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Research Journal of Agricultural Sciences
An International Journal

P- ISSN: 0976-1675
E- ISSN: 2249-4538

Volume: 13
Issue: 05

Res. Jr. of Agril. Sci. (2022) 13: 1658–1659

CARAS

Res. Jr. of Agril. Sci. (Sep-Oct 2022)
13(5): 1658–1659

ISSN: 0976-1675 (P)
ISSN: 2249-4538 (E)

www.rjas.org

Short Communication

Flowers and Fruits of *Garcinia gummi-gutta* (L.) Roxb.

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Received: 15 Aug 2022 | Revised accepted: 06 Oct 2022 | Published online: 29 Oct 2022

***Key words*:** *Garcinia gummi-gutta*, Hardwood, Polygamous, Diseases, Medicine

Garcinia gummi-gutta (L.) Roxb. is small to medium sized tree belonging to the family clusiaceae (Guttiferae). The family is characterized by the presence of yellow resin [1]. It is a wild tropical and subtropical plant. *Garcinia gummi-gutta* is commonly known as brindle berry, Malabar tamarind and Kudampuli. Pollination is an important event in sexual reproduction and seed formation. *Garcinia gummi-gutta* is dioecious, producing male and female flowers on separate plants, flowering during March - April months. The flowers of *garcinia* are unisexual and are axillary in nature.

Many species of *Garcinia* have fruit with edible arils and are eaten locally. The seeds of *Garcinia indica* fruits yield valuable edible fat known as kokum butter [2]. Fruits are edible, but they are far too acidic to be consumed fresh. They are appreciated for the processed and dried pericarp, which is used as a condiment to flavour curries, as a popular spice in cooking, and as a prominent ingredient in many cuisines as a tamarind alternative. The fruits of *Garcinia* are food source for several animals, most species in *Garcinia* are known for their gum resin which is used as purgative or cathartic. Fruits of some *Garcinia* species are also one of the richest sources of red pigments in the plant kingdom [3-4]. The fruit has a high therapeutic efficacy against obesity and is used to treat rheumatism, rickets, and spleen enlargement. Fruit and syrup of *Garcinia* indica are very popular in Konkan region and have antioxidant and antibacterial properties [8].

Garcinia gummi-gutta flowers and fruits were collected from households in Thiruvananthapuram. The orange yellow mature fruits either drop from the tree or harvested manually. The rind is separated for processing immediately after harvest. Free hand sections of fresh fruits and flowers were taken and stained with Saffranin, Sudan III and TB'O'. The stained sections were mounted in glycerin and water observed under microscope.

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In *Garcinia gummi-gutta* the branching pattern was horizontal, while pendulous drooping pattern has also been observed rarely. The average size of leaves was 7-12 × 3.5-5cm while the leaf shape varied considerably from the typical elliptic to broad shapes [12] The apex and base of leaves were acute and rarely obtuse. The variation was also exhibited in flowers, fruits and seeds morphology [9]. *Garcinia gummi-gutta* is dioecious plant producing male and female flowers on separate plants. Flowering season of plants was March-April months. Male flowers are produced at terminal or axillary inflorescences as clusters of 2-20 flowers; whereas female flowers were produced at terminal or axillary branches as solitary or cluster of 2-6 flowers. Male flowers long yellow with red at base with sessile, actinomorphic, 4 or 5sepals, two seriate. Petals 4, pale yellow and unequal. Stamens (15-25) are straight, grey colored, attached to a pistillode with a non-functional stigma. Female flowers are actinomorphic, sessile, sepals 4 or 5 pale green or pale yellow, petals 4 or 5 pale yellow [5]. Staminodes (6-20) are found at the grooves of ovary, stigma broad and wet, ovary globose, 8-locular, single ovule in each locule and placentation axile. Pistillate flowers possess an umbrella shaped stigma with sticky surface (Fig 1-6). The *Garcinia gummi-gutta* fruits are fleshy to woody berry; seated on the usually persistent calyx. Seed 1-2, often flattened and enclosed in pulp. Fruits develop without pollination and fertilization. After blooming for at least 24-hour period, petals wither and drop within a few minutes. The unfertilized ovary develops to mature fruit within 4-6 months depending upon the species. The pericarp of *Garcinia gummi-gutta* is of great value for its delicate taste and flavour and the accessions were evaluated in terms of fruits size, rind thickness, acidity and yield. The average weight of fruits was 173g. Previous studies on 13 fruits and five seed characters of 51 accessions of Malabar tamarind by Abraham *et al*. [9] reported that the variability was found to be maximum for nipple length (74.08%) and minimum for fruit girth (12.8%) and the average fruit weight was 161g [10]. The fruit shape varied from globose, oblong and rarely to discoid shape. The thickness of fruit rind is a detrimental factor in food sector and the thickness varies from 6.25mm to 16.03mm. The fresh weight of fruit was in the range 45.7-173.3g. The number of grooves the fruit surface also varied significantly from 5to11 [11]. In young fruit of *Garcinia* contain outer epidermis shows cubic cells with outer periclinal walls slightly thickened.

Presence of schizogenous secretory receptacles, usually in the form of canals, but less frequently cavities. Secretory cells, which are readily stained with hematoxylin are common in the parenchymatous tissues and ray cells [6]. The rind of the mature fruit is constituted by the exocarp, represented by the periderm, and the mesocarp with secretory ducts and vascular bundles [7]. The endocarp, firmly attached to the fibrous testa, become the yellowish and edible pulp, rich in sugars (Fig 7-12).

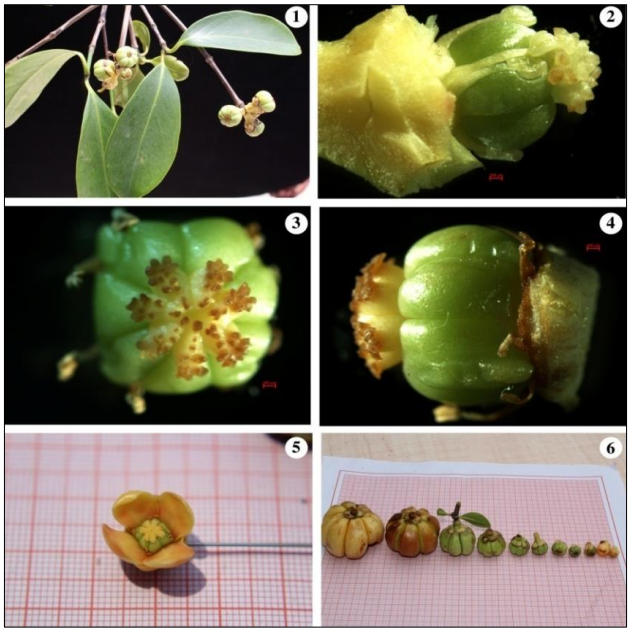

Fig 1 *Garcinia gummi-gutta* (L.) Roxb tiwg with fruits. Fig 2 *Garcinia gummi-gutta* (L.) Roxb flower bud showing gynoecium and staminoides. Fig 3 *Garcinia gummi-gutta* (L.) Roxb stigma (Upper view). Fig 4 *Garcinia gummi-gutta* (L.) Roxb ovary (Lateral view). Fig 5 *Garcinia gummi-gutta* (L.) Roxb opend female flower. Fig 6 Different stages of *Garcinia gummi-gutta* (L.) Roxb fruits

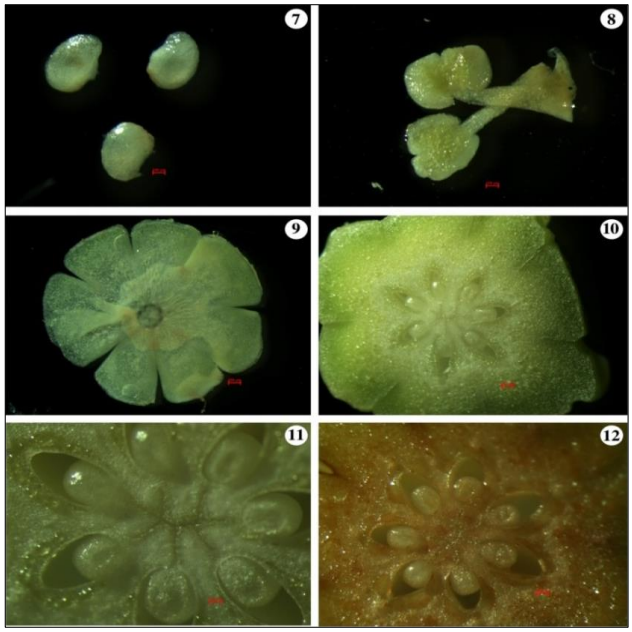

Fig 7 *Garcinia gummi-gutta* (L.) Roxb ovules. Fig 8 *Garcinia gummi-gutta* (L.) Roxb staminoides. Fig 9 *Garcinia gummi-gutta* (L.) Roxb c.s of bud ovary. Fig 10 *Garcinia gummi-gutta* (L.) Roxb c.s of ovary. Fig 11 *Garcinia gummi-gutta* (L.) Roxb c.s of ovary. Fig 12 *Garcinia gummi-gutta* (L.) Roxb c.s of ovary stained with sudan III

SUMMARY

Garcinia gummi-gutta (L.) Roxb. is a hardwood tree native to Southeast Asia. They are evergreen polygamous trees, shrubs, and herbs. About 35 species are reported to exist in India, many of which are endemic and economically important with immense medicinal properties. The tree is also grown in homes, mainly for its fruits that are used in food preparation. No serious pests or diseases affected the seeds or seedlings in the nursery. The extreme diversity of floral structure across the genus structures and its taxonomy is contentious. A number of species are important in local medicine, and some are cultivated for their fruit or as ornaments. In *Garcinia* morphological characteristics are of great importance for helping us to know the way for pollination. The genus *Garcinia* is represented by about 35 species in India, many of which are endemic and economically important with immense medical properties. Lack of awareness coupled with habitat destruction, is leading to genetic erosion of the forest resource and many species are threatened. *Garcinia* is yellowish fleshy and edible part of the fruit constituted by the parenchymatic endocarp and fibrous and lignified part is the seed integument. The present study revealed that the fruit contain yellow resin. Fruit syrup is used for antioxidant and antibacterial activity.

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