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Karonda: A Multipurpose Underutilized Fruit Crop with Industrial and Nutraceutical Potential

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Introduction:

Karonda (*Carissa carandas*) is a thorny evergreen shrub bearing clusters of small, ellipsoid berries that ripen from pale green through pink to deep purple-black. The ripe fruits are rich in dietary fiber, vitamin C, iron and other minerals. Their deep color comes from high anthocyanin content, giving strong antioxidant properties and making them useful natural colorants in food and pharma applications.

Nutritional and Medicinal Benefits: Karonda berries supply vitamin C, vitamin A, calcium, phosphorus and iron. In Ayurvedic tradition, the fruits are valued as antiascorbutic (for scurvy) and remedies for anemia, biliousness, stomach pain, indigestion, constipation and anorexia. Leaf and root extracts are used for fever, diarrhea, earaches and as stomachics or vermifuges. Modern studies confirm many benefits: karonda extracts show adaptogenic, antidiabetic, anti-cancer, anti-diarrheal and hepatoprotective activities.

Culinary Uses: In cuisine, unripe (green) karonda berries are most often used in pickles, relishes and chutneys, while fully ripe (red–purple) fruits are cooked into sweets and preserves. The fruit's natural pectin content makes it ideal for jams and jellies. A common preparation is *karonda murabba* (candied karonda): halved berries are boiled with sugar to make a sweet preserve. Ripe berries also flavor syrups, squashes and chutneys. In some regions they are used fresh (for sweeter cultivars) or even dried. In Western-style cooking, the tart red-purple fruits have been used as "faux cherries" (candied for cakes, tarts or puddings).

Industrial Uses: Karonda is valued in agro-industry and landscaping. Its dense, thorny growth makes it ideal for living hedges or fences. The wood (hard and insect-resistant) is used for spoons and small utensils, and the roots produce insect-repellent compounds. In food and pharmaceutical industries, the berry anthocyanins (mainly cyanidin-glycosides) are explored as natural colorants and in smart packaging applications. (Note: karonda

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contains cardiac glycosides in leaves/roots and should be used with care.)

Value-Added Products: The fruits are processed into a wide range of products. Worldwide, commercial jam, jelly, squash (fruit concentrate), syrup and chutney from karonda are sold Immature berries are pickled or cured into *achaar*, while ripe berries make jams, juices, candies and sherbets. Fermented products are also possible: research protocols exist for karonda wine (low-alcohol fermented drink) and bottled juice drinks.

Cultivation

Ideal Climate and Soil Conditions

Karonda thrives in warm, arid to semi-arid climates. It grows best in tropical and subtropical zones with high temperatures and low humidity. The plant is **highly heat-tolerant** (optimal 20–35 °C) but **suffers in cold** – frost or prolonged cold and heavy rainfall/waterlogging are detrimental. It tolerates drought and even saline/sodic soils once established, provided drainage is good.

Condition	Requirement
Climate	Tropical/subtropical; hot (20–35 °C); intolerant of frost or prolonged rain
Soil pH	5.0–8.0 (broadly adaptable)
Soil type	Light sandy-loam or alluvial; good drainage; tolerates saline/sodic soils
Rainfall	Low to moderate; waterlogged or waterlogged conditions are harmful

Soil: Karonda adapts to a wide range (sandy loam, laterite, alluvium) but prefers light, well-drained soils. The optimal soil pH is about **5.0–8.0**, though it will grow across that range. Heavy clay or poorly drained soils yield very poor growth.

Propagation Methods

Karonda can be propagated sexually or vegetatively. The main methods are:

- **Seeds:** Collect mature fruits and sow the seeds at the start of the monsoon (June–July). Seed germination requires warm, moist conditions and seedlings emerge in ~3–5 weeks. Seedling plants are usually grown in nursery bags and transplanted after ~8–10 months. Seed-grown plants typically begin bearing fruit 2–3 years after planting. (Note: seedlings show wide variability in fruit size/color.)
- **Cuttings:** Semi-hardwood stem cuttings (~25–30 cm long) can be taken in early monsoon (June–July). Under proper humid conditions, rooting success is moderate (roughly 30–40% reported). Cuttings can produce true-to-type plants, useful for preserving special varieties.
- **Air-layering:**In June–July, branches can be girdled and wrapped with moist soil/moss (air layers). Rooting takes ~3 months, with success rates of 30–60%.

The rooted layers are cut and transplanted after ~6–7 months of rooting.

- **Budding/Grafting:** Budding (e.g. shield budding in spring) or inarching can be used to propagate named varieties on rootstocks. These methods ensure uniform cultivar traits.

The following table summarizes propagation options:

Method	Season/Notes
Seed sowing	Sow ripe seeds in nursery at monsoon onset (Aug–Sept). Seedlings transplant in ~8–10 mo. Fruit in 2–3 yr.
Cuttings	Semi-hardwood cuttings (25–30 cm) in June–July; rooting ~30–40%.
Air-layering	Performed during wet season (June–July); roots form in ~3 mo, success ~30–60%
Budding/Grafting	Budding or inarching in spring/summer to multiply elite clones

Varities: Karonda (Carissa carandas) varieties can be broadly categorized into pickle types and table-use types based on fruit size and suitability for different purposes. Pant Manohar, Pant Sudarshan, and Pant Suvarna are commonly recognized as pickle varieties, while Konkan Bold, CHES K-II-7, and CHES K-35 are known for their larger size and suitability for fresh consumption.

Pickle Type Varieties:

- **Pant Manohar:**Developed at GB Pant University of Agriculture and Technology, this variety produces dense, medium-sized bushes with pink-blushed fruits.
- **Pant Sudarshan:**Also developed at GB Pant University, this variety has pink-blushed fruits that turn dark brown when ripe.
- **Pant Suvarna:**Another variety from GB Pant University, known for its pink-blushed fruits.

Table-Use Varieties:

- **Konkan Bold:**This variety is known for its larger fruit size, making it suitable for fresh consumption.
- **CHES K-II-7:**Similar to Konkan Bold, this variety is also known for its larger size and suitability for eating fresh.
- **CHES K-35:**This variety shares the characteristics of larger fruit size and suitability for fresh consumption with Konkan Bold and CHES K-II-7

Planting Season and Spacing

Plants are typically established with the onset of rains. In India, nursery seedlings or cuttings are planted in June–July. Seed-raised plants can start flowering by the 2nd year, with full cropping by year 3. Karonda grows into a multi-stemmed shrub 2–5 m tall.

For spacing, thin planting is acceptable for hedges, denser for fruit production. A recommended spacing is **2 m × 2 m** for orchards (≈2,500 plants/ha). For living fences or boundary plantings, a spacing of **1–1.5 m** apart is used. (≈300–400 plants per ha along a boundary). In home gardens, 1.5–2 m spacing ensures good air circulation.

Irrigation and Fertilization

Karonda is drought-hardy: once established, it rarely needs irrigation. . Young plants require more moisture: irrigate newly planted shrubs every 10–15 days in cool/dry seasons and every 6–7 days in hot/dry weather.. Traditional watering is by basin/flood, but drip irrigation greatly improves efficiency and growth. Mulching with dry leaves around the base helps conserve soil moisture. In older orchards (3+ years), irrigation is seldom applied except to enlarge fruits in drought conditions.

Fertilizer requirements are modest. Annual manuring (10–15 kg well-rotted farmyard manure or compost per plant) before flowering is recommended. In nutrient-poor soils or for high yields, apply balanced NPK: one-year-old plants may receive ~5 kg FYM + 100 g of an N:P:K blend, while mature plants (4+ years) may get ~15–20 kg FYM + 400 g NPK per year.. A typical practice is to fertigate or top-dress with compost in June–July (pre-flowering). Overall, karonda's response to fertilizer is mild, and excessive NPK can be wasteful; organic manure is particularly beneficial.

Pest and Disease Management

Karonda is generally resistant but has some key pests/diseases.

Anthracnose (a fungal spot on leaves and fruit) is the main disease; it causes dark lesions and fruit rot during wet weather. Control by good orchard sanitation (burn or bury fallen debris) and copper-based fungicide sprays early in the season.

Fruit flies can infest ripe berries: management includes sanitation (collecting/destroying fallen fruit) and traps. For example, methyl eugenol traps (4–6 traps/acre) and bait sprays (protein + insecticide such as spinosad or decamethrin) reduce fly populations. Minor pests include leaf-eating caterpillars and sap-suckers (aphids, mealybugs). These can be controlled with standard pesticides or organic options (neem oil, Bt sprays). Good airflow (through proper spacing and pruning) and field hygiene help prevent most problems

Regular pruning of shoots and suckers improves air circulation and harvest efficiency. After harvest, removing old decayed wood and fallen leaves can break pest cycles. No serious viral or bacterial diseases are known on karonda in cultivation, but general orchard hygiene is advised.

Yield Expectations per Plant/Acre

Karonda yields are modest but steady once established. A mature shrub typically produces **2–5 kg** of fruit per year under rainfed conditions. High-yielding selections and improved cultivars far exceed this: experimental varieties (Pant Sudarshan, Pant Manohar, etc.) have yielded **20–30 kg per plant** in India.Empirical data suggest ~4–5 kg is common for average plants, whereas select clones can reach 10–15 kg each.

On a per-hectare basis, with ~2,000–2,500 trees/ha (2×2 m spacing), this corresponds to roughly 5–12 tonnes of fruit per hectare annually under good management. In well-managed rainfed orchards, yields of **8–12 t/ha**are attainable (10–15 t/ha with irrigation and elite varieties). In low-input conditions (wild or hedgerow planting), yields are lower (a few tonnes/ha). Harvest normally begins in the 2nd–3rd year after planting and continues for many years; trees can remain productive for 15–20 years or more if pruned and renewed.

Processing

Harvesting Stage and Methods

Karonda fruits mature over a span of weeks. In northern India, flowering occurs in March–April and fruits ripen in July–September an the Western Ghats (Maharashtra/Konkan), flowering is Dec–Mar with fruit in April–June]. Each plant is harvested several times (2–4 pickings) as berries turn color. Maturity is judged by color change (green→pink→red/purple) and slight softening.

Harvesting is done **by hand**. It is customary to pick berries with their pedicel (stem) attached or to cut small fruiting branches. This helps minimize oozing of the white latex sap (which can bitter neighboring fruits). Ripe fruits are fragile and should be handled gently. Immediately after harvest, fruits are quickly placed in baskets or trays in the shade. Sorting is done to remove malformed or overripe berries. *Green or just-colored berries* are ideal for pickling; *fully soft (deep red/purple) berries* are used for jams, syrups and processing. In some practices, berries are left on short stems and transported in shallow baskets to keep them cool and prevent crushing.

Post-Harvest Handling

Post-harvest, fruits are graded and destemmed. Karonda berries are **perishable**. Mature firm fruits can be kept ~3–7 days at ambient (30–35 °C) room temperature, but fully soft ripe berries last only about **2–3 days.** Refrigeration (5–7 °C) extends life to ~10–14 days for mature fruit. To inhibit decay, some processors treat berries with 2000 ppm sulfur dioxide (SO_2) – this can preserve mature fruit for up to 6 months. However, such treatment is

mainly done on a commercial scale for shipping.

Before processing, it's important to wash the fruits and drain off excess water. Removing any latex residue (by a quick soak or air-drying cut stems) prevents off-flavors. For pickling, fruits are often lightly salted and blanched to remove latex. Overall, karonda is best processed (pickled, jammed, juiced) soon after harvest. Unprocessed ripe berries begin to ferment or spoil rapidly in heat.

Value-Added Product Techniques

Karonda fruits are processed much like other small fruits. Common value-added products and their methods include:

- **Jam & Jelly:** Berries are washed, halved (seeds usually removed for smooth jam), and boiled with sugar. A typical recipe is roughly **1:1 fruit to sugar by weight**. The mixture is heated until reaching a jelly stage. High pectin ensures setting. Modern processing often uses a flow-sheet: crush fruit, heat to ~80 °C, strain out skins/seeds, add sugar, boil, then hot-fill into sterilized jars. No artificial pectin is needed thanks to natural gelling. Jam may be plain or spiced (e.g. with cardamom).
- **Pickles (Achar):** Immature green berries are prepared as pickles. The procedure (traditional or commercial) involves washing and possibly blanching the fruits, then mixing with salt and spices. A common method: slit or crush the berries and mix with salt (10–15% w/w) and spices such as fenugreek, cumin, mustard seed, turmeric, and dried chilies. The spiced berries are layered in jars, often with mustard oil or vinegar, and left to ferment in the sun for 3–7 days. After fermentation, the pickle is sealed in sterilized jars (or jars can be bottled with oil/vinegar cover). Some recipes call for pre-frying the spices in oil before mixing. Flow chart (example): **Wash → Crush/score fruit → Mix with salt & spices → Pack in airtight jars → Sun-ferment 4–7 days → Bottle.** Pickles are shelf-stable due to the salt, vinegar/oil, and cooking.
- **Squash & Syrup:** Ripe berries are crushed and sieved to extract juice. The juice is then diluted or concentrated with sugar. For **squash** (drink concentrate), juices are typically diluted to 1:1 or 1:2 (fruit:water) and sugar added to ~50–60°Brix before heating. The blend is boiled briefly, cooled, and bottled]. Ascorbic acid or citric acid is often added to preserve color/vitamin C. For **syrup**, the process is similar but with higher sugar content

so it can be used undiluted as a dessert topping. Pasteurization (82–85 °C) and proper bottling ensure shelf stability].

- **Juices:** Fresh ripe berries can be fully crushed (with pectinase enzyme to clarify) and filtered. The clear juice is pasteurized and bottled as a refreshing drink. Alternately, blended drink products mix karonda juice with other fruit juices.
- **Fermented Beverages (Wine/Cider):** Experimental fermentations have been done. The general process is: crush the berries to pulp → enzymatic (pectinase) treatment → adjust soluble solids (~23°Brix) and acidity → inoculate with wine yeast (Saccharomyces cerevisiae) → ferment at ~28 °C for 8–10 days. After fermentation, the wine is clarified (bentonite) and stabilized (heated or sulfited) before bottling. The result is a low-alcohol wine (around 4–6% ABV) with karonda flavor. (A similar process can make a sparkling cider-like beverage from partially ripe berries.)
- **Candy (Murabba):** This traditional sweet is made by cooking whole or halved ripe berries in thick sugar syrup (often spiced with cloves or cardamom) until they are translucent. The soft candied fruit may be coated in sugar. Karonda murabba is popular in some Indian cuisines, served like candied cherries.
- **Dried Fruit:** Ripe karondas can be sun-dried or dehydrated into chewy snacks. Pre-treatment (blanching in syrup or dipping in a pectin bath) helps preserve color and speed drying. Dried berries keep for many months and can be rehydrated in cooking.

Overall, processing follows standard fruit preservation techniques. The high pectin and vitamin C of the fruit are advantages: jams gel well naturally, and products are nutritionally fortifying.

Preservation and Storage

Karonda products, once prepared, are fairly shelf-stable if canned properly. **Fresh fruit storage:** Unprocessed mature berries can last about **1 week**at room temperature (cool, dry conditions). Fully ripe (soft) berries have a very short shelf-life (2–3 days) and are best processed immediately. Refrigeration (5–7 °C) extends freshness to 10–14 days for firm berries. For long-term raw fruit storage, dipping berries in 2,000 ppm SO_2 (or packaging under SO_2 pads) can preserve them for **6 months.**, though this is mainly used by commercial packers.

Pickles and jams: Properly canned pickles, jams, squashes and juices can last months to years. (Sugar jams are high-acid

preserves and are self-sterilizing if boiled and sealed correctly.) Commercial jam and squash, once jarred and pasteurized, keep 1–2 years at ambient temperature. Pickles in oil/vinegar keep well over a year.

Chutneys and ketchup: Bottled chutneys or ketchups (with vinegar/sugar) last ~6–12 months refrigerated after opening. Dried karonda can last 1–2 years in sealed packs.

Wine/beer: Fermented karonda drinks should be bottled under anaerobic conditions; once pasteurized or sulfited, they can keep 6–12 months cool.

Conclusion:

Karonda preserves easily once processed. The key is to **harvest at the right maturity** (green fruit for pickles; fully ripe for jams) and handle gently. Products prepared by modern canning (boiling, sealing in sterilized containers) require no special storage beyond cool, dark conditions. Traditional home methods (sun-fermenting pickles, boiling jams) similarly give long shelf-life.