

A review of *Annona* species in Sri Lanka

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ABSTRACT

Sri Lankan is a country with an agrarian based economy, distinct number of *annona* species can be grown in Sri Lanka, as the country has different agro ecological zone. Among different species *Annona muricata*, *Annona squamosa*, *Annona reticulata* are the commercially available ones with prominent cultivars. Many countries considered it as an underutilized crop while it also considered as one of minor fruit species in Sri Lankan condition. It contains phytochemicals such as alkaloids, flavonoids, phenolic compounds, several pigments, essential oils, fatty acids and vitamins. Those chemicals demonstrate broad spectrum activities like anti-microbial, anti-fungal anti-oxidant, anti-inflammatory, anti-diabetic and the anti-tumour activity. Researchers should be focused on the medicinal value characterization and the genetic conservation of the available *annona* gene pool in the country. This review article deals about the morphological properties, physiological properties, phytochemicals, medicinal property and multiple uses of the different *annona* species in Sri Lanka. This review aimed to create effective awareness about different *annona* varieties in country, their medicinal, nutritional values and importance of conservation measures. Many of these species are significant for local food and nutrition security other than use as a traditional medicine.

Keywords: *Annona* species, bioactive compound, medicinal plant, minor fruits, plant morphology, underutilised crops

INTRODUCTION

Contribution of the neglected and underutilized crop species are important for the economy of the country and ensure the food security and the nutrients requirements of population in the world. Sri Lanka has nearly more than 60 underutilized fruit crops (Dhanayaka, 2015) which are rarely found in market and commercial level cultivation. Other than direct consumption of these underutilized fruits, there are huge potential to prepare the different preserved and value added food with higher shelf life with huge medicinal value. Genus *Annona* (belongs to Annonaceae family) consists of 109 species worldwide. Among them only a few species are used as the commercial cultivars, such as *A. muricata*, *A. squamosa*, *A. reticulata* and few hybrid species like *A. cherimola*, *A. diversifolia* (Abdulrahman and Kumar, 2015). Many counties *Annona* spp are growing in small scale, as cottage cultivation. Because of the factors such as climatic condition, poor agronomic conditions, and limited knowledge about harvesting, post-harvest handling and processing techniques. Specified agro climatic requirements (altitude, temperature, RH and the soil characters) restricted Annonaceae family plants to grow in

some regions of the world. Sri Lanka is a country with diverse climatic conditions covering 46 agro ecological zone, many *Annona* species can be grown. According to the Department of Agriculture, Sri Lanka, there are 6 *Annona* spp are cultivated as a commercial scale (Dilrukshi and Abhayagunasekara, 2020).

Annona is a tree or shrub, evergreen or semi deciduous with a yearly producing pattern (Ross and Ross, 2003). In few countries *Annona* is grown for commercial purposes, even though it's considered as the underutilised and non-neglected fruit, with multiple uses. Fruit flesh is edible, rest of the plant parts can be used for pharmaceutical purposes, health product, food supplement, cosmetic preparation etc. (Sandeep and Mittal, 2017). Since it contains number of naturally occurring phytochemicals with different biological properties and bio-active compounds responsible for the different treatments including muscular strength, cooling and reducing the burning sensation, enrich the blood supply. Leaves are important as anti-helminthic medicine (Sudip et al., 2014), which are important for the treatment of certain pathogen (Ross and Ross, 2003).

Table 1: Common names and botanical names of the different *Annona* spp.

Vernacular name	Common name	Botanical names
Cherimoya	Cherimoya	<i>Annona cherimoya</i> L.
Katuanoda	Sour sop	<i>Annonamuricata</i> L.
Welianoda	Bullock's heart	<i>Annonareticulata</i> L.
Sinianoda	Sugar apple, Sweet sop	<i>Anonnasquamosa</i> L.
Welatha	Pond apple	<i>Anonnaglabra</i> L.

(Pinto *et al.*, 2005)

Annona considered as one of the important minor fruits and possesses high nutritional properties same as other underutilized fruits as reported by Kalkame *et al.* (2018). It is considered as an excellent sources of vitamin C (Padmini *et al.*, 2017) while its flesh contain more than 58 % of sugar on dry weight basis (Sudip *et al.*, 2014). Fresh fruit is used for preparation of many beverage types such as wine, jellies, jams, fruit-butter like preserved, value added fruit items with long shelf life. *Annona* plant species can be adapted to the hard climatic conditions and poor soil condition, so it can be recognized as a plant that is adopted for the future food production under the harsh climatic conditions.

Seed consist of hard outer cover with wax coating. It creates great barrier to the water intake for initiate the germination (Ferreira *et al.*, 2016) hence seeds take much time for the germination. Seeds show more dormancy period of 6-8 months with regards to its anatomical and physiology of the embryo. Even the environmental conditions are favoured, seed germination get delayed because of the anatomical and physiological dormancy. Other than the physical and chemical methods, the plant hormones are one of another effective method to speed up the germination process by overcoming the dormancy. According to Chagas *et al.* (2013) by soaking seeds in Gibberellic acid at 50 -70 mg L⁻¹ for 12 hours is the more effective way to enhance the germination process. According to the Dresch *et al.* (2014), dormancy can break by applying GA₃, GA₁, GA₂, GA₇ which are biologically active compound, turn down the time spend for seed germination. Other than that cold scarification, storage times are effective to reduce the dormancy period (Dresch *et al.*, 2014).

According to the Dresch *et al.* (2014), seed germination percentage can be enhances by store seeds in a 5°C (34% RH) for 30 days and immerse in Gibberellinacid is very effective comparative to the other seed treatments.

There are few researchers focused on leaves but seeds and roots are still poorly studied. Aim of this review is aware the peoples about the available *Annona* spp in the Sri Lanka, nutritional and medicinal properties and pay the attention to researchers to study in poorly studied area.

Species in Sri Lanka

In Sri Lanka, major grown *Annona* species are *Annona muricata*, *Anona reticulata*, *Annona squamosa* and rarely available hybrid spp. called Cherimoya (Encina *et al.*, 2014).

1. *Annona muricata* / katuanoda: Different names are used to introduce *A.muricata*, such as Soursop, Katuanoda, Graviola and Gunabana. It's a kind of small plant with 5-8 m height and has an extensive root system. Branches are formed with the shape of inverted cones (Moghadamousi *et al.*, 2015). As this plant is a small and early-bearing habit which can be used as intercropping with larger fruit trees, like mango, avocado etc. Leathery featured leaves are present with ovate to elliptical shape. Flower is protandrous, large and light green in appearance. Petals are 6 in 2 whorls and outer whorls have three triangular sepals with ovate to acute shape. They are thick, fleshy and fitting together at the edges of petals. Narrow petals are present in the inner whorls, smaller and concave with the shape of finger nail. Numerous stamens are present with the shape of shield. Number of stigma present around the one ovule consists of a sticky stigma. As a result, pollinators are attracted



1.1

1.2

1.3

Figure 1.1: *A. muricata* leaf with shine leaf blade, **Figure 1.2:** *A. Muricata* plant, **Figure 1.3:** *Annona muricata* fruit,

to the plant and lead to pollination. Fruits are heart in shape, consisting of a number of carpel covered with fleshy, about 1.5mm length, pulp is white and juicy that is covered with its seeds. Fruit consists of 67.5% edible pulp, 20% peel, 8.5% seeds. Sugar constitute about 68% of the total solids. The most desirable feature is the extremely pleasing fragrance and flavour of the *A. muricata* fruit pulp (Ross, 2003).

A. muricata contains thirty seven phenolic compounds. Mainly seeds and pulp shows the more vitamins and carotenes and also thirty seven volatile compounds have been found other than eighteen essential oils. *A. muricata* is highly used for the treatment of cancer cells. It increases the existing ability of the non-cancer cells in the body. Higher amount flavonoids present and important to inhibit the cells proliferation and supress the migration of the cancer cells. Which induces the reaction with reactive oxygen species (ROS). *A. muricata* leaf extraction examined against the gastric injuries and demonstrated that toxicity provided against the worms in the human digestive system (Moghadamtousi *et al.*, 2015).

This is the widely available *anonna* spp in the Sri Lanka. Within the different agro climatic zones in the country, a number of *A. muricata* accession have been identified (Wahab *et al.*, 2011). Under the local condition many research focus on the nutritionals, medicinal and bio active compound

of different plant parts of a muricata other than improvement on the germ plasma.

2. *Annona reticulata*: It is known as bullock's heart, normally can be seen in the home garden of the low country wet zones. Plant height is around 6 - 7.5 m, with numerous lateral brunches. The plant comparatively less drought-tolerant than other *Annona* species. Upper leaves shine more than the lower leaf surfaces and have thin hair like structures. Leaves are deciduous, form an alternative pattern, shape is oblong or narrow-lanceolate and have a bad smell. Two to four flowers present with heart in shape, flowers rarely open, appear as clusters, have good fragrant and slender with 3 outer fleshy, consist with narrow petals, externally light-green and pale-yellow with a dark-red or purple inside at the base (Moghadamtousi *et al.*, 2018). Fruits are heart shaped; turn to yellow when turning to the ripening stage. When fruit turn in to the well ripening stage, white colour powder is appear in outer appearances. The seeds contain a hard outer ring, oval shape with shine exocarp. Around 75 seeds can be found in a matured fruit. There is a thick, cream-white layer of flesh beneath the skin. In each segment there is a hard, single, dark-brown to black and oblong shape, smooth seed nearly half an inch long (Moghadamtousi *et al.*, 2018 ; Yapwattanaphun *et al.*, 2011).



Figure 2.1: *A. reticulate* fruit



Figure 2.2: *A. reticulate* leaves



Figure 2.3: *Annona reticulate* plant



Figure 3.1: Plant



Figure 3.2: Leaf



Figure 3.3: Fruit



Figure 3.4: Seeds of *A. squamosa*

Plant contains numerous alkaloids, steroids, flavonoids, tannins, glycosides, phenolic compounds, amino acids, carbohydrates and proteins and the minerals like Ca, P, K, Mg, Na, Cl, S, Fe, Cu, Se, Co and Cr (Inkoto *et al.*, 2018). Nutritional content of the fruit is reported as nearly 17% sugar, 1.6% protein, and 0.26% fat. The fruit is a good source to enrich the blood, increase the muscular strength, traditionally which is used for the different ailment like diabetes, heart stokes, worm infection, internal parasite, constipation (Coria-Téllez *et al.*, 2018). Leaves are used as an anti-helminthic medicine.

3. *Annona squamosa*: Small plant with 3-7 m height, and it's a kind of deciduous plant with irregular branching habits. Inner barks are lighter yellow than outer bark. This can be easily grown with minimum care and is easily grown in the hot and dry climatic condition under any soil condition. Leaves are light green colour with lanceolate in shape with invisible hairs. Top portion of the plants shows leaves with dull green to dark green colour appearances, while the bottom part of the plant

leaves appears as pale blue green appearances. Flowers appear as clusters with 2-4 flowers with good fragrance and greenish white in colour during the January to May and fruits are produced during July to August. Sepals are about 16mm long and 6mm width, hairy and pointed. The shape of fruits normally round to heart. When fruit begins to ripe it turns into a greenish yellow colour and form white colour powdery sooty around the exocarp. Flesh is edible, sweet in taste, smooth and white in colour. Flesh is divided into carpel along the central axis. Each endocarp consists of seed with shiny outer appearance and oblong shape with 1.3- 1.6cm in size range (Orwa *et al.*, 2009).

Different plant parts are used for conventional medical purposes and the pharmaceuticals such as heart ailments, diabetes, hyperthyroidism. *A. squamosa* traditionally used for the treatment of epilepsy, diarrhea, worm infestation, constipation, hemorrhage, fever and thirst (Abdulrahman and Senthil Kumar, 2015).

4. *Annona senegalensis* (wild soursop): It's not highly domesticated spp that can be found in

the rural areas. Kind of small semi deciduous shrub or tree with rough bark with greyish, black in colour. Leaves are ovate to oblong in shape with rounded apex, lower surfaces of the leaf consist hair like brown colour structure, while upper surface is smooth.

Flowers have long stalk, green colour and have a specific fragrant. Fruit are globose or subglobose form, flesh is white to yellow with pleasant aroma and have many number of seeds in one fruit. Bark is used for preparation of different types of dye, and wood is prominently use for preparing different hand tools.

CONCLUSION

Annona spp is consider as a minor fruit with number of vitamins, minerals, bio active compounds, antioxidants and different plant base medicinal compounds. It have potential to develop the medicines and drugs for different aururvedic treatments with broad spectrum. As a Sri Lanka is a country, rich in different climate, contain higher number of *annona* accession with endemic values. But at the present condition, studies are limited to the few of selected accessions. *Annona* fruit consist with sweat pulp, which have greater potential to further process. Post-harvest management, value addition, research on mass propagation method and effective conservation measures are few of approaches that should be essential to further address.

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