Botany, traditional uses and pharmacological importance of Karanjwa (Caesalpinia bonduc (L.) Roxb.): A possible prophylactic AYUSH-unani single drug for the management of COVID-19

Mohd. Kashif Husain, Goli Penchala Pratap, Mokhtar Alam, Ghazala Javed and Munawwar Husain Kazmi

Abstract
Karanjwa (Caesalpaenia bonduc (L.) Roxb.) commonly known as a fever nut, is a flowering, straggling, and very thorny perennial shrub of Fabaceae, with a pantropical distribution. The species is well known for its medicinal and therapeutic values in Indian AYUSH-Ayurveda, Unani and Siddha systems of medicine. COVID-19 is an infectious disease caused by the recently discovered novel Coronavirus (SARS CoV-2). The most common symptoms of COVID-19 are fever, tiredness and dry cough. The Ministry of AYUSH, Government of India has issued the guidelines for qualified Unani practitioner to enhance the immunity and provide symptomatic relief in upper respiratory tract infection through prophylactic approach. One of the single drugs mentioned in the guidelines is Karanjwa (antipyretic, antimicrobial, anti-inflammatory and immune modulator). In Unani, the plant parts; nuts and leaves are described as anti-inflammatory (Muha’il-e-waram), anti-pyretic (Musakkin-e-alam), blood purifier (Musat-tta-Dam), anticonvulsant (Dāfi’-i-Tashannuj) and antiseptic (Dāfi’-i-Ta’ffun) and used to treat various diseases, specifically seasonal fevers (Hummā), bronchial asthma (Dīq al-Nafas), bronchitis (Sur-fī-Sarfa), ascites (Istisqa’ Ziqq), hydrocele (Qarw Ma’ā) and pleurisy (Dhāt al-Jamb). The Seeds of Karanjwa contain a bitter substance named bonducin, bonducellin and sphytoxin, citrulline and fatty acids. Seed coat as well as kernel’s exhibits analgesic and anti-inflammatory activities. The purpose of this review paper is to compile the available information on and therapeutic uses of Karanjwa (C. bonduc) in context of Unani System of Medicine and to discuss the botany and importance of the plant on the basis of folk uses, pharmacological activities and chemical constituents. There is a possibility that the potential characteristics of C. bonduc may be utilized more efficiently through clinical trials and further research in the time of pandemic.

Keywords: AYUSH-Unani, Fevers (Hummā), Caesalpinia bonduc, Fever Nut, Karanjwa, Anti-inflammatory, Bronchial Asthma (Dīq al-Nafas)

Introduction
Karanjwa (Caesalpaenia bonduc (L.) Roxb. Syn. C. bondoucella (L.) Fleming), commonly known as a fever nut, is a flowering, straggling and very thorny perennial shrub of Senna family (Fabaceae), with a pantropical distribution. The species is common all over India in coastal and other areas, especially the southern India, Mumbai and Bengal. The name of the species ‘bonduc’ is derived from the Arabic word ‘Bondece’ meaning a ‘little ball’ which indicates the globular shape of the seed. The seeds are grey coloured and resemble eyeballs, which explains the Sanskrit name ‘Kuberakshi’, meaning eyes of a Hindu God of wealth ‘Kubera’ [1]. Decoction of roasted kernels has been used in asthma [2, 3]. Paste prepared from kernel gives relief from boils and other such swellings [4]. Seeds of Karanjwa are claimed to be stptyc, purgative and anthelmintic and cures inflammations; useful in colic, malaria, hydrocele, skin diseases and leprosy [2, 3, 5]. Pharmacological studies on Karanjwa seeds showed that the plant possess; anti-diarrhoeal, antiviral, antibacterial, antimicrobial, antifungal, antidiabetic, antitumor, anti-inflammatory and analgesic, anti-filarial, anti-inflammatory, antioxidant, immunomodulatory, and trypsin and chymotrypsin inhibitor properties [6]. Of different AYUSH systems, Ayurveda and Unani both have long, but different histories in the application of medicinal plants for therapeutic treatments. Unani System of Medicine (USM) is considered as one of the most ancient systems of medicine, originated in Greece and expanded itself to India as one of the recognized traditional system [7]. The drug Karanjwa is used in Ayurveda, Unani and Siddha (ASU) systems may have similar or different therapeutic applications, depend upon the use and processing of the drug. In Ayurveda, the plant is used to treat different diseases; tumours, cysts and cystic fibrosis [8].
The leaves alleviate *Kapha* and *Vata*, are emmenagogue febrifuge and anthelmintic, and are useful in the treatment of fevers, splenomegaly, hepatomegaly, piles, intestinal worms, elephantiasis, amenorrhea, dysmenorrhea, and pharyngodynia [9]. The Siddha healers of Malabar region traditionally use the leaves of *C. bonduc* for the treatment of psoriasis [10]. *Karanjwa* is known to Unani System since ancient times. The Unani traditional scriptures and texts have various references to the use of this plant as an antipyretic, antimalarial, antimicrobial and anti-septic [11, 12]. *Karanjwa* is useful in *Hummayat* (fevers) due to change of season (*mausam*) and the kernel of the seed is used in the cases of continued or intermittent fevers [13]. The extract or powder of the kernel along with ginger, honey and salt give excellent stomachic effect to kids suffering from lactose intolerance [14]. Paste prepared from kernel gives relief from boils and other such swellings [14, 15]. *COVID-19* is an infectious disease caused by the novel Coronavirus (SARS CoV-2). The most common symptoms of COVID-19 are fever, tiredness and dry cough. Unani Medicine recognizes the influence of surroundings and ecological conditions on the state of health of human beings [15]. In Unani classical text the concept of epidemics is mentioned very clearly. The drugs in Unani System are used either singly or in combination. Unani medicine is one of the legitimately recognized traditional medicine systems of India. Considering the importance of the Unani System the Ministry of AYUSH, Government of India explored preventive, supportive and rehabilitative care of the patients, issued the guidelines [15] for qualified Unani practitioner to enhance the immunity and to provide symptomatic relief in upper respiratory tract infection through prophylactic approach. Among all, one of the single drugs mentioned in these guidelines is *Karanjwa* (antipyretic, antimicrobial, anti-inflammatory and immuno modulator) [15].

The present review attempts to provide the comprehensive information on *Karanjwa* (*C. bonduc*), its traditional uses in Unani Medicine, botany, pharmacology and important phytoconstituents to explore current research prospects and a possible role in the preventive management of Covid-19 with Unani medicine.

### 2. Description

**Caesalpinia bonduc** (L.) Roxb.

#### 2.1 Current Scientific Accepted Name

*Caesalpinia bonduc*

#### 2.2 Authority

(L.) Roxb.

2.3 Synonyms

- *Caesalpinia bonduc*ella (L.) Fleming
- *Caesalpinia. Crista* Thun
- *Guilandina bonduc*ella L.
- *Guilandina bonduc* L.

2.4 Classical Names

- **Ayurvedic**: Kantakikaranj, Kuberakshi, Latakaranj, Puti, Morata, Puti-kanaranj
- **Unani**: Karanjawa
- **Siddha**: Kazharchikkaai

2.5 Vernaculars

- **English**: Bonduc Nut, Nicker Bean
- **Hindi**: Gachika, Gajiga, Kanderi, Kantikaranj, Naktamala, Karanj
- **Kannada**: Gajiga, Heggajiga, Kitta, SannaGajiga
- **Malayalam**: Caretti, Kalanchik-Karu, Kalanci, Kulunjne, Avil, Kalimarakam

- **Marathi**: Gajaga, Kanchaki, Karbath, Rahedo, Saagaragota
- **Tamil**: Carakakoti, Carivacamt, Gech-Chakkay, Kaccakkay, Utarikkoti
- **Telugu**: Gachakaya, Theflagachha, Gutsakai, SukaJambuka, Yalakki
- **Arabic**: Akitmakit, HajraIlaqi, Hajra-ul-Aqaab, Hajra-ul-Masak, Hajra-ul-Nasara
- **Persian**: Ashak-e-Marium, Khayahe-i-Iblis, Khayahe-Iblis, Qana-e-Iblees

2.6 Classification (Bentham and Hooker System) [16]

**Kingdom**: Plantae – Plants

**Division**: Tracheophyta – Vascular plants

**Class**: Magnoliopsida– Dicotyledons

**Order**: Fabales

**Family**: Leguminosae (*nom. alt.* Fabaceae)

**Subfamily**: Caesalpinioideae

**Genus**: *Caesalpinia*

**Species**: *Caesalpinia bonduc* (L.) Rox

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**Fig 1A:** Plant of *C. bonduc*: B. Long peduncled raceme with yellow flowers; C. Ovate-elliptical leaflet; D. Pods with sharp prickles; E. Seeds

2.7 Citations [16].


2.8 Habitat

Common hedges, scrub forests, open areas, in plains and sacred groves

2.9 Habit

Large straggling very thorny perennial shrubs ((Fig 1.A),

2.10 Stem

Stem grey-downy, armed with hooked and straight hard yellow prickles.

2.11 Leaves

Leaves are bipinnate, 15–22 cm long; pinnae 4–6 pairs, prickled; leaflets 7–9 pairs, ovate – elliptic (Fig 1.C), 1.5–3.5 x 1–2 cm, glabrous above, pubescent below, base truncate, rotund, margin entire, apex obtuse, mucronate, petiole ca. 1 mm; stipules foliaceous.
2.12 Inflorescence
Long peduncled terminal and axillary racemes (Fig 1.B).

2.13 Flowers
Flowers 1.2 cm across, pale yellow (Fig 1B), in terminal and supra axillary spicate racemes, calyx tube campanulate, to 5 mm, gibbous at base, sepal 5 unequal, oblong-obovate, 4.5–5 x 1 mm; tormentose; petals 5., oblongate upper one smaller, 5 x 2 mm; laterals 5-6 x 1.5 -2.5 mm, apex obtuse, marked with yellow color; stamens 10, declareate, alternate, 5 long, to 5 mm, 5 short, to 4 mm, filaments attenuate, base glandular -villous, to 3 mm , ovary stipitate, globose, to 3 mm; style short to 2 mm, pubescent.

2.14 Fruit
Pods oblong-obovoid, somewhat flattened, 5-7 x 2.5-4.5 cm, brick colour, densely clothed with sharp prickles (Fig 1.D), apex beaked to 1 cm, dehiscent.

2.15 Seed
Seeds 1 or 2, subglobose, to 3 x 6 mm, oblong, smooth, polished, lead coloured (Fig 1E). Flowering: August-October; Fruiting, December-April

2.16 Distribution
This species is globally distributed in the Pantropics. Within India, it is found wild throughout the plains and in the deltaic regions of the western, eastern and southern India and reaching up to an altitude of 850 m. in the Himalayas. It is also cultivated as a hedge plant

3. Description in Unani Classical Texts [12, 13]
3.1 Mizāj (temperament)
Unani scholars have identified its temperament but differed in opinion related to its temperament [13]
- Hot and Dry in First Degree
- Cold and Dry in First Degree
- Hot and Dry in Third Degree (only few Physician accepted)

3.2 Part Used
- Seed nut / Seed Kernel/Leaves

3.3 Dose
- 3-5 g

3.4 Muzir (Adverse/Toxic Effect)
- Nausea, Dryness

3.6 Musleb (Corrective)
- Mirchsiyah (Piper nigrum) is used to remove its adverse effects.

3.7 Badal (Substitute)
- Berg-e-Karanjwa (Leaves of C. bonduc)

3.8 Af'āl (Pharmacological Actions in Unani medicine)
As per the Unani classical text [12, 13, 17, 18] Kāranjwa is;
- Anti-inflammatory (Muha: lil-e-waram)
- Anti-pyretic (Musakkin-e-alam)
- Blood Purifier(Musaffi-i-Dam)
- Anticonvulsant (Dāfi’-i-Tashannuj)
- Antiseptic (Dāfi’-i-Ta’affūn)
- Carminative(Kasir-i-Riyāb)
- Fluid Absorbent (Jādib Ruţābāt)

- Dessicant(Mujaffif)
- Antiasthmatic(Dāfi’-i-Zeepunnafas)
- Demulcent (Mulattif)
- Diuretic (Madīr-r-ī-Bawī)
- Difficulty in micturitio(nUsr-i-Bawī)
- Expectorant (Munaffis)

3.9 Istem'al (Therapeutic Indications in Unani medicine) [12, 13, 17, 18]
- Bronchial Asthma (Dīq al-Nafas)
- Bronchitis (Su’a’l-o-Surja)
- Orchitis (Waram al-Khūṣyatayn)
- Ascites (Istīsqa’ Ziqiqi)
- Hydrocele (QarwMa’ī)
- Seasonal Fever (Humād)
- Pleurisy (Dhat al-Janb)
- Stomatitis (Qula)

Leaf of Kāranjwa is useful in Hummayat (fevers) due to season (maasam) and predominance of morbid phlegm, blood and black bile (Fasad-e-Balgham, Dam and Sauda) [12, 13]. A poultice made up of powder and oil is useful to treat acne and pimples. The seed-kernel, burnt in any oil, is applied to infected wounds and cutaneous affections. Vaidyas suggested that the seasonal fever goes away by taking powder made by grinding the equal amounts of Kāranjwa and black pepper (8-10 g) twice a day [12, 13]. In Unani system of medicine, a prescription, Habbe Kāranjwa, is given as an antiperiodic in the fourth-day fever. Kāranjwa leaves, pounded with Piper nigrum are given in diseases due to vitiated blood. Kāranjwa is also used in various other conditions such as; bronchial asthma, bronchitis, fever, hydrocele, joint pain, and pleurisy [12, 13, 17, 18].

4. Folk-medicinal Uses
In folk medicine, the plant juice is given for two weeks after meals to cure intermittent fever. The ointment made from the seed-kernels is applied to hydrocele. As an infusion, they are prescribed in haemorrhages. Kāranjwa mixed with honey or castor oil is given as an anthelmintic. Mostly, grounded and roasted seeds are given internally [19, 20]. Seeds and root bark are very useful in simple, continued, and intermittent fevers, asthma, and colic. Seeds are febrifuge and antiperiodic; they are also valuable for dispersing swelling, restraining haemorrhage, and keeping off infectious diseases [1, 2, 19, 20]. Tender leaves are efficacious in liver disorders. Oil expressed from them is useful in convulsions and nervous complaints. Doses - Seed powder- 1 to 2 g; root powder- 1 to 2 g; leaf infusion - 12 to 20ml. The young leaves are applied to affected areas for the treatment of infections, gargoyle for sore throat, elephantiasis and smallpox, disorders of the liver and for expelling intestinal worms [3, 4, 19, 20]. The seeds are astringent and have been used to control contagious diseases, treat inflammation, colic, hydrocele, skin diseases and leprosy. The seed sprouts have been used for tumours. The root bark is used to treat fever, intestinal worms, tumours, amenorrhoea, cough and for removing the placenta after childbirth [1, 3, 4, 20]. An analysis of the literature on ethnobotanical data available (Table 2.) on C. bonduc showed that most of the workers have reported the use of C. bonduc (Karainjwa) seed, followed by leaf and root (Fig. 2), mostly in crude powder form (53%) followed by paste (33%). However, nearly 7% used Karanjwa as decoction and infusion (Fig. 3).

Most of the workers reported its ethnomedicinal uses as antipyretic (maximum), followed by treatment of hydrocele.
and diabetes. Other reports include the disease conditions including; pneumonia, piles, asthma, skin disorders, cough and arthritis (Fig 4.).

Fig 2: Part of Karanjwa (C. bonduc) plant used as ethno-medicine

Fig 3: Form of ethnomedicine – Karanjwa (C. bonduc)

Fig 4: Ethnomedicinal uses of Karanjwa (C. bonduc) in different disease conditions

Table 2: Ethnomedicinal uses of Karanjwa (Caesalpinia bonduc)

<table>
<thead>
<tr>
<th>S. No</th>
<th>Part Used</th>
<th>Ethnomedicine (Form)</th>
<th>Ethnomedicinal (Therapeutic) Uses</th>
<th>References</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Seed</td>
<td>Paste</td>
<td>Leucorrhoea, hydrocele</td>
<td>[21]</td>
</tr>
<tr>
<td>2</td>
<td>Leaf, Bark, Root, Seed</td>
<td>Powder</td>
<td>Antimicrobial, anti-fungal, anti-viral, Piles, Antipyretic</td>
<td>[22]</td>
</tr>
<tr>
<td>3</td>
<td>Seed</td>
<td>Powder</td>
<td>Vomiting, Hydrocele</td>
<td>[23]</td>
</tr>
<tr>
<td>4</td>
<td>Seeds</td>
<td>Powder and Paste</td>
<td>Pain Indigestion, Dysentery, Piles, Worms, Cough, Diabetes, Skin Diseases</td>
<td>[24]</td>
</tr>
<tr>
<td>5</td>
<td>Leaf</td>
<td>Paste</td>
<td>Hydrocele</td>
<td>[25]</td>
</tr>
<tr>
<td>6</td>
<td>Seed</td>
<td>Powder</td>
<td>Fever</td>
<td>[26]</td>
</tr>
<tr>
<td>7</td>
<td>Root</td>
<td>Powder</td>
<td>Asthma</td>
<td>[27]</td>
</tr>
<tr>
<td>8</td>
<td>Seed</td>
<td>Decocion</td>
<td>Arthritis, Resettlement of disturbed joints and bones specially after trauma.</td>
<td>[28]</td>
</tr>
<tr>
<td>9</td>
<td>Root</td>
<td>Powder</td>
<td>Fish Poison</td>
<td>[29]</td>
</tr>
<tr>
<td>10</td>
<td>Seeds, Leaves</td>
<td>Powder</td>
<td>Fever, Diabetics</td>
<td>[30]</td>
</tr>
<tr>
<td>11</td>
<td>Seeds, Leaves</td>
<td>Paste</td>
<td>Fever, Hydrocele</td>
<td>[31]</td>
</tr>
<tr>
<td>12</td>
<td>Root</td>
<td>Infusion</td>
<td>Malaria</td>
<td>[32]</td>
</tr>
<tr>
<td>13</td>
<td>Root, Bark</td>
<td>Powder</td>
<td>Epilepsy</td>
<td>[33]</td>
</tr>
<tr>
<td>14</td>
<td>Fruit</td>
<td>Powder</td>
<td>Pneumonia, Gastric Troubles</td>
<td>[34]</td>
</tr>
</tbody>
</table>

5. Pharmacological Evidence/ Experimental studies
A number of studies showed that C. bonduc plant possessed broad pharmacological properties including; anti-inflammatory, antioxidant, anticancer, antihyperuricemic hepatoprotective, antibacterial activity, and anti-fungal (Table 3).
Table 3: Pharmacological studies on Caesalpinia bonduc

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Activity</th>
<th>Part/ extract/</th>
<th>Experimental Studies/Cell Lines/ Animal Model/microorganism</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Antidiabetic</td>
<td>Alcoholic Extract- Seed Polyphenol Extract</td>
<td>Alloxan Induced Diabetic Male Albino Rats [44] Different doses of extract to hyperglycemic rats restored blood and serum glucose, insulin, reduced oxidative stress in pancreatic β cells by restoring free radical scavenging potential [55]</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Seed and shell Extract</td>
<td>in-vitro [46]</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Seed Extract</td>
<td>Showed a significant Antidiabetic activity in alloxan induced hyperglycemia rats [57]</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Aqueous and Ethanolic Extracts -Seeds</td>
<td>Significant blood sugar lowering effecting both type 1 and 2 diabetes mellitus in Long Evans rats [58]</td>
</tr>
<tr>
<td>2</td>
<td>Anti-inflammatory Antipyretic and Analgesic</td>
<td>Seed Oil</td>
<td>The oil exhibited anti-inflammatory activity in experimental rats in a paw edema test induced by carrageenan [59]</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ethanolic extract of whole seeds</td>
<td>In experimental albino rats [59]</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ethanolic extract (70%) of seed kernel</td>
<td>Exhibited marked antipyretic activity against Brewer’s yeast- induced pyrexia in rats, significant central analgesic activity and peripheral analgesic effect in both mice and rats In adult albino rats or mice [40]</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Flower extract</td>
<td>Reduced pyrexia in adult mice in carrageenan-induced inflammation, cotton pellet induced chronic granulomatus inflammation and autacoids-induced inflammation [41]</td>
</tr>
<tr>
<td>3</td>
<td>Antibacterial Antibacterial and Cytotoxic activities</td>
<td>Methanolic Seed extract</td>
<td>Inhibited growth of Gram-positive and Gram-negative bacteria by the diffusion method and exhibited a similar activity of the standard antibacterial kanamycin [62]</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ethanol extract and fractions of leaves</td>
<td>The extracts showed different zones of inhibition against four gram-positive and five gram-negative bacteria [43]</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Methanolic leaf and Bark extracts</td>
<td>Gram positive and Gram negative bacteria [44]</td>
</tr>
<tr>
<td>4</td>
<td>Anti-cancer</td>
<td>Phytochemicals from young twigs and leaves</td>
<td>In silico interaction between phytochemicals and cancer target proteins (TK, VEGF, and MMP) compared with their respective drug inhibitors [45]</td>
</tr>
<tr>
<td>5</td>
<td>Anticonvulsant</td>
<td>Petroleum Ether</td>
<td>Exhibited activities in convulsions models [46]</td>
</tr>
<tr>
<td>6</td>
<td>Antioxidant</td>
<td>Ethanolic extract</td>
<td>in vitro showed a high free radical-scavenging activity [47]</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Chloroform Extract</td>
<td>Exhibited in vitro radical scavenging effect [48]</td>
</tr>
<tr>
<td>7</td>
<td>Anti-filarial</td>
<td>crude extract or fractions of the seed kernel</td>
<td>Exhibited gradual fall in microfilariae count in L. sigmodontis-cotton rat model [49]</td>
</tr>
<tr>
<td>8</td>
<td>Antimalarial</td>
<td>Aqueous, cold alcoholic and hot alcoholic extracts</td>
<td>Exhibited inhibition in growth of Plasmodium falciparum [50]</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Root Extract</td>
<td>Exhibited dose-dependent suppression of parasite growth in vivo in mice [51]</td>
</tr>
<tr>
<td>9</td>
<td>Anti-Tumour</td>
<td>Methanolic extract</td>
<td>Exhibited significant antitumor activity in Ehrlich ascites carcinoma (EAC)-bearing Swiss albino mice [52]</td>
</tr>
<tr>
<td>10</td>
<td>Immunomodulatory</td>
<td>Ethanolic Seed Extract</td>
<td>in vivo experiments- sheep red blood cell and rats [53]</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Aqueous Seed extract</td>
<td>in vivo, cell mediated and humoral components of the immune system in rats [54]</td>
</tr>
</tbody>
</table>

6. Phytoconstituents
The main phytochemicals of C. bonduc seeds are; bonducin (a bitter substance), phytosterin in, fatty acids, caesalpins (α, β, γ, δ and ψ), the new constituents; dieterpine caesalpin, homoioflavone- bonducellin and citrulline, and different fatty acids [55]. Cassanefurano diterpene with good antimalarial activity against MDR K1 strain of P. falciparum, and many cassane diterpenoids [56] have been reported from the seed kernel [57]. Pipataline isolated from bark [58]. Cassane diterpenes, including caesaldekarin A, were isolated from roots [59]. Cytotoxic flavonoids have been isolated from young twigs and leaves [60]. The phytoconstituents are summarized in Table 4.

Table 4: Major Chemical constituents of C. bonduc (Karanjwa)

<table>
<thead>
<tr>
<th>S. No.</th>
<th>C. bonduc Plant Part(s)</th>
<th>Name of the Chemical Constituents</th>
<th>References</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Seed</td>
<td>Bonducin- A bitter substance</td>
<td>[55, 61]</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Phytosterinin</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Fatty acids, Caesalpins (α, β, γ, δ and ψ),</td>
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<tr>
<td></td>
<td></td>
<td>Bonducellin (Homois of lavone)</td>
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<td></td>
<td></td>
<td>Citrulline Cassanederpines,</td>
<td></td>
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<td></td>
<td></td>
<td>Neocaesalpins C, D</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Bondenolide Neocaesalin P, Neocaesalin H</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Cordylane A, CaesalpininB</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Bonducellin E</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Caesalpinolide A Caesalpinolide C, D and E</td>
<td>[56]</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Cassane Diterpinoens</td>
<td>[57]</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Cassane Furanoditerpene</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Bark</td>
<td>Caesaldekarin J Pipataline</td>
<td>[58]</td>
</tr>
<tr>
<td>3</td>
<td>Young Twigs Leaves</td>
<td>Cytotoxic Flavonoids</td>
<td>[60]</td>
</tr>
<tr>
<td>4</td>
<td>Roots</td>
<td>Caesaldekarin A</td>
<td>[59]</td>
</tr>
</tbody>
</table>


29. Deletta GI, Parthipan B. Medico-Botanical studies of angiosperms from select areas of Agastheeswaram Taluk in Kanyakumari District, Tamilnadu, Southern India. Int


