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Ficus elastica as a source of bioactive compounds: total polyphenol content, antioxidant capacity, mineral composition and potential therapeutic properties

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Abstract

Ficus elastica contains flavonoids, phenolic derivatives, triterpenoids and other specialized metabolites. This literature review examines phytochemical composition, antioxidant activity and potential therapeutic relevance. Experimental evidence supports antioxidant and antimicrobial activity, while anti-inflammatory and antiproliferative findings remain preliminary. Mineral composition, bioavailability and safety require further investigation before clinical applications can be established.

Introduction

The rubber tree (Moraceae) has traditional medicinal uses and offers chemically diverse compounds for natural product research. This review focuses on total polyphenols, antioxidant capacity, mineral composition and the limits of therapeutic interpretation.

Mineral elements support plant metabolism and physiological functions. However, their presence alone does not demonstrate medicinal benefits. Evidence linking macro- and micronutrient composition with antioxidant characteristics remains fragmentary, which identifies an important research gap.

Narrative review of the literature cited in the manuscript. The synthesis distinguishes isol1ated compounds from crude extracts and compares chemical assays, cell models and reported biological effects. No new experimental measurements were performed.

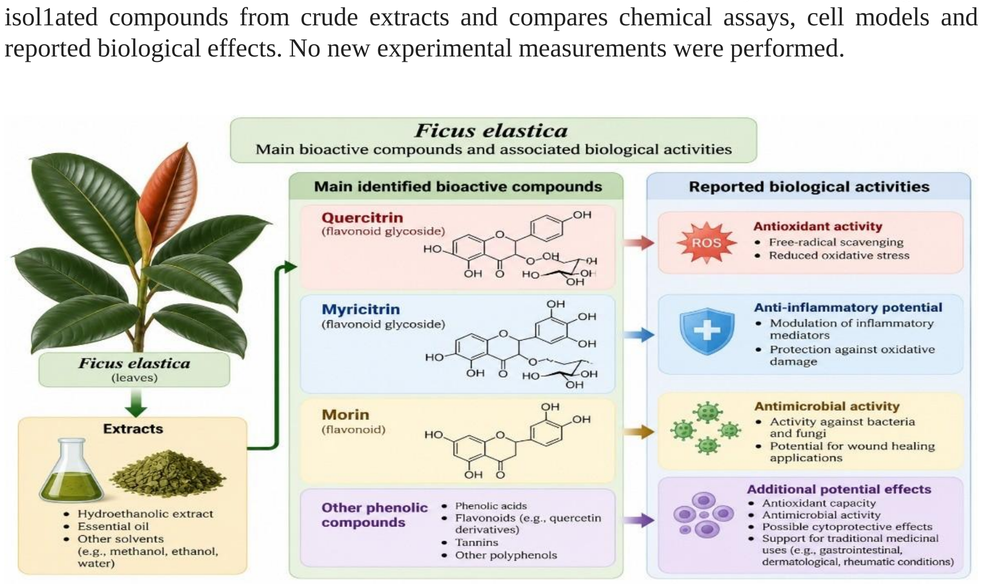


Figure 1. Main bioactive compounds and reported activities. Supplied illustration, based on the literature discussed in the manuscript [1–3]. Effects shown require experimental and clinical validation.

Chemical diversity

Leaves contain flavonoid glycosides and phenolic derivatives. Aerial roots also provide triterpenoids, phytosterols and specialized metabolites. Phenolic acids, glycosides and volatile terpenes contribute to chemical diversity. Compound-level identification should be distinguished from preliminary phytochemical screening [1,3].

Discussions

Polyphenols and antioxidant capacity

Hydroethanolic leaf extract: total phenolics of 13.3299 ± 0.1583 g%, expressed as tannic acid equivalents [4].
Ethanolic leaf extract: IC_{50} = 13.82 µg/mL (DPPH) and 23.29 µg/mL (ABTS) [2].
Methanolic leaf extract: ORAC response equivalent to 4.2 µM Trolox at 5 µg/mL [1].

Values from different extracts and assays are not directly comparable. Chemical antioxidant activity alone does not establish therapeutic efficacy.

Other reported biological activities

Antimicrobial: ficusamide showed MIC = 3 µg/mL against Staphylococcus saprophyticus [5].
Inflammatory signaling: leaf extract reduced TNF-α and increased IL-10 in hypoxia-exposed EA.hy926 cells [6].
Antiproliferative effects occur in selected cell models, but clinical benefit remains unestablished [3].

Table 1. Bioactive compounds reported in Ficus elastica

Identified compound(s)	Plant part	Chemical class	Identification / evidence	Reference
Quercitrin, myricitrin, kaempferin	Leaves	Flavonoid glycosides	Isolation, spectroscopy and literature comparison	Kiem et al., 2012
Morin, rutin, emodin	Leaves	Flavonoids; anthraquinone	Review reports; primary method not established here	Arsyad et al., 2023
Ficuselastic acid, feroxidin	Leaves	Phenolic naphthalene derivatives	MS, 1D/2D NMR and CD	Kiem et al., 2012
Oleanolic acid, ursolic acid	Leaves	Pentacyclic triterpenoids	Isolation and spectroscopic comparison	Kiem et al., 2012
Friedelin, friedelinol, betulinic acid, ursolic acid	Aerial-root bark	Triterpenoids	Reported isolation; primary method needs verification	Arsyad et al., 2023
β-Sitosterol, stigmasterol, sitosterol glucoside	Aerial-root bark	Phytosterols; sterol glycoside	Reported identification; primary method unspecified	Arsyad et al., 2023
β-Caryophyllene, γ-muurolene, camphene	Leaf essential oil	Sesquiterpenes; monoterpene	GC–MS	Attama et al., 2024
Syringin, benzyl glucopyranoside	Leaves	Phenolic glycosides	Isolation, spectroscopy and literature comparison	Kiem et al., 2012
Citroside B, corchoionoside C, roseoside, icariside F2	Leaves	Glycosides	Isolation, spectroscopy and literature comparison	Kiem et al., 2012
Glucopyranosyl abscisate sodium	Leaves	Abscisic acid-derived glycoside	HR-ESI-MS, NMR, CD, hydrolysis and sugar analysis	Kiem et al., 2012
Ficusamide, elasticoside	Aerial-root bark	Sphingolipid-related constituents	Reported isolation; primary method needs verification	Arsyad et al., 2023
Elasticamide, elastiquinone, ficusoside B, biochanin A	Aerial roots / wood	Diverse secondary metabolites	Reported isolation; consult compound-specific primary studies	Arsyad et al., 2023

The leaf essential oil contained 34 GC–MS-identified components, dominated by β-caryophyllene (50.57%), γ-muurolene (8.19%) and camphene (5.69%). At 10 µL/mL, it showed 45.26% DPPH inhibition and 74.90% hydrogen peroxide scavenging. Its volatile profile differs from polar phenolic extracts, and these chemical assays alone do not demonstrate protection in living organisms (Attama et al., 2024).

Chemical composition and antioxidant response

Quercitrin and myricitrin are glycosylated flavonols, whereas morin is an aglycone. Hydroxylation and glycosylation may influence antioxidant performance. Hydroxylated flavonoids can donate hydrogen atoms or electrons and stabilize radicals through resonance. These chemical properties help explain assay responses, but compound-specific intracellular mechanisms require validation [1–3].

In the ORAC study, the aqueous leaf fraction showed 23.4 µM Trolox equivalents, compared with 17.9 µM for ethyl acetate and 5.8 µM for n-hexane fractions. Extraction conditions therefore matter when interpreting antioxidant results [1].

Evidence and research priorities

Evidence remains preclinical. Standardized extracts, bioavailability and long-term safety require further study, including toxicological assessment of latex-associated constituents [3].

Conclusions

F. elastica offers promising antioxidant and antimicrobial lead compounds. Evidence remains preclinical, and mineral contributions are uncertain. Standardized analyses, mechanistic studies and comprehensive toxicological evaluation are essential before pharmaceutical applications [1–4].

Selected references

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