CHAPTER - 3.
AVERRHOA CARAMBOLA

Averrhoa carambola L.

3.1. Synonyms
Carambola, Carambola tree [1].

3.2. Introduction
Averrhoa carambola L. (Oxalidaceae) is commonly known as ‘Kamrakh’ or ‘Star fruit. Carambola had acquired the status of a modern commercial crop in the India. It is edible and has various uses. Also, the ripe fruit may be processed into fermented or unfermented drinks, jam or jelly, can be eaten fresh or as dessert. The unripe fruit also eaten as a vegetable. The sweet type is processed into wine in Surinam [2].

3.3. Botanical classification [3]

Division : Spermatophyta
Sub-division : Angiospermae
Class : Dicotyledonae
Sub-class : Polypetalae
Order : Geraniales
Family : Oxalidaceae
Genus : Averrhoa
Species : carambola
3.4. Vernacular names  [4]

English : Carambola apple

Urdu : Kamarakha

Hindi : Kamarakh

Sanskrit : Kamarangah

Telugu : Tamaratama

Tamil : Sagadam

Bengali : kamranga

Marathi : karambal

Assamese : kordoi

3.5. Habitat and distribution

The A. carambola was thought to be originated in Ceylon and the Moluccas [5], but it has been cultivated in Southeast Asia and Malaysia for many centuries. The plant is found throughout India, [6] particularly in Gujarat and Maharashtra states. It is also cultivated throughout the tropics and may be a native of Malaysia [7]. The carambola tree is a much-branched, slow-growing, bushy, broad and short-trunked with, rounded crown and reaches 20 to 30 ft in height [3].

3.6. General Description

Carambola tree is considered the more important between two species- Bilimbi (Averrhoa bilimbi L.) and carambola (Averrhoa carambola L.) The fruit is mainly cultivated in India and China. Plant is a handsome
evergreen tree about 9.0 m in height, leaves are compound, alternate, leaflets 5-11, glabrous surface, base oblique, apex is acute. The leaflets are sensitive to light and more or less inclined to fold together at night or when the tree is shaken or shocked. Small clusters of red stalked, purple-streaked flowers, about 6 mm wide, are borne on the twigs in the axils of the leaves. The color of the flowers are white and purple, fruit is ovoid and indehiscent [1, 3].

Fig 3.1 Exomorphic features of the plant-a-Tree; b- Leaves; c- Flower; d- Fruit
2.7. Phytoconstituents reported in *Averrhoa carambola*

*p*-Anisaldehyde [8] and β-sitosterol [9] were isolated from carbon tetrachloride and chloroform soluble portion of the methanol extract of stem bark of *Averrhoa carambola* L [10, 11]. Nordby and Hall reported that the major sterols which are found in the fruits of carambola are β-sitosterol, campesterol and isofucosterol [12]. It also contained the four major plant fatty acids – palmitic, oleic, linoleic and linolenic acid. Fruits of *Averrhoa carambola* L. are an excellent source of natural antioxidants [13]. Two alkyl phenols, namely, 2, 5-dimethoxy-3-undecylphenol and 5-methoxy-3-undecylphenol, were isolated together with two known benzoquinones, 5-O-methylumbelliferone and 2-dehydroxy-5-O-methylumbelliferone from the wood of *Averrhoa carambola* [14]. ζ-carotene, β-cryptoflavin, mutatoxanthin, β-carotene, β-apo-8′-carotenal, cryptoxanthin, cryptochrome and lutein were present in fruit of carambola [15]. Another compound identified included the following β-sitosterol, lupeol, anthraquinone glucoside [16].

3.8. Traditional medicinal uses

In Ayurveda, the ripe fruit is used as digestive, tonic and strengthening. The dried fruit is also used in fever, it has cooling and antiscorbutic properties. Fruits and fruit juice are commonly used as antioxidant and astringent. The ripe fruit is known for curing bleeding piles, particularly for internal piles. Fruits are useful in diarrhoea, vomiting, hyperdipsea, haemorrhoids, intermittent fever, scabies and general debility. Also, the fruit is sour, astringent to the bowels, allays thirst and is very much useful in the elimination of intestinal worms. The leaves are antipruritic, antipyretic, anthelmintic and are also helpful in scabies, fractured bones
and various types of poisoning, intermittent fevers and elimination of intestinal worms [1, 4].

3.9. Literature Review

3.9.1. Anti-inflammatory activity
Cabrini et al. reported that ethanolic extracts from A. carambola L. leaf and its ethyl acetate, butanol and hexane fractions are useful in reducing croton oil-induced ear edema and cellular migration in mice. These results justify the traditional use of this plant for skin inflammatory disorders. Analysis of the Potential Topical Anti-inflammatory Activity of Averrhoa carambola L. in mice was reported by Daniela et. al. [18, 19].

3.9.2. Hypotensive effect
Hypotensive effects of aqueous extract of Averrhoa carambola L. (Oxalidaceae) in rats were reported by \textit{in vivo} and \textit{in vitro} approach [20].

3.9.3. Hepatoprotective effect
Hepatoprotective effect of Averrhoa carambola fruit extract was reported on carbon tetrachloride induced hepatotoxicity in mice [21].

3.9.4. Antioxidant activity
A group of researcher reported that residue from star fruit is a good source for food ingredients and antioxidant nutraceuticals [22]. This study also showed that star fruit (Averrhoa carambola L.) is an excellent source of natural antioxidants and that polyphenolics are its major antioxidants. Analysis of polyphenolic antioxidants in star fruit was also done using liquid chromatography and mass spectrometry [23].

3.9.5. Hypoglycemic activity
In this study it has been reported that insoluble fiber rich fractions which were isolated from the pomace of carambola, contains potential
hypoglycemic effects as demonstrated by a study on several in vitro methods. The fiber also effectively absorbs glucose, retard glucose diffusion, postpone the release of glucose from starch and inhibit amylase activity to certain extent [24].

3.9.6. Anti-ulcerogenic Effects

It has been reported that the anti-ulcerogenic potential of extract of leaves of *Averrhoa carambola* administered by oral gavage in the following ulcer models in rats: lesions induced by acidified ethanol, indomethacin and acute stress. ACE, at doses of 800 and 1200 mg/Kg, p.o., only showed significant anti-ulcer activity in the acidified-ethanol-induced ulcer model in rats [17].

3.9.7. Anthelmintic activity

Shah N.A. et al (2011), reported the anthelmintic assay with the aqueous extract of *Averrhoa carambola* leaves at various concentrations (10, 50,100mg/ml) using albendazole as reference standard at the same concentration to that of the extract. It was found that the leaves of *Averrhoa carambola* displayed a significant anthelmintic activity in dose dependent manner [25].

3.9.8. Hypocholesterolaemic & Hypolipidemic activity

Chau CF. et al (2004) reported that the isolated water-insoluble fiber rich fraction (WIFF) from the pomace of star fruit, showed hypocholesterolaemic & hypolipidamemic activity. Investigation in hemsters showed pronounced cholesterol & lipid lowering affect of WIFF [26].

3.9.9. Antimicrobial activity

It was reported that *Averrhoa carambola* stem extracts exhibited antibacterial activity by inhibiting *Staphylococcus aureus* and *Klebsiella*
As indicated by a minimal bactericidal concentration (MBC) of 15.62 mg/ml and 125 mg/ml respectively. Again, Mia Masum Md. et al (2007) investigated the anti-microbial activity of *Averrhoa carambola* by disc diffusion method and reported that the methanolic extract and its petroleum ether, carbon tetrachloride, chloroform and aqueous soluble fractions of *Averrhoa carambola* bark inhibited the growth of various Gram +ve bacteria and Gram –ve bacteria [27, 28].

### 3.9.10. Anti-tumour activity

Selective activity against brain tumor cells was observed with an alcoholic extract from the stems of *A. carambola*, while an extract from the leaves was effective against liver carcinoma cells [29].

### 3.9.11. Phytochemical review

- Phytochemical study showed that two alkyl phenols, namely, 2, 5-dimethoxy-3-undecylphenol and 5-methoxy-3-undecylphenol, were isolated together from the wood of *Averrhoa carambola* with two known benzoquinones, 5-O-methyllemblen and 2-dehydroxy-5-O-methyllemblen [14].

- Another phytochemical study reported that the carotenoids of the tropical fruit *Averrhoa carambola* were investigated and from most of them mass spectra were taken. The main pigments were phytoflueene, ζ-carotene, β-cryptoflavin and mutatoxanthin. Additionally, β-carotene, β-apo-8′-carotenal, cryptoxanthin, cryptochrome and lutein were present in small amounts [15].
3.10. References


