₅₀ value of 734 µg/ml, as well as antidiabetic activity by inhibiting the alpha amylase and alpha glucosidase enzyme, which delays glucose absorption.¹³

In a study by Celine C. H., Sudiono J., and Trisfilha P., 2023, the seed coat extract of *B. flabellifer* L. fruit can reduce the ability of HSC-3 cell line cancer cells to survive by inhibiting cell proliferation due to its cytotoxicity effect with a very high IC₅₀ value of 141.9 µg/mL starting from the concentration of 93.75 µg/mL with the optimum concentration of 1,500 µg/mL (Figure 3).¹⁴

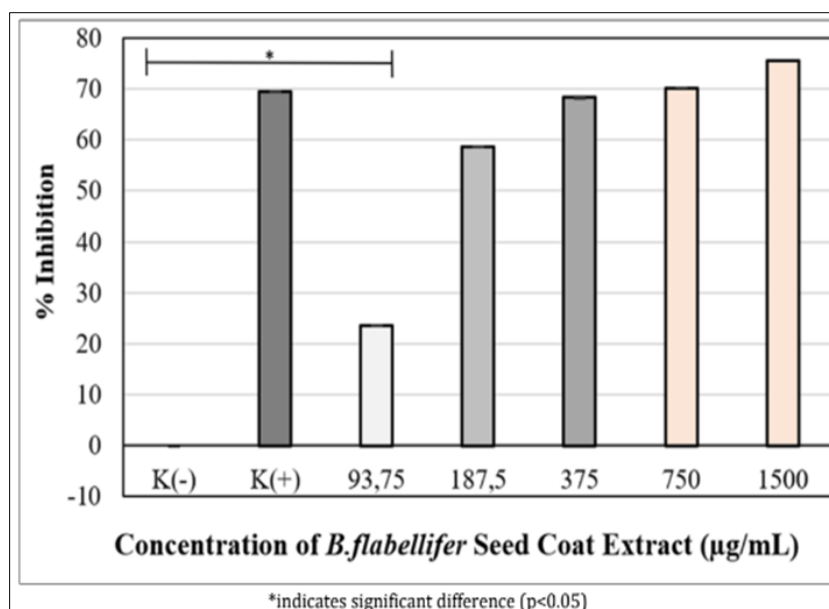


Figure 3 % HSC-3 cell line viability inhibition test result of *B.flabellifer* L. fruit seed coat extract at various concentrations, positive control, and negative control.¹⁴

The main finding of antibacterial and antifungal research in dentistry showed the seed coat, root, and sap of *Borassus flabellifer* L. could inhibit the growth of *Streptococcus mutans*, *Staphylococcus aureus*, and *Candida albicans*.¹⁵ The antibacterial properties through antioxidant activity such as tannins are able to deactivate the adhesiveness of bacteria and the mechanism of enzymes of protein transport to the cell through the destruction of the bacterial cell membrane, while flavonoids have antibacterial properties through several mechanisms such as inhibition of nucleic acid synthesis, membrane cell function and energy metabolism. Antibacterial activity of terpenoids function via the destruction of bacterial cell membranes. All these antibacterial properties interact with the active membrane or by dissolving its lipid components, leading to the increase of cell permeability which results in damage of the cell membrane. The fruit juice eliminates halitosis and inflammation through the antimicrobial effects including antifungal activity such as *Aspergillus flavus* by antioxidant properties, especially the polyphenol content within the seed coat.^{16,17}

4. Conclusion

It can be concluded that the *Borassus flabellifer* L. plant could be used for medical health purposes due to its medicinal properties such as strong natural antioxidant contents, mild toxic nature, cytotoxic and antiproliferative effect towards cancer cells as well as its antibacterial and antifungal properties.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

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