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## REVIEW ARTICLE

### ORIGIN, DISTRIBUTION, TAXONOMY, BOTANICAL DESCRIPTION, GENETIC DIVERSITY AND BREEDING OF *Luffa* spp.

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#### ABSTRACT

*Luffa* is a genus of tropical and subtropical vines in the Cucurbitaceae family. It grows as a flowering annual vine. In everyday non-technical usage, the luffa, also spelled loofah, usually means the fruit of the two species *L. aegyptiaca* and *L. acutangula*. Genus name was derived from the product "Loofah" used as bathing sponges, scrubber pads, doormats, pillows, mattresses, cleaning utensils. The plant name "Luffa" was introduced to Western botany nomenclature by the botanist Johann Vesling, who visited Egypt in the late 1620s and described the plant under cultivation with artificial irrigation in Egypt. In 1706 the botanist Joseph Pitton de Tournefort introduced the formal botany genus name "Luffa". In establishing the Luffa genus, Tournefort identified just one member species and called it "*Luffa arabum*". His 1706 article includes detailed drawings of this species (which is now called *Luffa aegyptiaca*). Origin of ridge gourd is not known. Smooth gourd may be a native of South Asia or Africa or Australia. The Luffa has essentially Old World origin in subtropical Asian region including particularly India. The origin of the Luffa (loofah) sponge is unknown as to where exactly it came from, but most scientists believe it originated in Asia or Africa and actual cultivation first started in India. Indo-Burma is reported to be the centre of diversity for sponge gourd. The young fruit is eaten as a vegetable and is commonly grown for that purpose in tropical Asia. Unlike the young fruit, the fully ripened fruit is strongly fibrous and inedible, and is used to make scrubbing bath sponges. The young shoots, flowers and leaves can be cooked, and the mature seeds can be roasted for consumption. An edible oil can be extracted from the seeds. The resulting oil meal can be fed to rabbits and catfish, or used as a fertilizer. Smooth luffa (*Luffa aegyptiaca*) produces pretty yellow flowers which are both showy and conspicuous, about 5-7.6 cm across with five petals. The fruits are green, up to 61 cm long and 7.6 cm in diameter; they are cylindrical and smooth, and shaped like a club, slighter wider on one end. Small fruits look like okra or little cucumbers. On older fruits, the outer skin eventually dries and turns brown and papery. Ridged loofah (*Luffa acutangula*), or "vine okra", is a similar species which has light yellow/white flowers and produces gourds that are ridged with ten angles. Vine okra is harder to peel for the sponge. The fruit section of *L. aegyptiaca* may be allowed to mature and used as a bath or kitchen sponge after being processed to remove everything except the network of xylem fibers. If the loofah is allowed to fully ripen and then dried on the vine, the flesh disappears leaving only the fibrous skeleton and seeds, which can be easily shaken out. In this review article origin, distribution, taxonomy, botanical description, genetic diversity, and breeding of *Luffa* spp. are discussed.

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## INTRODUCTION

*Luffa* is a genus of tropical and subtropical vines in the Cucurbitaceae family and it includes two cultivated species viz., *L. aegyptiaca* and *L. acutangula* (Joshi *et al.*, 2004; Chabert-Llompert, 2020; WIKI, 2022: WIKI, 2022a). It grows as a flowering annual vine. In everyday non-technical usage, the luffa, also spelled loofah, usually means the fruit of the two species *L. aegyptiaca* and *L. acutangula*. The fruit of these species is cultivated and eaten as a vegetable. The fruit must be harvested at a young stage of development to be edible. The vegetable is popular in China and Vietnam. When the fruit is fully ripened it is very fibrous. The fully developed fruit is the source of the loofah scrubbing sponge which is used in bathrooms and kitchens (Long An, 2015). Both ridge or ribbed gourd and smooth or sponge gourd belong to genus *Luffa*. Genus name was derived from the product "Loofah" used as bathing sponges, scrubber pads, doormats, pillows, mattresses, cleaning utensils, etc. Both species contain a gelatinous compound called luffein (Eagri, 2022).

The plant name "Luffa" was introduced to Western botany nomenclature by the botanist Johann Vesling (died 1649), who visited Egypt in the late 1620s and described the plant under cultivation with artificial irrigation in Egypt. In 1706 the botanist Joseph Pitton de Tournefort introduced the formal botany genus name "Luffa". In establishing the Luffa genus, Tournefort identified just one member species and called it "Luffa Arabum". His 1706 article includes detailed drawings of this species (which is now called *Luffa aegyptiaca*). The botanist Peter Forskål visited Egypt in the early 1760s and noted that it was called luf in Arabic (Long An, 2015; Luffa, 2022). They are known as loofah, smooth loofah, loofah sponge, loofa, luffa, loofa, loofah, sponge gourd, Chinese okra, elephant okra, dishrag gourd, towel gourd, and other common names in many different languages (Long An, 2015). The name *luffa* was taken by European botanists in the 17th century from the Egyptian Arabic name. In North America it is sometimes known as "Chinese okra", and in Spanish as *estropajo* (WIKI, 2022).

#### There are three species in the Genus *Luffa* viz. (Hasan, 2022):

- *Luffa acutangula* (Angled luffa, ridged luffa, vegetable gourd)
- *Luffa aegyptiaca* / *Luffa cylindrica* (Smooth luffa, Egyptian luffa, dishrag gourd, gourd loofa)
- *Luffa operculata* (Wild loofa, sponge cucumber)

In English *Luffa aegyptiaca* / *Luffa cylindrical* is known as luffa, loofah, loofa, sponge gourd, gourd luffa, luffa sponge, smooth luffa, dishrag gourd, Egyptian luffa (Hasan, 2022). It is also known as smooth luffa, sponge luffa, vegetable sponge gourd, climbing okra, dishcloth gourd, Chinese okra (Luswati, 2022). In English *Luffa acutangula* is known as angled loofa, angled loofah, Chinese okra, Chinese squash, dishcloth gourd, ribbed loofah, ridged gourd, silk gourd, silk squash, sinkwa towel sponge, strainer vine, and vegetable gourd (Chabert-Llompert, 2020). In Hindi-speaking North Indian states, it is called *torai*, *gilki*. In Bhojpuri speaking regions it is called *ghiura*. In Nepal and Nepali language speaking Indian states, it is called *ghiraula*. In Gujarat it is known as *turia* or *turya* as well as *ghissori* or *ghissora* in the Kutchi language. In Bengali-speaking Bangladesh and the Indian state of West Bengal, it is known as *dhudhul*. In Assam, it is called *bhul*. In Tamil Nadu, *Luffa acutangula* (ridged gourd) is called *peerkangai* and *Luffa aegyptiaca* / *Luffa cylindrica* (sponge gourd) is called *nurai peerkanka*. In Karnataka's Malenadu (Western Ghats) it is known as *tupadahirekayi*, which literally translates as "battersquash", also known as *Hirekayi* in Kannada. In Tulu language it is known as Peere. In Telangana, it is called *beerakaya*. In Andhra Pradesh, it is called *nehi beerakaya* or *beerakaya*. In Assam it is called *jika* (*Luffa acutangula*) and *bhula* (*Luffa aegyptiaca*). In Kerala, it is called *peechinga*. In the Palakkad area it is particularly called *poththanga*. In Maharashtra, India, *dodka* (ridge gourd luffa) and *ghosavala* (smooth luffa); In Manipur, India, *sebot* (*Luffa*, 2022).

Smooth luffa (*Luffa aegyptiaca*) produces pretty yellow flowers which are both showy and conspicuous, about 5-7.6 cm across with five petals. The fruits are green, up to 61 cm long and 7.6 cm in diameter; they are cylindrical and smooth, and shaped like a club, slightly wider on one end. Small fruits look like okra or little cucumbers. On older fruits, the outer skin eventually dries and turns brown and papery. Ridged loofah (*Luffa acutangula*), or "vine okra", is a similar species which has light yellow/white flowers and produces gourds that are ridged with ten angles. Vine okra is harder to peel for the sponge. Ridge Gourd (*Luffa acutangula* Roxb.) (2n = 26) (Hindi: Ghia tori) and Smooth Gourd (*Luffa cylindrica* Roem.) (2n = 26) (Hindi: Kali tori) (Eagri, 2022). The origin of the Luffa (loofah) sponge is unknown as to where exactly it came from, but most scientists believe it originated in Asia or Africa and actual cultivation first started in India. Incredibly, carbon dating revealed that the Luffa gourd was brought to North America over 9000 years ago! (Anon., 2022). Origin of ridge gourd is not known. Smooth gourd may be a native of South Asia or Africa or Australia (Eagri, 2022). The Luffa has essentially Old World origin in subtropical Asian region including particularly India (Vidhi, 2022). The genus *Luffa* is monococious with annual vines. Tendrils are branched. Leaves are five to seven lobed, nearly glabrous. Flowers are yellow and showy. There are five petals. The staminate flowers are in racemes while the pistillate flowers are solitary and short or long pedunculate. Anthers are free. Pistil has three placentae with many ovules. The stigmas are three and bilobate. The fruit is oblong or cylindrical. The rind becomes, dry on maturity (Vidhi, 2022). *Luffa aegyptiaca*, the sponge gourd, Egyptian cucumber or Vietnamese luffa, is an annual species of vine cultivated for its fruit, native to South and Southeast Asia (WIKI, 2022a). The synonymous botanical specific epithet "*aegyptiaca*" was given to this plant in the 16th century when European botanists were introduced to the plant from its cultivation in Egypt. In the European botanical literature, the plant was first described by Johann Veslingius in 1638, who named it "Egyptian cucumber". Veslingius also introduced the name "Luffa" (WIKI, 2022a).

In particular context of *L. cylindrica*, is a vigorous vine with slender, five angled stem, deltoid to nearly orbicular leaves in outline, but acutely pointed at the apex, usually three to seven lobed, scabrous and dentate margins (Vidhi, 2022). The flowers of ridge gourd start anthesis (opening) in the evening and remain open throughout the night and are ready for selfing and pollination in the early morning/ forenoon (Vidhi, 2022). Sponge Gourd is an annual climbing which produces fruit containing fibrous vascular system. It is summer season vegetable growing from Tarai to high hills in Nepal. Mid hills is most important zone where most of the farmers grow sponge gourd (Joshi et al., 2004). The main commercial production countries of Sponge Gourd are China, Korea, India, Japan and Central America (Joshi et al., 2004; Dhillon et al., 2016). Ridge gourd or *Luffa* is an elongated, cylindrical fruit pod in the Cucurbitaceae/gourd family of vegetables. Scientific name of Ridge Gourd: *Luffa acutangula* (L.) Roxb. It is a ridged and dark green vegetable with white pulp inside. It exhibits a spongy flesh with white pulp and seeds (Pathakamuri, 2022). Ridge gourd, also known as "tindora" or "tindli" in Hindi language, is a vegetable grown in Southern and Eastern India. It can be consumed raw by cutting it into pieces and dipping in salt water or cooked by boiling with curry leaves and tamarind. It has many health benefits and can be consumed in various ways. This vegetable can be consumed in various ways, such as raw, boiled or fried. The ridge gourd has many health benefits including aiding digestion and keeping the skin healthy (Pathakamuri, 2022). The ridge gourd has a long green stem that can grow up to 12 feet in length. The leaves form a thick circle around the stem and are arranged in a spiral pattern. The flowers are yellow with five petals and an orange-red crown at the center of each flower. It is also more cold-hardy than other gourds (Pathakamuri, 2022). Ridge gourd produces both male and female flowers separately on the same plant. Normally under natural conditions pollination occurs due to wind or pollinators like bees or butterflies (Pathakamuri, 2022). It is cultivated and eaten as a vegetable, but must be harvested at a young stage of development to be edible. The vegetable is popular in India, China, Bangladesh and Vietnam (WIKI, 2022). The young fruit is eaten as a vegetable and is commonly grown for that purpose in tropical Asia. Unlike the young fruit, the fully ripened fruit is strongly fibrous and inedible, and is used to make scrubbing bath sponges. Due to the use as a scrubbing sponge, it is also known by the common names, rag dishrag gourd gourd, sponge gourd, and vegetable-sponge. It is also called smooth luffa to distinguish it from the ridged luffa (*Luffa acutangula*), which is used for the same purposes (WIKI, 2022a). The young shoots, flowers and leaves can be cooked, and the mature seeds can be roasted for consumption (WIKI, 2022a).

An edible oil can be extracted from the seeds. The resulting oil meal can be fed to rabbits and catfish, or used as a fertilizer (WIKI, 2022a). Both crops are cultivated on a commercial scale and grown in homesteads for its immature fruits which are used as cooked vegetable. Fibre of mature dry fruits is used as a bath sponge (Eagri, 2022).

Ridge gourds are a rich source of iron, vitamin C, manganese and dietary fiber (Pathakamuri, 2022). As tender fruits are easily digestible and appetizing, it is prescribed for those who are suffering from malaria and other seasonal fevers (Eagri, 2022). For many people in Western cultures, the luffa conjures up images of the strange fibrous object that is used in the bath as a good scrubbing sponge, they make very good back scrubbers, but in the countries in which the loofah is grown it is also eaten as a vegetable. It is as fibrous as a vegetable, as it is as a sponge if it is fully ripe, so for culinary uses it is harvested when very young (Luffa, 2022).

In everyday non-technical usage, the luffa, also spelled loofah, usually refers to the fruits of the species *Luffa aegyptiaca* and *Luffa acutangula*. When the fruit is fully ripened, it is very fibrous. The fully developed fruit is the source of the loofah scrubbing sponge which is used in bathrooms and kitchens (WIKI, 2022). The fruit section of *L. aegyptiaca* may be allowed to mature and used as a bath or kitchen sponge after being processed to remove everything except the network of xylem fibers. If the loofah is allowed to fully ripen and then dried on the vine, the flesh disappears leaving only the fibrous skeleton and seeds, which can be easily shaken out. Marketed as *luffa* or *loofah*, the sponge is used as a body scrub in the shower (WIKI, 2022). In Paraguay, panels are made out of luffa combined with other vegetable matter and recycled plastic. These can be used to create furniture and construct houses (WIKI, 2022). Byzantine mosaics depicted both immature and mature sponge gourds, and it is presumed they were depicted because they were used as food (immature) and for hygiene (mature) (Avital and Paris 2014). In Israel, *Luffa aegyptiaca* has been in use since the time of the Late Roman Empire. Young fruits were used for food. Mature fruits were used as bath sponges. *Luffa aegyptiaca* fruits were decorated for the first time in art of the Byzantine era in Israel only. The fruits were decorated on mosaics of churches and synagogues in Israel (WIKI, 2022a) (Fig. 1).



**Fig. 1: Figure of sponge gourd fruit used in mosaic**

## ORIGIN AND DISTRIBUTION

India has been suggested as the center of origin of ridge gourd and this species is represented by three botanical varieties: var. *acutangula*, which is cultivated in Southeastern Asia and other tropical areas but to a lesser extent than sponge gourd; var. *amara* (Roxb.) C.B. Clarke, which is a wild form confined to India; and var. *forsakii* (Harms) Heiser & Schilling, a wild form (Robinson and Decker-Walters 1997). *L. acutangula* is native to tropical South Asia and naturalized throughout the tropics and subtropics. There is some discrepancy between sources in the exact native range, with listing it as native to India and Pakistan, but recording it as introduced in Pakistan (Chabert-Llompart, 2020). Origin of ridge gourd is not known. Smooth gourd may be a native of South Asia or Africa or Australia (Eagri, 2022). The main commercial production countries of sponge gourd are China, Korea, India, Japan and Central America (Oboh and Aluyor, 2009). *L. acutangula* is present in many regions in cultivation or as an escape, there is no evidence of presence in the New World in pre-Columbian times. It is abundant in Asia, probably abundant in tropical Africa, introduced in the West Indies and some Southern states of the USA, and also introduced and cultivated on a number of islands in the Pacific. In Cuba, *L. acutangula* is considered an invasive species, and it is mentioned as possibly invasive in Mexico and a potential invader on Nauru in the Pacific (Chabert-Llompart, 2020).

*Luffa* is considered to be an essentially Old World genus (Seshadri and More 2009). In the absence of convincing evidence, Whitaker and Davis (1962) reported Indo-Burma to be the center of diversity of sponge gourd, and it reached the Mediterranean by the third century CE for use as food (Avital and Paris 2014). Indo-Burma is reported to be the centre of diversity for sponge gourd (Joshi et al., 2004; Oboh and Aluyor, 2009). The origin of the Luffa (loofah) sponge is unknown as to where exactly it came from, but most scientists believe it originated in Asia or Africa and actual cultivation first started in India (Anon., 2022). The Luffa has essentially Old World origin in subtropical Asian region including particularly India (Vidhi, 2022). Smooth loofah, *Luffa aegyptiaca*, is probably native to tropical Africa and Asia (Luffa, 2022). Luffas can be found growing commercially worldwide. Smooth loofah, *Luffa aegyptiaca* is grown throughout most of Asia for food and for pot scrubbers, and is cultivated commercially in the United States for export to Japan (Luffa, 2022). *Luffa aegyptiaca*, the sponge gourd, Egyptian cucumber or Vietnamese luffa, is an annual species of vine cultivated for its fruit, native to South and Southeast Asia (WIKI, 2022a). Carbon dating revealed that the Luffa gourd was brought to North America over 9000 years ago! (Anon., 2022). *Luffa cylindrica* is native to India (Lusweti, 2022).

## TAXONOMY

The number of species in the genus *Luffa* varies from 5 to 7. Only two species *L. cylindrica* (smooth gourd) and *L. acutangula* (L.) Roxb. (ridge gourd) are domesticated. Flowers of these two species are monoecious. Two wild species are *L. graveolens* and *L. eclunata* (Joshi et al., 2004).

Sponge gourd (*Luffa cylindrica* Roem., syn. *L. aegyptiaca* Mill) and ridge gourd [*L. acutangula* (L.) Roxb.] are the two cultivated species of the genus *Luffa*. Wild species include *L. graveolens* Roxb. (var. *longistyla*), *L. echinata* Roxb., *L. tuberosa* Roxb., and *L. umbellata* Roem (Seshadri and More 2009). *Luffa* is a genus of tropical and subtropical vines in the Cucurbitaceae family, with five accepted species. Phenetic and cladistic analyses of 10 *Luffa* accessions belonging to five species indicated that the species are well differentiated, with *L. echinata* the most distinct. The cladistic analyses also revealed two phyletic lines, one comprised of *L. aegyptiaca* and *L. acutangula* and the other of *L. echinata*, *L. graveolens* and *L. operculata*. These results were later corroborated in a phylogenetic analysis based on molecular data (Chabert-Llompart, 2020). *Luffa cylindrica* is diploid species with 26 chromosomes ( $2n = 26$ ) and a cross-pollinated crop (Joshi *et al.*, 2004). A variant form of ridge gourd, locally known as “Satputia” in India, is hermaphroditic and bears fruits in clusters of 5–7. It was given a separate taxonomic status as *L. hermaphrodita* (Singh and Bhandari 1963). Gynocious landraces of ridge gourd have been reported from the Hoogly district of West Bengal, India (Fig. 2) (Munshi *et al.* 2010–2011).



Fig. 2: *Luffa hermaphrodita*

Major species of *Luffa* (Long An . 2015; WIKI, 2022; Hassan, 2022) (Fig. 3)

- *Luffa acutangula* (Angled luffa, ridged luffa, vegetable gourd, whose immature fruits are popular in Asian cuisine)
- *Luffa aegyptiaca* / *Luffa cylindrica* (Smooth luffa, Egyptian luffa, dishrag gourd, gourd loofa; is the variety most widely available from seed companies)
- *Luffa operculata* (Wild luffa, Ball luffa, sponge cucumber, used as a fibrous scrubbing sponge just like *Luffa aegyptiaca*).

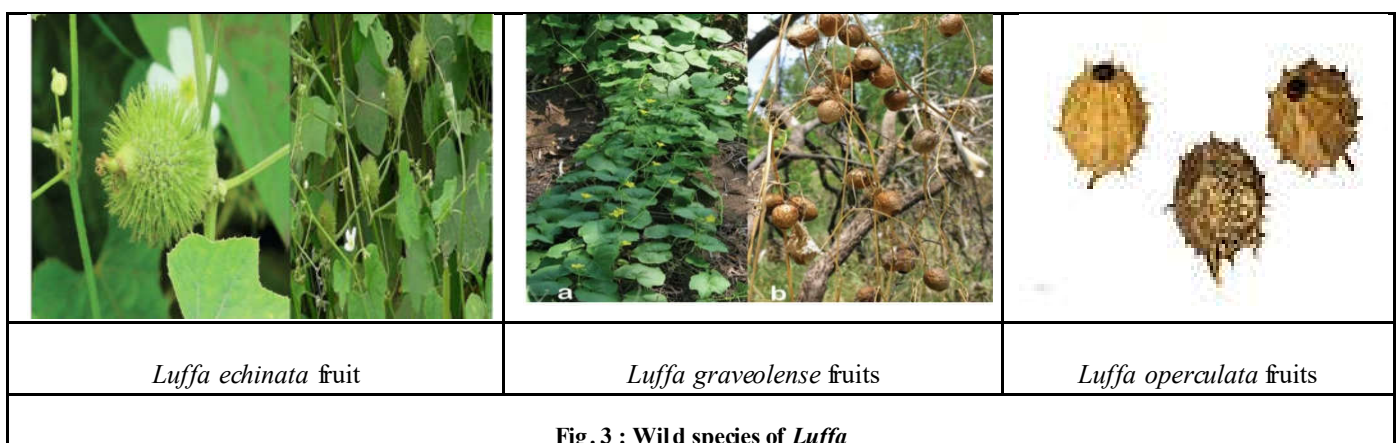


Fig. 3 : Wild species of *Luffa*

*Luffa* is a genus of tropical and subtropical vines in the Cucurbitaceae family, and the genus *Luffa* has two cultivated species viz., *Luffa aegyptiaca* / *Luffa cylindrica* (smooth luffa, Egyptian luffa, dishrag gourd, gourd loofa) and *Luffa acutangula* (angled luffa, ridged luffa, vegetable gourd) (Chabert-Llompart, 2020; WIKI, 2022; IBP, 2022)

Synonyms of *Luffa* (Long An . 2015; WIKI, 2022)

- *Poppya* Neck. ex M. Roem.
- *Trevouxia* Steud., orth. var.
- *Trevouxia* Scop. and
- *Turia* Forssk.

**Synonyms of *Luffa cylindrica* (IBP, 2022):**

1. <i>Bryonia cheirophylla</i> Wall.
2. <i>Cucumis acutangulus</i> Wall.
3. <i>Cucumis lineatus</i> Bosc
4. <i>Cucumis megacarpus</i> G. Don
5. <i>Cucumis pentandrus</i> Roxb. ex Wight & Arn.
6. <i>Luffa acutangula</i> var. <i>subangulata</i> (Miq.) Cogn.
7. <i>Luffa aegyptiaca</i> f. <i>sylvestris</i> (Miq.) W.J.de Wilde & Duyfjes
8. <i>Luffa aegyptiaca</i> Mill.
9. <i>Luffa arabum</i> Steud.
10. <i>Luffa cattu-picinna</i> Ser.
11. <i>Luffa clavata</i> Roxb.
12. <i>Luffa cordata</i> Meissn.
13. <i>Luffa cylindrica</i> M. Roem.
14. <i>Luffa hederacea</i> Wall.
15. <i>Luffa hederacea</i> Wall. ex G. Don
16. <i>Luffa insularum</i> A. Gray
17. <i>Luffa jacquini</i> Schrad.
18. <i>Luffa leiocarpa</i> F. Müll.
19. <i>Luffa leucosperma</i> M. Roem.
20. <i>Luffa luffa</i> (L.) Lyons
21. <i>Luffa parvala</i> Buch.-Ham.
22. <i>Luffa pentandra</i> Roxb.
23. <i>Luffa petola</i> Ser.
24. <i>Luffa racemosa</i> Roxb.
25. <i>Luffa satpatia</i> Buch.-Ham.
26. <i>Luffa satpatia</i> Buch.-Ham. ex G. Don
27. <i>Luffa scabra</i> Schumacher & Thonning
28. <i>Luffa striata</i> Schrad.
29. <i>Luffa subangulata</i> Miq.
30. <i>Luffa veitchii</i> Naud.
31. <i>Luffa vittata</i> Zipp. ex Span.
32. <i>Melothria touchanensis</i> H. Lév.
33. <i>Momordica carinata</i> Vell.
34. <i>Momordica cylindrica</i> L.
35. <i>Momordica luffa</i> L.
36. <i>Momordica operculata</i> Blanco
37. <i>Momordica reticulata</i> Salisb.
38. <i>Poppya fabiana</i> C. Koch
39. <i>Turia cordata</i> J. F. Gmel.
40. <i>Turia cylindrica</i> J. F. Gmel.
41. <i>Turia sativa</i> Forssk.

**Synonyms of *Luffa cylindrical* (Lusweti, 2022):**

- 1.*Luffa fluminensis* M.J. Roem.;
- 2.*Cucumis acutangulus* L.;
- 3.*Cucurbita acutangula* (L.) Blume;
- 4.*Luffa foetida* Cav.;
- 5.*Luffa plukenetiana* Ser.;
- 6.*Luffa hermaphrodita* Singh & Bandhari;
- 7.*Momordica luffa* Vell.

**Synonyms of *Luffa acutangula* (Chabert-Llompart, 2020):**

- 1.*Cucumis acutangulus* L.
- 2.*Cucumis lineatus* Bosc
- 3.*Cucumis longus* var. *indicus* Grew
- 4.*Cucumis megacarpus* G. Don
- 5.*Cucumis operculatus* Roxb. ex Wight & Arn
- 6.*Cucurbita acutangula* (L.) Blume
- 7.*Luffa acutangula* var. *subangulata* (Miq.) Cogn.
- 8.*Luffa amara* Roxb.
- 9.*Luffa drastica* Mart.
- 10.*Luffa fluminensis* Roem.
- 11.*Luffa foetida* Cav.
- 12.*Luffa forskalii* Schwaenf. ex Harns
- 13.*Luffa gosa* Ham.
- 14.*Luffa subangulata* Miq.
- 15.*Momordica tubiflora* Wall.
- 16.*Momordica tubiflora* Wall
- 17.*Momordica luffa* Vell.

**Synonyms of *Luffa echinata* (IBP, 2022 a):**

1. <i>Luffa bindaal</i> Roxb.
2. <i>Luffa bondel</i> Buch.-Ham. ex Steud.
3. <i>Luffa longistyla</i> Edgew.
4. <i>Momordica erinocarpa</i> Fenzl ex Naud.

### Common Species and Botanical Varieties of Luffa Gourds (Long An, 2015):

1-Species *Luffaacutangula*-Angled luffa, Chinese okra...

Varieties:

-*Luffaacutangula cutangula*

-*Luffaacutangula amara*

-*Luffaacutangula forskalii*

2-Species *Luffaegyptiaca*-Egyptian cucumber, Spongesourd, Vietnamese luffa (Mướp hương)...

Varieties:

-*Luffaegyptiaca egyptiaca*

-*Luffaegyptiaca* var. *leioarpa* -Wild luffa of Myanmar

-*Luffaegyptiaca* var. *peramara*

3-Species *Luffa amara*

4-Species *Luffa arabum*

5-Species *Luffa astori*

6-Species *Luffa batesii*

7-Species *Luffa bendaul*

8-Species *Luffa bondel*

9-Species *Luffa caldoniaca*

10-Species *Luffa clavata*

11-Species *Luffa cordata*

12-Species *Luffa cylindrica*, depending on Mill is *Luffaegyptiaca*-Smooth luffa, sponge luffa, vegetable spongesourd...

Varieties:

-*Luffa cylindrica* var. *insularum*

-*Luffa cylindrica* var. *multiflora*

13-Species *Luffa drastica*

14-Species *Luffa echinata*

15-Species *Luffa fluminensis*

16-Species *Luffa foetida*

17-Species *Luffa forskalii*

18-Species *Luffa friatoria*

19-Species *Luffa gosa*

20-Species *Luffa graveolens*

21-Species *Luffa heterocarpa*

22-Species *Luffa hermaphrodita*

23-Species *Luffa hilapikku*

24-Species *Luffa insularum*

25-Species *Luffa jacquinii*

26-Species *Luffa klainii*

27-Species *Luffa leioarpa*

28-Species *Luffa leucosperma*

29-Species *Luffa longistyla*

30-Species *Luffa luffa*

31-Species *Luffa operculata*-Wild luffa or Wild luffa).

Variety:

-*Luffa operculata* var. *intermedia*

32-Species *Luffa parvula*

33-Species *Luffa parvula*

34-Species *Luffa pentandra*

35-Species *Luffa purgans*

36-Species *Luffa quinquefolia*

37-Species *Luffa racemosa*

38-Species *Luffa saccata*

39-Species *Luffa satpattia*

40-Species *Luffa scabra*

41-Species *Luffa sepium*

42-Species *Luffa sphaerica*

43-Species *Luffa subangulata*

44-Species *Luffa sylvestris*

45-Species *Luffa tenera*

46-Species *Luffa tuberosa*

47-Species *Luffa umbellata*

48-Species *Luffa variegata*

49-Species *Luffa veitchii*

50-Species *Luffa vittata*

### Important Species and Botanical Varieties of Luffa (Long An, 2015)

1-Species *Luffa acutangula* - Angled luffa, Chinese okra...

Varieties:

-*Luffa acutangula acutangula*

-*Luffa acutangula amara*

-*Luffa acutangula forskalii*

2-Species *Luffa aegyptiaca* - Egyptian cucumber, Spongy gourd, Vietnamese luffa (Muróphuong)...

Varieties:

-*Luffa aegyptiaca aegyptiaca*

-*Luffa aegyptiaca* var. *leio carpa* - Wild luffa of Myanmar

-*Luffa aegyptiaca* var. *peramara*

3-Species *Luffa cylindrica*, depending on Mill. is *Luffa aegyptiaca* - Smooth luffa, spongy luffa, vegetable spongy gourd...

Varieties:

-*Luffa cylindrica* var. *insularum*

-*Luffa cylindrica* var. *multiflora*

4-Species *Luffa operculata* - Wild luffa or Wild loofah (in Vietnamese).

Variety:

-*Luffa operculata* var. *intermedia*

5-Species *Luffa sepium*

### Botanical varieties of *L. acutangula* (Chabert-Llompart, 2020):

In *L. acutangula*, the following three botanical varieties have been distinguished viz.,







- *L. acutangula* var. *acutangula*, the large-fruited cultivated types;
- *L. acutangula* var. *amara* (Roxb.) C.B. Clarke, a wild or feral type with extremely bitter fruits and confined to India; and
- *L. acutangula* var. *forskalii* (Harms) Heiser & E.E. Schill., confined to Yemen, where it occurs wild or possibly as an escape suggest that var. *forskalii* could have developed from var. *acutangula* after this was introduced to Yemen as a cultivated plant.







Successful interspecific crosses and reciprocal crosses were made between these two species viz., *L. acutangula* and *Luffa cylindrica*. The F<sub>1</sub> plants were generally intermediate between the parents. The F<sub>1</sub> showed various irregularities, like, univalents, rings, chains of four chromosomes, chromatin bridges and fragments at metaphase. The percentage of good pollen ranged from 18 to 40%. Thus, the species are not easily crossable and the F<sub>1</sub> appears to be of not much practical value (Vidhi, 2022).

### BOTANICAL DESCRIPTION

There are two common species in the *Luffa* genus: smooth luffa (*Luffa aegyptiaca* Mill.), also called sponge gourd, and angled luffa (*Luffa acutangula* (L.) Roxb.). Smooth luffa, as its name suggests, produces green, squash-like fruit. For angled luffa, the fruit slightly resembles a cucumber or zucchini with 8 to 10 longitudinal ridges and ribs and a dark green color. Luffa is a fast-growing, long-season, and warm-climate crop that prefers neutral to slightly alkaline soil conditions with high moisture, growing annually in tropical and subtropical conditions. The stem is glabrous and ribbed and can grow up to 10 m. Tendrils have 3 to 5 branches with stems 5-7.5 cm in length and branches 7.5-10 cm in length. A trellis is needed for optimum fruit production and to cultivate straighter fruits (Zong *et al.*, 1993). Mature luffa seeds are typically dark and hard. Immature seeds typically have a lighter color and are softer than mature ones. The leaves of luffa are alternating and palmate-like. A fully developed leaf is typically up to 30 cm wide and 15 cm long and has an acute-end lobe, serrated edges, and is hairless. For planting or transplanting, the distance between plants is usually 1 m and the distance between rows is 2 m. Vine length is up to 9 m. Vertical trellises of 2 m in height are recommended because they substantially increase fruit yield (Davis 1994). A mature luffa plant can bear about 6-7 fruit in ideal growing conditions. The mature luffa leaves have petioles 1 to 3 inches in length. The leaves have 3 to 7 lobes depending on soil fertility. Lamina shape is ovate or broadly ovate. Fully developed laminae are 7.5-15 cm in length and 5-12.5 cm in width, with 3 to 7 broad, rounded, or obtuse lobes. Some varieties are hispid-covered on either the back or both sides of the leaf. Luffa inflorescences are monoecious: males have elongate racemes with 10 to 16 flowers, and females have a solitary flower. Both male and female flowers are yellow or orange and 5-7.5 cm in diameter. The pollinated flowers develop cylindrical fruit, and only young, immature fruits, which require the hot growing season of about two to three months, can be harvested for consumption as a vegetable. Luffa seeds are elliptical: a quarter to three eighths of an inch in length, one eighth to a quarter inch in width, and one sixteenth of an inch in thickness. Seeds are smooth or slightly rugose. Immature seeds are white in color, whereas mature seeds are dark brown or black. One mature luffa fruit contains 30 or more seeds (Fig. 4 & 5). (Partap *et al.* 2012).

According to Long An (2015) the luffa gourd plant is an annual tropical or subtropical climbing vine. Luffa is a fast-growing, long-season, warm-climate vine plant that can climb up to 4.5 m high. There are several types of Luffa grown in the Orient. They are trailing or climbing annual herbs, monoecious; stems to 7 m long, 2-3 mm diam, ± glabrous, ribbed. Tendrils have 3-5-branches, with the stem 4.5-8 cm long, branches 5-9 cm long. When the fruit section of the plant matures, it can be used as an organic bath or kitchen sponge. Some people even use the juice of this very beneficial plant to treat jaundice. Luffa species (*Luffa aegyptiaca* and *Luffa acutangula*), also known as vegetable sponge or dishcloth gourds, are grown mainly for their useful fibrous tissue skeleton. Young fruits can be eaten as squash, used in stews or even used in place of cucumbers. Leaves have petiole 1.5-6.5 cm long. The leaves are 7-20 cm across and have 3-7 lobes. Lamina is ovate to broadly ovate in outline, 3-14 cm long, 2.5-13 cm wide, with 3-7 broad rounded or obtuse lobes, the lobes crenate, base cordate with the sinus wide, apex acute, hispid on both surfaces. Inflorescences are usually unisexual, rarely with male and female flowers. Male flowers are in elongate racemes, rarely solitary; racemes 10-16 flowered, 3-30 cm long; peduncles 1.5-12 cm long; bracts ovate, 2-3 mm long, glandular; pedicels of racemes in inflorescences 5-20 mm long, of solitary flowers 8-64 mm long; hypanthium broadly campanulate, 2-3 mm long; calyx lobes 5, triangular, 4-10 mm long, pubescent abaxially; corolla lobes 5, ovate-broadly spatulate, 12-20 mm long, ± glabrous, yellow; stamens 3, inserted towards the base of the hypanthium; anthers one 1-theous, two 2-theous, flexuose; disc absent. Female flowers are solitary, sometimes paired in axils; pedicels 3-20 mm long; ovary ovoid, 8-12 mm long, long-attenuate, pilose, shortly echinate; hypanthium above the constriction and perianth similar to male; staminodes 3; style c. 3 mm long; stigmas 3, 2-lobed, c. 2 mm long. Fruit ovoid, 2.5-4.5 cm long, 2-4 cm diam, glabrescent, echinate, many-seeded, dehiscent by an apical operculum; fruiting pedicel 2-20 mm long.

		
Plants	Male flower	Female flower
		
Fruits	Plants with fruits	Sponge and Seeds
<b>Fig. 4 : Botanical description of <i>Luffa cylindrica</i></b>		

		
Plants with flowers Fruits	Male flower	Female flower
		
Fruits	Plants in polyhouse	Seeds
<b>Fig. 5: Botanical description of <i>Luffa acutangula</i></b>		

The pollinated flowers grow cylindrical green fruits that eventually develop into a seed pod filled with many intertwined cellulose fibers. The outer skin is removed to reveal the "loofah" inside. The fruit is edible only when immature and is cooked like zucchini. The fruit setting may be relatively sensitive to the day length. Many varieties could perform relatively poor during the long day season in early summer and perform much better during the late summer and fall when the shorter daytime season arrives. The matured fruit forms sponge-like fibers inside. After the fruit matured, dried, skin and seeds removed/cleaned, fibers are often used as scrubbers, cleaning pads or bath sponges. Seeds are elliptic form, 7-8 mm long, 4-5 mm wide, smooth or slightly rugose, dark brown mottled black, the margin narrowly winged. Luffa seeds, particularly Ridged Skin varieties, have hard skin and may take a long time to germinate. They need warm/moist soil conditions for germinating. For improving the seed germination, it is suggested to break slightly the seed at the non-seed-eye area/edge by clipping or sanding. This treatment will allow water entering the seed inside core to trigger the germination process. The male flowers are relatively easy to identify because the blossom is connected to the vine by a long, rather thin stem. These flowers will bloom for one day and then fall off. The female flowers are noticeable because they have a small green luffa between the blossom and the vine. These usually begin to appear 1-2 weeks after the first males begin to bloom and are located on the vines. As the vine grows, it continues to set new female blossoms (Horticulturetalk. 2021). According to Vidhi (2022) the genus *Luffa* is monoecious with annual vines. Tendrils are branched. Leaves are five to seven lobed, nearly glabrous. Flowers are yellow and showy. There are five petals. The staminate flowers are in racemes while the pistillate flowers are solitary and short or long pedunculate. Anthers are free. Pistil has three placenta with many ovules. The stigmas are three and bi-lobate. The fruit is oblong or cylindrical. The rind becomes, dry on maturity. In particular context of *L. cylindrica*, is a vigorous vine with slender, five angled stem,



deltoid to nearly orbicular leaves in outline, but acutely pointed at the apex, usually three to seven lobed, scabrous and dentate margins. Pistillate and staminate flowers may occur in the same leaf axil also. Fruits are nearly cylindrical, 1-2 feet long, straight or curved, normally with light furrows or stripes but not ribbed. Seeds are black, flat, smooth without margins, 10-15 mm long. The flowers of ridge gourd start anthesis (opening) in the evening and remain open throughout the night and are ready for selfing and pollination in the early morning/forenoon. The flowers of sponge gourd open in early morning hours and are suitable for selfing/crossing almost throughout the day. *Luffa (Luffa aegyptiaca)* is a large, fast-growing tendriled vine that hails from Southeast Asia. Grown for its unique fruit, luffa takes much longer to grow than other gourds, about 90 to 120 days. And once the fruit has reached its mature size, you need to figure in several weeks for it to develop its tough inner fibers and dry on the vine before you can harvest it. What you might not know about luffa is that when they are still young and tender, luffa gourds are actually edible vegetables in the cucumber family that can be eaten raw or cooked. However, the fruit grows so fast, about an inch-and-a-half per day, that it's difficult to keep up with harvesting them on time so it's best to grow luffa for sponges and let them grow to about two feet long. Large yellow blooms precede the gourds, attracting bees and butterflies. Because luffa vines can reach a length of up to 30 feet, with palm-shaped leaves up to ten inches wide, growing them on a trellis is best, and not merely for space reasons. Luffa that is grown on the ground tends to be curved, and keeping the vines and fruit off the ground and dry reduces the risk of disease and rotting in humid or wet weather (Hassan, 2022). The loofah is a rampant, fast growing annual vine. The vine can get more than 9 m long and scrambles over anything in its path. The large leaves are lobed and have silvery patches on the topsides. Smooth luffa (*Luffa aegyptiaca*) produces pretty yellow flowers which are both showy and conspicuous, about 5-7.6 cm across with five petals. The fruits are green, up to 61 cm long and 7.6 cm in diameter; they are cylindrical and smooth, and shaped like a club, slightly wider on one end. Small fruits look like okra or little cucumbers. On older fruits, the outer skin eventually dries and turns brown and papery. Ridged loofah (*Luffa acutangula*), or "vine okra", is a similar species which has light yellow/white flowers and produces gourds that are ridged with ten angles. Vine okra is harder to peel for the sponge. (Luffa, 2022)

Herbaceous vine, monoecious, creeping or climbing by axillary tendrils, attaining 5-10 m in length. Stems green, angular, scabrous; tendrils trifid. Leaves alternate; blades 15-20 cm long, 5-7-palmatilobed, chartaceous, the lobes more or less deep, the apex acute or acuminate, the base cordiform or hastate, the margins sinuate-dentate or denticulate; upper surface scabrous; lower surface pale green, scabrous; petioles 8-10 cm long. Flowers unisexual, actinomorphic. Calyx urceolate, with keeled lobes, 10-12 mm long, triangular; corolla pale yellow, the lobes deep, obtuse. Staminate flowers in racemes; stamens 3, the filaments free, 3-4 m long, villous. Pistillate flowers solitary, with a hypanthium less than 1 cm long; staminodia 3, minute, glandular; ovary inferior, trilocular, claviform, 10-angled, with numerous horizontal ovules, the style short, the stigmas globose. Fruit claviform, with 10 longitudinal ribs, 15-30 cm long, the pericarp crustose, dehiscent by apical pores; seeds numerous, ovate, 11-12 mm long, blackish, rugose (Chabert-Llompart, 2020). Loofahs are of two types: (1) the angled loofah (ridge gourd), *Luffa acutangula* L. Roxb. and (2) the smooth loofah (smooth gourd), *Luffa cylindrica*. They are annual and largely monoecious, bearing ridged, and smooth fruits respectively. Immature loofah fruits are used as vegetables and mature fruits are used for fiber. Gourds produce long, cylindrical fruits, 10-40 cm in length and 6-10 cm in diameter. The ridge gourd has fruit with about 10 distinct longitudinal acutely angled ribs. Loofahs are a good source of carbohydrates, vitamin C, and minerals; the fibres are used for industrial purposes. *Luffa cylindrica*, *Luffa acutangula*, *Luffa echinata* and *Luffa graveolens* are the important species of Luffa; the first two are commercially grown in several countries and are of economic importance. *Luffa cylindrica* flowers in the morning (4-8 am) while *Luffa acutangula* flowers in the afternoon and evening (5-8 pm) (Kalloo, 1993).

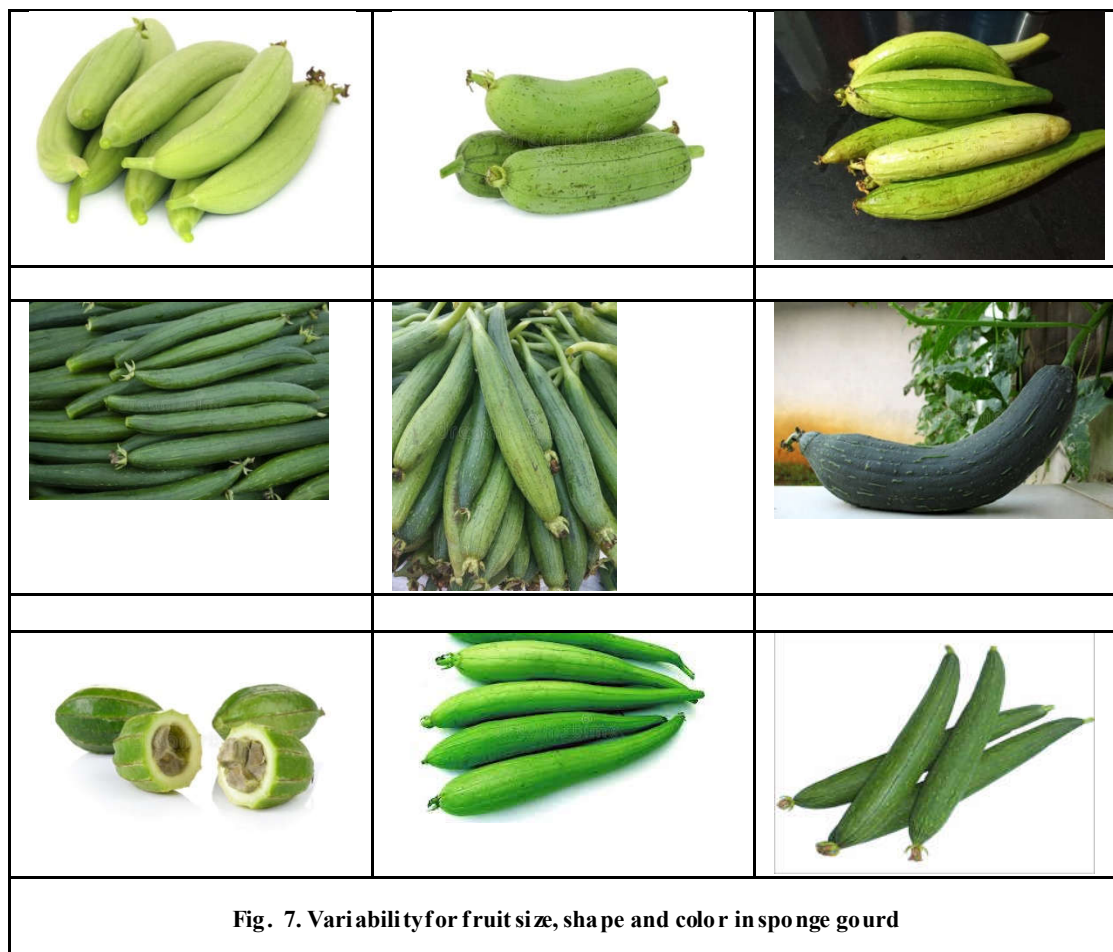
**Pollination:** *Luffa cylindrica* flowers in the morning (4-8 am) while *Luffa acutangula* flowers in the afternoon and evening (5-8 pm) (Kalloo, 1993). Luffa needs insects to carry out the pollinating process for setting fruits. If the insects or bees are not available in your area, the pollinating process can be done manually, by picking up male flowers and transferring pollens to female flowers (by face-to-face touching the centre part of flowers). This process should be carried out when flowering is active during the daytime. If the pollination is success, the fat portion of the female flower will grow into full size fruit (Long An, 2015). Even though luffa gourd produces large number of male and female flowers (generally 10:1 ratio), it mainly depends on bees for pollination. The male flowers seem to be in a cluster with one female flower among or fairly close to them. Bees will do the pollinating -- don't use insecticides. In general if the pollination does not occur, female flower will fall off or it may grow initially but fall off later. So if your garden is lack of bees you should go for hand pollination by using brush or cotton swab to move pollen or pull off a male flower and gently rub the yellow hair-like structures of the male flower against the middle parts of a female flower. Repeat the procedure for 2 to 3 days (Narayana, 2016). Both male and female flowers look similar but male flower grows on long peduncle and first to appear. It bloom for one day and then fall off. Whereas female flower grows on short peduncle but it has an ovary in the shape of the fruit (Narayana, 2016).

## GENETIC DIVERSITY

Great variability for fruit size, shape and color is observed in both species of *Luffa* (Fig. 6 & 7). (Dhillon *et al.*, 2016). In crop improvement, genetic diversity has been considered as an important factor, which is essential pre-requisite for any breeding programme in order to obtain high yielding progenies. Quantitative measurement of genetic divergence among individuals has enabled the plant breeders to understand the racial affinities and evolutionary pattern in various crop species or cultivated plants as well as in decision making for selection of desirable parents to be involved in hybridization programme (Kumar *et al.*, 1998 and Rameshkumar, 2011) (Fig. 6 & 7).

Totally thirty five ridge gourd genotypes were grouped into five clusters based on D2 values, which exhibited no association between geographical and genetic divergence. The intra-cluster distance was maximum for cluster III (167.41) and minimum for cluster V (0). The maximum distance at inter-cluster level was between cluster II and cluster V (535.54) followed by clusters III and II (195.34) which may serve as a potential genotypes for hybridization programme. On the basis of mean performance of different clusters, genotypes having better performance for days taken for first female flower appearance, highest female flower number per vine, narrow sex ratio, fruit length, days taken for first harvest, fruit weight, lowest crude fibre content, highest carbohydrate content and protein content were observed in cluster V. Genotypes having vine length, fruit girth, less seeds number per fruit and more hundred seed weight were recorded in cluster II. The genotypes of the cluster III were grouped for high fruit flesh thickness, fruits number per vine and fruit yield per vine which could be utilized as donor parents for respective traits in hybridization programme for enhancing the yield of other accessions grouped in a cluster in F1s and could be fixed by transgressive segregants followed by continued selection in advance generations which may lead to development of high yielding varieties with desired component characters (Rani *et al.*, 2017). Genetic variations and relationships among cultivated and wild genotypes of five taxa of Indian Luffa were examined using inter simple sequence repeats (ISSR), directed amplification of minisatellite DNA (DAMD) markers and morphological characterization. Morphometric evaluation of 21 discrete characters in 51 representative accessions segregated the

five taxa of *Luffa* in three main clusters: the two wild species (*L. echinata*, *L. graveolens*) in the first, and the cultivated *L. aegyptiaca* (smooth gourd) and *L. acutangula* (ridged gourd) *L. hermaphrodita* (Hermaphrodite luffa) in the second and third clusters, respectively.



Cumulative data analysis of 15 ISSR and seven DAMD markers revealed high percentage polymorphism (97.67 %), moderate genetic distance (0.06–0.72, avg. 0.51), and low heterozygosity and Shannon index values ( $H = 0.15$ ;  $I = 0.22$ ) across all the 76 genotypes assayed. A UPGMA

dendrogram, based on the combined marker data, resolved the five taxa in two main clusters with high bootstrap support. The morphological and molecular trees showed in congruence in the number of main clusters resolved and in the disposition of the wild and cultivated taxa in different sub-clusters. The cluster analyses and PCoA plots revealed a nested grouping of the hermaphrodite *Luffa* within the ridge gourd group. The Bayesian STRUCTURE analysis identified three genetic clusters for the five assumed taxa. Outcrossing test revealed a mixed mating system in Indian *Luffa*. This is the first ever report on the mating system in *Luffa* using molecular markers. The study also demonstrates the utility of using more than one DNA marker in the assessment of molecular diversity in a widely cultivated crop genus like *Luffa* with a narrow genetic base (Misra *et al.*, 2017).

To study morphological variability in cultivated and wild *Luffa* from different agro-ecological regions of India, a total of seventy accessions were assembled. Morphological variations in leaf, fruit and seed characters were found to delimit cultivated and wild *Luffa* species. Cluster analysis revealed two major clusters, one comprising of 36 accessions of *Luffa acutangula* and the other of 30 accessions belonging to *L. aegyptiaca*. A local cultivar "Satputia" (*L. hermaphrodita*) was classified along with cultivated *L. acutangula* and wild *L. acutangula* var. *amara*. Wild species namely *L. graveolens* and *L. echinata* were clustered closer to the *L. acutangula* (Prakash *et al.*, 2013). A germplasm collection consisting of 112 *Luffa acutangula* (ridge gourd) accessions, mainly from Thailand were evaluated. A total of 2834 SNPs were used to establish population structure and underlying genetic diversity while exploring the fruit characteristics together with genetic information which would help in the selection of parental lines for a breeding program. The study found that the average polymorphism information content value of 0.288 which indicates a moderate genetic diversity for this *L. acutangula* germplasm. STRUCTURE analysis ( $AK$  at  $K=6$ ) allowed us to group the accessions into six subpopulations that corresponded well with the unrooted phylogenetic tree and principal coordinate analyses. When plotted, the STRUCTURE bars to the area of collection, we observed an admixed genotype from surrounding accessions and a gene flow confirmed by the value of  $F_{ST}=0.137$ . AMOVA based on STRUCTURE clustering showed a low 12.83% variation between subpopulations that correspond well with the negative inbreeding coefficient value ( $F_{IS} = -0.092$ ) and low total fixation index ( $F_{IT}=0.057$ ). There were distinguishing fruit shapes and length characteristics in specific accessions for each subpopulation. The genetic diversity and different fruit shapes in the *L. acutangula* germplasm could benefit the ridge gourd breeding programs to meet the demands and needs of consumers, farmers, and vegetable exporters such as increasing the yield of fruit by the fruit width but not by the fruit length to solve the problem of fruit breakage during exportation (Perez *et al.*, 2021). Kumari *et al.* (2019) to establish the species delimits and varietal identities of *L. acutangula* and *L. aegyptiaca* varieties grown in Sri Lanka using morphometric, phylogenetic and organoleptic assessments the study was undertaken. They assessed five varieties of *L. acutangula* and three varieties of *L. aegyptiaca*. The vegetative and reproductive data were collected for the morphometric analysis and DNA sequence polymorphism of the markers *rbcl*, *trnH-psbA* and ITS for the phylogenetic analysis. We also conducted an organoleptic assessment based on taste parameters; aroma, bitterness, color, texture, and overall preference using the dishes prepared according to the most common Sri Lankan recipe for *Luffa*. The variation of the vegetative and reproductive traits grouped *L. acutangula* varieties into two distinct clusters. The *trnH-psbA* polymorphism provided the basis for the species delimits of *L. acutangula* and *L. aegyptiaca*. The *rbcl* and ITS polymorphisms provided the basis for the identities of the varieties of *L. aegyptiaca* and *L. acutangula* respectively. In the phylogeny, the *L. acutangula* varieties of Sri Lanka formed a unique clade and the *L. aegyptiaca* varieties formed a reciprocal monophyletic group in comparison to worldwide *L. aegyptiaca* reported. The taste parameters aroma, texture, color, and overall preference were significantly different among the *Luffa* varieties. The *L. aegyptiaca* varieties received lower preference in the organoleptic assessment. The present study sets the species delimits, phylogenetic positions and the varietal identities of the cultivated germplasm of *Luffa* and revealed the distinct morphological and organoleptic properties of each variety. Out of 103 microsatellite markers used for studying the genetic diversity among local landraces of *Luffa* species, 56 were found polymorphic, including 38 gSSR and 18 eSSR, respectively. A total of 197 amplification products were obtained. The mean number of alleles per locus was 3.52. The PIC ranged from 0.037 to 0.986, while size of amplified product ranged from 105 to 500 bp. Cucumber-derived SSRs were amplified within *L. acutangula* (68%), *L. aegyptiaca* (61.16%), and *L. hermaphrodita* (60.2%), with an average of 63.12% cross-transferability. The Jaccard's coefficient ranged from 0.66 to 0.97, with an average of 0.81. High genetic variability was observed for node of 1st hermaphrodite flower (6.4–17), days to 1st hermaphrodite flower (38–52.1), days to 1st fruit harvest (43–65), number of fruit per cluster (1–5.9), fruit length (3.9–25 cm), fruit weight (18.4–175 g), number of fruit per plant (20–147.5), and yield per plant (2.2–4.7 kg). Two sub-populations were identified including 21 genotypes (sub-population I) and 06 genotypes (sub-population II), these two sub-populations showed 0.608–0.395% of the ancestral relationship to each other. This study provides information for future exploration, collection, and utilization of *Luffa* genotypes, as well as the polymorphic markers identified could be available for the study of landmarks in linkages, genomic structures, evolutionary ecology, and marker-assisted selection (MAS) in *Luffa* species (Pandey *et al.*, 2018). *Luffa aegyptiaca* is a popular climbing herb endemic in Egypt. We studied the genetic diversity among ten *Luffa* landraces collected from different districts in Egypt. The results obtained from DNA fingerprinting revealed that there were polymorphic loci with average percentage of 44.6 among collected landraces whereas polymorphic loci obtained from SDS-PAGE were 23%. Discrimination between landraces was more efficient by using RAPD-PCR marker than total proteins SDS-PAGE which showed a limited level of intraspecific diversity (Abdel *et al.*, 2016). *Luffa cylindrica* (L.) M. Roem is an underutilized vegetable and a potential biodiesel crop for future. Its fruits are edible and used as vegetable. To aid in the selection of lines for breeding, genetic variation and structure of ten populations of *L. cylindrica* were determined with three morphological characters and 23 sequence-related amplified polymorphism (SRAP) markers. All the three morphological characters were found diverse among 45 accessions. The SRAP primers produced a total of 177 bands, out of which 129 were polymorphic. Informative markers assessed by different measures (polymorphism information content = 0.18, marker index = 1.26, resolving power = 2.87) will direct the selection of primers for cultivar identification in *L. cylindrica*. Low level of genetic differentiation among populations and higher level within populations ( $G_{ST} = 0.4073$ ,  $N_m = 0.7277$ ,  $H_e = 0.124$ ,  $I = 0.20$ ) was detected that might be due to cross-pollinated nature of *L. cylindrica*. The clustering pattern obtained through dendrogram and principal coordinate analysis was loosely concordant with the geographical distribution. The Bayesian structure analysis indicated an admixture type of population distribution. The results designate that SRAP and morphological markers are informative for characterization of *L. cylindrica* and identification of distinctive cultivars (Tyagi *et al.*, 2015).

## BREEDING

**Germplasm:** The World Veg listed 341 accessions of *L. acutangula* in 2016, but 95 % are inactive. GRIN listed 67 *L. acutangula* accessions in 2016 from nine countries; 50 of them from India. Fifty-nine of the accessions are currently available. The WorldVeg listed 409 accessions of *L. aegyptiaca* in 2016, but 96 % were inactive. There are 78 *L. aegyptiaca* accessions in the GRIN collection from 13 countries; 54 of them are from India. Sixty-four (82 %) of the *L. aegyptiaca* accessions are currently available (Dhillon *et al.*, 2016).

*Breeding Goals of Luffa:* Breeding goals of *Luffa* are 1) Earliness, 2) High female: male sex ratio, 3) Uniform, thick, cylindrical fruits free from bitterness, green/light green, 4) Tender, non-fibrous fruits for longer time, 5) High fruit yield (high fruit number and weight), and 6)

Resistance to powdery mildew and downy mildew (Vidhi, 2022). Qualitative Genetics of *Luffa*: Two multiple-allelic loci, A and G, determine sex expression in *L. acutangula*. They indicated that the  $F_2$  of monoecious  $\times$  hermaphrodite segregated in a di-genic ratio of 9 monoecious: 3 andromonoecious: 3 gynoeceious: 1 hermaphrodite forms. Similar results regarding the inheritance of sex forms in *L. acutangula*. It was also reported similar results in the  $F_2$  and backcross generations as given below from the cross of monoecious  $\times$  hermaphrodite forms in *L. acutangula* (Vidhi, 2022).

#### F2 ratio:

9 Monoecious  
3 Andromonoecious  
3 Gynoeceious  
1 Hermaphrodite

#### Backcross ratio:

1 Monoecious  
1 Andromonoecious  
1 Gynoeceious  
1 Hermaphrodite

The bitterness has been reported to be governed by a single dominant gene Bi. Further, these authors have reported that the corolla colour (orange yellow with green veins of *L. cylindrica* vs. lemon yellow of *L. acutangula*), the fruit surface (ridged of *L. acutangula*), seed surface (pitted vs. non-pitted in *L. acutangula*), and the type of androecium i.e. stamens,  $5 = 2 + 2 + 1$  of *L. acutangula* vs. five free stamens of *L. cylindrica* were monogenically inherited (Vidhi, 2022).

#### Breeding Methods of *Luffa* (Vidhi, 2022):

- Inbreeding and selection
- Crossing of complementary parental lines and handling of segregating generations through pedigree/bulk/backcross/single seed descent method
- Heterosis breeding

South and South-east Asia are the centers of diversity of *Luffa*. There is no systematic approach to *Luffa* improvement. For genetic improvement and development of new varieties of *Luffa*, population improvement—especially mass selection and recurrent selection methods—can be employed. Pedigree selection is also used to develop new varieties. Gynoeceious lines are available in *Luffa* and can be used for the production of hybrids. Ethrel can be sprayed on monoecious lines to regulate the female and male flower array and the production of hybrid seeds (Kalloo, 1993).

#### Varieties-Ridge gourd (Eagri, 2022; Vidhi, 2022):

Developing institution	Variety	Special features
IIHR, Bangalore.	Arka Sumeet	Fruits lush green, cylindrical, 55 cm long 2.5 cm girth and 380 g weight with prominent ridges, delicate aroma. Days to first harvest 50-55.
	Arka Sujat	Fruits lush green, cylindrical, medium long (35-45 cm) and average weight (350g). Yield 63 t/ha in 100 days.
IARI, New Delhi.	Pusa Nasdar	Fruits club shaped, light green in colour, 15-20 fruits / plant, yield 15-16 t/ha.
GBPU&T, Pantnagar.	Pant Torai-1	Fruits 5 cm long and club shaped, yield 10 t/ha. More suitable for rainy season.
Tamil Nadu Agricultural University	CO.1	Fruits long (60-75 cm), first harvest in 55 days, 10-12 fruits / plant weighing 3-4 fruits / kg.
	PKM-1	Fruits dark green, average weight 300g, yield 28-30 t/ha in 160 days.
	CO.2	Fruits very long (90-100 cm), weighing 350-400g., green with shallow grooves, duration 120 days, yield 25 t/ha.
HARP, Ranchi	Swarna Manjari	Tolerant to powdery mildew. Fruits elongated, medium sized, highly ridged, green with soft flesh. Days to first harvest 65-70 days. Yield 18-20 t/ha in 140-150 days.
	Swarna Uphar	Fruits elongated, medium sized (200g), ridges with soft weak flesh. Days to first harvest 65-70. Fruits lush green, cylindrical, 55 cm long 2.5 cm girth and 380 g weight with prominent, ridges, delicate aroma. Days to first harvest 50-55.
Punjab Agricultural University Ludhiana.	Punjab Sada Bhar	Fruits long, 3-5 cm thick and slightly curved, yield 10 t/ha.
KKV, Dapoli	Konkan Harita	Fruits dark green, 30-45 cm long, tapering at ends, 10-12 fruits / plant.

Satputia is a cultivar in Bihar which is hermaphrodite and produces pale green small fruits in clusters. In each cluster 5-7 fruits are produced. Yield is 20-25 t/ha.

#### Varieties – Sponge gourd (Eagri, 2022; Vidhi, 2022):

Developing institution	Variety	Special features
IARI, New Delhi.	Pusa Chikni	Early variety. Fruits smooth dark green and cylindrical, 15-20 fruits / plant.
	Pusa Supriya	Fruits pale green, 15-20 cm long, straight and slightly curved at stem end, pointed distal end with long peduncle, average fruit weight 110 g at vegetable harvest stage. Yield 10-11 t/ha.
	Pusa Sneha	Suitable for long distance transport, fruits dark green, 20-25 cm long with hard skin and soft flesh. Yield 12 t/ha.
MPAU, Rahuri.	Phule Prajakta	Fruits medium green with dark green sutures, yield 15 t/ha.
BAC, RAU, Sabour, Bihar	Rajendra Nenua	Fruits long, greenish white, smooth and thick, resistant to fruit fly and fruit rot. Yield 25 t/ha.

**Hybrids of ridge gourd:** Popular ridge gourd hybrid cultivars include Naga, Mallika, Rama (East-West Seeds), NS-3 (Namdhari Seeds), Aneceta (Advanta India), MHRG-7, Surekha (Mahyco), Gaurav and Pallavi (Sungro Seeds).

These hybrids are widely preferred in India due to their adaptability, prolific fruit setting and best fruit quality (attractive light-green to green color, 25–40 cm long, prominently ridged tender fruits with rich taste). Popular ridge gourd cultivars derived from landraces include Pusa Nasdar, Pusa Nutan, Hisa Kali Tori, Gujarat Anand Ridge Gourd-1, and Pant Tori-1 (Dhillon *et al.*, 2016).

**Cultivars of sponge gourd:** Sponge gourd cultivars popular with farmers in India include White Seeded (Century Seeds), Alok (VNR Seeds), Lohit (Tropica Seeds), Nutan and Sonali (Sungro Seeds), NS 441 (Namdhari Seeds), Maya (Bio Seeds), Harita (Mahyco) and NHSG (Nimal Seeds). These hybrids gained prominence and popularity among farmers due to their strong and vigorous vines, high yield potential, wide adaptability and nearly cylindrical, 20–30 cm long, tender fruits with attractive dark-green or light-green colors. Popular open-pollinated cultivars developed through selection from landraces of sponge gourd include Pusa Chikni, Pusa Supriya, Pusa Sneha, Azad Tori-2, and Pant Chikni Tori-1. In India, consumers prefer unripe tender fruit of sponge gourds and ridge gourds before it becomes fibrous, irrespective of the size (Dhillon *et al.*, 2016).

## USES

Immature fruit of sponge gourd is used as vegetables, which is good for diabetes. Oil is also extracted from seeds for industrial use (Joshi *et al.*, 2004). The fibrous vascular system inside the fruit after separating from the skin, flesh and seeds, can be used as a bathroom sponge, as a component of shock absorbers, as a sound proof linings, as a utensils cleaning sponge, as packing materials, for making crafts as a filters in factories and as a part of soles of shoes (Joshi *et al.*, 2004). The use of the luffa fruit is dependent on its growth stage. The immature fruit is a nutritious vegetable and is popular in Asian cuisine. Additionally, another species of luffa, called ball luffa (*Luffa operculata* (L.) Cogn.), is used as a fibrous scrubbing sponge for household cleaning. Its common names include sponge cucumber and wild loofah (Filipowicz and Schaefer 2014). Ball luffa is rarely, if ever, eaten. Moreover, luffa sponges are recyclable and biodegradable and can be applied as an eco-friendly material in packaging, water absorption, and water waste treatment. Sponge gourd also is known as towel gourd, smooth loofah, vegetable sponge, and dishcloth gourd. Ridge gourd is also known as angled loofah, ribbed gourd, silk gourd, and Chinese okra. The immature, tender fruits of these two species are consumed as cooked vegetables. The mature, fibrous endocarp can be used as a sponge, the loofah scrubbing sponge, and is popular with consumers in the U.S.A., Japan and Asia. (Dhillon *et al.*, 2016). In cooking, the immature fruits, 7.6-15 cm in length, can be stir-fried whole or sliced, or they can be grated and used in soups and omelets. They are used extensively in curries. Larger fruits that are 10-15 cm in length are peeled because the skin becomes bitter (Luffa, 2022). In addition to the immature fruits, the Chinese also eat the young shoots, leaves and flower buds. In fact, fried gourd flowers are quite a delicacy, and the raw flowers are 'a nice addition to tossed salads'. The flowers can be used much as zucchini/courgette flowers are used – for example fried in a tempura batter (Luffa, 2022). The young shoots, flowers and leaves can be cooked, and the mature seeds can be roasted for consumption (WIKI, 2022a). An edible oil can be extracted from the seeds. The resulting oil meal can be fed to rabbits and catfish, or used as a fertilizer (WIKI, 2022a). Loofah is an edible plant, so you can harvest young and eat them in the same manner you would a young zucchini or summer squash. Immature Luffa Gourds can be eaten raw, or cooked like summer squash. Anything under 10 cm doesn't need to be peeled. From 10 to 15 cm, you may wish to peel it, as the skin can be bitter at that point. The flowers on the ridged varieties can also be eaten as you would squash blossoms. When a luffa fruit dries out and is peeled, you are left with its fibrous interior, which can be used as a sponge (Anon., 2022). The young fruit is eaten as a vegetable and is commonly grown for that purpose in tropical Asia. Unlike the young fruit, the fully ripened fruit is strongly fibrous and inedible, and is used to make scrubbing bath sponges. Due to the use as a scrubbing sponge, it is also known by the common names, rag dishrag gourd, sponge gourd, and vegetable-sponge. It is also called smooth luffa to distinguish it from the ridged luffa (*Luffa acutangula*), which is used for the same purposes (WIKI, 2022a).

## NUTRITIONAL VALUE

Luffa fruit is rich in phosphorus, potassium, vitamin A, and vitamin C, with benefit to the immune system and general health. Luffa has diuretic and purgative effects. It helps alleviate asthma and skin disease (Dhiman 2012). Luffa also contains triterpenoid saponins such as lucyosides and flavonoids such as apigenin. The seed extracts contain polypeptides, e.g., luffins. These physiologically active compounds have pharmacological effects such as anti-inflammation, anti-fungal, anti-allergy, anti-asthma, and anti-tussive (Partap *et al.* 2012).

### Nutritional Values of Ridge Gourd

#### Nutritional Values of Ridge Gourd per 100g (Sangh *et al.*, 2012)

Dishcloth gourd, cooked, no salt	
Nutritional value per 100 g	
Energy	56 kJ (13 kcal)
Carbohydrates	14.34 g
Sugars	5.17 g
Dietary fiber	2.9 g
Fat	0.34 g
Protein	0.66 g
Vitamins	Quantity %DV <sup>†</sup>
Vitamin A	260 IU
Thiamine (B1)	4% 0.046 mg
Riboflavin (B2)	4% 0.042 mg
Niacin (B3)	2% 0.26 mg
Vitamin B6	8% 0.099 mg
Folate (B9)	3% 12 µg
Vitamin C	7% 5.7 mg
Vitamin E	2% 0.24 mg
Vitamin K	2% 1.7 µg
Minerals	Quantity %DV <sup>†</sup>
Calcium	1% 9mg
Iron	3% 0.36 mg
Magnesium	6% 20 mg
Phosphorus	4% 31 mg
Potassium	10% 453 mg
Sodium	1% 21 mg
Zinc	2% 0.17 mg

Ridge gourds are rich in calcium, magnesium and zinc. They are also low in calories and contains 94% moisture. It provides essential nutrients like vitamin A, C, B6 and folate. Ridge gourds are also rich in antioxidants, which help to prevent diseases like cancer. It is also an excellent source of dietary fiber and carbohydrates. Further, it is also an average sources of B-complex vitamins such as thiamine, niacin (vitamin B3), pantothenic acid (vitamin B5), pyridoxine (vitamin B6) and minerals such as calcium, iron, zinc, potassium, manganese and magnesium (Pathakamuri, 2022).

**Nutritional Values of Ridge Gourd per 100g (Pathakamuri, 2022)**

Nutrients	Amount per 100 g
Calories	13.15 kcal
Carbohydrates	1.72 g
Protein	0.91 g
Fat	0.14 g
Calcium	13.7 mg
Phosphorous	33.06 mg
Omega-3 fats	26.42 mg
Sodium	4.71 mg
Potassium	118 mg
Folate (vitamin-B9)	29.26 mcg
Vitamin-C	5.42 mg
Beta carotene	348 mcg
Vitamin-A	58 mcg
Magnesium	16.15 mg

#### Nutritional Value of Sponge Gourd

Sponge Gourd or luffa contains a variety of antioxidants, vitamins, nutrients, lipids and minerals. The fruit is rich in carbohydrates and vitamin A. It also contains vitamin B5, potassium, manganese, copper, fiber, vitamin B6, vitamin C, and contain magnesium (Syakira, 2018). According to Healthbenefits (2022) sponge gourd has various types of nutrients. It is rich in Vitamin A, Carbohydrate, Vitamin B5, Manganese, Potassium and very low in Lipid, fat, Protein, Sodium and Vitamin K. Its range of minerals is truly impressive including Manganese, Potassium, Copper, Magnesium, Iron and Phosphorus. Nutritional value of Sponge gourd are as follows:

Serving Size: 1 Cup (178 g)  
Calories 100 Kcal.  
Calories from Fat 5.49 Kcal.

Proximates	Amount	% DV
Water	150.04 g	N/D
Energy	100 Kcal	N/D
Energy	417 kJ	N/D
Protein	1.17 g	2.34%
Total Fat (lipid)	0.61 g	1.74%
Ash	0.66 g	N/D
Carbohydrate	25.53 g	19.64%
Total dietary Fiber	5.2 g	13.68%
Total Sugars	9.2 g	N/D

Minerals	Amount	% DV
Manganese, Mn	0.397 mg	17.26%
Potassium, K	806 mg	17.15%
Copper, Cu	0.151 mg	16.78%
Magnesium, Mg	36 mg	8.57%
Iron, Fe	0.64 mg	8.00%
Phosphorus, P	55 mg	7.86%
Zinc, Zn	0.3 mg	2.73%
Sodium, Na	37 mg	2.47%
Calcium, Ca	16 mg	1.60%
Selenium, Se	0.4 µg	0.73%

Vitamins	Amount	% DV
Vitamin A	463 µg	66.14%
Vitamin B5 (Pantothenic acid)	0.892 mg	17.84%
Vitamin B6 (Pyridoxine)	0.176 mg	13.54%
Vitamin C (Ascorbic acid)	10.1 mg	11.22%
Vitamin B1 (Thiamin)	0.082 mg	6.83%
Vitamin B2 (Riboflavin)	0.075 mg	5.77%
Vitamin B9 (Folate, Folic acid)	21 µg	5.25%
Vitamin B3 (Niacin)	0.463 mg	2.89%
Vitamin E (alpha-tocopherol)	0.43 mg	2.87%
Vitamin K (phylloquinone)	3 µg	2.50%

Lipids	Amount	% DV
<b>Saturated fatty acid</b>	0.048 g	0.07%
Palmitic acid (hexadecanoic acid) 16:00	0.034 g	N/D
Stearic acid (octadecanoic acid) 18:00	0.014 g	N/D
<b>Mono unsaturated fatty acids</b>		
Oleic acid (octadecenoic acid) 18:1	0.112 g	N/D
<b>Polyunsaturated fatty acids</b>		
Linoleic acid (octadecadienoic acid) 18:2	0.263 g	N/D

\*Above mentioned Percent Daily Values (%DVs) are based on 2,000 calorie diet intake. Daily values (DVs) may be different depending upon your daily calorie needs. Mentioned values are recommended by a U.S. Department of Agriculture. They are not healthbenefittimes.com recommendations. Calculations are based on average age of 19 to 50 years and weighs 194 lbs.

## HEALTH BENEFITS

### Health Benefits of Ridge Gourd

Luffas have considerable potential as a medicinal food. It is rich in Vitamin C and also has a reasonable supply of minerals. There is also research still awaiting on some chemicals that at present have no known activity. The seed in particular deserves far more analysis. The Oleonic acid known to be in the seed has extensive useful activity being for example, Antiarrhythmic, Antibacterial, Anticarcinomic, Antigingivitic, AntiHIV, Antiinflammatory, Antimalarial and Antiplasmodial! Even when young, the fruit has a considerable amount of fibre, but this makes it a natural laxative with a perhaps less harsh profile than bran. There is some quite helpful activity in combatting a number of skin diseases – acne, eczema, alopecia (Luffa, 2022). Ridge Gourd is low in saturated fat, cholesterol and calories that aids in weight loss. It is high in beta-carotene which is good for enhancing eye sight. Being rich in dietary fibers and smooth flesh, luffa facilitates easy digestion and easy movement of food through the bowel (Pathakamuri, 2022).

The ridge gourd is a good source of folate which helps to reduce the risk of heart disease, stroke and cancer. It can also help to lower the risk of diabetes by regulating blood sugar levels. Ridge gourd contains good amount of cellulose and high in water content that helps to relieve from constipation. Both cultivars (ridged and smooth varieties) compose phenolic antioxidants such as carotenes, lutein and crypto-xanthins (Pathakamuri, 2022). According to Pathakamuri (2022) the health benefits of ridge gourd are as follows:

**Weight Loss:** Ridge gourd contains carbohydrates and dietary fiber which are essential for weight loss and inherently. The ridge gourd contains an enzyme called cellulase which breaks down the cellulose and makes it easier to digest. This helps in weight loss as well as reducing fat content in the body. It possesses negligible concentrations of saturated fats and cholesterol. This, in turn, helps to digest proteins, carbohydrates and fats in food bang on upon ingestion and also turn away the excess accumulation of fats in body tissues. Ridge Gourd also helps in preventing constipation, indigestion, heartburn and other digestive disorders by increasing the production of digestive enzymes such as amylase, lipase and protease. It is also rich in Vitamins C, A and B6 which are essential for weight loss by boosting metabolism rates, promoting faster fat burning, and detoxifying the body.

**Enhances Eye Sight:** Ridge gourd is a very beneficial for the eyes. It improves eye sight, reduces eye strain and also provides protection against cataracts and macular degeneration. It also has anti-inflammatory properties which can help with eye irritations such as conjunctivitis. It has been scientifically proven that ridge gourd is good for the eyes. The antioxidants present in this fruit help in improving vision and also protect against cataracts. Being a valuable antioxidant, beta carotene rids the optic nerves and visual blood vessels of toxins, thereby shielding the eyes from harmful free radicals. Ridge gourds are rich in vitamin A which helps in reducing eye strain by providing much needed relief from dryness, irritation of the eyes, night blindness, floaters, etc. The significant amounts of vitamin A in ridge gourd, in the form of beta carotene, contribute to improving eyesight even at an older age.

**Liver health:** The ridge gourd has many health benefits for the liver, as well as other organs of the body. It helps in purifying blood and also removes toxins from the body through urine. Ridge gourd is bestowed with the ability to purify blood of toxic wastes, alcohol residues and undigested food particles. Hence it plays a crucial part in augmenting liver health and bile function. Bile is a fluid secretion of the liver, which helps break down lipids or fats. It boosts up and nourishes the liver health and protects the liver from alcohol intoxication. The benefits of ridge gourd for liver health are: 1) Improves liver function, 2) Reduces inflammation, 3) Prevents liver diseases, and 4) Protects the liver from damage by free radicals.

**Relieves Constipation:** Ridge gourd has been used as a remedy for constipation for centuries in India and other countries. It works as an effective laxative because of its high fiber content which helps to soften stools. Constipation is a common condition that affects people all over the world. It is characterized by the infrequent or difficult passage of stools. The health benefits of ridge gourd for constipation are: 1) It has high water content which helps in easy bowel movements, and 2) It contains inulin which can help aid digestion.

**Skin Health:** Ridge gourd is a type of vegetable that has many health benefits for skin health. Ridge gourd has blood purifying qualities and it is skin friendly. It makes sure you to stay clear from pimples and acne. The skin is the largest organ in the human body and it needs to be taken care of properly to maintain its health. The ridge gourd contains essential nutrients like vitamin C, folate, potassium and magnesium that are essential for maintaining healthy skin. Ridge gourd has anti-inflammatory and antioxidant properties which helps to reduce the appearance of wrinkles and fine lines on the skin. It also helps to hydrate the skin and prevent it from becoming dry and flaky.

**Controls Diabetes:** Ridge Gourd is a vegetable that has a number of health benefits. It has been used in traditional medicine for centuries and is today being researched for its potential to help people with diabetes. Ridge Gourd is an excellent source of dietary fiber and is also rich in many other nutrients. It has a low glycemic index, which means it does not cause a rapid rise in blood sugar levels. It helps in lowering blood sugar levels and regulating insulin production. Ridge gourd is a low-calorie food which can be consumed by diabetics without any worry. It is hypoglycemic, which helps maintain the blood sugar levels. Hence, ridge gourd is an ideal vegetable for controlling diabetes. Moreover, insulin like peptides and alkaloids in ridge gourd help control blood sugar levels, hence maintaining body weight and metabolism in diabetes.

**Heart health:** The ridge gourd has been found to be a good source of antioxidants which are essential for maintaining a healthy heart by fighting free radicals that can damage cells. Ridge gourd is rich in potassium and magnesium which are essential for the proper functioning of the cardiovascular system. Ridge Gourd helps to maintain heart health by lowering cholesterol levels and blood pressure, preventing heart attacks and strokes, reducing the risk of diabetes, etc.

#### Other Health Benefits

- Ridge gourd helps to manage acidity as well as ulcers.
- Reduces sugar in blood and urine
- prevents chronic diseases like cancer
- It is also used for treating kidney stones and urinary tract infections.
- It acts as a cooling agent and aids in handling burning sensation during urination.
- Ridge gourd juice is used to heal jaundice
- Strengthen your immune system against any infection
- It also effectively treats other infections arising in the hepatic duct.

#### Health Benefits of Sponge gourd

*Luffa cylindrica*, otherwise known as Sponge gourd is a fibrous plant with fruits containing black seeds. It grows as a flowering annual vine with pollinated flowers developing into cylindrical green fruits filled with seeds in a system of many intertwined cellulose fibres. The fruit is edible especially when young and it contains group of compounds such as phenolics, flavonoids, oleanolic acid, ascorbic acid,  $\alpha$ -tocopherol, carotenoids, chlorophylls, triterpenoids and ribosome-inactivating proteins, which makes it highly effective when used for medicinal purpose. *Luffa cylindrica* contains chemical components that have effects on hypersensitivity reactions, serve as immunostimulant, anti-inflammatory agent and function in glycosidase activity, inhibit protein synthesis with structural-function relationship of type I RIPs suggesting potentials for antitumour and antiviral activities, and also induce uterine contraction to hasten child birth (Oxytocics). The traditional and medicinal uses of *Luffa cylindrica* were explored and the shortcomings associated with its uses were highlighted and discussed. *Luffa cylindrica* as a medicinal plant has been widely employed in treatment of many diseases and used in offering solutions to clinical problems relating to child birth.







Although to many communities where this plant is used, little did they know about the secret of its potency. Scientific research has shown the presence of some chemical components and proteins in *Luffa cylindrica*, and many others, which made it possible for them to be used as potentially effective chemical agent in health care delivery (Azeez et al., 2013). Pharmacological actions of *Luffa cylindrica* are 1) Anti-inflammation, 2) Anti-fungus, 3) Analgesia and sedation, 4) Anti-myocardial ischaemia, 5) Anti-hyper triglyceride, 6) Immuno stimulation, 7) Anti-allergy, and 8) Anti-asthma, anti-tussive and expectorant effects (Sangh et al., 2012).


#### SPONGE MAKING

Luffa sponge gourd (*Luffa aegyptiaca* Mill.) is an annual tropical or subtropical vine used for its fruit. The fruit can be eaten at the green or immature stage, but it is more commonly used at the mature stage for the sponge. The skin of the fruit, or gourd, is initially green and turns brown at maturity. As the gourd matures, a dense fibrous network of cellulose forms inside the fruit, and is what is harvested and used as a sponge. The fibrous network provides support for the fruit and serves as a mechanism for seed dispersal. The sponge has a variety of commercial purposes including personal hygiene products, household cleaning products, steam engine filters, craft items, insulation, padding for saddles, and immobilizing agents in biotechnology (Wehner, 2022). The fruit section of *L. aegyptiaca* may be allowed to mature and used as a bath or kitchen sponge after being processed to remove everything except the network of xylem fibers. If the loofah is allowed to fully ripen and then dried on the vine, the flesh disappears leaving only the fibrous skeleton and seeds, which can be easily shaken out. Marketed as *luffa* or *loofah*, the sponge is used as a body scrub in the shower. In Paraguay, panels are made out of luffa combined with other vegetable matter and recycled plastic. These can be used to create furniture and construct houses (WIKI, 2022). In order to make the sponges, the fruit is allowed to fully mature on the vine until they have turned brown and their stems have turned yellow. If the loofah is allowed to fully ripen and then dry out on the vine, the flesh disappears leaving only the fibrous skeleton and seeds. Once the loofah outer skin is dry and brown, it is peeled and the seeds are shaken out. The seeds are saved because an edible oil can be pressed from them. The dry loofahs can be soaked in water for a few days to make it easier to peel off the skin, but this may affect the seeds, making it more difficult to extract the oil. Although we tend to think of loofah as a bath brush, they are also potentially good pan scrubbers and make good filters. Even with regular use, loofah sponges last for months, rubbing bodies or dishes, but they do eventually wear out and need to be replaced. This said, the luffa is a far more eco-friendly scrubber than the plastic variety and it is from a sustainable source. The potential uses of this plant are really only now beginning to be explored. In Paraguay, panels are made out of luffa combined with other vegetable matter and recycled plastic. These are being used to create furniture and construct houses (Luffa, 2022). Luffa is ready to be harvested in the fall when they are tan in color and lightweight, and their skin has fully dried to a hard shell. When you shake a luffa, you should hear the seeds rattle, which is a sign that the inside fibers have dried and hardened as well. Cut the fruit from the vine with one to two inches of the stem attached. To make sponges, immerse the luffa in warm water for about 20 minutes, or until the skin can be easily removed. Remove the seeds by shaking them loose, and remove any pulp. Once you have gutted the luffa, soak in a 10 percent bleach solution for one hour to clean it. Rinse it well under fresh water and shake it to remove excess water, then dry in a warm well-ventilated place before storing (Fig. 8 & 9) (Hassan, 2022).





		
Cut the tip with a secateur	Peeling off the skin	Sponge
		
Skin and seeds	Sponges	The fibrous skeleton of the fruit is used as a household scrubber. The fiber is <u>xylem</u> . It has semi-coarse texture and good durability
<b>Fig. 8. Making sponge from sponge gourd fiber</b>		

		
A bathroom loofa sponge	Natural Hand made soap	Luffa soap
<b>Fig. 9. Songe, soap made from sponge gourd fiber</b>		

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