



Research Article

MEDICINAL PLANTS USED IN *NEERILIVU* (DIABETES MELLITUS) IN TRADITIONAL MEDICINE -  
REVIEW AND ASSESSMENT OF SCIENTIFIC EVIDENCE

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ABSTRACT

*Sarapenthira vaithiya murailkal (Neerilivu chikitchai) (SVM-NC)* is a classic book written in a poetic form. It mentioned the treatment of *Neerilivu* (Diabetes Mellitus (DM)). According to the mode of administration, Siddha medicines are categorized into two classes; Internal medicine and external medicine. Medicinal plants, Metals and Minerals are used to prepare medicines from ancient times for the treatment of *Neerilivu* (DM). According to the Siddha literatures signs and symptoms of *Neerilivu* can be compared with Diabetic Mellitus in modern aspect. Diabetic Mellitus is a chronic metabolic disorder. Many drugs are mentioned for the treatment of *Neerilivu* (DM) in *SVM-NC*. **Aim:** The aim of the study is to identify the types of Siddha drugs and its ingredients from *SVM-NC* and research article. Data were collected, tabulated and analysed. This information was used to identify the medicinal plants that are being used in the management of *Neerilivu* (DM) in the traditional medicine. **Results and Discussion:** Eighty-five drugs were identified from the analysis. Out of 85 drugs, 83 drugs (98%) are used as internally and 2 drugs (2%) are externally. Among the 85 internal medicine, 28 (33%) are *Chooranam*, 20 (24%) are home remedy, 12 (14%) are *Kudineer* and 8 (9%) are *Vizhuthu*. Two external medicines are oil. 124 medicinal plants were identified from 83 internal medicines. 63 Families were identified in 124 medicinal plants. 10% (26) Medicinal plants are belonging to Fabaceae family. From these plants, 34 (27%) plants are used as root, 19 (15%) plants are used as leaves and seeds and 17 (14%) plants are used as bark. These plants have Siddha properties; taste (Astringent: 41 (33%), bitter: 32 (26%), sweet: 28 (23%), potency (hot: 81 (61%), cool: 37 (30%) and efficacy (pungent: 68 (55%), sweet: 50 (40%). Among the 85 drugs, *Cassia auriculata*, *Phyllanthus emblica*, *Strychnos potatorum*, *Terminalia chebula*, *Terminalia bellirica*, *Syzygium aromaticum* and *Salacia reticulata* are used many times in medicine preparation. Previous researches showed that these ingredients have antidiabetic activity, hepatoprotectives and anti-oxidant. **Conclusion:** This review provides useful documented evidence and scientific evidence on the treatment of *Neerilivu* (DM) in traditional medicine.

**KEYWORDS:** *Neerilivu*, Diabetic Mellitus, Medicinal plants, Traditional Medicine.

INTRODUCTION

Over the past few years, it has been proven that the traditional medical system also plays a vital role in healthcare around the world. Siddha system of medicine is one of the traditional systems of medicine practiced predominantly in Sri Lanka and India. Siddha system considers the human body as a collection of tri-humors and seven basic elements. *Vatham*, *Pitham* and *Kapham* are the tri-humors which are the life constituents of the human body. The equilibrium of humors is considered as health and its disturbance or imbalance leads to disease. Siddha authentic texts are explained disease, diagnostic methods, treatment, preventive aspect, etc. Many Siddha Authentic text are available in Sri Lanka and India<sup>[1]</sup>.

*Sarapenthira vaithiya murailkal (Neerilivu chikitchai) (SVM-NC)* is an important text in Siddha System of traditional Medicine. It is a classic book written in a poetic form. It mentioned the treatment of *Neerilivu* (Diabetes Mellitus (DM)). According to the mode of administration, Siddha medicines are categorized into two classes and they are internal medicine and external medicine. Medicinal plants, metals and minerals are used to prepare medicines from ancient times for the treatment of *Neerilivu* (DM). According to the Siddha literatures signs & symptoms of *Neerilivu* can be compared with Diabetic Mellitus in modern aspect. Diabetic Mellitus is a chronic metabolic disorder. Many drugs are mentioned for the treatment of *Neerilivu* (DM) in *SVM-NC*<sup>[2]</sup>. The aim of the study is to identify the

types of Siddha drugs and its ingredients from SVM-NC and research article. Data were collected, tabulated and analysed. This information was used to identify the medicinal plants that are being used in the management of *Neerilivu* (DM) in the traditional medicine.

## METHODOLOGY

### Study Design

It is a literature review. Data were collected from *Sarapenthira Vaithiya Murai (Neerilivu chikitsai)* (SVM-NC), authenticated Siddha text and related research article.

### Place and Duration of Study

Government Siddha Medical College and Hospital, Palayamkottai from March 2020 to March 2021.

### Data Collection

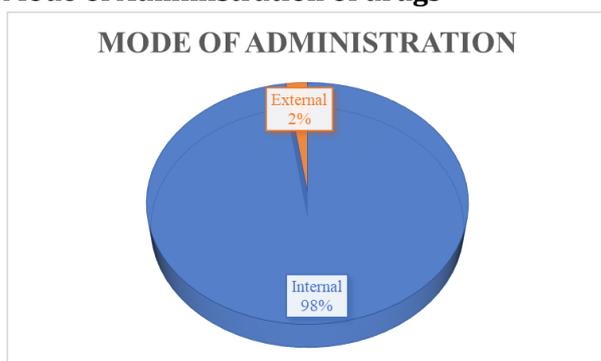
Data for the literature review were collected from SVM-NC and related journals. This information was used to identify the medicinal plants that are being used in the treatment of *Neerilivu* in the traditional medicine. For this purpose, 85 drugs were identified from the analysis. 124 medicinal plants from 63 families which were stated in the SVM-NC were reviewed among 85 drugs. The characteristics of the identified medicinal plants species for the review were taxonomic positions (Scientific, English and Tamil), families, the specific part used, Siddha properties (taste, potency and efficacy), pharmacological actions; validate the pharmacological action with relevant research article. These were recorded for the 124 selected medicinal plants. Information was obtained from the SVM-NC and website.

### Statistical Analysis

Collected data were processed and statistically analyzed by a simple statistical method using Microsoft Excel 2019.

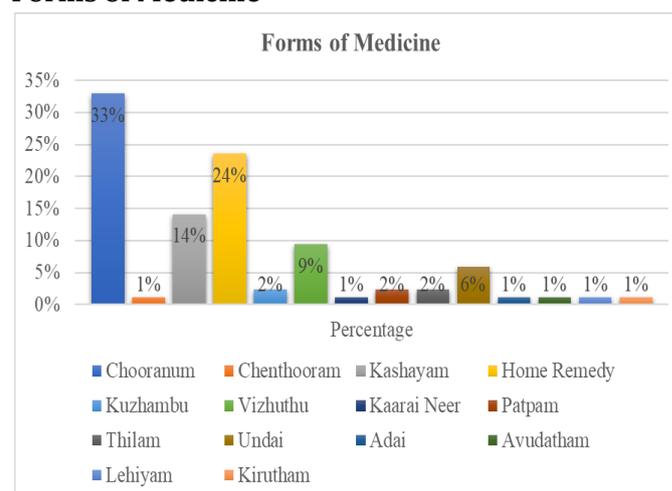
## RESULTS AND DISCUSSION

### Mode of Administration of drugs



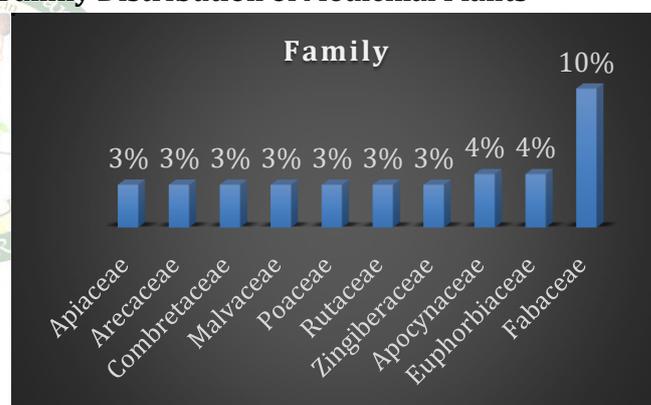
Eighty-five drugs were identified from the analysis. Out of 85 drugs, 83 drugs (98%) are used as internally and 2 drugs (2%) are externally.

### Forms of Medicine



Among the 85 Internal medicine, 28 (33%) are *Chooranum*, 20 (24%) are home remedy, 12 (14%) are *Kudineer*, 8 (9%) are *Vizhuthu*, 5 (6%) are *Undai*, 2 (2%) are *Patpam*, *Thilam*, *Kuzhambu* and 1 (1%) are *Adai*, *Lehiyam*, *Kirutham* and *Kaarai neer*.

### Family Distribution of Medicinal Plants



Among the 85 drugs, 124 medicinal plants are identified. 63 Families were identified in 124 medicinal plants. 10% (26) plants are belonging to Fabaceae, 4% (5) plants are belonging to Apocynaceae and Euphorbiaceae and 3% (4) plants are belonging to Apiaceae, Arecaceae, Combretaceae, Malvaceae, Poaceae, Rutaceae and Zingiberaceae.

### Taxonomic Position of the Medicinal Plants

128 medicinal plants belonging to 63 families have been documented for treatment of *Neerilivu* (DM). The taxonomic position of the medicinal plants is briefed in Table 1.<sup>[3,4]</sup>

**Table 1: Taxonomic Position of the Medicinal Plants**

| Family Name             | Botanical Name                                    | English Names                               | Other Names  |
|-------------------------|---|---|--|
| Acanthaceae             | <i>Hygrophila auriculata</i> , Schumach           | Long leaved barleria                        | <i>Nithagam, Ikkuram, Kaagandam, Thuragatha moolam, Mundagam</i>                   |
|                         | <i>Justicia adhatoda</i> Linn                     | Malabar - nut                               | <i>Aadathodai, Vaasai</i>  |
| Alangiaceae (Cornaceae) | <i>Alangium salvifolium</i> (Linn.f) Wang         | Sage leaved Alangium                        | <i>Ankolam, Chemmaram, Seai</i>  |
| Amaranthaceae           | <i>Aerva lanata</i> . Linn Juss- ex schultes      | Common wayside weed                         | <i>Sirukan peelai, Katpethi, Paasana pethi, Kan peelai</i>                         |
|                         | <i>Alternanthera sessilis</i> (Linn) R.Br.ex DC   | Sessile plant                               | <i>Kodduppai, Seethai</i>  |
|                         | <i>Amaranthus tricolor</i> , Linn                 |   | <i>Silli, Meha naatham</i>   |
| Amaryllidaceae          | <i>Curculigo orchioides</i> , Gaertn              | Black musale                                | <i>Vaaragi, Musali, Thaalammooli, Thiralaaram</i>                                  |
| Anacardiaceae           | <i>Anacardium occidentale</i> . Linn              | Cashew nut tree                             | <i>Koddai munthiri maa, Kollamma</i>   |
|                         | <i>Lannea coromandelica</i> (Houtt) Merr          | Rhus olina, Wodier, Jhingam                 | <i>Mothgam, Udimaram</i>   |
| Annonaceae              | <i>Polyalthia longifolia</i> (Sonn.) Thwaites     |   |  |
| Apiaceae                | <i>Anethum graveolens</i> . Linn                  | The Dill, Gardendill, Anet                  | <i>Sojik keerai seeds, Mathurikai</i>  |
|                         | <i>Centella asiatica</i> (Linn.) Urban            | Indian Peenywort                            | <i>Sandagi, Pindeeri, Yosavalli</i>  |
|                         | <i>Coriandrum sativum</i> , Linn                  | Coriander seeds                             | <i>Urul arisi, Thaniya</i>   |
|                         | <i>Cuminum cyminum</i> . Linn                     | Cumin seeds or fruit                        | <i>Asai, Seeri, Upakumpapesam, Natseeri, Pithanaasini,</i>                         |
| Apocynaceae             | <i>Hemidesmus indicus</i> . Linn R.Br             | Indian Sarasaparilla, Country Sarasaparilla | <i>Ankaari mooli, Narunedi, Paathala mooli, Saaripam, Paartkodi, Kirushnavalli</i> |
|                         | <i>Holarrhena pubescens</i> , Wall. Ex G.Don      | The Kurchi, Tellicherry Bark, Concessi      | <i>Kasappu, Vetppalai, Kuvalap paalai, Kulap paalai</i>                            |
|                         | <i>Tabernaemontana divaricata</i> (Linn)          | East Indian rose bay, Ceylon Jasmine        | <i>Nanthipaththiri, Nanthiyavarththam, Paddidai, Valampuri, Sujothanan Maalai</i>  |
|                         | <i>Tylophora indica</i> (Burm.f.) Merrill         | Vomiting swallow wort                       | <i>Naippalai</i>   |
|                         | <i>Watakaka volubilis</i> (Linn) Staf             | Sweet obtuse leaved minusops                | <i>Theem palai, Kodip paalai</i>   |
| Aponogetonaceae         | <i>Aponogeton monostachyon</i> , Linn             | Aquatic root                                |  |
| Arecaceae               | <i>Areca catechu</i> , Linn.                      | Areca nut boiled tender                     |  |
|                         | <i>Borassus flabellifer</i> , Linn                | Palmyra palm, Brab tree                     | <i>Thaalam, Karumpuram, Edakam, Ghamam, Tharuviragan, Thaali</i>                   |
|                         | <i>Cocus nucifera</i>                             | Coconut palm, Coconut tree                  | <i>Thenku, Pologa karpavirudcham, Thaalai</i>                                      |
|                         | <i>Phoenix dactylifera</i> L.                     | Date palm                                   |  |
| Aristolochiaceae        | <i>Aristolochia indica</i> , Linn,                | Indian birthwort                            | <i>Eswara mooli, Perun kizhangu,</i>   |
| Asteraceae              | <i>Vernonia cinerea</i> . Linn Less               | Ash colored fleabane                        | <i>Sagathevi, Thevakantham, Sittilai</i>   |
| Bignoniaceae            | <i>Stereospermum colais</i> (Buch.-Ham.ex Dillw.) | Trumpet flower, Yellow snake powder         | <i>Kanni, Paadalimaram, Paadalam</i>   |
| Boraginaceae            | <i>Cordia dichotoma</i> Forst.f                   | Sebestem plum                               | <i>Naruvali, Naruvili, Seetham, Naruvuli</i>                                       |
| Brassicaceae            | <i>Brassica juncea</i> , Czern &                  | Mustard                                     | <i>Iyavi</i>   |

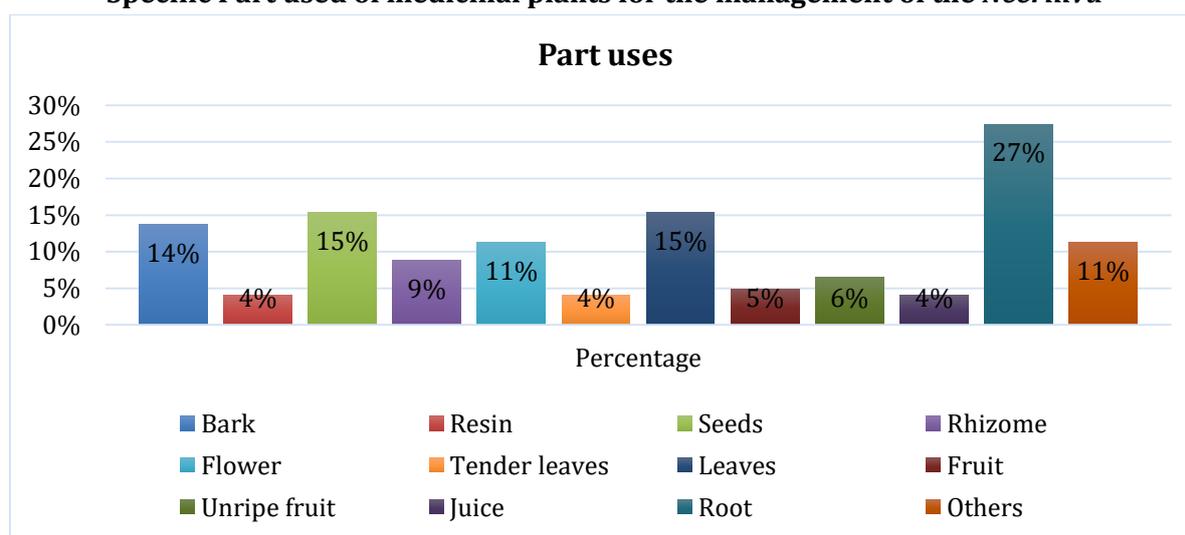
|                |   |   |  |
|----------------|---|---|--|
|                | Coss  |   |  |
| Burseraceae    | <i>Commiphora caudata</i> (Wight & Arn.) Engl                             |   |  |
| Calophyllaceae | <i>Mesua nagassarium</i> (Burm.f) Kosterm                                 | Ceylon iron wood  | Nagam, Nagaputpam, Nakesaram, Kesaram, Sampeyapam                          |
| Capparaceae    | <i>Crataeva magna</i> (Lour.) Dc.   | Three leaved caper  | Mavillingu, Kumarakam, Varani  |
| Combretaceae   | <i>Terminalia arjuna</i> . Roxb. Ex. DC wight & Arn                       | <i>Arjuna myrobalan</i> ,<br><i>Arjun</i>                         | Aruchunam, Kagupam, Poothavam, Poolanthi                                   |
|                | <i>Terminalia bellirica</i> (Gaerin.) Roxb                                | <i>Beleric Myrobalans</i>   | Asam, Amutham, Thanikkai,  |
|                | <i>Terminalia chebula</i> . Retz  | <i>Chebulic Myrobalan</i> ,<br>Ink nut                            | Arithagi, Emavathi, Kadu   |
| Convolvulaceae | <i>Rivea hypocrateriformis</i> (Disr.)                                    | Velvet leaf, Wound plant  | Karunchcharanai, Paadai, Malaitangi, Vaarigam, Wetpenti, Vadathiruppi root |
| Costaceae      | <i>Costus speciosus</i> (Koenig ex Retz) J.E. Smith                       | Costus root   | Kostam, Kura, Oli  |
| Cucurbitaceae  | <i>Coccinia grandis</i> (Linn) Voigt                                      | Ivy gourd   |  |
|                | <i>Cucumis sativus</i> Linn   | Common Cucumber   | Uruvaaram, Urrvaarugam, KatKaady, Mirunthu                                 |
|                | <i>Luffa acutangula</i> (Linn) Roxb                                       | Ribbed luffa, Ribbed gourd, Ridged gourd                          | Koosavathi   |
| Cyperaceae     | <i>Cyperus rotundus</i> , Linn  | Nut grass   | Muththagkasu   |
| Ebenaceae      | <i>Maba buxifolia</i> (Rottb.) Pers.                                      |   |  |
| Euphorbiaceae  | <i>Euphorbia pilulifera</i> , Linn  | Australian Sthima weed  | Siththira paaladai   |
|                | <i>Macaranga peltata</i> (Roxb.) Mull. Arg.                               |   |  |
|                | <i>Phyllanthus amarus</i> . Schum & Thonn                                 | Indian Phyllanthus  | Kizhvai Nelli, Keela nelli   |
|                | <i>Phyllanthus emblica</i> . Linn   | Indian goseberry  | Aamalam, Aalagam, Aampal, Aamarigam, Thaththari,                           |
|                | <i>Phyllanthus reticulatus</i> . Pori                                     |   |  |
| Fabaceae       | <i>Abrus precatorius</i> , Linn   | Indian liquorice wild liquorice                                   | Gundumani, Guntrimani, guntri viththu                                      |
|                | <i>Acacia catechu</i> , (Lin.f)   | Black Catechu, cutch tree   |  |
|                | <i>Acacia nilotica</i> (Linn.) Willd. ex Del. ssp. indica (Benth.) Brenan | Indian gum arabic tree  | Karuvelam, Karuvel   |
|                | <i>Cajanus cajan</i> (Linn) Mill sp                                       | Dholl   | Aadaki, Kaachchi, Thorai,  |
|                | <i>Cassia alata</i> . Linn  | Ringworm shrub  | Semai akathi, Malai thakarai, Peiyakathi,                                  |
|                | <i>Cassia Auriculata</i> Linn   | Cassia, Avaram  | Avirai, Emapuddpy, Mekaari, Aakuli & Thalapoodam                           |
|                | <i>Cassia fistula</i> . Linn  | Indian Ladurnam, Pudding pipe tree, Purgig cassia, Purgig fistula | Sarakkonrai, Mathalai  |
|                | <i>Cassia senna</i> , Linn  | Country senna (Indian or Tinnevelly senna)                        | Nilaaavarai, Nilavagai, Naadu nilavirai, Aalakaalam                        |
|                | <i>Glycyrrhiza glabra</i> , Linn  | Jequity, Indian or Jamaica Liquorice                              | Athingam, Addi, Mathookam, Kuntri veer                                     |

|                |  |   |   |
|----------------|--|---|---|
|                | <i>Mimosa pudica</i> . Linn                                  | Sensitive or humble plant, Touch me not               | <i>Thottar chinungi, Ilachchagi,</i>  |
|                | <i>Tamarindus indica</i> Linn                                | Tamarind tree   | <i>Thingthurunee, Aampiram, Chinthooram, Chinthagam, Eagin, Chintham</i>              |
|                | <i>Trigonella foenum graecum</i> Linn                        | Fenugreek, Greek hayes                                | <i>Menthiyam, Maythy, Venthai</i>   |
|                | <i>Vigna mungo</i> (Linn) Hepper                             | Black gram  | <i>Maadam, Maasam</i>   |
| Hypocrataceae  | <i>Salacia reticulata</i> wight                              |   | <i>Ponkorandi, Kadalranji</i>   |
| Iridaceae      | <i>Crocus sativus</i> , Linn                                 | Saffron   | <i>Gnalalppu, Kasmeeram</i>   |
| Lamiaceae      | <i>Gmelina asiatica</i> . Linn                               |   |   |
|                | <i>Plectranthus vettiveroides</i> (Jacob) Singh & Sharma     | White cus cus grass                                   |   |
| Lauraceae      | <i>Cinnamomum verum</i> . J. Presl                           | Bark of Cinnamon                                      | <i>Karuvaap paddai</i>  |
| Liliaceae      | <i>Allium cepa</i> . Linn                                    | Onion   | <i>Vengayam, Erulli, Ulli, Eravulli, Kayam</i>  |
| Loganiaceae    | <i>Strychnos potatorum</i> . Linn.f.                         | Clearing nut tree                                     | <i>Illam, Kathagam, Sillam, Theru</i>   |
| Malvaceae      | <i>Abutilon indicum</i> , G.Don                              | The country mallow, Indian mush mallon                | <i>Kakkadi, Kikkasi</i>   |
|                | <i>Gossypium arboreum</i> . Linn                             | Red cotton tree, cotton tree                          |   |
|                | <i>Gossypium herbaceum</i> Linn                              | Indian cotton plant                                   | <i>Achchathe napalai, Paty, Uththary, Kaatpaasam, Pannal</i>                          |
|                | <i>Sterculia foetida</i> . Linn                              | Tree of heaven  | <i>Pi Nari maram</i>  |
| Meliaceae      | <i>Azadirachta indica</i> A.Juss                             | Margosa tree, Neem tree, Indian lilac                 | <i>Ariddam, Thuththai, Nimpam, Paari pathiram, Pisu mantham, Vaathati, Veppu</i>      |
| Menispermaceae | <i>Coscinium fenestratum</i> . (Gaertn) Colebr               | Tree turmeric, False Calumba                          | <i>Thaaruvi, Kaalayakam</i>   |
|                | <i>Tinospora cordifolia</i> (Willd) Miers ex Hook.f. & Thoms | Heart leaved moon seed, Tinospora, Gulancha tinospora | <i>Amirthavalli, Somavalli, Amirthai, Amirthak kodi, Kundali</i>                      |
| Moraceae       | <i>Artocarpus heterophyllus</i> Lam                          | Jack fruit tree                                       | <i>Shakkai, Palavu, Palaasam, Varukkai, Eekaaravaley</i>                              |
|                | <i>Ficus benghalensis</i> , Linn                             | The banyan tree                                       | <i>Eyakkurotham, Kaamaram, Kooli, Tholmaram, Pazhumaram, Pootham, Vadam, Vaanokki</i> |
|                | <i>Ficus racemosa</i> , Linn                                 | Country fig, Cluster Fig, Gular Fig                   | <i>Atham, Athavu, Uthumparam, Koli, Suppirathsdam</i>                                 |
| Moringaceae    | <i>Moringa oleifera</i> Lam.                                 | Horse radish, Drum stick tree                         | <i>Sikkuru, Kirancham, Kilavi, Soppanchanam</i>                                       |
| Musaceae       | <i>Musa paradisiaca</i> . Linn                               | The Plantain tree                                     | <i>Ampanam, Arampai, Oosai, Kathali, Kavar,</i>                                       |
| Myristicaceae  | <i>Mystric fragrans</i> Houtt                                | Nut Meg   | <i>Kulakkai, Jathikkai</i>  |
| Myrtaceae      | <i>Syzygium aromaticum</i> (L) Merr. & L.M.Perry             |   |   |
|                | <i>Syzygium cumini</i> (Linn) Skeels                         | Jambul  | <i>Sampu, Navval, Sathavam, Aarukatham, Surapipathirai</i>                            |
| Nymphaeaceae   | <i>Nelumbo nucifera</i> , Gaertn                             | The sacred Lotus                                      | <i>Aravintham, Pundarikam, Kamalam</i>  |
|                | <i>Nymphaea nouchali</i> , burm.f.                           | The (white) water lilly                               | <i>Alpam, Kumutham, Kairavam</i>  |
|                | <i>Nymphaea pubescens</i> , Wild                             | White water lilly                                     | <i>Aampal, Kajiravam, Kumutham, Kairavam</i>  |
| Oleaceae       | <i>Jasminum grandiflorum</i> , Linn                          | Common jasmine  | <i>Malli, Iruvatchi, Kodimallikai</i>   |
| Pandanaceae    | <i>Pandanus odoratissimus</i> . Linn. F                      | Fragrant screw pine                                   | <i>Kandal, Kathagai, Kaithai, Paddigai, Musali</i>                                    |

|                |  |  |  |
|----------------|--|--|--|
| Pedaliaceae    | <i>Sesamum indicum</i> , Linn                    | Gingelly oil plant, Sesame                           | <i>Thilam</i>  |
| Pinaceae       | <i>Cedrus deodara</i> (Roxb.ex D.Don) G.Don.     | Himalayalan Cedar, deodar                            | <i>Devadaru, Irutharu, Tharam, Pathiratharugam</i>                     |
| Piperaceae     | <i>Piper betle</i> , L.                          |  | <i>Vettilai</i>  |
|                | <i>Piper longum</i>                              | Long pepper  | <i>Aarkathi, Ulavanaasi, Kudari</i>                                    |
|                | <i>Piper nigrum</i> . Linn                       | Black pepper   | <i>Kolakam, Kuru milagu, Vallisam, Maasam,</i>                         |
| Plantaginaceae | <i>Bacopa monnieri</i> (Linn) Pennell            | Thyme leaved gratiola                                |  |
| Plumbaginaceae | <i>Plumbago zeylanica</i> . Linn                 | Ceylon lead wort                                     | <i>Sithira mooli</i>   |
| Poaceae        | <i>Bambusa arundinacea</i> (Retz.) Wild          | Bamboo, Thorny bamboo                                | <i>Ari, Aampal, Paathiri, Mudngal, Velam</i>                           |
|                | <i>Saccharum officinarum</i> . Linn              | Sugarcane, Noble cane                                | <i>Punatpoosam, Ikku, Veai</i>   |
|                | <i>Sorghum vulgare</i> (Linn) Pers.              | Maize, Great millet                                  |  |
|                | <i>Vetiveria zizanioides</i> . (Linn) Nash       | Cuscus grass, vetiver, Khus Khus                     | <i>Kuruver, Vilalver, Iruveli, Viranam</i>                             |
| Rhamnaceae     | <i>Ziziphus mauritiana</i> , Lam                 | The indian jujube tree, Chinese dale                 |  |
|                | <i>Ziziphus oenoplia</i> (Linn) Mill             | Jackal Jujube  |  |
| Rubiaceae      | <i>Catunaregum spinosa</i> (Thumb.) Tiruvengadam | Emetic nut, Common emertic nut                       |  |
|                | <i>Catunaregum spinosa</i> (Thumb.) Tiruvengadam | Emertic nut tree, Common emetic tree                 | <i>Mathukkarai, Maraadam, Maruvakam, Marukkarai pazham</i>             |
| Rutaceae       | <i>Aegle marmelos</i> Linn.corr                  | Bael tree, Holy fruit tree                           | <i>Kusaapi, Koovilam, Koovilai, Sivaththurumam, Ninmaly, Maathuram</i> |
|                | <i>Citrus limon</i> (Linn) Burm f                | Lime   |  |
|                | <i>Limonia acidissima</i> Linn                   | Wood apple, Elephant apple, Curd fruit, Monkey fruit | <i>Kadippagai, Kapiththam, Vilavu, Vellil</i>                          |
|                | <i>Toddalia asiatica</i> . Linn Lam              | Forest pepper  |  |
| Salvadoraceae  | <i>Azima tetraacantha</i> Lam                    | Mistletoe berry thorn, Four spined meneita           | <i>Changanchedi, Natchangan, Mudchangan</i>                            |
| Santalaceae    | <i>Santalum album</i> . Linn                     | Sandalwood   |  |
| Sapindaceae    | <i>Cardiospermum halicacabum</i> , Linn          | Ballon Vine, Heart Pea or Winter Cherry              | <i>Mudatkuttan, Mudakkaruththan</i>                                    |
| Sapotaceae     | <i>Madhuca longifolia</i> (koenig) Macbride      | The Narrow leaved Mohua, Mowa tree                   | <i>Iruppai, Kuligam, Mathoogam</i>                                     |
|                | <i>Manilkara hexandra</i> (Roxb. Dubard          | Obtuse leaved mimusops                               | <i>Seevani, Seevanthi</i>  |
|                | <i>Mimusops elengi</i> . Linn                    | Pointed leaved ape flower                            | <i>Ilanji, Ksaram, Vagulam</i>   |
| Smilacaceae    | <i>Smilax china</i> Linn                         | China root   | <i>Mathusmigam, Mathusmeeki, Shenapattai, Parankich chakkai</i>        |
| Solanaceae     | <i>Datura metel</i> , Linn                       | <i>Datura</i> ( White flowering) Thorn apple         | <i>Ummaththai</i>  |
|                | <i>Solanum melongena</i> Linn                    | Egg plant, Brinjal                                   | <i>Valuthalai, Vali thunai</i>   |

|                |                                      |                            |   |
|----------------|--------------------------------------|----------------------------|---|
|                | <i>Solanum torvum</i> Swartz         | Unarmed night shade        | <i>Sundaik keerai, Malaisundai, Kaduki</i>  |
| Symplocaceae   | <i>Symplocos racemosa</i> Roxb       | The Lodh tree, Lottur bark | <i>Kaasa sangai, Kaaya vilai, Thillagam, Loththu kaththol, Vellathippattai</i>                      |
| Taccaceae      | <i>Tacca pinnatifida</i> , Forst. f. | Wild Amorphophalus         | <i>Kattu chenai, Periya karunai</i>   |
| Umbelliferae   | <i>Ferula asafoetida</i> Linn        | Asafoetida                 | <i>Athiyakirakam, Inku, Iranam, Iraamadam, Kanthi, Kaayam, Santhunaasam, Poothanaasam, Vallegam</i> |
| Zingiberaceae  | <i>Curcuma longa</i> Linn            | Turmeric                   | <i>Arisanam, Kaansani, Nisi, Peetham</i>  |
|                | <i>Curcuma zedoaria</i> , Rosc.      | The round white zedoary    | <i>Seemai Kichchili kizhangu, Poola Poolan kilangu, Kachchoram</i>                                  |
|                | <i>Elettaria cardamomum</i> , Moton  | Cardamom Seeds             | <i>Aanchi, Korangam, Thudi</i>  |
|                | <i>Zigiber officinale</i> , Rose     | Dried Ginger               | <i>Arukkan, Ingi, Verkombu</i>  |
| Zygophyllaceae | <i>Tribulus terrestris</i> . Linn    | Mall Caltrops              | <i>Thirikandam, Thirikandakam</i>   |

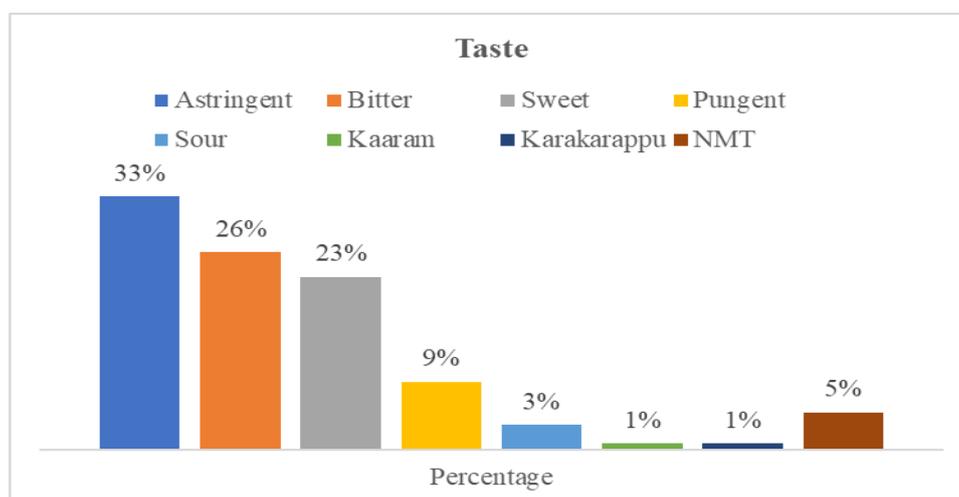
**Specific Part used of medicinal plants for the management of the Neerilivu**



Among the 124 medicinal plants, 34 (27%) plants are used as root, 19 (15%) plants are used as leaves and seeds and 17 (14%) plants are used as bark, 14 (11%) plants are used as flowers, 11 (9%) plants are used as rhizome, 8 (6%) plants are used as unripe fruit, 6 (5%) plants are used as fruit, 5 (4%) plants are used as juice, tender leaves and resin.<sup>[3,4]</sup>

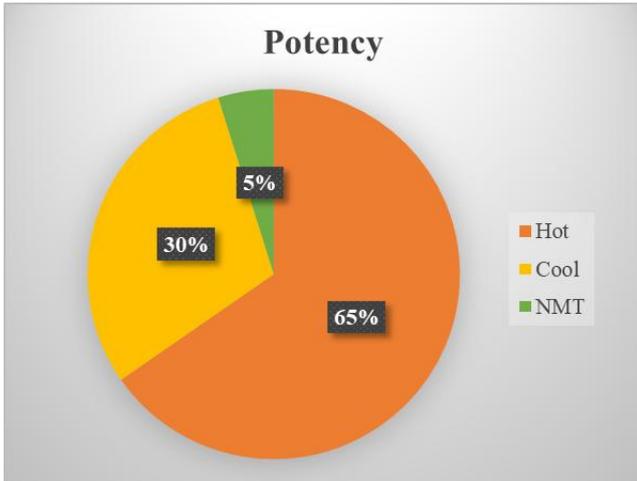
**Siddha properties of the medicinal plants**

**Taste**



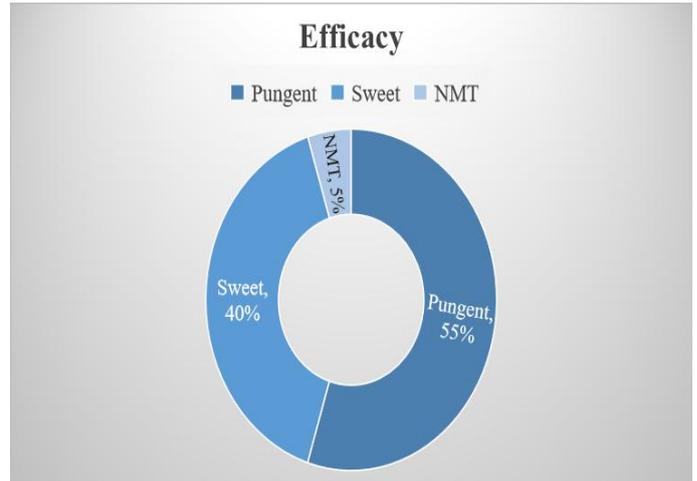
33% (41) have astringent, 26% (32) have bitter, 23% (28) have sweet, 9% (11) have pungent, 3% (4) have sour taste and 1% (1) has *Kaaram* and *Karakarappu*.<sup>[3,4]</sup>

**Potency**

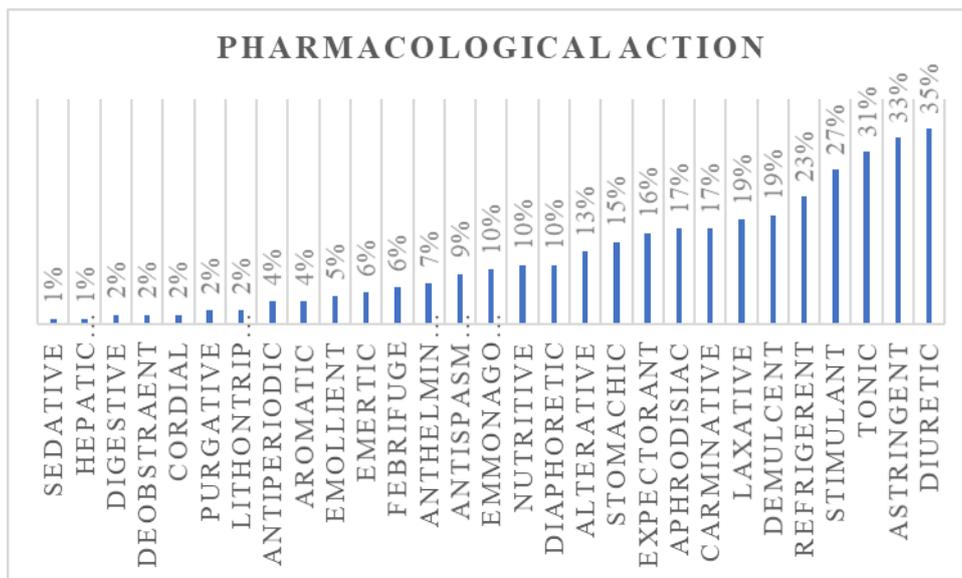


61% (81) plants have hot and 30% (37) plants have cool potency.<sup>[3,4]</sup>

**Efficacy**

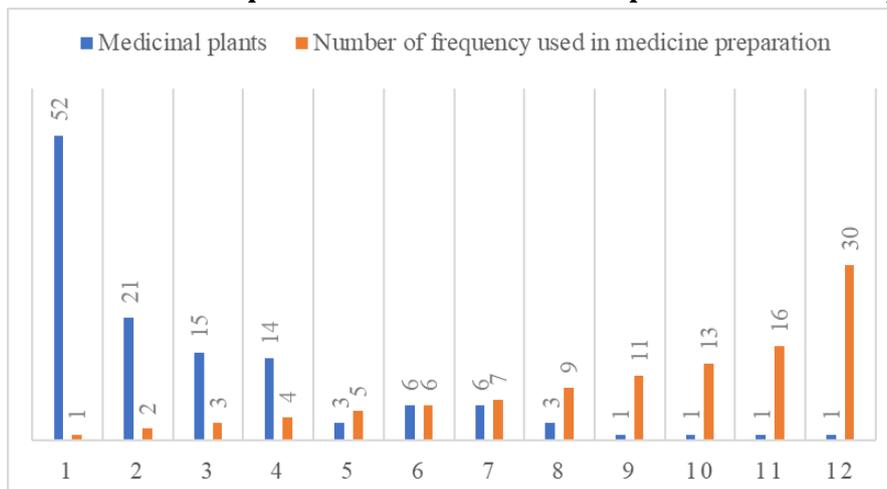


55% (68) have pungent and 40% (50) have sweet efficacy.<sup>[3,4]</sup>



35% (43) plants have diuretic, 33% (41) plants have astringent, 31% (38) plants have tonic, 27% (34) plants have stimulant, 23% (28) plants have refrigerant, 19% (24) plants have demulcent and laxative, 17% (21) plants have aphrodisiac and carminative, 16% (20) plants have expectorant, 15% (18) have stomachic and 13% (16) plants have alterative pharmacological action<sup>[3,4]</sup>.

**Description of number of frequencies used the medicinal plants in medicine preparation**



Among the 85 drugs, 124 medicinal plants are used in medicine preparation. *Cassia auriculata* is used in 30 drug preparation, *Phyllanthus emblica* is used in 16 drug preparation, *Strychnos potatorum* is used in 13 drug preparation, *Terminalia chebula* is used in 11 drug preparation, *Terminalia bellirica*, *Salacia reticulata* and *Syzygium aromaticum* are used in 9 drug preparation, *Zingiber officinale*, *Rivea hypocrateriformis*, *Piper nigrum*, *Elettaria cardamomum*, *Cyperus rotandus* and *Cuminum cyminum* are used in 7 drug preparation and *Glycyrrhiza glabra*, *Gossypium herbaceum*, *Mystric fragans*, *Piper longum*, *Satalum album* and *Tribulus terrestris* are used in 6 drug preparation.<sup>[3,4]</sup>

### Summarized the Biological Activity of Medicinal Plants

#### *Cassia auriculata* Linn

##### Antihyperglycemic activity

Latha and Paris *et al.*, 2003 studied that the aqueous extraction of *Cassia auriculata* flower has anti-hyperglycaemic effect and improved gluconeogenesis during diabetes is shifted towards normal and the extract improves the glucose utilization by increasing glycolysis. The effect of *Cassia auriculata* flower extract was significantly greater than that of glibenclamide<sup>[5]</sup>.

Gupta *et al.*, 2009 found that the present study was designed to test the anti-atherosclerotic capacity of aqueous extract of *Cassia auriculata* L. leave in streptozotocin (STZ)- induced diabetic rats. Rats were induced diabetic by STZ (45mg/kg, ip). Diabetic rats were administered orally with *C. auriculata* leaf extract at a dose of 400mg/kg daily for 21 days. The supplementation of extract to the diabetic rats produced significant reductions in fasting blood glucose and significant changes in serum lipid profile and apolipoprotein B. Lipid peroxidation was found to be pointedly suppressed in extract-fed diabetic rats. Significant reduction in serum levels of oxidized low-density lipoprotein, soluble vascular cell adhesion molecule and plasma fibrinogen with a concomitant elevation in serum nitric oxide has been observed in diabetic rats following treatment with aqueous extract. Histopathological examination of heart myocardium of extract treated diabetic rats revealed reverse of fatty change toward normal. These results suggest that *C. auriculata* aqueous leaf extract shows anti-atherosclerotic role in the diabetes and it suggest that extract may help to prevent the progression of heart diseases<sup>[6]</sup>.

##### Anti-oxidant activity

Juan-Badaturuge *et al.*, 2011 found that the alcoholic extract from the aerial part of *Cassia auriculata* showed effective antioxidant activity when

evaluated by DPPH radical scavenging, lipid peroxidation and reducing power analysis<sup>[7]</sup>.

##### Hepatoprotective

Jaydeokar. *et al.*, 2014 found that the root extract of *C. auriculata* has hepatoprotective activity against ethanol and antitubercular drug-induced hepatotoxicity in rats, possibly due to an inhibition of hepatic metabolizing enzymes and antioxidant activity<sup>[8]</sup>.

#### *Phyllanthus emblica* Linn

##### Anti hyperglycemic activity

Srinivasan *et al.*, 2018 found that the different concentrations of quercetin show significant antihyperglycemic effects and effective defence mechanisms in STZ-induced diabetic rats<sup>[9]</sup>.

##### Anti-oxidant

Pientaweeratch *et al.*, 2016 has studied that the ethanol *P. emblica* extract contain high phenolic content and showed the most potent antioxidant property<sup>[10]</sup>.

##### Hepatoprotective

Thilakchand *et al.*, 2013 *Phyllanthus emblica* has been proven to provide protection against various types of hepatotoxic agents, such as ethanol, paracetamol, carbon tetrachloride, heavy metals, ochratoxins, hexachlorocyclohexane and antitubercular drugs. Regular diet of *P. emblica* has been shown to be helpful in reducing hyperlipidemic, metabolic syndrome, hepatocellular carcinoma and hepatotoxicity resulting from iron overload. The main constituents of photochemical quercetin, gallic acid, corilagin and ellagic acid were also identified as hepatoprotective against the toxicity of paracetamol, microcystins, galactosamine and lipopolysaccharide<sup>[11]</sup>.

#### *Strychnos potatorum*. Linn.f.

##### Anti hyperglycemic activity

Yadav, *et al.*, 2014 found that *Strychnos potatorum* has antidiabetic activity. In Wistar albino rat, the diabetic state was induced by intra peritoneal injection of alloxan at a dose of 100mg/kg of body weight. Blood glucose level drops by 53% with extract treatment, demonstrating the antidiabetic potential of the plant. The insulin level also raised up to 61µg/ml within 30 days of extract treatment compared to control with 51µg/ml. Plant extract has efficiently reduced the initial cholesterol 219µg/ml level into 170µg/ml<sup>[12]</sup>.

##### Anti-oxidant and Hepatoprotective activity

Sanmugapriya & Venkataraman (2006) has studied that the present research shows the hepatoprotective and antioxidant activities of the seed powder (SPP) and aqueous extract (SPE) of *Strychnos potatorum* seeds against CCl<sub>4</sub>- induced acute hepatic damage. Hepatic damage was achieved

by injecting 3ml/kg, s.c. of CCl<sub>4</sub> in equal proportion with olive oil. Both SPP and SPE at the doses 100 and 200mg/kg, p.o. provided significant ( $p < 0.001$ ) hepatoprotective action by reducing the serum marker enzymes such as serum glutamate oxaloacetate transaminase (SGOT) and serum glutamate pyruvate transaminase (SGPT). They also reduce the high levels of ALP and serum bilirubin. Reduced enzymic and nonenzymic antioxidant levels and high levels of lipid peroxide levels are restored to normal by administration of SPP and SPE. Histopathological studies also confirmed the hepatoprotective activity of SPP and SPE compared with the CCl<sub>4</sub> treated control groups. The results obtained were compared with Silymarin (50mg/kg, p.o.), the standard drug. SPE (200mg/kg, p.o.) has shown significant hepatoprotective activity similar to that of the standard drug, Silymarin (50mg/kg, p.o.)<sup>[13]</sup>.

#### ***Terminalia chebula*. Retz**

##### **Anti hyperglycemic activity**

Rao & Nammi (2006) studied that the chloroform extract of *T. chebula* seeds produced dose-dependent reduction in blood glucose of diabetic rats and comparable with that of standard drug, glibenclamide in short term study. It also produced a significant reduction in blood glucose in a long term study. Significant renoprotective activity is observed in *T. chebula* treated rats. The results show a long-term action on lowering of blood glucose by *T. chebula* and is probably mediated through increased secretion of insulin from the  $\beta$ -cells of Langerhans or through extra pancreatic mechanism<sup>[14]</sup>.

##### **Anti-oxidant and Hepatoprotective activity**

Lee, et al., 2005 found that an aqueous extract of fruit of *T. chebula* on the tert-butyl hydroperoxide (t-BHP)- induced oxidative injury detected in cultured rat primary hepatocytes and rat liver. Both treatment and pre-treatment of the hepatocytes with the *T. chebula* extract (TCE) significantly reversed the t-BHP-induced cell cytotoxicity and lactate dehydrogenase leakage. In addition, TCE has shown in vitro ferric-reducing antioxidant activity and 2,2-diphenyl-1-picrylhydrazyl free radical-scavenging activities. The in vivo study has shown that pre-treatment with TCE (500 or 1000 mg/kg) by gavage for 5 d before a single dose of t-BHP (0.1mmol/kg i.p.) significantly reduced the serum levels of the hepatic enzyme markers aspartate aminotransferase and alanine aminotransferase and reduced the indicators of oxidative stress in the liver, such as the glutathine disulfide content and lipid peroxidation, in a dose dependent manner. Histopathologic studies of the rat livers have shown that TCE has reduced the incidence of liver lesions, including hepatocyte

swelling and neutrophilic infiltration, and repaired necrosis induced by t-BHP. Based on the results described above, we assume that TCE has the potential to play a role in the hepatic prevention of oxidative damage in living systems<sup>[15]</sup>.

#### ***Terminalia bellirica* (Gaerin.) Roxb**

##### **Anti hyperglycemic activity and antioxidant**

Gupta et al., 2020 found that Antioxidant activities of extracts were measured using in vitro assays viz., DPPH free radical scavenging, reducing power, hydroxyl radical scavenging and phosphomolybdate assays. Antidiabetic potential is measured by in vitro  $\alpha$ -amylase inhibitory activity and in vivo serum biochemical assays in alloxan-induced diabetic rats. Ethyl acetate (EA) extract showed considerable free radical scavenging abilities in DPPH and HRSA assays (up to 94%), reducing power assay and appreciable total antioxidant power in phosphomolybdate assay (78mg PGE/g). The EA extract showed comparatively better  $\alpha$ -amylase inhibitory activity (IC<sub>50</sub> 43.5mg/ml) as compared to aqueous (AQ) extract (IC<sub>50</sub> 74.8mg/ml). The activity was similar to standard drug acarbose. Antidiabetic activity of extracts was studied in alloxan-induced diabetic rats for 28 days. The ethyl acetate extracts also exhibited superiority over the aqueous extracts during in vivo antidiabetic assays. The results revealed that *T. bellirica* fruit extracts possess antioxidant,  $\alpha$ -amylase inhibitory and antidiabetic activities and hence it could be helpful for the management of hyperglycemia and oxidative stress<sup>[16]</sup>.

##### **Hepatoprotective**

Gupta et al., 2021 found that Long term use and overdose of diclofenac (DCF), an anti-inflammatory drug is known to cause oxidative stress and liver damage. The present study reports on the antioxidant, and hepatoprotective activities of *T. bellirica* (Tb) fruit aqueous and ethyl acetate extracts and its bioactive compound ellagic acid (EA) against DCF-induced toxicity. In vitro antioxidant activities were measured by ABTS and FRAP assays while anti-inflammatory activity was assessed by the albumin denaturation method. The adverse effects of DCF and hepatoprotective potential of Tb extracts and EA were tested in serum and liver tissue of rats after oral administration for 21 days. Silymarin was used as standard hepatoprotective agent for comparison. Hepatic markers analysed in serum included ALP, GPT, GOT, LDH,  $\gamma$ -glutamyl transferase, total protein, creatinine, and uric acid while superoxide dismutase (SOD) and catalase (CAT) were analysed in liver tissue. The EA has shown superior ABTS radical scavenging, FRAP, and anti-inflammatory activities as compared to fruit extracts. DCF treatment has led to

increase in the levels of most of the serum hepatic markers with decline in total serum protein as well as SOD and CAT in liver tissue. The supplementation of extracts, EA and silymarin in DCF treated rats significantly reduced the adverse effects of DCF on serum and tissue markers. Histopathology of the liver shown that extracts and EA significantly reduced the degree of liver fibrosis. The hepatoprotective potential of EA was comparable to the silymarin but activity of Tb fruit extracts was slightly lower. Among fruit extracts ethyl acetate extract has shown better activity than aqueous extract. The results showed that ellagic acid and *T. bellirica* fruit extracts have potential to mitigate oxidative stress and hepatotoxicity produced by long term use of diclofenac<sup>[17]</sup>.

### ***Syzygium aromaticum* (L) Merr. & L.M.Perry**

#### **Anti hyperglycemic activity, Anti-oxidant & Hepatoprotective**

Adefegha *et al.*, 2014 found that Diabetic rats were placed on dietary regimen containing 20-40 g kg<sup>-1</sup> clove bud powder. The results showed that supplementation with Clove Bud Powder (CBP) gradually reduced blood glucose level in diabetic rat compared to control diabetic rats without CBP supplementation (DBC). In addition, reduced activity of  $\alpha$ -glucosidase was observed in CBP and metformin- treated rat groups when compared to that of the DBC rat group. In addition, the DBC group had significantly ( $P < 0.05$ ) higher lipid concentrations (except for high-density lipoprotein cholesterol) compared to all other groups. Furthermore, CBP had significantly ( $P < 0.05$ ) reduced activity of liver enzymes (alanine aminotransferase, aspartate aminotransferase and alkaline phosphatase) and showed high levels of antioxidant status (glutathione, ascorbic acid, superoxide dismutase and catalase)<sup>[18]</sup>.

### ***Salacia reticulata* wight**

#### **Anti hyperglycemic activity**

Radha *et al.*, 2009 found that, *Salacia reticulata* bark was tested for its hypoglycemic and hypo-lipidaemic effect. Sixty type II diabetics were enrolled, consisting of experimental group 30 and control group 30. The experimental group received 2 grams of K *Salacia reticulata* powder daily for a period of 90 days and control group did not receive any supplements. Blood glucose levels before and after treatment was estimated in both groups at baseline and at 90 days. There was slightly decrease in fasting blood glucose, HbA1c and lipid levels at the end of 90 days in the supplemented group. The experimental group showed encouraging results which call for long term supplementation in Diabetes Mellitus<sup>[19]</sup>.

### **Anti-oxidant and Hepatoprotective**

Yoshikawa *et al.*, 2002 studied that the hepatoprotective effects of the hot water (SRHW) and methanolic (SRM) extracts from the roots and stems of *Salacia reticulata* were evaluated using an oxidative stress-induced liver injury model. Both SRHW and SRM extracts (400mg/kg, p.o.) significantly suppressed the increase in Glutamic Oxaloacetic Transaminase (GOT) and Glutamic Pyruvic Transaminase (GPT) activities in carbon tetrachloride (CCl<sub>4</sub>)- treated mice. These extracts also inhibited CCl<sub>4</sub>- induced thiobarbituric acid-reactive substance (TBA-RS) formation, which shows an increased lipid peroxidation in the liver. A good correlation ( $r = 0.945$ ,  $p = 0.01$ ) was observed between the number of phenolic compounds in the extracts and their inhibitions of TBA-RS formation. The IC<sub>50</sub> values of the extracts on 1, 1-diphenyl-2-picrylhydrazyl (DPPH) radical scavenging were less than 10mg/ml and the antioxidative activities of six phenolic compounds from the roots of *S. reticulata* were tested. Mangiferin, (-)-49-O'-methylepigallocatechin, and (-)-epicatechin-(4 $\beta$ →8)-(-)-4'-O-methylepigallocatechin, which a main phenolic compounds, showed potent scavenging activity on DPPH radicals and their concentrations required for 50% reduction of 40mM DPPH radicals were 5.9, 10, and 3.2mM, respectively. On the other hand, against the CCl<sub>4</sub>-induced serum GOT and GPT elevations and TBA-RS formation in mice, mangiferin and (-)-49-O-methyle pigallocatechin showed potent activity at a dose of 100mg/kg, but (-)-epicatechin-(4 $\beta$ →8)-(-)-4'-O-methyle pigallocatechin did not. These results suggest that the antioxidative activity of the main phenolic compounds is involved in the hepatoprotective activity of *S. reticulata*<sup>[20]</sup>.

### **CONCLUSION**

Among the 124 medicinal plants, *Cassia auriculata*, *Phyllanthus emblica*, *Strychnos potatorum*, *Terminalia chebula*, *Terminalia bellirica*, *Syzygium aromaticum* and *Salacia reticulata* are used many times in medicine preparation. Previous researches showed that these ingredients have anti-diabetic activity, hepatoprotectives and anti-oxidant. This review provides useful documented evidence and scientific evidence on the treatment of *Neerilivu* (DM) in traditional medicine.

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