

UNDERUTILIZED FRUITS OF THE WESTERN GHATS: BIODIVERSITY, NUTRITIONAL POTENTIAL, AND DEVELOPMENT OPPORTUNITIES

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ABSTRACT



*The Western Ghats of India harbour diverse wild and underutilized fruit species with considerable nutritional, ecological and socioeconomic value. Fruits such as kokum (*Garcinia indica*), lasora (*Cordia dichotoma*), karanda (*Carissa spinarum*) and chironji (*Buchanania cochinchinensis*) offer opportunities for dietary diversification, value addition and rural livelihood development. However, habitat degradation, unsustainable harvesting, limited domestication and weak market linkages constrain their utilization. Integrating in situ conservation, cultivation, nutritional research and community-based processing could enhance biodiversity conservation, nutritional security and sustainable livelihoods in the region.*

KEYWORDS: Biodiversity conservation, Indigenous fruits, Nutritional security, Rural livelihoods, Value addition, Western Ghats

INTRODUCTION

The Western Ghats, extending approximately 1,600 km along India's western coast, represent one of the world's major centres of biological diversity and are recognized as a global biodiversity hotspot. Their varied topography, rainfall patterns and climatic conditions support diverse forest ecosystems and numerous plant species, including taxa of considerable nutritional, medicinal and economic importance. Among these resources, wild and underutilized fruits constitute an important but insufficiently developed component of regional plant diversity.

Species such as *Garcinia indica* (kokum), *Syzygium jambos* (rose apple), *Buchanania cochinchinensis* (chironji), *Carissa spinarum* and *Cordia dichotoma* have traditional uses as foods, ingredients in processed products and, in some communities, components of traditional medicine. Depending on the species and growing conditions, their fruits may provide vitamins, minerals, dietary fibre, oils and other bioactive compounds. Many are adapted to local environments and may offer opportunities for diversified production, agroforestry and climate-resilient livelihood systems.

Despite their potential, many underutilized fruits remain neglected in mainstream agricultural research, commercial horticulture and formal food markets. Habitat degradation, changes in land use, unsustainable harvesting, limited planting material, inadequate post-harvest infrastructure and insufficient market development can restrict their conservation and utilization. Furthermore, a lack of standardized information on their nutritional composition, cultivation requirements, safety and processing characteristics limits their wider adoption.

Promoting these species requires an integrated approach that combines biodiversity conservation with scientific evaluation, sustainable harvesting, domestication and community participation. This article examines the nutritional and ecological importance of selected underutilized fruits of the Western Ghats and discusses opportunities for their conservation, value addition and sustainable commercialization.

IMPORTANCE OF WILD AND UNDERUTILIZED FRUITS

- 1. Nutritional and dietary importance:** Wild and underutilized fruits can supplement diets dominated by staple cereals and other energy-rich foods. Depending on the species, they provide micronutrients, dietary fibre, natural sugars, organic acids and phytochemicals. Some fruits and kernels may also contribute useful quantities of oils and proteins. Their nutritional composition, however, varies with genotype, maturity, growing environment, processing and storage conditions. The inclusion of locally available fruits in household diets can improve dietary diversity, particularly in remote rural and forest-dependent communities where access to a wide range of fresh produce may be seasonal or limited. Encouraging their consumption alongside established horticultural crops may also help preserve traditional food practices and local knowledge.
- 2. Livelihood and economic importance:** Wild fruits provide supplementary food and income to some forest-dependent households. They may be sold fresh in local markets or processed into pickles, jams, juices, syrups and other products. For example, *Cordia dichotoma* fruits are traditionally used in pickles, while fruits of *Carissa spinarum* can be processed into jams and other preserved products. Kernels of *Buchanania cochinchinensis* are commercially valued as chironji, and kokum (*Garcinia indica*) is used in regional food preparations and processed products. Developing appropriate harvesting, grading, processing and marketing systems could increase the value retained by local collectors and small-scale producers. Such initiatives should ensure fair returns to communities and avoid encouraging excessive extraction from wild populations.
- 3. Ecological importance:** Wild fruit-bearing trees and shrubs contribute to forest biodiversity and provide food and habitat for wildlife. When incorporated into suitable agroforestry systems, they may diversify farm production, provide shade, contribute organic matter and support beneficial organisms.

Their roots and canopy can also contribute to soil protection and microclimate regulation, although the magnitude of these benefits depends on species characteristics and management. Where ecologically appropriate, integrating native fruit species into farm boundaries, home gardens and degraded agricultural landscapes can support landscape diversification. Restoration efforts should prioritize locally native species and suitable planting sites rather than introducing species indiscriminately into natural habitats.

4. **Nutraceutical and food-processing potential:** Several underutilized fruits contain phenolic compounds, carotenoids, vitamin C and other constituents of interest to food scientists. These characteristics provide opportunities for developing fruit-based beverages, concentrates, powders, natural ingredients and other value-added products. Nevertheless, the presence of bioactive compounds does not by itself establish a health benefit. Nutritional composition, bioavailability, processing stability, antinutritional factors and food safety must be evaluated before specific health claims are made. Scientific validation and appropriate regulatory compliance are therefore essential for developing credible nutraceutical products.

SELECTED UNDERUTILIZED FRUIT SPECIES OF THE WESTERN GHATS

The following species illustrate the diversity of wild and underutilized fruits associated with the Western Ghats and adjoining landscapes. Their distribution, local names, seasonal availability and reported uses can vary among locations. Species-specific nutritional figures and medicinal claims should be confirmed using primary research before being used in commercial or scientific communications.

1. ***Elaeagnus kologa* — Kolungai:** *Elaeagnus kologa* is reported from parts of the Nilgiri region and is associated with local wild-fruit use. Its edible fruits may provide opportunities for dietary diversification and local marketing. However, information on its nutritional composition, reproductive biology, propagation and cultivation remains limited compared with that available for established fruit crops. Where wild populations face pressure from harvesting or habitat change, conservation should begin with verification of species identity, population status and habitat requirements. Propagation trials, seed-germination studies and evaluation of suitable cultivation methods could help determine whether the species is a candidate for home gardens or other appropriate cultivation systems.
2. ***Cordia dichotoma* — Lasora or Lasoda:** *Cordia dichotoma* is a small to medium-sized tree found in several parts of India, including suitable habitats within the broader Western Ghats region. Its fleshy fruits are consumed at different stages of maturity and are widely used in traditional pickling. The fruits contain polysaccharides and other constituents of interest for food and phytochemical research.

The species also has a history of use in traditional medicinal preparations, including formulations associated with cough remedies. These traditional applications should be distinguished from clinically demonstrated therapeutic effects. Its potential for home gardens, farm boundaries and small-scale processing makes it relevant to livelihood diversification. Research on fruit quality, processing methods, shelf life and standardized planting material could improve its commercial prospects.

3. ***Canthium parviflorum*** — **Locally known as Kaduk or Karanda in some areas:** *Canthium parviflorum* is a shrub associated with dry and other seasonally suitable habitats. Its small fruits are reported as edible in some local food traditions, and ethnobotanical accounts describe its use in traditional remedies. The species may have potential for documenting indigenous food knowledge and investigating plant-derived bioactive compounds. However, claims that its fruits are among the richest sources of β -carotene, or that they contain a particular concentration of this compound, require confirmation from a traceable analytical study. Any reported value should specify the analytical method and whether the result is expressed on a fresh-weight or dry-weight basis. Further research could examine fruit acceptability, nutritional composition, propagation and the sustainability of harvesting. Local names and reported uses should be documented with reference to the specific communities and locations in which they occur.
4. ***Carissa spinarum*** — **Karanda or Cherumully:** *Carissa spinarum* is a thorny shrub found in various habitats across South Asia and other regions. Its fruits are consumed locally in some areas and may be suitable for preparing preserves, jams, syrups and other processed foods. The nutritional and phytochemical composition of the fruits merits further investigation, particularly regarding vitamin C, minerals and phenolic compounds. However, the composition of *C. spinarum* should not be inferred directly from studies of related species, including *Carissa carandas*, because different species may vary substantially in their chemical characteristics. The shrub may be useful in selected farm-boundary or agroforestry systems, subject to local ecological suitability and management requirements. Research on fruit quality, consumer acceptance, processing performance and safe utilization could help establish its potential as a supplementary fruit crop.
5. ***Buchanania cochinchinensis*** — **Chironji:** *Buchanania cochinchinensis*, commonly known as chironji, is a deciduous tree valued for its edible kernels. The kernels are used in food preparations and are commercially important in some regional markets. They contain substantial amounts of oil and protein, although reported concentrations vary according to the source material and analytical basis. The species offers opportunities for combining forest-resource management with the development of higher-value food products. However, commercial harvesting should be balanced

with natural regeneration and the long-term maintenance of wild populations. Harvesting practices that damage trees or reduce regeneration can undermine future supplies. Potential development activities include improving seed collection, nursery propagation, planting-material availability, kernel processing and storage. Community-based enterprises could also explore quality grading and traceable sourcing to improve market returns.

6. ***Elaeocarpus tectorius* — Bikki Palzam:** *Elaeocarpus tectorius* is a tree reported from tropical forest habitats in parts of South and Southeast Asia. Its fruits are used as food by wildlife and, in some locations, by local communities. The species may therefore be relevant to both forest ecology and the documentation of traditional food resources. Claims concerning exceptionally high carotenoid concentrations or specific medicinal effects require confirmation from reliable species-specific studies. In particular, numerical values for carotenoids should be checked carefully to distinguish total carotenoids from individual compounds and to establish the correct reporting units. Conservation and research priorities include documenting its distribution, assessing the status of wild populations, understanding fruiting and regeneration patterns, and evaluating propagation methods. Any future utilization should be based on verified identification, sustainable collection and evidence of food safety.
7. **Other fruit resources:** Other species associated with wild-fruit use in the Western Ghats and surrounding regions include *Flacourtia indica* (governor's plum), *Diospyros* species, *Garcinia* species and selected wild *Prunus* species. Their distribution and suitability for consumption or cultivation must be assessed individually rather than assumed from the characteristics of related species. Collectively, these resources may contribute to seasonal dietary diversity, local food traditions and livelihood opportunities. However, their successful development depends on reliable identification, sustainable harvesting, adequate nutritional data and appropriate post-harvest handling.

4. CONSERVATION AND DEVELOPMENT STRATEGIES

The conservation and sustainable utilization of underutilized fruits require coordinated action across ecological, agricultural, nutritional and socioeconomic domains. The following strategies address the principal constraints identified above.

1. ***In situ conservation and habitat restoration:*** Protecting wild populations within their natural habitats is essential for maintaining genetic diversity and ecological relationships. Conservation measures should include habitat protection, monitoring of population regeneration and the identification of areas where harvesting pressure is excessive. Where appropriate, native fruit-bearing species can be

incorporated into restoration projects and farm boundaries. Such interventions should be based on verified distribution records and local ecological conditions. Species should not be introduced into natural habitats outside their native ranges simply because they have commercial potential.

2. *Domestication and cultivation:* Domestication can reduce dependence on wild collection while providing farmers with additional production options. Priority species should be selected according to local suitability, consumer demand, nutritional potential, ease of propagation and conservation status. Research and extension programs should support the development of quality planting material, nursery techniques, propagation protocols and suitable cultivation practices. Home gardens, mixed agroforestry systems and farm boundaries may provide opportunities for selected species, depending on their growth requirements and compatibility with existing land uses. Farmer Producer Organizations and community groups could help coordinate planting-material production, cultivation demonstrations and collective marketing. Domestication should complement, rather than replace, the protection of genetically diverse wild populations.
3. *Value addition and post-harvest management:* Seasonality and perishability can limit the market value of wild fruits. Small-scale processing facilities could help address these constraints through the production of juices, jams, pickles, dried products, concentrates and other locally appropriate foods. For example, kokum can be developed into suitable processed food products, while chironji kernels can be graded and processed for food markets. The choice of product should be based on the properties of the raw material, local demand and the technical and economic feasibility of processing. Training in hygienic processing, packaging, storage and quality control is essential. Community processing units should also have access to appropriate equipment, reliable raw-material supplies and information on food-safety requirements.
4. *Market linkages and equitable benefit sharing:* Weak market connections, inconsistent product quality and limited transport infrastructure can restrict income opportunities for fruit collectors and small producers. Producer cooperatives, transparent purchasing arrangements and partnerships with food processors may improve market access. Improved grading, packaging, traceability and information about product origin could help establish niche markets for selected fruits. However, claims about premium prices, export potential or growing consumer demand should be supported by market assessments rather than assumed. Policies supporting local enterprises, sustainable harvesting and small-scale processing can strengthen value chains. Benefit-sharing arrangements should recognize the contributions of indigenous and local communities, particularly where traditional knowledge and locally conserved genetic resources support product development.

5. *Research, propagation and quality assessment:* Research is needed to identify promising species and genotypes, improve propagation, characterize fruit composition and establish suitable post-harvest practices. Priority areas include:

- Taxonomic identification and documentation of distribution.
- Assessment of wild population status and regeneration.
- Evaluation of fruit yield, quality and seasonal availability.
- Analysis of nutritional composition, antinutritional factors and food safety.
- Development of propagation, nursery and cultivation protocols.
- Assessment of processing performance, shelf life and consumer acceptance.
- Economic analysis of cultivation, collection and value-added products.
- Nutritional and medicinal claims should be supported by appropriate analytical and experimental evidence. Studies should distinguish preliminary laboratory findings from evidence of benefits in humans.

6. *Documentation of indigenous knowledge:* Local and indigenous communities hold valuable knowledge about fruit collection, preparation, storage and traditional uses. Documenting this knowledge can support biodiversity conservation and the preservation of regional food cultures. Such documentation should be conducted with community participation, informed consent and appropriate recognition of knowledge holders. Where traditional knowledge contributes to commercial development, benefit-sharing and relevant legal requirements should be addressed. Extension programs can help communicate safe preparation methods, promote suitable traditional recipes and encourage sustainable harvesting. Knowledge documentation should complement scientific evaluation rather than substitute for nutritional, safety or clinical evidence.

5. CHALLENGES AND FUTURE OPPORTUNITIES

Despite their potential, underutilized fruits face several interconnected challenges. These include habitat loss, uncertain availability of planting material, inadequate information on cultivation requirements, limited nutritional characterization, short shelf life and weak market infrastructure. In some cases, overharvesting may threaten natural regeneration, while low and irregular production can make commercial processing difficult.

Future initiatives should prioritize species for which conservation needs, nutritional value and livelihood opportunities can be demonstrated. Participatory research involving local communities, agricultural

universities, forestry institutions, food scientists and rural enterprises can help establish practical development models.

Climate-resilient production systems and diversified agroforestry may provide suitable settings for selected species, but claims of drought tolerance or climate resilience should be supported by species-specific evidence. Similarly, the development of nutraceutical products and export markets should follow scientific validation, food-safety assessment and realistic economic analysis.

Monitoring should assess not only income and product sales but also changes in wild populations, regeneration, harvesting pressure and the distribution of benefits among stakeholders. This would help ensure that commercial development contributes to long-term conservation rather than increasing pressure on vulnerable resources.

6. CONCLUSION

Underutilized fruits of the Western Ghats represent valuable biological resources with potential contributions to dietary diversity, rural livelihoods, agroforestry and biodiversity conservation. Species such as *Cordia dichotoma*, *Carissa spinarum* and *Buchanania cochinchinensis* illustrate opportunities for linking traditional food use with scientific research and value addition. Nevertheless, their potential should not be overstated without reliable evidence on nutritional composition, food safety, cultivation and market demand. A coordinated strategy combining in situ conservation, domestication, sustainable harvesting, post-harvest processing and equitable market development is essential. Research institutions, government agencies, local communities and private enterprises should work together to improve species identification, develop suitable planting material, validate nutritional claims and strengthen community-based value chains. With evidence-based management and appropriate safeguards, underutilized fruits can contribute to the conservation of the Western Ghats' biological heritage while supporting more diverse and sustainable rural livelihoods.

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