ABSTRACT

In India, karonda fruits, which are still underutilized and proves effective to satisfied nutrition demand. Fruits are one of the most vital component of the foods known to be consumed by humans since beginning of human race. Several underutilized fruits are unfamiliar, unknown and less eaten. However, underutilized fruits have not yet received much awareness as antioxidant sources compared to commercial fruits. These fruits are neglected due to ignorance factor, lack of information, unavailability, deficient in these fruits promotional campaigns, difficulty in storage and harvesting. Now, these fruits may be included in the health promotion campaigns. In this review article related to different study aspects of the fruit karonda, includes the importance of morphological and microscopically study and preliminary phytochemical investigation in karonda of fruit along with its nutritional value.

KEYWORDS: Carissa carandas; Karonda fruits; Apocynaceae; Triterpenoids; Carissin; Under utilized fruit.
INTRODUCTION

World Health Organization reported that fruits are rich in fiber, antioxidants, organic acids, vitamins, phenolic contents and considered to be a protective foods. They are used as a source of traditional medicine to cure many health problems and contributes as a main source of livelihood for the poor people. Fruits are one of the most vital component of the foods known to be consumed by humans since beginning of human race. Not only fresh fruits, ripe or raw fruits, but also dried fruit have been equally significant part of the basic diet of human beings due to the presence of rich nutrients in fruits. It provides essential minerals and vitamins, which in addition of helping boosting the immunity also helps to cure many diseases.\(^1\)\(^2\)\(^3\)

Underutilized fruits or neglected crops are not cultivated commercially, not grown and very rarely found in the market. They are nutritionally beneficial for the people and play an important role in human health. These fruit species may be distributed globally, but still find some restriction in their consumption and production system. Several underutilized fruits are unfamiliar, unknown and less eaten. However, underutilized fruits have not yet received much awareness as antioxidant sources compared to commercial fruits. These fruits are neglected due to ignorance factor, lack of information, unavailability, deficient in these fruits promotional campaigns, difficulty in storage and harvesting. Now, these fruits may be included in the health promotion campaigns.\(^4\) Recent research has been mentioned karonda Carissa caronda are considered for our the review purpose due to their higher nutritional value and medicinal uses.\(^5\)\(^2\)

Karonda fruits are highly astringent and slightly acidic in nature, it also contains maximum amount of pectin, vitamins and minerals.\(^6\) Due to its astringency no one can eat this fruit without processing. Once fruits are processed, processed products can be preserved throughout the year. karonda's value-added products contain essential vitamins and minerals.\(^2\)

Ayurveda stipulates following usage of unripe fruits of karonda :- i) anthelmintic,\(^7\) ii) astringent, iii) appetizer,\(^8\) iv)antipyretic,\(^9\) v) antidiabetic,\(^10\) vi) \(^{11}\) vii) \(^{12}\), viii) rheumatism and also to treat diseases of brain. Ayurveda also mentions that It is also useful in treatment of diarrhea, anorexia and intermittent fevers. Karonda Fruits have also been studied reported for its analgesic, anti-inflammatory and lipase-1 activities.\(^7\) This fruit is used by
tribal healers of Western Ghat region of maharashtra and Karnataka as hepato protective and anti-hyperglycemic.\cite{13}

This study would mainly focus on the basis of scientific investigators to provide information of traditional uses, earlier as well as current investigation on these karonda fruits So that the researcher can give more attention on investigation or innovation to validate scientific nutraceutical and pharmacological activity this data can be used for further researcher can explore the development on \textit{Carissa carandas} fruit; Karonda fruit.

\textbf{In brief Plant Profile}

\textbf{Synonyms of Carissa carandas}

Wild Karonda, Jungli Karonda, Kavali, Karamdika, Chirukila, Vaka, Kalivi, Karamacha, Karmarda Karekayi, Garji, Kavali, Karanda, Karwant, Avighna, Kalakkay, Kalachedi Carissa carandas belongs to the dogbane family Apocynaceae , found to be widely distributed throughout India. The shrub is commonly known as karonda ‘Christ’s thorn’.\cite{8} The scientific classification of plant is

\begin{itemize}
  \item Classification Kingdom: Plantae Class: Angiosperms
  \begin{itemize}
    \item Sub-class: Eudicots
    \item Superorder: Asterids
    \item Order: Gentianales
    \item Family: Apocynaceae
    \item Genus: Carissa
    \item Species: Carandas
  \end{itemize}
\end{itemize}

\textbf{Pharmacognostical characters of Carissa carandas linn}

\textit{Carissa carandas} Linnis karonda plant is an erect thorny shrub with height in 2 to 3 m, bark is in grey colour, wood hard in nature with simple or forked spines which are rough or smooth 0.5 to 6.2 cm long brown to greenish at the base and deep brown towards the tips. The whole plant morphology and microscopy is as shown in Table No.1

\begin{table}[h]
\centering
\begin{tabular}{|c|c|c|}
\hline
\textbf{Sr.No.} & \textbf{Part of the plant} & \textbf{Pharmacognostical characters of Carissa carandas} \\
\hline
1 & Leaves & Leaves are ovate, 4.5 cm long, 2.5 cm broad, Petiolated, petiole 0.5-6 mm long; ovate shaped or elliptic or orbicular. Apex acute or rounded at the apex and rounded at the base entire margin and reticulate \\
\hline
\end{tabular}
\caption{Pharmacognostical characters of \textit{Carissa carandas} Linn.\cite{14}}
\end{table}
pinnate venation. Surface of leaves are glabrous or pubescent. Leaves exuding white latex, when plucked from the stem.

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Part of the plant</th>
<th>Phytochemical composition of Carissa carandas</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>Inflorescence</td>
<td>Inflorescence terminal or occasionally axillary, dense-flowered cymes.</td>
</tr>
<tr>
<td></td>
<td>Flowers</td>
<td>Flowers are short-stalked, fragrant, bisexual, bracteates, cyclic and actinomorphic. Colour of flower is between white and rose. Calyx is polysepalous, with 5 sepals, green, 2 to 3 mm, long. Corolla is tubular at the base of flower and dilated at the top, five-lobed, glabrous and white in colour. Androecium, with 5 stamens, each 2 to 3 mm long which is inserted near the neck of the tubular portion of the corolla. Gynoecium is in superior with a spindle-shaped stigma, which is 7 to 8 mm long.</td>
</tr>
<tr>
<td>4</td>
<td>Fruits</td>
<td>Fruits are Pinkish red to black in colour, globose or ellipsoidal in shape, 5-25 mm long and 3-20mm wide.</td>
</tr>
<tr>
<td>5</td>
<td>Seeds</td>
<td>Lanceolate, occurs in black colored, 5 to 6 mm in length, 4 mm in diameter.</td>
</tr>
</tbody>
</table>

Phytoconstituents Of *Carissa Carandas* Linn

Phytoconstituents are the chemicals which are occur in plants naturally and derived from the plants, specifically secondary metabolic compounds. All the Phytochemicals are responsible for organoleptic properties and have potential biological significance. There may be plenty of different phytochemical are found in plants. Mostly the class of phytoconstituents found In Carissa Carandas Linn such as alkaloid, tannin, carbohydrate, glycoside specially in Anthraquinones glycosides, saponins, terpenoids, flavonoids and steroids etc as shown in Table No.2.

Table No.2: Phytochemical composition of different Shrub parts of Carissa carandas.\(^7\)

<table>
<thead>
<tr>
<th>Sr.No.</th>
<th>Part of the plant</th>
<th>Phytochemical composition of Carissa carandas</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Leaves</td>
<td>Triterpene, alcohol, ursolic acid</td>
</tr>
<tr>
<td>2</td>
<td>Roots</td>
<td>Carissone, Carindone, Carinol, Odoroside H, digitoxigenin, glucose and D- digitalose</td>
</tr>
<tr>
<td></td>
<td>Flowers</td>
<td>Myrcene, limonene, linalool, camphene, canine, dipentene, farnesol, α terpeneol, nerolidol, dihydrojasmine, citronellal, geranyl acetate, nerylacetate.</td>
</tr>
<tr>
<td>4</td>
<td>Fruits</td>
<td>Reducing and non reducing sugar, glucose, galactose, glycine, alanine, Phenylalanine, vitamin C, Pectin, Carissol, Lupeol, cerine, malonic acid, oxalic acid, tartaric acid, malic acid, glycolic acid and citric acid.</td>
</tr>
<tr>
<td>5</td>
<td>Seeds</td>
<td>Fatty acids – palmitic acid, stearic acid, oleic acid, linoleic acid, linolenic acid, and arachidic acid.</td>
</tr>
</tbody>
</table>
Various test performed for phyto chemical screening constituents found in *Carrisa carandas* Linn

The preliminary phytochemical studies were performed for testing the different Phytoconstituents present in the which were extracted by using different solvents Carrisa Carandas such as alkaloids, carbohydrates, flavonoids, proteins, resins and saponins present in the drug.

**General Test for Preliminary Screening of various extract**[^14]

Preliminary screening of various extracts of the plant material was carried out for qualitative determination of the groups of phytoconstituents present in this herb.[^28][^15]

**Alkaloids**

- **Dragendorff’s test**
  A few mg of alcoholic or aq. extract of the drug was dissolved in 5 ml of distilled water, to which 2 N Hydrochloric acid was added until an acid reaction occurred, and then 1 ml of Dragendorff’s reagent was added. An orange or orange red precipitate was considered positive test for alkaloids.

- **Hager’s test**
  To 1 ml of alcoholic extract of the drug in a test tube, a few drops of Hager’s reagent were added. Formation of yellow precipitate confirmed the presence of alkaloids.

- **Wagner’s test**
  1 ml of alcoholic extract of the drug was acidified with 1.5% v/v of hydrochloric acid and a few drops of Wagner’s reagent were added. A yellow or brown precipitate considered the presence of alkaloids.

- **Mayer’s test**
  A few drops of Mayer’s reagent were added to 1 ml of acidic aqueous extract of the drug. White or pale yellow precipitate was considered positive for the presence of alkaloids.

**Carbohydrates**

- **Benedict’s test**
  0.5 ml of aqueous extract of the drug was added to 5 ml of Benedict’s solution and boiled for 5 mins. Formation of a brick red coloured precipitate indicated the presence of carbohydrates.

[^14]: [Link to reference]
[^28]: [Link to reference]
[^15]: [Link to reference]
• Fehling’s test
2 ml of aqueous extract of the drug was added to 1 ml of a mixture of equal parts of Fehling’s solution ‘A’ and Fehling’s solution ‘B’ and contents of the test tube were boiled for few mins. A red or brick red precipitate indicates the presence of carbohydrates.

• Molisch’s test: In a test tube containing 2 ml of aqueous extract of the drug 2 drops of a freshly prepared 20% alcoholic solution of b- naphthol was added and mixed and then 2 ml of conc. sulphuric acid was poured so as to from a layer below the mixture. Carbohydrates, if present, produce a red-violet ring, which disappears on the addition of an excess of alkali solution.

**Flavonoids**

• Shinoda’s test
In a test tube containing 0.5 ml of alcoholic extract of the drug, 5-10 drops of dil. hydrochloric acid followed by a small piece of magnesium was added. In the presence of flavonoids a pink, reddish pink or brown colour indicated the presence of flavonoids.

• Triterpenoids
Liebermann-Burchard’s test: 2 ml of acetic anhydride solution was added to 1 ml of petroleum ether extract of the drug in chloroform followed by 1 ml of conc. sulphuric acid. A violet coloured ring indicated the presence of triterpenoids.

**Proteins**

• Biuret’s test
1 ml of hot aq extract of the drug was added and then 5-8 drops of 10% w/v sodium hydroxide solution was added followed by 1 to 2 drops of 3% w/v copper sulphate solution. A red or violet colour indicated the presence of protein.

• Millon’s test
Aqueous extract of the drug in 1 ml of distilled water was dissolved and 5-6 drops of Millon’s reagent was added. A white precipitate which turns red on heating indicates the presence of protein.

**Resins**
The extract was dissolved in acetone and the solution was poured into distilled water. Turbidity indicated the presence of resins.
Saponins
5 ml of an aqueous extract of the drug was taken in a test tube then a drop of sodium bicarbonate solution was added, the mixture was shaken vigorously and left for 3 mins. Honeycomb like froth showed the presence of saponins.

Table No. 3: Preliminary Phytoconstituents present in fruit extracts of *Carissa carandas* Linn. Phytoconstituents.

<table>
<thead>
<tr>
<th>Phytoconstituents in Chemical group <em>Carissa carandas</em> Linn</th>
<th>Extract with Petroleum ether (60-80)</th>
<th>Extract with Chloroform</th>
<th>Extract with Ethyl Acetate</th>
<th>Extract with Ethyl Alcohol</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alkaloids</td>
<td>-</td>
<td>-</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Flavonoids</td>
<td>-</td>
<td>-</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Glycosides</td>
<td>-</td>
<td>-</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Carbohydrates</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>+</td>
</tr>
<tr>
<td>Sterols</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Terpenoids</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Tannins</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Saponin</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>+</td>
</tr>
</tbody>
</table>

Nutraceutical properties of *Carissa carandas* Linn

*Carissa carandas* Linn Karonda fruits have been used as a food supplement or and medicinal purpose for centuries and are of increasing importance for nutraceutical. A natural ‘food colorant cum nutraceuticals supplement’ was prepared from the ripe fruits of karonda. The lamila was the formulation of karonda ripe fruit. 1 ml of this naturally colour pigment suspension formulation is sufficient to give lovely red colour to one serving of any colourless beverage (100 ml) such as lemonade. One serve of such supplemented beverage may in addition contain 469.2 μg anthocyanin, 12.7 mg flavonoids, 14.1 mg. phenol, with total antioxidant activities to be 390 μM Trolox Equivalent. At present, many commercial karonda fruit products are available in the market.[15]

Lupeol, Beta-sitosterol Ursolic acid (UA) is a natural triterpene chemical group of pentacyclic triterpenoid which is commonly distributed in the medicinal plant kingdom and mostly it is found in all types of edible fruits and vegetables. This triterpene moiety not only is shows to reduce the inflammatory responses but also have immunomodulating properties. Lupeol and Beta sitosterol its synthetic derivatives have a great potential to act as an anti- inflammatory, anti-microbial, anti-proliferative, anti-invasive, anti-angiogenic, antiprotozoal, and cholesterol-lowering agent.
Lupeol and Beta-sitosterol is a plant substance similar to cholesterol. It might help reduce cholesterol levels by limiting the amount of cholesterol that is able to enter the body. It can also bind to the prostate to help reduce swelling (inflammation).

**Vitamin C/ Ascorbic acid:** It is a vital nutrient for health. It helps to perform various body function such as maintain bones, skin, and blood vessels and many more as follows.

- It helps the body produce collagen, L-carnitine, and some neurotransmitters.
- It is also well known for its antioxidant activity. As an antioxidant, it helps remove unwanted substances known as reactive oxidative species (ROS) from the body.
- It helps in the absorption of iron in body.
- It not only boosts the immune system but also enhances wound healing activity.

**Indole-3-carbinol:** It is used for prevention of breast cancer, colon cancer, and other types of cancer. The National Institutes of Health (NIH) has reviewed indole-3-carbinol as a possible cancer preventive agent and is now sponsoring clinical research for breast cancer prevention.

Mostly the class of bioactive constituents along with their chemical structure found in Carissa Carandas Linn/ karonda fruit such as Lupeol, Beta-sitosterol Ursolic acid Vitamin-c and indole-3-carbinol along with their importance etc as shown in Table No.4

**Table No. 4: Name of bioactive constituent along with structure and their biological importance.**

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Name of Bio active constituents of karonda fruit</th>
<th>Chemical structure</th>
<th>Biological Importance</th>
<th>References</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>β-Sitosterol</td>
<td><img src="image" alt="Chemical structure" /></td>
<td>potential to reduce blood cholesterol levels Anti-diabetic Anti viral</td>
<td>[16][17]</td>
</tr>
<tr>
<td>2</td>
<td>Lupeol</td>
<td><img src="image" alt="Chemical structure" /></td>
<td>antiprotozoal, antimicrobial, antiinflammatory, antitumor and chemopreventive properties</td>
<td>[18][5][19]</td>
</tr>
<tr>
<td></td>
<td>Compound</td>
<td>Properties</td>
<td>References</td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>------------------</td>
<td>---------------------------------------------------------------------------</td>
<td>------------</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Ursolic acid</td>
<td>Anti-inflammatory, anti-oxidant, anti-apoptotic, and anti-carcinogenic</td>
<td>[16][20]</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Lanstenolic acid</td>
<td>Effective in the treatment of scabies, intestinal worms, pruritus, biliousness and also used as antiscorbutic, anthelmintic</td>
<td>[21][22]</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Carinol</td>
<td>Antiscorbutic, anthelmintic</td>
<td>[7]</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Carissone</td>
<td>Antiprotozoal, antimicrobial, antiinflammatory, antitumor</td>
<td>[26]</td>
<td></td>
</tr>
</tbody>
</table>
CONCLUSION

Nowadays, emphasis is given to herbal technology and neutraceutical having bioactive moiety. Karonda fruit has nutraceuticals and the pharmaceutically blended products that possess both nutritional value and medicinal value. Such a product is designed to improve the physical health, fight against day-to-day challenges such as stress, increase longevity, etc. The many fruits act as food and neutraceutical used also used as medicine. As we know the Fruit are excellent sources of natural sugar and important principally for containing vitamins, minerals, phytochemicals, antioxidants, pigments, energy, organic acids, dietary fiber and other food components. The plant C. carandas is easy to cultivate and free of serious pests and diseases. Fruits, leaves, and roots possess phenolic acids, flavonoids, steroids, terpenoids, and carotenoids which are responsible for varied pharmacological activities. Over the centuries, this plant has served as a major source of medicines for treating dysentery, anemia, diarrhea, and also used to prevent diseases. In the modern era, these Karonda fruit can be used as an immunity booster; antioxidants due to presence of various bioactive components such as vitamin-C, essential amino acids, minerals and volatile oil in the fruit which is essential for...
many more pharmacological activities. There is need for isolation of specific components which are responsible for both the properties medicinally active as well as act as a potential neutraceutical. Thus, karonda fruit are an excellent choice of fruit with lots of nutritional value amongst the other fruit. The value added product can meet the dearth of new product in the market and serve the purpose of nutritional security along with healthy and safe life. By this we can prove what Hippocrates said, “Let food be the medicine and medicine be the food”.

BIBLIOGRAPHY


