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Culinary melon of South India: A review

KRM Swamy[1] and Prem Nath[2]

Abstract

Culinary melon or Mangalore melon or South Indian melon (*Cucumis melo* var. *acidulous*) is a botanical variety of *Cucumis melo* L. It is grown in localised sub–regions unlike dessert melons grown everywhere. One such region consists of Karnataka, Tamil Nadu, Kerala Andhra Pradesh, and Telangana in South India. The culinary form or non-dessert of *Cucumis melo* are a distinct group distributed and adapted well essentially under humid tropics of Southern India. Culinary melons have a special feature that the fruits can be stored under room temperature up to 8-10 months without losing their freshness. They can be stored for many weeks by hanging them from the ceiling, firmly bound by thin coconut fibre ropes. This ethnic vegetable is used for preparation of various culinary items. It has a variety of common names viz., vellari, vellarikka, Mangalore melon, Mangalore *southekayi*, *Kanivellari,* Malbar cucumber, Madras cucumber, culinary melon, etc. This review article deals with Introduction, Family Cucurbitaceae, Culinary melon/Mangalore melon, Origin and distribution, Botany and classification of *Cucumis melo*, Description of some of the botanical varieties of *Cucumis melo,* intraspecific/ infraspecific crossability of *Cucumis melo,* collection and evaluation of culinary melon germplasm, growing area in South India, crop improvement, high yielding varieties, cultural practices, nutritive value, medicinal value, uses, and cultural significance.

Key words: Botanical variety, crossability, culinary melon, cultural significance, infraspecific, intraspecific, medicinal value, nutritive value.

Introduction

Culinary melon or Mangalore melon or South Indian melon (*Cucumis melo* var. *acidulous*) is a botanical variety of *Cucumis melo* L. It is grown in localised sub–regions unlike dessert melons grown everywhere. One such region consists of Karnataka, Tamil Nadu, Kerala Andhra Pradesh, and Telangana in South India. This culinary melon or vegetable melon has spread and produced manifold between 1969-2020, but the technical information on this crop is still scanty. In sub-region like West Coast, with long and heavy rain and hardly fresh vegetable available, the stored vegetable like pumpkin and ash gourd and *Mangalore Southekayi* are the best bet available. But technical information available on *Mangalore southekayi* is much less. This provides opportunity for scientists and agricultural development officials to focus on this crop: (a) to identify its genetic potential, (b) to improve on its quality and yield and (c) employ its long shelf-life potential into dessert muskmelon which is short of it.

Mangalore southekayi is coming up fast in production and consumption in southern states. Realising the importance and potentials of this crop, the PNASF extended strong support to the research and development of this potential food crop through a PNASF/UHSB Research project. The non-dessert or culinary forms of *Cucumis melo* are a distinct group distributed and adapted well essentially under humid tropics of Southern India. Culinary melon or vegetable melon or South Indian melon (*Cucumis melo* subsp. *agrestis* var. *acidulus*) belongs to the family Cucurbitaceae. In English, it is popularly called as Mangalore melon, golden melon, culinary melon. Although much of the information about culinary melon calls them cucumbers, they are not cucumbers! They are actually a part of the so called "*acidulus*" group of melons (*Cucumis melo*). Culinary melons or South Indian melons have a special feature that the fruits can be stored under room temperature up to 8-10 months without losing their freshness. They can be stored for many weeks by hanging them from the ceiling, firmly bound by thin coconut fibre ropes. This ethnic vegetable is used for preparation of various culinary items. *Cucumis melo* var. *acidulus* is widely cultivated in Southern India as a vegetable crop. The fruit of culinary cucumber looks like a cucumber and feels and tastes just like a gourd when cooked. It is a common and popular vegetable found in almost every home in Southern India. Culinary melon is being cultivated in Karnataka, Andhra Pradesh, Tamil Nadu and Kerala states. This is a popular vegetable crop in humid tropical region of South India, with a variety of common names viz., vellari, vellarikka, Mangalore melon, Mangalore southekayi, Kanivellari, Malbar cucumber, Madras cucumber, culinary melon, etc.

[1]Retired Principal Scientist & Head, Division of Vegetable Crops, ICAR-Indian Institute of Horticultural Research, Bengaluru.

[2]Former Asst. Director General, Food & Agriculture Organization of the United Nations (FAO-UN); and Chairman, P.N. Agricultural Science Foundation (PNASF), #9, 1st Cross, 1st Main, 1st Block, Rajmahal Vilas (RMV) Extension 2nd Stage, Bengaluru- 560 094

*Corresponding author, Email: krmswamy@gmail.com

Family Cucurbitaceae

The gourd family, Cucurbitaceae also called as cucurbits, is among the economically most important plant groups and includes numerous widely cultivated crops such as squash and pumpkin (*Cucurbita* spp.), watermelon [*Citrullus lanatus* (Thunb.) Matsum.& Nakai],cucumber (*Cucumis sativus* L.) and melon (*Cucumis melo* L.). Cucurbitaceae consists of about 118 genera and 825 species. Cucurbits are present in both the New and Old World and are among the most important plant families that supply human with edible products and useful fibers (Whitaker and Davis 1962). According to Jeffrey (2005) the botanical classification of commonly cultivated species of family Cucurbitaceae (Gourd family) are furnished in Table 1.

Melon (*Cucumis melo* L.) is one of the important horticultural crops worldwide and plays an important role in international trade. Different forms of melon are known that are morphologically different and have different uses. The main plant organ used is the fruit, which is used both immature and mature (McCreight and Staub 1993) as desserts and vegetables for salad. Melon seeds may be eaten after being slightly roasted or edible oil can be extracted from them. *Cucumis melo* L. is more polymorphic than other species in the genus (Pitrat et al. 2000). Such polymorphism is greatest in the fruit characters. There have been several attempts to taxonomically subdivide melons into sub-species, botanical varieties or groups. Naudin (1859) proposed a classification of the species into 10 botanical groups after extensive study of the diverse forms. Naudin's classification remained a basis for melon intra-specific classification with amendments being brought about by several authors (Whitaker and Davis 1962, Munger and Robinson 1991, Robinson and Decker-Walters 1997). Seven intra-specific groups of melon are known at present: *agrestis* (wild melon), *cantalupensis* (sweet melon), *inodorus* (winter melon), *flexuosus* (snake melon or snake cucumber), *conomon* (pickling melon), *dudaim* (mango melon or pomegranate melon), and *momordica* (snap melon).

Culinary Melon/ Mangalore Melon

The melons (*Cucumis melo*, Cucurbitaceae) are a diverse group of fresh, dessert fruits including *C. melo* var. *cantalupensis*, with a rough and warty skin, non-netted (cantaloupe), *C. melo* var. *inodorus*, with a green, yellow or orange skin (winter melons), *C. melo* var. *reticulatus*, with a netted skin (true muskmelon). However, some other melons are considered 'culinary vegetables' (*C. melo* var. *acidulus*) and they are used as vegetables rather than dessert melon. *C. melo* var. *acidulus* is widely cultivated in Southern India and used as a vegetable throughout the year since it has a long shelf-life (Manohar and Murthy 2014). In English it is popularly called as Indian cucumber, Indian yellow cucumber, yellow cucumber, **lemon cucumber, vegetable cucumber, culinary melon, acid melon, sour melon, culinary melon,** Mangalore melon, Malabar cucumber, Madras cucumber, and Sri Lankan cucumber. **I**n South Indian states, it is known by a variety of local names; *Mangaluru southekayi, sambar southekayi, bannada southekayi***,** *thouthe, mage-kayi, moge-kayi, mogem,* (in Kannada; Dakshna Kannada, Udupi, Uttara Kannada, Kodagu), *dosakaya, dosakaya cucumber, kakdi, bollari* (in Telugu); Malabar cucumber**,** *vellari, kanivellari, vishuvellari, vellarikka* (in Malayalam), Madras cucumber (in Tamil). Mangalore melons are known as *mogge* or *magge* in the Konkani dialect, which simply means "colored cucumber" (Munshi and Alvarez 2005, Eflora 2007, Gondi et al. 2016, Suzanne 2016). Although much of the information about vegetable cucumber calls them cucumbers they are not cucumbers! They are actually a part of the so called "*conomon*" group of melons (*Cucumis melo*). Traditionally the *conomon* melons have been used in the Far East for pickling. The fruit of culinary melon (*acidulus*) looks like a cucumber and feels and tastes just like a gourd when cooked. It is a common and popular vegetable found in almost every home in Southern India (Suzanne 2016). Stepansky et al. (1999) classified melons into seven botanical varieties. *Cucums melo* var. *conomon* **(***conomon* group) includes the oriental pickling melon. The fruits are smooth, cylindrical, and may be green, white, or striped. The flesh is white and can taste either sweet or bland. Vines bear dark, spiny leaves, sericeous ovaries. This corresponds to (having an obvious similarity) Naudin's *Cucums melo* var. *acidulus*. *Dosakaya/ sambar cucumber*/ vegetable melon/ culinary melon (*Cucumis melo* var. *acidulus*), resembling golden cucumber but with green patches turning darker on ripening, flesh white, used in sambar and pachadi preparations, and is monoecious. According to Pitrat (2008) Mangalore melon/*sambar southekayi/ bannada southekayi/ dosakayi/ vellarikka* is unique to Southern India and geographically distributed to Southern India. Hence the botanical name of Mangalore melon/sambar southekayi should be *C. melo* var. a*cidulus.* In the land races grown in Southern India, the fruits are oval or elliptic, smooth with a green or orange skin, uniform or with spots; white, firm, crisp flesh; neither sugar nor aroma. Previously, some authors used the botanical name, *C. melo* var. c*onomon* (Oriental pickling melon)

Table 1: Botanical classification of Cucurbitaceae (Gourd family)

Genus	Scientific name	Common name
Benincasa	*Benincasa hispida*	Wax gourd (white pumpkin, ash gourd)
Citrullus	*Citrullus lanatus*	Watermelon
	Citrullus lanatus var. *citroides*	Citron (preserving melon)
Cucumis	*Cucumis sativus*	Cucumber
	Cucumis metuliferus	African horned cucumber
	Cucumis anguria	West Indian gherkin (bur cucumber)
	Cucumis melo	Melons
	Cucumis melo var. *acidulus*	South Indian melon, Culinary melon, Sour melon, Acid melon
	Cucumis melo var. *conomon*	Oriental pickling melon, Asian pickling melon
	Cucumis melo var. *cantalupensis*	True cantaloupe (rare in U.S.)
	Cucumis melo var. *chito*	Mango melon, Lemon melon, Vine peach
	Cucumis melo var. *dudaim*	Pocket melon, Plum granny, Dudaim melon
	Cucumis melo var. *flexuosus*	Snake melon (Armenian cucumber)
	Cucumis melo var. *inodorus*	Winter melon (Casaba, Crenshaw, Honeydew)
	Cucumis melo var. *momoridca*	Phoot , Snap melon
	Cucumis melo var. *reticulatus*	Muskmelon, Cantaloupe (U.S), Persian melon
Cucurbita	*Cucurbita ficifolia*	Malabar gourd, Fig leaf gourd
	Cucurbita foetidissima	Buffalo gourd
	Cucurbita maxima	Squash – winter varieties: (Banana, Buttercup, Delicious, Hubbard, Marrow, Show, Turban)
	Cucurbita argyrosperma	Squash - winter types and for seed: (Cushaw,
	(formerly *Cucurbita mixta)*	Silver-seeded gourds)
	Cucurbita moschata	Squash: (Butternut, Cheese, Large Crookneck)
	Cucurbita pepo	Squash – summer and winter types (acorn, crookneck, straightneck, scallop, cocozelle, pumpkin, zucchini, vegetable marrow)
Lagenaria	*Lagenaria siceraria*	Bottle Gourd, Calabash (hard-shelled gourd)
Luffa	*Luffa acutangula*	Ridge gourd, Angled Luffa (Chinese okra)
	Luffa aegyptiaca	Sponge gourd, Smooth Luffa
Momordica	*Momordica* var. *balsamina*	Balsam pear
	Momordica var. *charantia*	Balsam pear, Bitter melon, Bitter gourd
Sechium	*Sechium edule*	Chayote (vegetable pear), Chow-Chow
Sicana	*Sicana odorifera*	Casabanana
Trichosanthes	*Trichosanthes anguina*	Snake gourd, Serpent gourd
Coccinia	*Coccinia grandis*	Scarlet gourds, Ivy gourd

for Mangalore melon/vellarikka/culinary melon/sambar southekayi/ (Subha et al. 1986, Silpa et al. 2000). But the actual botanical name for the South Indian landraces of culinary melon/ sour melon is *C. melo* var. *acidulous* (Manohar and Murthy 2012, Manohar and Murthy 2014, Manoj and Murthy 2012).

Dosakaya or yellow cucumber is a small, round or oval shaped, light green to bright yellow colored vegetable, with a crisp crunchy skin and a mild sweetish and tarty taste (a pleasant sour taste). Few people from Andhra region also call it as *budamekaya* (Vahrehvah 2017). The best way to appreciate the unique qualities of the Mangaluru melon/ clinary melon is to simply slice one open. Its striped rind is tough yet yields easily. Its cream-colored flesh (much like a muskmelon's flesh) has the crunchy, watery texture of a cucumber, yet holds its form when cooked (Fig. 1). The seeds are edible, yet mildly bitter, which is why the vegetable is often de-seeded before it is used. Placenta will be little sour. It is usually cooked and not eaten raw. Its flesh also has a slight sourness, which lends itself well to pickling (Economic Times 2012.).

Origin and Distribution of Culinary Melon/ Mangalore Melon

Melons originated from tropical Africa, north of the equator, and their cultivation spread northward and eastward thousands of years ago. Much diversity of melons is found in Iran, Turkey, Spain, India, China, and the central Asian republics of the former Soviet Union. Apparently, the first culinary use of melons by man was of the immature fruits, much in the manner of cucumber. Immature melons are not sweet but instead bland, like cucumbers. Sweet melons are a relatively recent development, perhaps dating back only to the Middle ages (Schaffer and Paris 2003). In the history of Europe, the Middle Ages lasted approximately from the 5th to the late 15th centuries. Pickling melon probably is native of Asia though it has been in cultivation for so long, its habitat is obscure (PFAF 2012). According to Swami Virendra Bhat, in charge of the community kitchen at the Dharmasthala shrine in Karnataka's Malnad region Mangalore *southekai* (cucumber in Kannada) predate the arrival of the British to India" (Pawar 2016). Mr Dattatreya Hedge, a progressive

Fig. 1: South Indian landraces of culinary melon/ Mangalore melon
(*Cucumis melo* var. *acidulus)*

farmer from Sirsi (Uttara Kannada) emphasized the importance of *moggekayi* (culinary melon) in the socio-cultural practice of *Havyaka Bhahmins* during *pooja/ vrata* (Personal Communication).

Mangalore melons are the group of culinary melons of *Cucumis melo* ssp. *agrestis* var. *acidulus* which differs from the Southeast Asian melons of the group *Cucumis melo* ssp. *agrestis* var. *conomon*. Both the groups might have been originated from the wild progenitor *Cucumis melo* ssp. *agrestis* and the *Cucumis melo* ssp. *agrestis* var. var. *acidulus* group might have been domesticated in Southern India. Independent domestication of Mangalore melons or culinary melons of Southern India has led to their flowering behavior (monocious), difference in size, shape, skin color and shelf-life of fruits and the seed size. Mangalore melons have a long shelf-life of more than six months and crisp flesh, which can be exploited for shelf-life enhancement of musk melons (personal communication). *Dosakai* cucumbers are small in size and are round to oblong in shape. The smooth rind is edible, thin, yellow, and is overlaid with hues of green and orange with intermittent stripes and spots. As the cucumber matures, the skin becomes a darker yellow, and the green patches grow smaller. The pale cream to white flesh is firm, watery, and crunchy with small, yellow, edible seeds encased in a slippery coating. The flesh also has a mild, sweet fragrance that is reminiscent of melon. Dosakai cucumbers can be consumed both raw and cooked. When raw, they have an opaque flesh that is semi-sour and tart with slightly bitter seeds. When cooked, the flesh becomes translucent and soft with a tangy, sweet flavor (Specialty Produce 2020). Known by a variety of local names such as Mangalore *southekayi* (or cucumber) and thouthe, it is used to make tangy curries and is also simply stir-fried, sometimes with a coconut and raw mango paste, to make a palya or vegetable side dish. In Andhra Pradesh, where the yellowish gourd is called dosakaya, it is used to add heft (heaviness or weight) and nutritive value to tuvar dal in a dish known as dosakaya pappu. It is also made into a spicy pickle called dosvakaya (Economic Times 2012).

The botanical name of culinary melon/Mangaluru melon/ Mangaluru southekai is *Cucumis melo* var. *acidulus*. Singh (2013) stated that *Cucumis melo* subsp. *agrestis* var. *acidulus* has many forms in cultivation, differing from cucumber (with which they often been confused in past but have white flesh as against greenish white in cucumber- *Cucumis sativus*). Some of these were earlier also separated under var. *mukuwa* Makino, and var. *conomon* (Thunb.) Makino under *C. melo* directly. The fruits of wild melon cultivars *(Cucumis melo* subsp. *agrestis;* Synon.: *C. melo agrestis*), are with smooth skin, and tart or bland taste, will not exceed 10 cm in length, and will be bitter in taste before maturity. They are often confused with cucumbers (*Cucumis sativus*). Wild melon (*Cucumis melo* var. *agrestis*) is also known as wild musk melon, gulagayi, Hubballi *southekayi* and *mekkekayi* in North Karnataka. Whereas, Mangalore melon or Mangalore *sauthekayi* (*Cucumis melo* subsp. *agrestis* var. *acidulus*) grows up to 25 cm x 20 cm in size and will be sweet (rather not bitter) always (Khale 2019). *Dosakai* cucumbers are native to India and the immediate surrounding southern states and regions and have been grown since ancient times. Today the Dosakayi cucumbers are prevalent in southeastern India in Andhra Pradesh (Anon. 2020, Specialty Produce 2020). Hence, culinary melon or Mangalore melon must have originated independently from its monoecious wild relative (*Cucumis melo* subsp. *agrestis*), probably in the earstwhile Dakshina Kannada district or West coast region of South India. The African melon *Cucumis melo* subsp. *agrestis* Naudin is an andromonoecious, annual, trailing-vine plant.

The origin of this ancient vegetable is lost in antiquity (the distant past, especially before the sixth century). British botanist contends that this was introduced to the East coast by William Roxburgh, a famous botanist of the time. Indian food historians tend to disagree, quoting references to the vegetable in Kannada and Tamil literature that predate this British era. All theories, including the vegetable itself, taste best when taken with a pinch of salt, of course! So why is the Madras cucumber called so, when all Southern states as well as several in the North East have been growing it for centuries? Well the name Madras refers to the erstwhile Madras Presidency, encompassing most of South India, the primary region where the vegetable is traditionally

grown, known as *dosakaya,* Mangaluru *southekayi, naadan vellarikka*, and a host of other local names, these cucumbers are rarely eaten raw. Their firm, watery texture, and slightly tangy (having a strong, piquant flavour or smell) taste make them perfect to add in *sambar, kootu, pappu*, and *huli* (Aravamudan 2018). It is also reported that the exact origin of culinary melon/ Malabar cucumbers is unknown and is under some debate. According to a 1789 catalouge at the Royal Botanic Gardens at Kew in Britain, the Malabar cucumber was introduced to India by Scottish botanist William Roxburgh. However, according to locals in Southern India, there is a reference to the Malabar cucumber in Indian literature that pre-dates the arrival of the British. Today Malabar cucumbers can be found in local markets and specialty grocers in India, China, Myanmar, Nepal, Pakistan, Sri Lanka, and Bhutan (Speciality 2019). The melon germplasm of the humid tropics of Southern India has been collected and assessed by Fergany et al. (2011). They reported that the collected populations belong to two groups: *C. melo* var. *acidulus* Naudin and *C. melo* var. *momordica* (Roxb.) Duthie et Fuller. They also recommended that additional collections of melon genetic resources should be made from Southern India as this could lead to the discovery of genetic diversity not present in the existing world collections of melon (Sunita and Murthy 2013).

Stepansky et al. (1999) placed both Oriental pickling melon (*C. melo* var. *conomon*) and sour melon/culinary melon/vegetable melon (*C. melo* var. *acidulus*) under *C. melo* var. *conomon.* But Pitrat (2008) placed sour melon/culinary melon/vegetable melon under *C. melo* var. *acidulus,* as this botanical variety is unique to Southern India and geographically distributed to Southern India. Hence the botanical name of Mangalore melon/ *sambar southekayi* should be *C. melo* var. *acidulus.* In the landraces grown in Southern India, the fruits are oval or elliptic, smooth with a green or orange skin, uniform or with spots; white, firm, crisp flesh with neither sugar nor aroma. Previously, most of the authors used the botanical name, *C. melo* var. c*onomon,* excepting a few authors (Manohar and Murthy 2012, Manoj and Murthy 2012, Sunita and Murthy 2013, Manohar and Murthy 2014), who used *C. melo* var. *acidulus* for the South Indian sour melon/acid melon/ culinary melon/vegetable melon. Stepansky et al. (1999) have reported that a more "continuous" distribution of genetic variation in the germplasm may indicate that the varietal groups of melon may have formed over a relatively short time-span, which can be probed by only a small proportion of the traits that are scored. Another, complementary explanation for such pattern of variation relates to the fact that melon varieties did not evolve any reproductive barriers between them. Wild and feral genotypes continue to grow, in many countries, in proximity of sweet or vegetable landraces, with which they may freely hybridise. The occasional occurrence of sweet agrestis fruits may have resulted from such exchange.

The South Indian melon accessions collected belong to mainly two botanical varieties, *momordica* and *acidulus*, which are bearing non-sweet fruits and are consumed as vegetables. These are non-sweet, and vegetable types can be clearly separated from other botanical varieties. The accessions belonging to the *acidulus* group were mainly characterized by a very ûrm white ûesh and the absence of sugar and aroma. Most of the collections of *acidulus* were with white and off-white coloured ûesh within the fruit, fruits of *accidulus* showed very long shelf-life (more than 6 months) (Manohar and Murthy 2012). The results of the most comprehensive phylogenetic analysis for the genus to date (Sebastian et al. 2010) suggest that the wild ancestor of domesticated melons is from Asia, and the high diversity of landraces in India and East Asia supports the idea of an Asian domestication center (Akashi et al. 2002, Dhillon et al. 2007, Tanaka et al. 2007, Dwivedi et al. 2010).

Cucumis melo was subdivided in two subspecies *C. melo* subsp. *melo* and *C. melo* subsp. *agrestis* (Naudin) Pangalo (Grebenscikov 1953, Jeffrey 1990, Kirkbride 1993), and all plants with long, spreading hairs on the ovaries were named *C. melo* subsp. *melo*, while plants with short haired ovaries were named *C. melo* subsp. *agrestis* (Kirkbride 1993). The variety *agrestis* is distinguishable by having appressed hairs on the ovary and 2-5 cm long fruit; in specimens of the cultivated var. *melo* (with numerous cultivars) the hairs on the ovary are spreading (Kirkbride 1993). Since domesticated melons show various pubescence types of their ovaries, the horticultural system of up to 19 cultivar groups does not match the current subspecies concept (Pitrat 2013, Pitrat 2017). *Cucumis melo* is the most variable species of the genus *Cucumis.* The variation of the fruits surpasses that found in all the rest of the genus. They vary in size, internal color, and surface ornamentation and color. Because of this tremendous man-induced and –maintained variability of the fruit, the infraspecific classification of *C. melo* based on fruit characters has been a long-standing topic of interest. Naudin (1859) proposed the first practical scheme of infraspecific taxa within the Linnean hierarchy with 10 varieties. Various schemes have been proposed through intercalation or interpolation of ranks, use of additional ranks to express cultivar biology, change of ranks, etc., but Naudin's system is still the most reasonable one.

Consequently, I have chosen to use the character of pubescence type on the female-flower hypanthium to delimit the botanical subspecies proposed here for C. *melo* (Kirkbride 1993).

Botany and Classification of *Cucumis melo*

Cucumis melo is the most variable species of the genus *Cucumis*. The variation of the fruits surpasses that found in all the rest of the genus. They vary in size, internal color, and surface ornamentation and color. Because of this tremendous man-induced and –maintained variability of the fruit, the infraspecific classification of *C. melo* based on fruit characters has been a long-standing topic of interest. Naudin (1859) proposed the first practical scheme of infraspecific taxa within the Linnean hierarchy with 10 varieties. Various schemes have been proposed through intercalation of ranks, use of additional ranks to express cultivar biology, change of ranks, etc., but Naudin's system is still the most reasonable one. Consequently, I have chosen to use the character of pubescence type on the female-flower hypanthium to delimit the botanical subspecies proposed here for C. *melo* (Kirkbride 1993). The species *Cucumis melo* is taxonomically divided into two subspecies, ssp. *melo* and ssp. *agrestis*. Pitrat (2008) grouped melons into 15 widely accepted horticultural groups, *inodorus, cantalupensis, reticulatus, adana, chandalak, ameri, chate, flexuosus,* and *dudaim* (in ssp. *melo*), and *momordica, conomon, chinensis, makuwa, acidulus and tibish* (in ssp. *agrestis*). He also suggested the domestication of two subspecies might be independent and formed the foundation of multiple domestication hypothesis in melon. The characters of botanical varieties (Pitrat 2008) are summarized in Table 2.

Cucumis melo is the most polymorphic species which is a character of great importance in taxonomic studies. Several taxonomic studies have attempted to taxonomically subdivide melons into subspecies, botanical varieties or groups. Whitaker and Davis (1962), Munger and Robinson (1991), Robinson and Decker-Walters (1997) also contributed to Naudins classification, which remained a basis for melon intra-specific classification with amendments being brought. These taxonomic studies result in 7 intra-specific groups of melons: *agrestis* (wild melon), *cantalupensis* (sweet melon), *inodorus* (winter melon), *flexuosus* (snake melon or snake cucumber), *conomon* (pickling melon), *dudaim* (mango melon or pomegranate melon) and *momordica* (snap melon). Jeffery (1990) reported that the species *C. melo* is a polymorphic taxon encompassing a large number of botanical and horticultural varieties or groups. Melon is divided into two subspecies, *C. melo* ssp. *agrestis* and *C. melo* ssp. *melo*, differentiated by the pubescence on the hypanthium and ovary. Munger and Robinson (1991) proposed a simplified version of Naudin's taxonomy, dividing *C. melo* into, a single wild variety viz., *C. melo* var. *agrestis*, and six cultivated varieties viz., *cantalupensis, inodorus, conomon, dudaim, flexuosus* and *momordica*. The high polymorphism of cultivated melons (*Cucumis melo* L.) has led botanists to propose different infraspecific classifications. Two main schools can be recognized: one following the pioneer work of Naudin and the Russian one. The latter has focused mainly on central Asian diversity that had been underestimated by Naudin and his followers. Botanically, melons are considered to consist of two subspecies, *C. melo* ssp. *melo* and *C. melo* ssp. *agrestis* Jeffrey. Melons contain a wide diversity of fruit sizes, shapes, and colors. This diversity has been the subject of many attempts at classification. Probably the most comprehensive and comprehensible classification is that of Pitrat et al. (2000), who have recognized 16 cultivar-groups. Their classification is summarized in Table 3. However, the distinction between groups may become blurred with increasing breeding efforts, since all the groups of *Cucumis melo* are easily hybridized with one another (Schaffer and Paris 2003). Recently, Liu et al. (2004) concluded after an extensive evaluation of 72 melon accessions belonging to 6 melon varieties: *cantaloupensis, reticulatus, inodorus, makuwa, acidulus,* and *saccharinus,* that accessions which were previously classified in the same variety by traditional taxonomy were also located closely to each other using Principal Component Analysis (PCA) approach in 35 different morphological and physiological plant characters.

Description of Some of the Botanical Varieties of *Cucumis melo*

The fruits in this species *Cucumis melo*, commonly called as muskmelon or sweet melon vary considerably in terms of shape, size, rind, texture, flavor and flesh color. This is a polymorphic taxon that produces not only edible muskmelons (straight species) but also six different edible varieties or groups (some experts prefer the term group because variety only applies to plants in the wild) as follows (PF 2019):

***Cucumis melo* var. *acidulus* (Sour melon, Acid melon, Culinary Melon, Vegetable melon):** *Cucumis melo* var. *acidulus* is widely cultivated in Southern India as a vegetable crop. The fruit of culinary cucumber looks like a cucumber and feels and tastes just like a gourd when cooked. It is a common and popular vegetable found in almost every home in Southern India

Table 2: The characters of melon botanical varieties

Botanical variety name	Geographical distribution	Characters	Sex type	Examples of cultivars
conomon (Pickling melon)	East Asia	Elongated fruit, smooth Thin skin, non sweet and non cucumber, aroma fruit, white firm flesh	Andromonoecious	Shirouri, Freeman's cucumber, Aodaisimouri, Wasadauri
makuwa (Oriental sweet melon, cucumber melon, makuwa melon, pineapple melon, Korean melon,)	East Asia	Flat to round to oval fruit, smooth thin skin, sweet and a little aroma, white flesh	Andromonoecious	Ginsen makuwa, Kanro makuwa, Kinko makuwa, Ogon 9
chinensis	China and Korea	Pear shape fruit, light or dark green with spots skin, green or orange flesh, medium sugar content, little or low aroma.	Andromonoecious and Hermaphrodite	PI 161375, PI 255479, PI 255479
momordica (Snap melon)	India	Flat to round to elongated fruit, smooth or ribbed thin skin, bursting and low aroma when ripen, mealy and white flesh, low sugar content.	Monoecious	PI 124111, PI 414723, PI 164343, PI 183307, PI 532841, Faizabadi phoont, Gill patti phut
acidulus (Sour melon, Acid melon, Culinary Melon)	Southern India	Oval or elliptic, smooth with a green or orange skin, uniform or with spots; white, firm, crisp flesh; neither sugar nor aroma.	Monoecious	PI 164323, PI 90625, Kekiri
tibish (Seinat, Tibish melons)	Sudan	Oval shape with dark green skin with light or yellow stripes; white, firm flesh without sugar and aroma.	Andromonoecious	Tibish and Seinat cultivar
chate (Ajjuol melon)	Mediterranean basin, western Asia	Round to oval with ribs and light to dark green skin fruit; white to light orange flesh without either aroma or sugar; climacteric fruit.	Monoecious or Andromonoecious	Carosella
flexuosus (Snake melon)	Northern Africa to Turkey to Iraq to India	wrinkled; white to light orange, mealy at maturity without either sugar or aroma Long to very long fruit, light green or dark green, ribbed or	Monoecious	Fakouss, Fegous, Adjour, Alficoz, Silka, Kakri long green, Acur, PI 222187
cantalupensis (Rock melon)	Europe, Western Asia, North and South America	Flat to oval fruit with strongly to moderately ribbed with a smooth skin; orange flesh, aroma and sweet; climacteric fruit.	Andromonoecious	Charentais, Ogen, Ananas d' Amérique, Noir des Carmes, Prescott, Muscatello
reticulatus (Netted melon)	Europe, Asia, North and South America	Round to oval fruit with a typical netted skin with or without ribs; orange, aromatic and sweet flesh; climacteric fruit.	Andromonoecious	Topmark, PMR 45, Hale 's Best, Delicious 51, Sucrin de Tours, Earl's favourite, Galia
ameri (Xinjiang Hami melon,)	Western and Central Asia	Elongated and oval shaped with a yellow to light green skin color fruit; slightly netted skin; white to light orange juicy flesh with a low aroma and very good sugar content; climacteric fruit.	Andromonoecious	Ananas, Altajskaja, Khatoni, Kzyl urum
inodorus (Winter melon)	Central Asia, Mediterranean basin, North and South America	Round to elliptic fruit with skin to yellow to dark green skin with spots or uniform, often wrinkled, with or without ribs; white flesh, sweet and low aroma.	Andromonoecious	Piel de Sapo, Rochet, Amarillo, Cassaba, Kirkagac, Yuva, Hassanbey, Tendral, Honeydew, Branco
dudaim (Pocket melon)	Central Asia, from Turkey to Afghanistan	Round, small, yellow with ochre stripes and a velvety skin; strong typical aroma; white thin flesh without any sugar; climacteric fruit	Andromonoecious	Queen Anne's pocket melon, Dastanbou, PI 177362
chandalak	Mature fruits	Oblate to spherical, green or yellow, slightly netted or wrinkled, flesh white or green, sweet, low aroma, climacteric	Andromonoecious	Arka Jeet
chito	Mature fruits	Round, very small, smooth, yellow, flesh white, bland, no aroma.	Monoecious	Mango
adana	Mature fruits in Turkey	Spherical to long oval, slightly netted, flesh thin, orange or white, bland, mealy, climacteric.	Andromonoecious	Graydanka

(Suzanne 2016). Culinary melon is being cultivated in Karnataka, Andhra Pradesh, Tamil Nadu and Kerala states of India. This is a popular vegetable crop in humid tropical region of South India, with a variety of common names viz., *vellari melon*, culinary melon (Anon. 2019). **I**n South Indian states it is known by a variety of local names; Mangaluru *southekayi***,** *sambar southekayi***,** *thouthe, mage-kayi, moge-kayi, mogem*, (Dakshna Kannada, Udupi, Uttara Kannada, Kodagu), in Kannada; *dosakaya*, *dosakaya cucumber, kakdi, bollari* in Telugu; Malabar cucumber**,** *vellari, kanivellari, vishuvellari, vellarikka* in Malayalam, Madras cucumber, in Tamil

Table 3: Classification of melons, *Cucumis melo*, to subspecies and cultivar-groups

Subspecies	Group	Maturity at consumption	Description
agrestis (ovary with short hairs)	*Conomon*	Immature, similar to cucumber, in Eastern Asia	Elongate fruits
	makuwa	Mature in Eastern Asia	White flesh, little aroma, flat/round/pyriform
	chinensis	Mature in Eastern Asia	Colored flesh, little aroma, pyriform
	momordica	Immature in India	Skin bursting when ripe
	acidulus	Mature fruits in South India	Cooked in India, firm with crisp flesh, no sweetness or aroma
melo (ovary with long hairs)	*cantalupensis*	Mature fruits in Europe	Sweet flesh, aromatic, smooth or warted, climacteric
	reticulatus	Mature fruits in North America, Japan, Western Asia, and Europe	Sweet flesh, aromatic, netted, climacteric
	adana	Mature fruits in Turkey	Thin flesh, low in sugar, climacteric
	chandalak	Mature fruits in Central Asia	Sweet, climacteric, slightly wrinkled, low aroma
	ameri	Mature fruits in Central Asia	Sweet, climacteric, low aroma, netted
	inodorous	Mature fruits in Central Asia, Europe, and North America	Sweet, no aroma, usually wrinkled, not climacteric, long-keeping
	flexuosus	Immature fruits in North Africa	Very long fruit, climacteric
	chate	Immature fruits in North Africa	Elongate fruits
	tibish	Immature green fruits in Sudan	Small, oval, no sugar, no aroma
	dudaim	Mature fruits	Used as an ornamental or aromatic, small, round, no taste, highly aromatic, climacteric
	chito	Mature fruits	Very small, round, smooth yellow fruits

(Munshi and Alvarez 2005, Eflora 2007, Gondi *et al*. 2016, Suzanne 2016). Stepansky et al. (1999) classified melons in to seven botanical varieties. *Cucums melo* var. *conomon* includes the oriental pickling melon. The fruits are smooth, cylindrical, and may be green, white, or striped. The flesh is white and can taste either sweet or bland. Vines bear dark, spiny leaves, sericeous ovaries. This corresponds to (having an obvious similarity) Naudin's *Cucums melo* var. *acidulus*. *Dosakaya/ sambar cucumber*/ vegetable melon/ culinary melon (*Cucumis melo* var. *acidulus*), resembling golden cucumber but with green patches turning darker on ripening, flesh white, used in sambar and pachadi preparations, and is monoecious. A number of vegetable types of *Cucumis melo* (botanical varieties), often with elongate fruits resembling cucumbers, are grown in India and the Far East and used as vegetables. These forms are mostly domesticate of subspecies, *agrestis* (NRC 2008 Fig. 2).

Fig. 2: Culinary melon

***Cucumis melo momordica* (Snap melon, *phut*):** *Cucumis melo* var. *momordica* is an annual climber growing to 1.5 m. The species is monoecious (individual flowers are either male or female, but both sexes can be found on the same plant) and is pollinated by Insects. The plant is self-fertile. Suitable for: light (sandy), medium (loamy) and heavy (clay) soils and prefers well-drained soil. Suitable pH: acid, neutral and basic (alkaline) soils. It cannot grow in the shade. It prefers moist soil. Fruit - raw or cooked. The fruits are small and smooth, either oval or cylindrical in shape with a mealy, somewhat insipid or slightly sour flesh. They are eaten when young and still tender, either raw or cooked as a vegetable. Ripe fruits are used for dessert. Seed - raw. Rich in oil with a nutty flavour but very fiddly to use because the seed is small and covered with a fibrous coat. The seed contains between 12.5 - 39.1 percent oil. An edible oil is obtained from the seed (PFAF 2012). Snap melon is native to India, where it is commonly known as *'phut'* or *'phoont'* which means to split. Its fruits invariably crack at maturity and the flesh tastes mealy. Immature fruits are cooked or pickled, eaten as salad (Karnataka) and the mature, low sugared flesh is eaten raw. Snap melon is cultivated in many parts of India (Fig. 3).

Fig. 3: Snap melon

***Cucumis melo conomon* (Oriental pickling melon):** Oriental pickling melon (scientific name: *Cucumis melo* var. *conomon*) is a vining annual growing to 1.5 m., native to China and India. It produces yellow flowers in summer and harvests the fruit in the fall. Because it is a

member of the genus *Cucumis*, the petals are crumpled. The species is monoecious (individual flowers are either male or female, but both sexes can be found on the same plant) and is pollinated by Insects. The fruit's outer skin is glossy and can be white or green, but it turns white when fully ripe and it is whiter than a cucumber (Fig. 4). It has a lighter sweetness and taste, and it has a crispy texture when chewed. Most of its ingredients are water and low in calories, but it contains vitamin C, vitamin B1 and carotene. Both mature and immature fruits are made into sweet or sour pickles (PFAF 2012).

Fig. 4: Oriental pickling melon

***Cucumis melo* var. *tibish* (Tibish melon):** *Tibish* fruits are used mainly as fresh vegetables in Sudan. Immature green fruits are harvested, cut into slices and added to green fresh salad. Slices of the immature fruits are also pickled and either eaten fresh or added to cooked foods. Longitudinal *tibish* slices are also eaten with a sauce of hot pepper, salt and lime, making a very popular dish. Leaves of *tibish* plants are dark green. Flowers are yellow, but sometimes brighter yellow flowers are observed in both. *Tibish* accessions are dominantly andromonoecious. Fruits produced by *tibish* accessions are oval, oblate or elongate, although oval fruits are dominant. Fruit ribs are absent in almost all tibish fruits. Secondary fruit skin colour is observable on the fruits of *tibish* accessions. The design produced by such colour is mainly in the form of longitudinal stripes (Fig. 5). The fruit size of *tibish* is generally medium, with a length of around 15 cm, but exceptionally small fruits of about 8 cm or long fruits reaching about 25 cm can also be found. The fruit flesh of *tibish* is normally whitish or light green, more or less firm, not sweet and lacks aroma (El Tahir and Taha Yousif 2016).

***Cucumis melo* var. *agrestis* (Wild melon, wild musk melon, small melon, small gourd):** The native habitat of Wild Melon *(Cucumis melo* ssp. *agrestis* Synon.: *Cucumis melo* var. *agrestis)* is obscure but is presumably West Africa where the species occur wild and widely. Asia is certainly a second centre of diversity of the subspecies agrestis. It is a annual climber growing to

Fig. 5: Tibish melon

1.5 m. The species is monoecious (individual flowers are either male or female, but both sexes can be found on the same plant) and is pollinated by Insects. The plant is self-fertile. *Cucumis melo* ssp. *agrestis* is a Prostrate or climbing annual vine, stems 1.8 m long. leaves alternating along the stems, 2-9 cm long, 30-80 mm wide, rough, hairy, 3-7 lobed, with toothed margins. Male and female flowers on the same plant (Monoecious). Flowers tubular, yellow, with 5 lobes, solitary or in clusters of 2-4 on stalks arising from the bases of the leaves. Fruit green to yellow (Cunningham et al. 1992). The African melon *Cucumis. melo* subsp. *agrestis* Naudin is an andromonoecious, annual, trailing-vine plant. This subspecies is cultivated in many African regions for its edible kernels that can be used as a soup thickener preferentially during popular fetes and prestigious ceremonies (Leonie et al. 2009). Wild melon (*Cucumis melo* ssp. *agrestis* Syn: *Cucumis melo* var. *agrestis)* is one of the traditional vegetable crops that can be exploited in marginal lands in north Karnataka with minimum crop husbandry practice (Fig. 6). Even though it is an under-exploited Cucurbit, it has attained high value and occupied a pride place in rural cuisine because of its pleasant flavour with rich colours. It is commonly called as senat seed, small gourd, wild melon, wild musk melon. It is also called as *kachari* in Hindi, *shinde* in Marathi, *chibdin* in Konkani, *gumi* in Assames, *budamakayi* in Telugu and *mekkekayi* or *Hubballi southekayi* or *kanchikayi* or *gulagayi* in Kannada language. It is an ideal summer vegetable crop mainly growing for fresh vegetable as well as for pickling purpose. Fruits are varying in size, small to medium and big fruits with smooth tender skin, white flesh usually with little sweetness and odour (Ganiger et al.

Wild melon vine with leaves | Wild melon vine with fruit | Ripe fruits of wild melon

Fig. 6: Wild melon

2017). Wild melon is valued for its medicinal properties commonly used as a cooling agent, skin cleanser or moisturizer, first aid treatment for burns and abrasions. The root is diuretic and emetic. Sprouting of melon seeds produces toxic substance in its embryo and the seeds have antitussive, digestive, febrifuge and vermifuge properties. Fine powder of dried *kachari* is best natural meat tenderizer. The fresh fruits are used for making chutney, and pickling. Seeds are edible with the qualitative properties of oils fits the description of edible oils.

Intraspecific/Infraspecific Crossability of *Cucumis melo*

Pangelo (1951) reported that all the seven varieties of *Cucumis melo viz*., *Cucumis melo* var. *cantaloupensis* Naud.; *Cucumis melo* var. *reticulatus* Naud.; *Cucumis melo* var, *indorus* Naud.; *Cucumis melo* var. *flexuosus* Naud.; *Cucumis melo* var. *conomon* Mak.; *Cucumis melo* var. *chito* Naud.; and *Cucumis melo* var. *dudaim* Naud., hybridized readily with one another and there was apparently very little sterility even among progenies from crosses involving variant types.

According to Subha et al. (1986) the lines CS 26 (*Cucumis melo* var. *cocomon;* Oriental pickling melon) and CS 52 (*Cucumis melo* var. *momordica;* snap melon) collected indigenously, differed from other melon varieties for their plant habit and fruit characteristics. CS 26 (*Cucumis melo* var. *cocomon;* Oriental pickling melon) is grown in the midlands of Kerala (India) for ripened fruits. These fruits are stored in the open for up to one year for year round use. CS 52 (*Cucumis melo* var. *momordica;* snap melon) is grown on the coasts of Kerala during summer months for their ripened and cracked fruits which yield delicious flesh. The study was carried out to determine the compatibility of these two varieties with *Cucumis melo* var. *indorus* Naud. (winter melon); *Cucumis melo* var. *flexuosus* Naud. (snake melon); and *Cucumis melo* var. *utilissimus* Duth and Full (snake cucumber; synon: *Cucumis melo* var. *flexuosus* Naud). All the five botanical varieties of *Cucumis melo* were found to be crossable with each other. No significant reciprocal effect was observed indicating that the maternal parent did not have any influence on the crossability index. The crossability index was highest for Oriental pickling melon x long melon (79.19). and the lowest for muskmelon x snake melon (47.15%) It was less than 50% in muskmelon x snake melon, long melon x muskmelon, long melon x snap melon and snap melon x muskmelon. The crossability index was more than 70 percent in Oriental pickling melon x long melon and snake melon x Oriental pickling melon. In other crosses, the crossability index varied from 50 to 70%. The genetic divergence could also be considered as a measure of affinity. Muskmelon and snake melon were the most divergent (D^2 = 0.38). In the order of affinity, the five melon varieties could be arranged as Oriental pickling melon, long melon, snap melon, snake melon, and muskmelon. (CS 26 should be *Cucumis melo* var. *acidulous*, as all the South Indian landraces of culinary melon belong to *Cucumis melo* var. *acidulous*). *Cucumis melo* includes a wide range of cultivars. Although crosses outside the species are sterile, intra-specific crosses are generally fertile, resulting in a confusing range of variation (Purseglove 1968). However, USA's National Research Council reported that the intra-specific classification of this highly polymorphic species (*Cucumis melo*) is confusing. Several species and varieties have also been erected from time to time, but this may not be justified as all the forms hybridize readily and there are many intermediate types (NRC 2008).

Collection and Evaluation of Culinary Melon Germplasm

Culinary melon (*Cucumis melo* var. *acidulus*) is endemic to tropical humid Southern India and cultivated in Kerala, Karnataka, Andhra Pradesh and Tamil Nadu. Fruits have long shelf life. The tender fruits are consumed as salad or used for 'sambhar' preparation. Melon cultivars

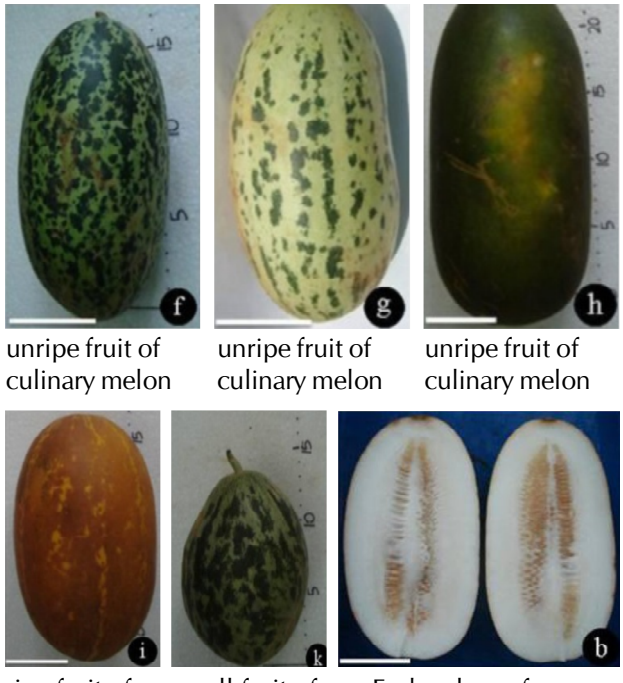

Fig. 7: Fruits of culinary melon landraces

present in India exhibit tremendous diversity, such as, shape, colour, biochemical composition and taste with respect to fruit and reported to have resistance to various bacterial and fungal diseases (Dhillon et al. 2012, 2014). Dosakai cucumbers are native to India and the immediate surrounding southern states and regions and have been grown since ancient times (Anon. 2020). Manohar and Murthy (2012) have collected 22 accessions of culinary melon (*C. melo acidulus)* from Haveri (5), Shimoga (3), Udupi (11) and Uttara Kannada (3) districts of Karnataka and evaluated them. The fruits of *acidulus* are used for cooking purpose, these fruits neither ripe, nor crack. The fruits were non-sweet. The ûesh was crisp and off white in colour. The rind was hard and had a very long shelf-life. The rind of the fruits can be correlated with that of shelf-life; the fruits with hard rind had a very long shelf-life and can be stored up to 4- 6 months. The maximum seed length was 10.2 mm (Manohar and Murthy 2012) (Fig. 7).

Seven districts of Kerala viz. Trissur, Malappuram, Wayanad, Kozhikod, Kasaragod, Kannur, and Thiruvananthapuram were surveyed and collected 15 accessions/ landraces of culinary melon. Six districts of Karnataka viz. Dakshina Kannada, Udupi, Uttara Kannada, Shimoga, Kodagu and Chitradurga were surveyed, and collected 40 accessions/ landraces of culinary melon. One seed collection was made from Hyderabad (Telangana) and 17 collections were made from Andhra Pradesh. Five collections from Tamil Nadu and 2 collections from Goa were also made. The 80 accessions were evaluated during 2018 and 2019 at College of Horticulture, Sirsi (Karnataka). The landraces of culinary melon (*Cucumis melo* var. *acidulus*) found in Kerala are locally called as kanivellari, fruits- elongated, golden yellow on maturity, with or without green patches, average wt of 1.5 to 2 kg with white flesh having sweat odour like *momordica*. Whereas Andhra Pradesh and Telangana landraces are round, small to medium in size, average weight of 250 g to 750 g, golden yellow with green patches to no stripe on maturity commonly known as dosakaya. The flesh was thinner than that of any other state landraces with sour taste. However, Karnataka landraces have lot of variability in fruit color, shape, and size. Variable colors from green to yellow with white to green patches, ablong to pyriform shape; weighs 2.0-2.5 kg; thick white, turgid and crunchy flesh with good taste. In coastal Karnataka (Udupi, Mangalore, Kumta, Honnavar, Bhatkal, Kundapur) golden yellow fruits with white to green patches with medium size marketable fruits are found in each and every vegetable shop. In Malnad Katnataka especially in Sirsi and Siddapur taluk of Uttara Kannada, green to dark green, big size fruits were grown during summer and fruits are stored up to 8-10 months (Shet et al. 2019). The landraces of culinary melon grown in South India are furnished in Fig. 8.

Fig. 8: Variability for fruit shape, size, and colour in the germplasm collected from South India

Growing Areas of Culinary Melon in South India

Culinary melon (*C. melo* var. *acidulus*) is used as vegetables rather than fruit. *C. melo* var. *acidulus* is widely cultivated in Southern India and used as a vegetable throughout the year since it has a long shelf-life (Manohar and Murthy 2014). Culinary melon (*Cucumis melo* var. *acidulus*) is endemic (restricted to a defined geographical area.) to tropical humid southern India and cultivated in Kerala, Karnataka, Andhra Pradesh and Tamil Nadu. Fruits have long shelf-life. The tender fruits are consumed as salad or used for 'sambar' preparation (Manoj and Murthy 2012). This vegetable is not quite easily available in the Northern parts of India. Now we can see it on the shelves of the supermarkets, Malls, Vegetable shops in cities like Bengaluru, Mysore and Chennai.

Culinary melon/Mangalore melon is an all time favorite vegetable crop grown in Malnad and coastal Karnataka especially Mangalore, Udupi, Uttara Kannada, Chikkamagaluru, Shivamogga, Hassan and Coorg districts; Kerala, Tamil Nadu, Tellangana, and Andhra Prdesh (Manohar and Murthy 2014). It is also grown in Gulbarga, Bijapur, Raichur, Bagalkot, Belgaum, Gadag, Koppal, Haveri, Mysore, and Davanagere. Survey was conducted at Sirsi and Yallapura, Siddapur, Kumta and Honnavar taluk of Uttar Kannada, Sagar, Hosnagara, Thirhalli, Soraba taluk of Shivamoga, Sringeri, Kadur taluk of Chickmagalore, Belthangadi, Ujire, Sulya, Mangalore taluk of Dakshina Kannada, Bramhavar taluk of Udupi, and Madikeri taluk of kodagu district. In Sirsi, Yellapur and Siddhapur most of the Brahmin farmers cultivated the crop for their own consumption during rainy season. The farmers are cultivating crops mainly for marketing especially for culinary purpose in Temple as well as big functions like marriages, conferences (Shet et al. 2019).

More and more farmers are attracted to vegetable cucumber/ culinary melon cultivation as they find it a lucrative crop. It takes hardly two-three months for the harvest. Earlier, truck loads of *kani vellari* for *Vishu* used to come from Tamil Nadu and Kanataka. The area under cultivation of vegetable cucumber has increased considerably during the last few years. Now, the local farmers are offering a sizeable quantity of vellari to the *Vishu* market. Vegetable cucumber has been cultivated on hectares of land in Kadavallur, Kattakambal, Kadangode, Velur panchayats in Chovvannur block, says Ms. K.S. Sreedevi, Field Assistant of ATMA (Agriculture Technology Management Agency). "Kudumbasree units and individual farmers are doing the cultivation in their own land and sometimes in leased land. The cultivation generally starts soon after the paddy harvest. However, shortage of water prevents farmers from expanding the area under cultivation" says Ms. Sreedevi (Staff Reporter 2013). In Guntur and East Godavari districts of Andhra Pradesh sambar southekayi is grown. It is called dosa sagu, kurakayalu in Telugu. It is a summer season crop; grown from November to June. It is being grown in sandy oils (*isuku bhumi*) in Baptla and Godavari riverbed. Because of sand mining in Godavari river bed, the area of this crop is getting reduced (Personal Communication). Moreover, in Tamil Nadu and Pondicherry culinary melon is like Kerala types and it is grown in a limited area, that too in Pondicherry region. In Goa state, Mangalore melon/ southekayi (moghe- Konkani Name) is not cultivated but used as vegetable in a few fish curries. This vegetable goes from coastal and other parts of Karnataka.

Crop Improvement in Culinary Melon

Evaluation of germplasm: Among the 24 culinary melon genotypes tested for their performance for fruit fly incidence under northern dry zone of Karnataka, the genotypes viz. Sirsi Local followed by BCMCO-01 BCMCO-02 and BCMSO-03 were found with least infestation of cucurbit fruit fly. However, the powdery mildew incidence was less in genotypes like Mysore Local, Sirsi Local and Thirthalli Local. Among the genotypes BCMCO-02, Sirsi Local and BCMSO-03 had shown moderate resistant to the downy mildew disease. These genotypes were found better as compared to the released (Kerala varieties) varieties which could be used as sources for further crop improvement programmes (Gondi et al. 2016). During the year 2010-2011 evaluation of 25 culinary melon F1 hybrids for yield, quality and pest and diseases was done at UAS, Bengaluru. The F1 hybrid CMC GKVK 1 X CMC GKVK 2 have shown better performance for characters such as fruit length and fruit diameter, while the F1 hybrid CMC GKVK 2 X CMC GKVK 4 performed well for other characters such as per cent fruit set, number of fruits, total fruit yield per vine and also it was moderately resistant to powdery mildew. However, the fruit flesh thickness and total soluble solids were high with the F1 hybrid CMC GKVK 1 X CMC GKVK 12 (Thyagaraj et al. 2014).

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Breeding for shelf-life: An important property of *acidulus*, i.e. shelf-life, can also be explored by breeders to develop better melon varieties with longer shelf-life. Some melon varieties were classiûed as climacteric fruit, causing a huge market loss within a short time between harvest and consumption. Poor keeping quality limits their wide commercial acceptance, and thus long shelflife has become an indispensable character in modern cultivars of melon (Fergany et al. 2011). The

landraces of culinary melon collected from Kerala state showed increased shelf-life. This important trait of *acidulus*, i.e. shelf-life, can be explored by breeders to develop better melon varieties with longer shelf-life (Manohar and Murthy 2012).

Breeding for pest and diseases resistance: Melon germplasm (*acidulus* and *momordica*) of Southern India have shown to possess resistance to Cucumber mosaic virus, Zucchini yellow mosaic virus, Powdery mildew (races 1, 2, 3, 5), Fusarium wilt (races 1, 2) (Fergany et al. 2011). Melon germplasm (*acidulus* and *momordica*) of Southern India has shown to possess resistance to *Aphis gossypii* and leaf miner (Fergany et al. 2011). Pest and different agents, such as bacteria, fungi and viruses are known to provoke diseases and great losses in melons. Their distribution and impact on melon plants vary around the world. *Fusarium* wilt, powdery mildew, *Alternaria* leaf blight and gummy stem blight are among the important fungal diseases known. The landraces of culinary melon collected from Kerala state should be assessed for disease resistance characteristics by using molecular markers. These landraces need to be analyzed for their ability to be used as bred cultivars for commercial breeding purpose (Sunita and Murthy 2013).

Vegetable melons are grown almost all over Sudan. Potential of indigenous Sudanese melons as sources for genetic resistance has been reported. Resistance to different pests and diseases was found to be much more common among the Sudanese melon types *tibish* and *agrestis*, than among other cultivated melons. Both types are of a truly indigenous nature, as Humaid melons are wild *agrestis* melons growing naturally in the country, while Tibish melons seem to be unique to Sudan and only landraces are being cultivated. Diseases against which important promising results were obtained included *Fusaium* wilt, powdery mildew, ZYMV, CABYV and WCSV. Resistance against some newly emerging disease syndromes was also identified within such indigenous melons. Moreover, sources of resistance against some insects such as white fly, leaf miner and fruit fly were also identified. Detection of genetic resistance to different pests and diseases seems to be potentially high within the Sudanese wild *agrestis* melon (Humaid) for almost all fungal and viral diseases and insect pests tested (El Tahir and Taha Yousif 2016).

High Yielding Varieties of Culinary Melon

Mudicode: This variety was released by Kerala Agricultural University (KAU), Trichur. It gives an average yield of 30.4 tonnes per hectare. This variety can be grown in home gardens and in commercial farms as well. The fruit size will be 1.8-2.5 kg each. The attractive oval- shaped fruits can be harvested from 55-60 days after sowing, and the crop will last until 79 or 88 days. The early- maturing variety 'Mudicode is ideally suited for growing in Thrissur, Palakkad and Ernakulam districts. It is recommended that the variety should follow a spacing of 2 m x 1.5 m. About 500-750 g seeds will be required to cover a hectare (Agri.Correspondent 2001).

Arunima: This variety was released by Kerala Agricultural University (KAU), Trichur. This improved variety developed from a local type collected from Kasaragode district, is also an early- maturing type, and it is ideally suited for rice fallows during summer. It has a spreading growth habit with branched stem. The leaves are broad with hairy veins and petioles. Male flowers are produced in clusters, while female flowers are solitary. Fruits are large and attractive with uniform cylindrical shape. The fruits are bright green with creamy spots when tender, and they turn orange yellow upon ripening. The average length of the fruit is 33.14 cm and the girth 40.72 cm. The flesh thickness of the fruit is 3.6 cm, and each fruit will contain about 645 seeds. The average fruit weight is 2.3 kg at full maturity. The total duration of the crop is 60 days. It is relatively tolerant to downey mildew but is susceptible to mosaic disease under field conditions. The average yield under normal field practices is 27 tonnes per hectare. The fruits are of good quality with a long shelf life. Under normal storage conditions, the fruits can be kept without spoilage for up to 90 days. Hence, this is an ideal variety for off-season marketing. The variety should ideally be sown in the second week of January, and the harvest can be had in the first week of April enabling the farmers to get premium price in the market (Agri.Correspondent 2001).

Saubhagya: This is a variety released by Kerala Agricultural University (KAU), Trichur. It is a short duration, less vigorous high yielding variety, maturing in 65-70 days and is suitable for high density planting. Other good qualities of Saubhagya, like concentrated fruiting and small attractive fruits, led to its wide acceptance among the vegetable growers of Kerala state. High density planting needs more nutrients than the crop planted at the normal recommended spacing (Ningaraju and Joseph 2014). In addition to these high yielding varieties, farmers are also growing many local types or landraces of culinary melon or Mangaluru melon in South India.

Cultural Practices for Culinary Melon

Cultural practices followed for musk melon is to be followed**.** However**, t**he cultural practices followed by farmers in Dakshina Kannada district are furnished. After harvesting paddy in October, the land is ploughed and leveled. In the paddy fallows seeds can be sown from Dec-June. Summer moths are good. 15 cm deep and 60 cm wide trenches are prepared at a spacing of 2 m; and 60 cm wide irrigation channels are also prepared. Soil is loosened in the trench; weeds and other things are removed. Poultry manure is added and mixed with soil. Sambar southekayi seeds are soaked in water for 24 hours; then the seeds are mixed with little kerosene. This will prevent the damage of seeds by ants. Seeds are sown in line in the trenches. Seeds are sown in line in the trench; then covered with soil. Plant to plant spacing is 22.5 cm; the extra seedlings are removed with some soil/ball of earth and planted elsewhere. After germination of seeds at 3 leaf stage suphala is applied away from the root zone and covered with soil. After 3 days of suphala application, the soil is drenched with cow dung water. Then the trench is filled with little soil. After 3 days of this, poultry manure is applied. After 3 days of this suphala is applied. 21 days after seed sowing, the plants will start vining. At this stage little soil is put at the base of plants (earthing up). Crop is sprayed with Roger at the time of vining and flowering. Fruits are harvested at weekly intervals; 5-7 harvests can be made. For local market immature fruits/green fruits are harvested. For storage purpose or for seed extraction, fully ripe fruits are harvested. The Average fruit weight will be 1.5 kg; 8-10 fruits per plant can be harvested (Fig. 9). In the beginning the fruit weight will be more; then the subsequently harvested fruits will have reduced weight. An average yield of 100-120 q of fruits can be harvested from an acre. Crop duration is 65-75 days. The fruits can be stored for 6 months; after 40 days of storing, the fruits develop orange colour. After 6 months of storage, the seeds will germinate inside the fruits; therefore, the taste of the fruit gets reduced (Personal communication).

Nutritive Value

Madras cucumbers are an excellent source of fibre, especially when they are unpeeled. Rich in vitamins A, C, E and K, they also contain antioxidants that help to delay the ageing process. But most importantly, they have an easy, agreeable flavour that is enhanced even by simple accoutrements. That's as good a reason as any to give these colourful gourds a try (Vidya 2012; Economic Times 2012). According to Mangalore based nutritionist Sharavati Rao. "They are extremely rich in antioxidants and vitamins A, C, and E. They can help prevent macular degeneration in the eyes. The antioxidants in these seeds can keep blood cholesterol under check and decrease the risk of cancer. In fact, the vitamin C fights cold and flu by boosting immunity. Apart from being a great source of minerals like magnesium, phosphorous and potassium that regulate blood pressure." (Pawar 2016). **Culinary melon** is low in fat and cholesterol. The flesh is primarily composed of water but also contains ascorbic acid **(vitamin C)** and caffeic acid, both of which help soothe skin irritations and reduce swelling. Its hard skin is rich in fiber and contains a variety of beneficial minerals including silica, potassium and magnesium. The silica in culinary melon is an essential component of **healthy** connective tissue, which includes muscles, tendons, ligaments, cartilage, and bone. Fruit **juice** is often recommended as a source of silica to improve the complexion and health of the skin, plus its high-water content makes it naturally hydrating-a must for glowing skin. Fruits have around 95 % of water content which is a great way to increase the fiber and water intake. There is a high content of **vitamins A, B6** and **C** present in the flesh of the fruit**.** In addition to that these fruits are known to have a high concentration of minerals such as calcium, potassium, magnesium and silica. The nutritional values per 100 g of cucumbers without peel are: Carbohydrates: 3.63 g Sugars: 1.67 g Dietary Fiber: 0.5 g Fat: 0.11 g Protein: 0.65 g Thiamin (Vitamin B1): 0.027 mg Riboflavin (Vitamin B2): 0.033 mg Niacin

Field preparation

Sambar southekayi plants

Stored fruits

Fig. 9: Growing of culinary melon

(Vitamin B3): 0.098 mg Vitamin B6: 0.040 mg Calcium: 16 mg Iron: 0.28 mg Magnesium: 13 mg Phosphorus: 24 mg Potassium: 24 mg Zinc: 0.20 mg (Anon. 2017, Swamy 2017).

The *sambar* cucumbers are rich in vitamins A and C and are filled with antioxidants and micronutrients. They also contain a small but suprising percentage of proteins and fats, perfect vegetarian diets that are generally deficient in them. The small, slightly bitter seeds are also used extensively in the cosmetics industry (Aravamudan 2018). Mangalore melons are an excellent source of fibre, especially when they are unpeeled. Rich in vitamins A, C, E and K, they also contain antioxidants that help to delay the ageing process. But most importantly, they have an easy, agreeable flavor. They also contain minerals such as magnesium, phosphorous, and potassium (Economic Times 2012, Speciality 2019). *Dosakaya* cucumbers are a rich source of dietary fiber, eliminating toxic compounds from the gut, and also contain vitamins C, E, and K, potassium, and magnesium (Specialty Produce 2020). The nutritional profile and medicinal properties of non-conventional vegetable *Cucumis melo* var *agrestis* were estimated. Ash content with 3.8 percent moisture 80.9 percent, carbohydrate content 31.2 percent, protein content was 18.9 percent in fruit part. However, the presence of Phenolic compounds alike total alkaloids and total Tannis was also observed, beside this the heavy metals was found available and analysis shows presence of Cu, Fe, Zn, Co with 138, 141, 17.6 and 0.03 of ppm concentration were found respectively, although very minute concentration of Mn, Pb and Cd perceived below the limit of detection. Hence it was concluded from present study that *Cucumis melo* var *agrestis* (Fruit) was found nutritious that can be used as food to overwhelm the situation of malnutrition (Memon et al. 2018).

Medicinal Value

The traditional knowledge of farmers says it has lot of medicinal usage from human being to pet animals. Consumption of Culinary melon flesh during summer reduces the dehydration and avoids body heat. The extracted juice from seeds is used against dyspepsia (indigestion) and also as body heat reducer. The entire fruit will be given to cow and buffello to remove/digest the newborn calf's umbilical cord (personnal communication). The fruits which contain moderate amount of vitamins and mineralsThe fruits possess cooling properties and are used as a skin moisturizer and as a digestive agent. Even seeds are used for preparation of juice against dyspepsia (indigestion). They are as easy to grow as any other melons and are very productive (Lakshmi et al. 2017). The fruits of *Cucumis melo agrestis* can be used as a cooling light cleanser or moisturiser for the skin. They are also used as a first aid treatment for burns and abrasions. The flowers are expectorant and emetic. The fruit is stomachic. The seed is antitussive, digestive, febrifuge and vermifuge. When used as a vermifuge, the whole seed complete with the seed coat is ground into a fine flour, then made into an emulsion with water and eaten. It is then necessary to take a purge in order to expel the tapeworms or other parasites from the body. The root is diuretic and emetic. A paste of the plant is applied as a poultice around the naval when there is difficulty in urinating (PFF 2020).

Uses

Mangalore melons or culinary melons are rarely eaten raw and are best suited for boiling, stir-frying, or pickling. They are commonly sliced and boiled in *sambar*, which are lentil-based stews of Southern India and are sliced and added to curries or stir-fries. They are also diced in chutneys, mixed with salt, water, and spices to create pickles, or grated into *dosas* which are fermented rice or gram flour pancakes. They pair well with tamarind, garlic, onions, chillies, and coconut (Agri.Correspondent 2001, WIKI 2017, Speciality 2019). *Dosakaya* is a yellow Indian curry cucumber. It has mild sweet taste and neutral flavor. It is used extensively in the preparation of stews and curries, particularly during the summer season in southern parts of India and Sri Lanka. Dosakai cucumbers are best suited for both raw and cooked applications such as stir-frying, sautéing, and boiling. They can also be used in sambar curry, stews, kootu or stir-fry, kurma, or used as a replacement for potatoes in soup. Some of the most popular dishes in India that use *dosakaya* cucumbers are *dosakaya pachdi*, *dosakaya paruppu*, stuffed *dosakaya* curry, *dosakaya* sambar, and *dosakaya* fish curry. In addition to savory preparations, *dosakaya* cucumbers can also be sliced and used for pickling. *Dosakaya* pairs well with mustard seeds, curry leaves, turmeric, cumin, ginger, onions, garlic, sesame seeds, coriander, lentils, tomatoes, spinach, green beans, okra, eggplant, eggs, chicken, potatoes, coconut, and mango. They will keep for a couple of weeks when stored in the crisper drawer (of the refrigerator. *Dosakaya* avakai pickles are a household staple. The pickling process is quick, and the dish is ready in twenty-four hours, unlike the traditional mango pickle which takes a week. Indian pickles are very salty, spicy, and can be added to a wide variety of dishes or consumed as a standalone snack (Specialty Produce 2020).

Mangalore melon also finds the maximum number of uses in the cuisines of Tamil Nadu, Andhra Pradesh and coastal Karnataka. Its mild flavour lends itself well to strong, fragrant preparations such as sambar. But it seems to find particular favour in traditional Mangalorean vegetarian recipes. It takes cooking to bring out the best in it. And it handles heat just fine, holding its own and not falling to pieces even after a long simmering in a spice bath (Economic Times 2012). *Dosakaya* is a yellow cucumber available in Andhra Pradesh. These fruits are generally spherical in shape. They are commonly cooked as curry, added in sambar or soup, daal, and also in making *dosa-aavakaaya* (Indian pickle) and chutney. It is a smooth skinned fruit, relatively hard, and not used for salads. It is cooked as spicy curry. It becomes orange colored when the fruit is matured. Many dishes are prepared in Andhra Pradesh using dosakaya such as *dosakaya talimpu, dosakaya pachadi, dosakaya ooragaya, dosakaya pappu, dosakaya pulusu*, *dosakaya sambar* and *dosakaya perugu pachadi*. It is used to make tangy (a sharp taste or smell) curries and is also simply stir-fried, sometimes with a coconut and raw mango paste, to make a palya or vegetable side dish **(Vidya 2012).** In the local language, this melon is known as '*vellari*' and the tender fruits are consumed as salad and matured fruits are used for '*sambhar*' preparation. '*sambar*', a vegetable stew based on a broth with tamarind and 'toor dal' (small lentils), is a dish common in south India and Sri Lanka Tamil cuisines (Manohar and Murthy 2012). The fruits of *acidulus* are used for cooking purpose in northern Karnataka. These fruits neither ripe nor crack. The fruits of *acidulus* are non-sweet. The ûesh of the fruits of *acidulus* was crisp and off white in colour. The rind of *acidulus* was hard and had a very long shelf-life (Manohar and Murthy 2012). **Culinary melons or yellow cucumbers** resembling a **lemon** in appearance, the flavor is more delicately **sweet** and less acidic than the common **green cucumber. Culinary melons or yellow cucumbers** (tender ones) could also be eaten fresh and can be **pickled** when they get ripen (Anon. 2017).

Cultural Significance

The general belief is that the sambar southekayi or Mangalore melon symbolises everything positive about life. The vegetable is an integral part of 'Vishukanni', because the Malayali believes that sighting it after waking up at dawn on the *'Vishu'* day would prove auspicious for him or her for the rest of the year (Staff Reporter 2013). The day of Vishu in the Malayali tradition signifies the sun's transit into the *Meda Raasi* (first solar month). The Vishu marks the first day of the astronomical year and hence Lord Vishnu and his incarnation Lord Krishnn are worshipped on the day of *Vishu*, as Lord Vishnu is considered as the God of Time. It was on this day that Lord Krishna killed the demon Narakasura and because of this Krishna idols are kept in the *Vishu kani*. The Vishu has been celebrated in Kerala from the reign of Sthanu Ravi since 844 A.D. The Malayalam word "kani" literally means "that which is seen first", so "*Vishukkani*" means "that which is seen first on *Vishu*". The traditional belief is that one's future is a function of what one experiences, that the New Year will be better if one views auspicious joyful things as the first thing on *Vishu*. Therefore, Malayali's spend the day before preparing a setting, usually a tray, of auspicious items. This setting is the first thing they see when they wake up on the *Vishu* day. The highlight of every *Vishukkani* bowl is the '*Kanivellari*' (golden cucumber/golden melon) for sure. Most of the people go straight to the Vishu markets and buy the best cucumber available to prepare *Kani* next day (Wikipedia 2020).

With an eye on *Vishu*, farmers have started switching over to the cultivation of sambar southekayi. A bumper harvest will stand them in good stead because there is going to be a heavy demand for the vegetable during *Vishu* festival in Kerala. As paddy farming has not been profitable in recent times, the farmers have been forced to think out-of-the-box. They have found February suitable to start growing this vegetable, because the plants need at least two months to be ready for harvest. As '*Vishu*' falls in April, the farmers look forward to a good yield which would fetch them handsome returns in the market (Staff Reporter 2013).

Conclusion

- Culinary melon or Mangalore melon (*Cucumis melo* var. *acidulous*) is a botanical variety of *Cucumis melo* L. It is grown in localised sub–regions unlike dessert melons grown everywhere. One such region consists of Karnataka, Tamil Nadu, Kerala Andhra Pradesh, and Telangana in South India.
- The non-dessert or culinary forms of *Cucumis melo* are a distinct group distributed and adapted well essentially under humid tropics of Southern India.
- Culinary melons or South Indian melons have a special feature that the fruits can be stored under room temperature up to 8-10 months without losing their freshness. They can be stored for many weeks by hanging them from the ceiling, firmly bound by thin coconut fibre ropes.

- This ethnic vegetable is used for preparation of various culinary items. It has a variety of common names viz., vellari, vellarikka, Mangalore melon, Mangalore *southekayi*, *Kanivellari,* Malbar cucumber, Madras cucumber, culinary melon.
- According to Swami Virendra Bhat, in charge of the community kitchen at the Dharmasthala shrine in Karnataka's Malnad region Mangalore *southekai* (Mangalore melon) predate the arrival of the British to India".
- Culinary melon or Mangalore melon must have originated independently from its monoecious wild relative (*Cucumis melo* subsp. *agrestis*), probably in the earstwhile Dakshina Kannada district or West coast region of South India.
- Some authors (Subha et al. 1986, Silpa et al. 2000) have used the botanical name, *C. melo* var. c*onomon* for culinary melon of South India. But correct botanical name for culinary melon of South India is *C. melo* var. *acidulus* (Manohar and Murthy 2012, Manoj and Murthy 2012, Sunita and Murthy 2013, Manohar and Murthy 2014).
- *Cucumis melo* includes a wide range of botanical varieties. Although crosses outside the species are sterile, intraspecific crosses are generally fertile, resulting in a confusing range of variation (Purseglove 1968). However, USA's National Research Council reported that the intraspecific classification of this highly polymorphic species (*Cucumis melo*) is confusing. Several species and varieties have also been erected from time to time, but this may not be justified as all the forms hybridize readily and there are many intermediate types (NRC 2008).

सारांश

सब्जी पाक खरबूजा या मेंगलोर खरबूजा या दक्षिण भारतीय खरबूजा (कुकुमिस मेलो वार. एसीडुलस) सामान्य खरबूजा (कुकुमिस मेला एल.) की एक वानस्पतिक प्रभेद है। यह सीमित स्तर पर खरबूजा उगाने वाले सभी जगहों पर स्थानीय रूप से उगाया जाता है। ऐसा ही क्षेत्र दक्षिण भारत के कर्नाटक, तमिलनाडु, केरल, आन्ध्र प्रदेश एवं तेलंगाना में पाया जाता है। पकनीय रूप या गैर मिठाई प्रभेद कुकुमिस मेलो से भिन्न समूह वितरित है और दक्षिण भारत के आर्द्र कटिबंध में अनुकूलन ज्यादा हैं। सब्जी खरबूजा के फलों को कमरे के सामान्य तापक्रम पर 8–10 महीने तक बिना ताजापन समाप्त हुए भण्डारित करने का विशिष्ट गुण पाया जाता है। इन्हें नारियल के रेशा से बनी रस्सी के सहारे छत के नीचे लटकाकर कई सप्ताह तक रखा जा सकता है। इसे संजातीय सब्जी को कई प्रकार के पाक व्यंजन बनाने में उपयोग किया जाता हैं। किस्मों के अनेको सामान्य नाम जैंसेः वेल्लारी, तेल्लारीका, मेंगलोर खरबूजा साउथेकाई, कानी वेल्लारी, मालाबार खीरा, मद्रास खीरा, सब्जी पाक खरबूजा से जाना जाता है। यह पुननिरीक्षण परिचय, कुकुरबिटेसी कुल, सब्जी पाक खरबूजा/मेंगलोर खरबूजा, उद्भव एवं वितरण, वनस्पति एवं कुकुमिस मेलो का वर्गीकरण पर आधारित है। कुकुमिस मेलो के कुछ वानस्पतिक किस्मों का विवरण कुकुमिस मेलो से अन्तर्राप्रजातीय/अन्तःप्रजातीय संस्करण, सब्जी पाक खरबूजा के जनन द्रव्यों का एकत्रीकरण तथा मूल्यांकन, दक्षिण भारत के क्षेत्रों में खेती करना, फसल उन्नयन अधिक उपज देने वाली किस्मों, सस्य पद्धतियों, पोंषकीय मूल्यों, औषधीय मूल्यों, उपयोग तथा सांस्कृतिक महत्व को भी दर्शाता है।

Refeences

Agri.Correspondent (2001) High yielding varieties for Kerala. The Hindu. July 12, 2001.

Akashi Y, Fukuda N, Wako T, Masuda M and Kato K (2002) Genetic variation and phylogenetic relationships in East and South Asian melons, *Cucumis melo* L., based on the analysis of five isozymes. Euphytica 125: 385–396.

Anonymous (2017) Yellow cucumber (*dosakaya*). HiGrow Seeds. Cucumber non-hybrid seeds. http://www.seedbasket.in/Yellow-cucumber-dosakaya

Anonymous (2020) Dosakai information, recipes and facts. specialtyproduce.com/produce/Dosakai_10150.php

Aravamudan Sriram (2018) The greenskeeper: Madras cucumbers. Bangalore Mirror Bureau. 19 Feb 2018.

Cunningham GM, Mulham WE, Milthorpe PL and Leigh JH (1992) Plants of Western New South Wales. Jan 1992, pp 625.

Dhillon NP, Ranjana R, Singh K, Eduardo I, Monforte AJ (2007) Diversity among landraces of Indian snapmelon (*Cucumis melo* var. *momordica*). Genet Resour Crop Evol 54 (2007) 1267-1283.

Dhillon NP, Monforte AJ, Pitrat M, Sudhakar P, Singh PK., Reitsma KR, Garcia-Mas J, Abhishek S and McCreight JD (2012) Melon landraces of India: Contributions and importance. Plant Breed Rev 35: 85-150.

Dhillon NP, Singh H, Pitrat M, Monforte AJ and McCreight JD (2014) Snapmelon (*Cucumis melo* L. Momordica Group), an indigenous cucurbit from India with immense value for melon breeding. XXIX International Horticultural Congress: Sustaining Lives, Livelihoods and Landscapes (IHC-2014): 1102.

Dwivedi NK, Dhariwal OP, Krishnan SG and Bhandari DC (2010) Distribution and extent of diversity in *Cucumis* species in the Aravalli ranges of India. Genetic Resources and Crop Evolution 57: 443–452.

Economic Times (2012) Madras cucumber: Finding the origins of this South Indian vegetable. The Economic Times, 9.12.2012.

Eflora (2007) *Cucumis melo* subsp. *agrestis* var. conomon. Efloraofindia (Database of Indian Plants- developed by the members of Efloraofindia Google Group).

El Tahir LM and Taha Yousif M (2016) Indigenous melons (*Cucumis melo* L.) in Sudan: a review of their genetic resources and prospects for use as sources of disease and insect resistance.

Fergany M, Kaur B, Monforte A, Pitrat M, Rys C, Lecoq H, Dhillon N and Dhaliwal S (2011) Variation in melon (*Cucumis melo*) landraces adapted to the humid tropics of Southern India. Genet Res Crop Evol 58: 225-243.

Ganiger VM, Balesh Goudappanavar, Shruti Gondi and Bhuvaneshwari G (2017) Evaluation studies of wild melon (*Cucumis melo* subsp. *agrestis*) genotypes for growth, yield and quality traits. Int J Pure App Biosci 5 (2): 1132-1137.

Grebenscikov I (1953) Die entwicklung der melonensystematik (ein beitrag zur systematik der kulturpflanzen). Kulturpflanzen 1: 121–138.

Gondi Shruti P, Ganiger VM, Bhuvaneshwari G, Madalageri MB, Kotikal YK and Manjunatha G (2016) Evaluation of Oriental pickling melon (*Cucumis melo* L var *conomon*) genotypes for pest and disease reaction under Northern dry zone of Karnataka. J Environ Ecol 7 (1): 29-36.

Jeffrey C (1990) Systematics of cucurbitaceae: An overview. In DM Bates, RW Robinson and C Jeffrey [eds] Biology and utilization of the cucurbitaceae 77–95. Cornell University Press, Ithaca, NY, USA.

Jeffrey C (2005) A new system of cucurbitaceae. Biot Zhurm 90: 332-335.

Jisha MS, Suhara Beevy S and Nair GM (2011) Species relationship in the genus *Cucumis* L. revealed by crossability, chromosome pairing and seed protein electrophoresis. The Nucleus 54: 35-38.

Khale Aarti (2019) Efloraofindia. https://sites.google.com/site/efloraofindia/species/a—l/cl/cucurbitaceae/cucumis/cucumis-melo-l-subsp-melo/cucumis-melo-subsp-*agrestis*/cucumis-melo-subsp-*agrestis*-var-conomon.

Kirkbride Jr Joseph H (1993) Biosystematic monograph of the genus *cucumis* (cucurbitaceae): Botanical Identification of Cucumbers and Melons. U.S. Department of Agriculture Agricultural Research Service, Systematic Botany and Mycology Laboratory, Beltsville, Maryland 20705-2350, USA, Parkway Publishers, Boone, North Carolina.

Lakshmi ML, Lingaiah HB, Mohan Rao A, Putta Raju TB, Pitchaimuthu M and Gowda DM (2017) Research note: Variability and genetic divergence studies for economic traits in indigenous oriental pickling melon (*Cucumis melo* var. *conomon*) genotypes. Electr J Plant Breed 8(1): 365-370.

Leonie Kouonon C, Jacquemart, Anne-Laure, Zoro Bi1, Arsene I, Bertin, Pierre, Baudoin, Jean-Pierre and Dje Yao (2009) Reproductive biology of the andromonoecious *Cucumis melo* subsp *agrestis* (Cucurbitaceae). Ann Bot 104: 1129–1139.

Liu L, Kakihara F and Masahiro K (2004) Characterization of six varieties of *Cucumis melo* L based on morphological and physiological characters including shelf-life of fruit. Euphytica 135: 305-313.

Manohar SH and Murthy HN (2012) Estimation of phenotypic divergence in a collection of *Cucumis melo*, including shelf-life of fruit. Scientia Horticulturae 148: 74–82.

Manohar SH and Murthy HN (2014) Fatty acid profile of *Cucumis melo* var *acidulous* (culinary melon) seed oil. J Amer Oil Chem Soc 91 (5): 815-816.

Manoj Godbole and Murthy HN (2012) In vitro production of haploids via parthenogenesis in culinary melon (*Cucumis melo* var. *acidulus*). Indian Journal of Biotechnology 11: 495-497.

McCreight JD and Staub J (1993) Report of the cucurbit working group. USDA-ARC, Washington, DC, USA.

Memon MN, Ghanghro AB, Memon AR, Usman G, Shah AM and Abro A (2018) Nutritional profile and medicinal properties of *Cucumis melo* var *agrestis:* A non-conventional vegetable. Sindh University Research Journal (Science Series), 50(1): 115-118.

Munger HM, Robinson RW (1991) Nomenclature of *Cucumis melo* L. Cucurbit Genetics Cooperative Report 14:43–44.

Munshi AD and Alvarez JM (2005) Hybrid melon development. Journal of New Seeds 6(4): 321-360

Naudin C (1859) Essais d' une monographie des especs et des varieties du genre Cucumis. Annales des Sciences Naturelles 11: 5-87.

Ningaraju GK and Joseph PA (2014) Effect of drip fertigation on growth and yield of oriental pickling melon (*Cucumis melo* var *conomon* (L.) Makino) under high density planting. Int J Sci Res Publ 4(6): 1-5.

NR C (2008) Melon. In: Lost crops of Africa. Vol. III: Fruits. Washington, DC, The National Acadmies Press, pp 135-147.

Nuñez-Palenius HG, Gomez-Lim M, Ochoa-Alejo N, Grumet R, Lester G and Cantliffe DJ (2008) Melon fruits: Genetic diversity, physiology and biotechnology features. Crit Rev Biotechnol 28(1): 13-55.

Pangelo KI (1951) Wild melons. Bull Appl Bot Genet Plant Breed 23:545-560.

Parthasarathy VA and Sambandam CN (1980) Taxonomic position of dosakaya (*Cucumis* sp.) - The acid melon of India. Cucurbit Genetics Cooperative Report 3:63.

Pawar Yogesh (2016) Madras, Mangalore and a yummy cucumber. DNA (Mumbai), February 28, 2016.

PF (2019) *Cucumis melo* var *flexuosus*. Plant Finder. www.missouribotanicalgarden.org/PlantFinder/PlantFinder...

PFAF (2012) *Cucumis melo* melon, cantaloupe. Plants for A Future Plant Database (1996-2012), pfaf.org/user/Plant.aspx?LatinName=Cucumis+Melo.

PFF (2020) *Cucumis melo agrestis* – (Naudin.) Pangal. Plants for a future. https://pfaf.org/user/Plant.aspx? LatinName= Cucumis +melo+agrestis.

Pitrat M, Hanelt P and Hammer K (2000) Some comments on interspecific classification of cultivars of melon. Acta Hortic 510:29–36.

Pitrat M (2008) Melon. In: Prohens J.and Nuez F[eds], Handbook of plant breeding –Vegetables I: Asteraceae, Brassicaceae, Chenopodicaceae and Cucurbitaceae. Springer Science+Business Media, LLC, New York, pp 238 317.

Pitrat M (2013) Phenotypic diversity in wild and cultivated melons (*Cucumis melo*). Plant Biotech 30: 273–278.

Pitrat M (2017) Melon genetic resources: phenotypic diversity and horti-cultural taxonomy. Pp 25–60. In: R. Grumet et al. [eds.] Genetics and genomics of Cucurbitaceae. Springer, Berlin, Germany.

Robinson RW and Decker-Walters DS (1997) Cucurbits. CABI, Wallingford, UK.

Schaffer AA and Paris HS (2003) Melons, squashes and gourds. In: B. Caballero et al.(eds) Encyclopedia of Food Sciences and Nutrition. Academic Press, N.Y.

Sebastian P, Schaefer H, Telford IRH and Renner SS (2010) Cucumber (*Cucumis sativus*) and melon (*C. melo*) have numerous wild relatives in Asia and Australia and the sister species of melon is from Australia. Proceedings of the National Academy of Sciences, USA 107: 14269–14273

Shet Ratnakar M, Shantappa T, Shivanand Hongal, Veeresh SM, Sujatha P, Raghavendra Gunnaiah and Jagadeesha RC (2019) Collecting and evaluation of culinary melon germplasm accessions in India. South East Asian Vegetable Symposium, Malacca, Malaysia, from 9-11 July 2019, pp 78-79.

Silpa R, Anitha P, Pradeepkumar T, and Laly John C (2000) Chacter association and path analysis for horticultural traits and fruit-fly infestation in Oriental pickling melon (*Cucumis melo* var *conomon* Mak.). Vegetable Science 47(1): 85-92.

Singh Gurcharan (2013) Know your fruits and vegetables: Cucurbits. Power Publishers, Kolkata.

Speciality (2019) Malabar cucumbers. Speciality Produce, https://www.specialtyproduce.com/produce/Malabar_Cucumbers_15804.php

Specialty Produce (2020) Dosakai information, recipes and facts. Specialty Produce. https://specialtyproduce.com/produce/Dosakai_10150.php.

Staff Reporter (2013) Farmers find cucumber cultivation lucrative. The Hindu. Thrissur, February 17, 2013 http://www.thehindu.com/todays-paper/tp-.

Stepansky A, Kovalski I and Perl-Treves R (1999) Intraspecific classification of melons (*Cucumis melo* L.) in view of their phenotypic and molecular varia-tion. Plant Systematics and Evolution 217: 313–333.

Subha MM, Gopalakrishnan PK, and Peter KV (1986) Compatibility among *Cucumis melo* varieties *inodorus, acidulous*, *flexosus, momordica* and *utilissimus*. Cucurbit Genetics Coop Rept 9: 78-80.

Sunita Premnath Koli, and Murthy HN (2013) Estimation of phenotypic divergence in a collection of *Cucumis melo* from Kerala State, Southern India. Agricultural Sciences 4(7A): 21-31.

Suzanne F (2016) Growing field marrow/Madras cumcumber / sambar cucumber in a pot in India. 9 October 2016. http://suespottedterracegarden.blogspot.in/2016/10/growing-field-marrowmadras-cumcumber.html

Swamy KRM (2017) Origin, Distribution and Systematics of Culinary Cucumber (*Cucumis melo* subsp *Agrestis* var conomon). Journal of Horticultural Sciences 12: 1-22.

Tanaka K, Akashi Y, Fukunaga K, Yamamoto T, Aierken Y, Nishida H, Long CL (2007) Molecular characterization of South and East Asian melon, *Cucumis melo* L. and the origin of group *Conomon* var. makuwa and var. *conomon* revealed by RAPD analysis. Euphytica 165: 233–247.

Thyagaraj GN, Puttaraju TB, Santhosh N, Padmaraja Prakash SR (2014) Evaluation of F1 hybrids in Oriental pickling melon for yield and quality attributes. Trend Biosci 7(17): 2518-2523.

Vahrehvah (2017) Budamkaya lemon cucumber dal. https://www.vahrehvah.com/budamkaya-lemon-cucumber-dal.

Vidya B (2012) Madras cucumber: Finding the origins of this South Indian vegetable. The Economic Times, December 9, 2012.

Whitaker TW and Davis GN (1962) Cucurbits: Botany, cultivation and utilization. Leonard Hill, London, UK.

WIKI (2017) *Cucumis*. From Wikipedia, the free encyclopedia. https://en.wikipedia.org/wiki/Cucumis.

Wikipedia (2020) Vishu. Wikipedia, the free encyclopedia. 2020. https://en.wikipedia.org/wiki/Vishu.