Volume 4, Issue 2
February I 2026

Agri Roots
e- Magazine

www.agrirootsmagazine.in

ISSN: 2583-9071

Biochemical Composition and Bioactive Compounds of Wood Apple (*Limonia acidissima* L.)

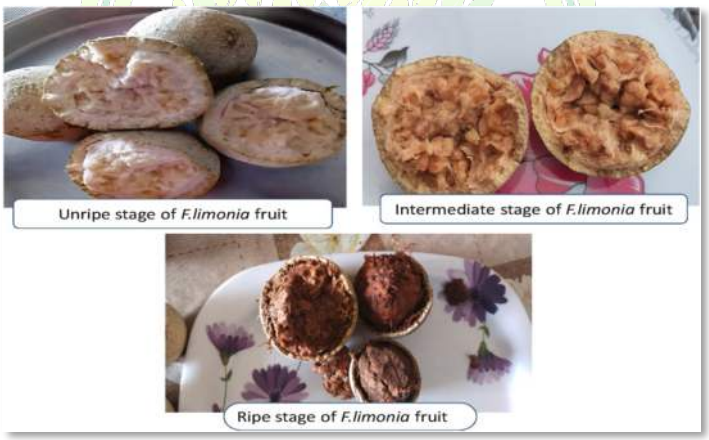
ARTICLE ID: 0334

Priya Pandey[1], R. N. Kewat[2], Garima Dixit[1], Sheetanu Singh[1]

[1]Research Scholar, Acharya Narendra Deva University of Agriculture and Technology, Kumarganj, Ayodhya, India

[2]Professor, Acharya Narendra Deva University of Agriculture and Technology, Kumarganj, Ayodhya, India

Wood apple (*Limonia acidissima* L.; synonym *Feronia limonia*) is a perennial underutilized fruit tree belonging to the family Rutaceae. Native to the Indian subcontinent, it is widely distributed across India, Bangladesh, Sri Lanka, and Southeast Asia. The fruit is traditionally valued for its distinctive flavor and medicinal applications in Ayurveda and other ethnomedicinal systems.



Wood apple is nutritionally rich and possesses considerable antioxidant potential. Various plant parts exhibit curative properties due to the presence of proteins, carbohydrates, dietary fiber, calcium, phosphorus, and diverse phytochemicals. Fruit composition varies with genotype, environmental conditions, soil type, and maturity stage. In India, fruits mature during October–November, with ripening extending from January to June.

The pulp contains substantial amounts of polyphenols, tannins, vitamins, amino acids, and flavonoids, contributing to health benefits such as reduced risks of cardiovascular diseases, cancer, and diabetes. Recent scientific investigations have focused on validating these traditional claims through biochemical and phytochemical analyses.

Botanical Description and Uses

Limonia acidissima is a medium-to-large deciduous tree characterized by rough bark and thorny branches. The fruit possesses a hard woody shell enclosing sticky brown pulp with embedded seeds.

The pulp is consumed fresh or processed into beverages, jams, sweets, and traditional remedies. Fruits, leaves, bark, and seeds are extensively used in herbal medicine due to their rich phytochemical profile and bioactivity.

Proximate and Nutritional Composition

Macronutrients

Proximate analysis of wood apple pulp reveals:

- **Carbohydrates:** ~24.74% (dry weight)
- **Proteins:** ~9.30%
- **Fat:** ~0.99%
- **Crude Fiber:** ~3.32%
- **Ash:** ~2.73%

Fresh pulp contains approximately 79% moisture, with protein (8.3–8.35%), fat (1–2%), and total sugars (~6.4%). These values vary with maturity and growing conditions.

Sugars and Organic Acids

Chromatographic studies have identified:

- **Major Sugars:** Fructose (~16.40%) and glucose (~14.23%)
- **Organic Acids:** D-tartaric, citric, and ascorbic acids
- **Vitamin C:** Approximately 2.55 mg/g in certain varieties

These compounds contribute to the characteristic sweet–sour taste of the fruit.

Mineral Content

Wood apple pulp contains essential minerals including:

- **Calcium and Phosphorus:** Important for bone health
- **Iron:** Supports hematopoiesis
- **Potassium, Magnesium, And Zinc:** Maintain electrolyte balance and enzymatic functions

The potassium–sodium ratio suggests potential benefits for blood pressure regulation.

Fatty Acid Profile

Although total lipid content is low, nutritionally valuable fatty acids are present:

- **Saturated:** Palmitic and stearic acids
- **Unsaturated:** Oleic (~23.89%), α-linolenic (~16.55%), and linoleic (~10.02%)

These unsaturated fatty acids contribute to cardiovascular and anti-inflammatory benefits.

Bioactive Phytochemicals

Wood apple contains diverse secondary metabolites responsible for its pharmacological properties.

Phenolic Compounds and Flavonoids

- High total phenolic content
- Presence of quercetin and related flavonoids
- Strong correlation with antioxidant activity

Coumarins

Compounds such as psoralen and umbelliferone exhibit antimicrobial and dermatological bioactivities.

Alkaloids, Tannins, and Steroids

Phytochemical screening confirms the presence of:

- Alkaloids
- Tannins
- Steroids and terpenoids
- Saponins

These constituents contribute to antimicrobial, antidiarrheal, and metabolic effects.

Other Bioactive Classes

Additional compounds include quinones, lignans, triterpenoids, and essential oils, indicating broad chemical diversity.

Functional Properties and Bioactivities

Antioxidant Activity

Phenolics and flavonoids provide strong free-radical scavenging capacity, reducing oxidative stress.

Antimicrobial and Antidiabetic Effects

Traditional applications and experimental studies suggest antimicrobial and antidiabetic potential arising from synergistic phytochemical interactions.

Pharmacological Activities of *Limonia acidissima*

- **Anti-inflammatory:** Helps reduce cardiovascular risk and enhances immunity
- **Anti-ulcer:** Phenolic compounds protect gastric mucosa and reduce leukocyte infiltration
- **Ayurvedic formulations containing Kapitha (Wood Apple):**
  - *Vajra Kapat Rasa* – diarrhea and malabsorption
  - *Nyagrodhadi Choorna* – urinary disorders and diabetes
  - *Dashamoolarishta* – anemia, postpartum care, cold, cough, and digestive disorders

Conclusion

Limonia acidissima exhibits a rich biochemical composition comprising carbohydrates, proteins, minerals, unsaturated fatty acids, vitamins, and diverse bioactive phytochemicals. Phenolics, flavonoids, coumarins, alkaloids, and terpenoids contribute to its antioxidant, antimicrobial, anti-inflammatory, and gastroprotective properties.

These nutritional and pharmacological attributes validate traditional uses and highlight the fruit's potential for incorporation into functional foods, nutraceuticals, and herbal formulations. Further clinical investigations are required to establish therapeutic efficacy and safety in humans.

References

1. Karunanithi, A., & Venkatachalam, S. (2019). Optimization of ultrasound-assisted extraction of phenolic compounds from wood apple pulp: Identification of phytochemicals using GC-MS. *Chemical Industry and Chemical Engineering Quarterly*, 25(4), 361–368.
2. Lamani, S., Anu-Appaiah, K. A., Murthy, H. N., Dewir, Y. H., & Rikisahedew, J. J. (2022). Analysis of free sugars, organic acids, and fatty acids of wood apple (*Limonia acidissima* L.) fruit pulp. *Horticulturae*, 8(1), 67.
3. Srivastava, R., Mishra, N., Tripathi, S., Fatima, N. T., & Mishra, N. (2025). Influence of fruit stages on chemical compositions, phytochemicals, and antioxidant activity of wood apple (*Feronia limonia* (L.) Swingle). *Heliyon*, 11(3).
4. Wakchoure, S. M., Raut, P. G., Jadhav, S. N., Kinikar, D., & Dhangar, H. Multipotential traditional plant wood apple (*Limonia acidissima*): A review.