• Behavior of powder to different chemical reagents.
• Fluorescence characteristics of powder.
• Percentage of loss on drying.
• Ash values.
• Extractive value of the leaves of medicinal plant
  \textit{(Aegle marmelos)}.
• Preliminary Phytochemical analysis of leaf extracts.
• Quantitative Phytochemical screening of leaf extracts.
• TLC and HPLC profiles.
• GC- MS studies.
• Toxicological screening.
• Pharmacological and Biochemical evaluation.
  \begin{itemize}
  \item Anti-ulcer activity.
  \item Anti-inflammatory activity.
  \item Anti-pyretic activity.
  \item Anti-oxidant activity.
  \item Anti-microbial activity.
  \end{itemize}

2. REVIEW OF LITERATURE

MORPHOLOGY

<table>
<thead>
<tr>
<th>Botanical name</th>
<th>\textit{Aegle marmelos} (L.) Corr.</th>
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<tbody>
<tr>
<td>Syn.</td>
<td>\textit{Crataeva marmelos} Linn.</td>
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</tbody>
</table>
Genus: Aegle
Species: marmelos
Family: Rutaceae

**Vernacular names** (Nadkarni, 1978)

**English**: Bengal quince, Beal fruit, Golden apple, Holy fruit, Indian quince, Stone apple.

**Tamil**: Aluvigam, Iyalbudi, Kuvilam, Mavilangai, Vilwam, Villuvam.

**Telugu**: Bilvamu, Maluramu, Maredu, Sailushamu, Sandiliyamu, Sriphalamu.

**Hindi**: Bel, Bili, Sirphal, and Bela,

**Sanskrit**: Adhararutha, Asholam, Atimangaliya, Bilva, Durarutha, Gandhaptra, Goharitaki, Hridyagandha, Kantakadhya, Kapitana, Sriphala, Lakshmiphala, Mahakapitthakya.

**Bengal**: Bael, Bel,

**Gujarat**: Billi,

**Kannada**: Bela, Bilva

**Malayalam**: Koovalam, Vilwam.

**Orissa**: Belo

**Description**

Armed tree to 8(15) m; branched pubescent; spines axillary, to 2 (6) cm, Straight, single or paired. Leaves 3(5) foliate, to 5 cm; leafletes elliptic, lanceolate or oblong obviate; terminal ones 4.5 x 2.5 cm; lateral ones 2.5 x 1 cm, chartaceous, globarous, base cuneate or rounded, margin subcrenulate,
apex obtuse, sometimes acuminate, retuse; petiole 2.5 cm terminal with petiole to 5mm. Panicles axillary, to 10x4.5cm, Peduncle to 1cm; Pedicel to 2mm, Pubescent. *Flowers* 5 merous, bisexual, 2.5cm across. Calyx tube cupulour, to 5mm; lobes 4 or 5 triangular. Petals 5, white, oblong, and sub equal, 1 x 0.6cm, Fleshy, spreading. Disc obscure. Stamens α. ca. 5u; filaments to 3mm, basally subconnate; anthers oblong, to 4mm. *Ovary* ovoid; >10 celled; ovules α per cell; stigma sub sessile, *Fruit* oblong. *Berry* ovoid, 8 x 6 cm Woody; Seeds α, oblong to 8 x 4 mm.


**Distribution**

Found all over India, from sub Himalayan forests, Bengal, Central and in Burma (Nadkarani, 1927). This is tree occurs in the sub mountainous regions and plains almost throughout India. It is also cultivated (Jain, 1968) commonly throughout the country accenting to 1200 MSL (Karup, 1977). Taxonomic description, distribution, pharmacognostical studies leading to establishment of correct identify of the raw drugs used and propagation methods of Vilva were given by Namibiar *et al.*, (2000). In west Bengal, there are 13 types of fruits in *Aegle marmelos*. Based on the fruits size and shape, the fruits were grouped under five categories (oval, flat, spherical, oblong and pear shaped) and in each group three subgroups (small, medium, big) were separated (Ghosh *et al.*, 2001).

**Morphological studies**
Leaves

Leaves commonly alternate and 3- foliate arrangement of the leaves, in some of variants rarely 5- foliate arrangements. Petiole is 2.5-6.3 cm long, terete. Dimension of the leaflets 5-10 by 2.5-6.3cm. The sizes of leaflets are petiole length varies in different variants.

Leaf

In T.S., Petiole is broad ‘C’ shaped in outline with a single layer of schizogenous cavity and a conspicuous broad. ‘C’ shaped vascular bundle in the centre. Epidermis is single layered occasionally interrupted with sunken stomata on both surfaces and over- lined by a thick layer of cuticle. Interior to the epidermis is a many layered palisade tissue, which consists of closely, packed oval cell without much intercellular space.

The chloroplasts are more abundant in the palisade cells and less in the spongy tissue. Both upper and lower epidermal layers bear stomata. Each stoma has two guard cells and two subsidiary cells and they correspond to rubiaceous type. The numerical values like vein- islet number, palisade ratio and stomata index are significantly diagnostic features of this species (Krishnan Nambiar et al., 2000).

Flower

Flower is generally greenish white, sweet scented, about 2.5cm across, 2-sexual, in short axillary panicles. Calyx flat, pubescent,4-lobed; lobes
rounded, sometimes obscure. Petals 4, spreading, oblong, thick, gland-dotted, much exceeding the sepals, imbricate.

**Spine**

Spine is present in the axils of leaves. They are either single, double or absent in some variants. If a pair of spine is present the arms are either equal or unequal. Spine length 2-3cm.

**Stem bark**

Grey in color more warty and less number of cracks and fissures. Thickness 4-8mm; cork zone showing 5-8 stratification. Stone cells present in more number of groups in the phelloderm and also present in groups in the phloem fibers present in groups arranged in concentric rings (Anonymous, 1976).

**Stem**

Transverse section of the stem reveals the presence of 1) Well developed periderm consisting of cork, phellogen and phelloderm, 2) Distinct patches of stone cells above the phloem region, 3) Several layers of cambium, 4) Conspicuous xylem with large vessels and uniseriate medullary rays and 5) Parenchymatous pith.

**Root**
The T.S. of root shows the presence of
1. Outer zone of cork which gets peeled off consequent on secondary growth.
2. This is followed by phellogen and secondary cortex whose cells contain abundance of starch grains.
3. Interior to the cortex is the characteristic concentric patches of sclerenchyma.
4. Phloem is concentrically arranged; phloem cells alternating with narrow strip of sclerenchyma.
5. Medullary rays, distinct ring of cambium, wood consisting of large vessels, tracheids and fibers, uniseriate and biseriate medullary rays filled with starch grains, and pentarch primary xylem are other features (Krishnan Nambiar et al., 2000).

Fruits

Macroscopic

Fruit, sub-globous, 5-18cm in diameter, externally greenish when young, yellowish brown when ripe, rind about 1.5mm-3mm thick hard and woody, surface smooth or slightly granular bearing a circular scars at the point of attachment with peduncle.

Microscopic
Inner side of the pulp shows a longitudinal central axis and eight to fifteen or more locules and each locule contains ten or more seeds. Seed commonly is yellowish brown, oblong, slightly compressed and with a hard white hair or absent in some of variants. Seeds non-endosperm and surrounded by a mucilaginous mass. Embryo with thick fleshy cotyledons (Anonymous, 1986 and 1998).

Seed Germination

Among the various treatment given to seed of Bael (Aegle marmelos), water soaking result in highest percentage of germination (80%) which was closely followed by concentrated sulfuric acid treatment for 20 min. (76%) and least percent of germination occurred with concentrated sulfuric acid (10min) + thiourea 1 percent (20%). Although water soaking resulted in highest percentage of germination, it took longer time for initiation and completion of germination as compared to concentrated sulfuric acid, which resulted in quicker germination (Nayak and Sen, 1999).

Floral Vasculature

Floral vasculature of A.marmelos was worked out by Krishnan Nambiar et al., 2000.

Calyx lobe
Each lobe is supplied by a single vascular strand, which gets divided into three branches, from the base itself. These branches in-turn go on branching and re-branching irregularly and from a network.

**Petal**

Each petal is supplied with five vascular strands of these, the middle one gets branched into two, near about the centre of the petal. The two laterals on either sides of the median, branch into three from the base itself. Each branch again gets abruptly branched. The two peripheral ones get simply branched into four from base itself giving rise to laterals.

**Stamen**

Each stamen is supplied with a single vascular strand, which traverse through the connective and reaches up to the rip without any branching.

**Gynoecium**

Eleven bundles enter into the ovary. Each one branches into two. Peripheral traverse through the ovary wall and the central one form the ventral bundle and supplies the ovules. So eleven peripheral bundles and eleven central bundles which supply the ovules are seen in cross section of the ovary. The two branches of each bundle again join at the top of the ovary and enter into the stigma. Thus eleven bundles are seen in the stigma. Thus eleven bundles are seen in the stigma. Further each bundle gets feebly branched.
Gums and Resins

One of the sources of gum in Asia is Asiatic tropic gum from *Aegle marmelos* (Bengal quince). These are distinct plant products insoluble in water but dissolve in alcohol, ether, carbon-di-sulfide and certain other solvents with heat they first soften and then melt to a more or less clear, sticky fluid. They burn with a smoky flame and are resistant to most reagents and to decay. Resin is generally secreted in plant tissue in special layer of secretary cells which secret the resin into the cavity through a thin cuticular skin (Sambamurty and Subramanyam, 1989).

MEDICAL PROPERTIES

\[ \sigma_\kappa \Delta \]

\[ \varphi \downarrow \kappa \Delta \implies E[ \varphi \omega \Omega \Delta \sigma \Theta \zeta \Theta \ldots B \]

\[ \kappa \downarrow \kappa \Delta \ldots \ldots \implies \zeta \zeta[\ldots \Delta \implies \kappa \kappa_\kappa \mu \kappa \mu | \sigma_\kappa \cap \zeta \Theta | \sigma_\kappa \kappa | \zeta \Delta ] \]

\[ \partial \uparrow \kappa \Delta \implies \zeta \kappa \zeta | f \Delta. \]
In Siddha literature Vilwam is used for all Piththa diseases. *Aegle marmelos* plants leaf, fruit and bark are widely used for many diseases. According to the verse in Agathiyar Gunavakadam, leaf, flower, and fruit are used for venereal diseases, ulcers and azoospermia.

The unripe dried fruit is astringent, digestive, stomachic, used to cure diarrhea and dysentery. Sweet drink (Sherbet) prepared from the pulp of fruits produce a soothing effect on the patients who have just recovered from bacillary dysentery. The unripe and half ripe fruits improve appetite digestion. The ripe fruit is a good and cure dyspepsia (indigestion). The pulp from the unripe fruit is soaked in gingerly oil for a week and this oil is smeared over the body before bathing. This oil is said to be useful in removing the peculiar burning sensation in the soles. The roots and the bark of the tree are used in the treatment of fever by making a decoction of them. Good against malaria. The leaves are made into a poultice and used in the treatments of ophthalmic. The roots are sweet, cure the fevers caused by tridosha, stop pain in the abdomen, the palpitation of the heart and allay urinary troubles.

An unripe Bael fruit is taken it’s cracked in two or three places and roasted when the inside of the fruit is a softened by the heat and the starch is further converted into sugar. This is mooed with let water to which a little fried and pulverized Anise (*Foeniculum vulgare*) is added and the whole mixture is strained so that the starch water containing Bael-sugar, the active anti-dysenteric principle of Bacl fruit and the fine particles of the carminative anise, are taken as food three or four times a day (*Nadkarani*, 1927)
All parts of *Aegle marmelos* are medicinally useful like, leaves, fruit pulp, and flower, stem bark, root bark, (Chopra *et al.*, 1956, 1968; Kirtikar and Basu, 1986; Anonymous, 1986; 1968). Ripe fruit is sweet, aromatic, cooling, alterative, and nutritive. When taken fresh, it is useful in constipation, chronic dysentery and dyspepsia. Unripe fruit is astringent, digestive, stomachic and demulcent. Pulp is stimulant, antipyretic and antiscorbutic. Fresh juice is bitter and pungent. Root and stem bark are used as antipyretic.

The flowers of *A. marmelos* are astringent and antiseptic. The flowers and leaves yield a volatile oil. From the flowers is distilled a perfume called ‘Marmala Water’. Marmala water diluted in three or four times its volume of distilled water makes a useful collyrium for catarrh conjunctivitis.

The root, when taken internally acts as aromatic stomachic, carminative, and mild dystringent, and proves useful in anorexia, acute and chronic dyspepsia, acute diarrhoea and dysentery, flatulence and colic. After absorption it is excreted by the skin and bronchial mucous membrane, and stimulating those acts as a diaphoretic and expectorant. As a diaphoretic it is useful in typhoid and other continued fever with diarrhoea and flatulence and as an expectorant in chronic bronchitis and proves useful in diarrhoea and dysentery after the acuter symptoms subside. In case of diarrhoea and dysentery, milk prepared by boiling it with the pulp of the unripe fruit agrees much better than plain milk. The ripe pulp taken with sugar is laxative, and is useful in habitual constipation and hemorrhoids (Emmanuvel Roberts, 1931).
Fruit is very valuable in habitual constipation, chronic dysentery and dyspepsia. It is one of the ingredients in the ‘Dasamul’ or ten roots used in Ayurveda. Unripe or half ripe fruit, owing to the presence of tannins or mucilagenous substances which act as demulcent, cut up in slices and sundries or roasted and made in to a comfiture (conserve) or a powder, is prescribed in chronic diarrhoea and chysentery, with debility of the mucous membrane, intestinal conditions specially useful in chronic diarrhoea and dysentery of children where there is no fever (Nadkarani, 1927).

An unripe Bael fruit is taken (in which these starch is on the point of being converted in to sugar); it is cracked in two or three places and roasted when the inside of the fruit is a little softened by the heat and the starch is further converted in to sugar. This is mixed with hot water to which a litter fried and pulverised Anesi (*Foeniculum vulgare*) is added and the whole mixture is strained so that the starch water containing Beal-sugar, the active anti-dysenteric principle of Bael fruit and the fine particles of the carminative anesi, are taken as food 3 or 4 times a day.

Beal fruits are eaten during convalescence after diarrhoea. Bael marmalade or aromatized confection is useful at the breakfast during convalescence from chronic dysentery or diarrhoea, for daily use as a preventive during cholera epidemics. It is also given to prevent the growth of piles. Decoction of the root, root-bark and sometimes the stem-bark is useful is intermittent fever, also in hypochondriacs, melancholia and palpitation of the heart (Nadkarani, 1927).
Tender fruit Tikta kashyar-rasn, ushma veeryam, vata kapha haram, pittakaram, grahi, ruksam, lagu, Panchanam, balaym, improves agning Fruits-mathura, grur Root – vataharam.

In homeopathic treatments it is largely used for conjunctivitis and stys (pain, stitching with sensation of dust particles in eyes with lachrymator. Style (orzaiolo), mostly over upper eyelids Rhinities (Cold & Conyza with the symptoms of conyza, sneezing, redness of eyes and blockage of nose); coccygodynia (pain in coccye especially on getting up and better by walking); Nocturnal seminal emission with amorous dreams; chornic dysentery (Alternate diarrhea & constipation, stool losse with mucus).

ETHNOBOTANICAL INFORMATION

The term “Ethnobotany” was first used by Harshberger (1985) and its scope was much elaborated later (Faulks, 1958 and Ford, 1978). Since then there has been a growing interest in this field (Jain, 1985). Ethnobotany in the wilder context denotes the entire realm of useful relationship between plant and man. Ethnobotany studies assume great importance in enhancing our knowledge about the plants grown and used by native / tribal communities (Arora, 1997).

Ethnomedical information on Aegle marmelos is available from many parts of India and other countries. Available ethnomedical literatures reveal that entire plant, leaf, fruit, stem bark, root and essential oil of fruits of this plant are used in various diseases. Decoction of dried leaf of Aegle marmelos and entire plants of Borreria hispida, Cardiospermum helicacabum, Evolvulus alsinoides is used as medicine for curing jaundice, inflammation,
piles, asthma, malarial fever, dysentery, skin disease etc., (Jayabarathi, 1998).

The plant has been already reported for eye complaints from the
district of kamrup in Assam. It reduces heat in abdomen used by the tribals
from Ranchi and Hazaribug district of Bihar and Mirzapur district of
Uttarpradesh (Maheswari et al., 1996). It is given the honor by saying it as
sriphala and by associating it with Lord Shiva who is fond of its leaves.
Bilva is one of the members of dasmula in which its root is used (Jain, 1989).

*Aegle marmelos* was used as a stick by the Babylonian slam 7000
years ago. Puppetries and dental oral health have been discussed (Alimas, et
al., 1996). In Srivilliputhur T.K., of Tamilnadu ethnobotanical study
reported that, 40 plants including *A. marmelos* wers found to be commonly
used as medicine for curing jaundice, piles, dysentery, malarial fever (Jayabarathi et al., 1999).

Dhanapandi et al., (2007) observed ethanoveterinary herbel practices
in Thanjavur district, Some of ethanoveterinary plants used from the study
area include *Aegle marmelos, Casia auriculata, Mukia scarbrella* and *Lippia
nudifloea*.

Applying of leaf paste on head has been reported as remedy for
premature graying of hair. The leaf juice of *A.marmelos* is used in
diabetsoema; the Leaves along with the seed of *Foeniculam vulgare* are used
for chronic diarrhea and dysentery (Jain, 1989).
Stem yields a gum and leaves contain essential oil. Stem and root are used as antipyretic (Nadkarni, 1927). One of the sources of gum in Asia is Asiatic tropic gums from of *A. marmelos*.

Bark of Beal tree and the roots *Andrographis paniculata* are made into a paste. The paste is made into small piles after drying in sunlight one tablet is taken thrice daily to cure diarrhea (Maheswari, 1996).

Only ripe fruits are eaten. A delicious drink is prepared by mixing the fruit with sugar and milk medicinally; the pulp of ripe fruit is given for chronic stomach disorders (Manorajan Sharma *et al.*, 2002).

The pulp of fruit is commonly used for preparation if jam, candy, syrup etc, the tribal child use roasted fruit. The mucilaginous substance around seed is used as an adhesive. The tripinnately digital leaves are used for worship by tribal (Maheswari, 2000).

The root infusion has been reported to reduce body ache and indigestion in children. The plant has been already reported for body ache from Kamrup district of Assam. Root is applied externally on snake bite (Samba murty and Subramaniyam, 1980)

It is given the honor by saying it as ‘sriphala’ and by associating it with Lord Shiva who is fond of its leaves. Bilva is one of the members of Dasmula in which its root is used (Jain, 1989).

The root powder has been reported as remedy for dyspepsia, gastric trouble, jaundice and swellings. The plant has been already reported for
gastric trouble from sandal pargana of Bihar. Root decoction helps normal delivery (Rosakutty et al., 2000).

*Aegle marmelos* leaves claimed to be useful in treating pain, fever, inflammation, respiratory disorders, cardiac disorders, dysentery and diarrhea (Dymock William et al., 1890, Kirtikar et al., 1935 and Murugesu Mudaliar, 1988). More than 30 identified compounds from the leaves of *Aegle marmelos* have been reported (Chatterjee and Bose, 1952, Sharma et al., 1980 and Chatterjee and Satyesh, 1994). Based on the ethnomedical reports, following clinical and pharmacological studies were done.

1. Dried Leaf– Digestive
   Hot H₂O Ext: Oral: Human Adult

2. Fruit – Antispasmodic activity (unspecified type) ETOH – H₂O (1:1) Ext Guinea pig – conc. used not stated : Active : Ileum:

3. Used as digestive and stomachic – Dried Fruit
   Hot H₂O Ext: Oral: Human Adult

4. Dried fruit– Stomachic
   Hot H₂O Ext: Oral: Human Adult


6. Dried fruit –Smooth muscle relaxant activity – H₂O Ext. Rat
Anti histaminic activity ETOH – H₂O (1:1) Ext. and anti spasmodic activity (unspecified types) ETOH – H₂O (1:1) Ext. were also reported.

The leaf juice of *Aegle marmelos* used in diabetes and oedema (Jain, 1989). The leaves of *Aegle marmelos* with the seeds of *Foeniculam vulgare* Mill are used for cure of chronic diarrhoea and dysentery. Root decoction helps in normal delivery (Rosakutty *et al.*, 2000).

Ethnobotanical observation of Kollihills, TamilNadu, reveal 21 plant used in veterinary medicine. Tribes, Kolli-Malayalis of this area depend upon these plants for curing various diseases (Geetha *et al.*, 1996).

Seven leaves of wood apple (*Aegle marmelos*) and seven seeds of Black pepper (*Piper nigrum*) are to be chewed like pan with rock salt (Kala namak) for 21 days every morning in empty stomach. It can regress any kind of body tumor they claim (Jain, 1995).

Ripe fruits are sweet aromatic, cooling, alternative, and nutritive (Anonymous, 1976). Unripe or half ripe fruit astringent, digestive and stomachic, used for diarrhoea, dysentery. The rind of unripe fruit yields a yellow dye (Anonymous, 1986).

Only ripe fruits are eaten. A delicious drink is prepared by mixing the fruit with sugar and milk medicinally; the pulp is applied externally on snakebite. Bark of Beal and the roots of *Andrographis paniculata* are made into a paste. The paste is made in to small pills after drying in sunlight; one tablet is taken thrice daily to cure diarrhoea (Mahaswari, 1996).
The yield and physiochemical characters of 13 types of bael fruits (*Aegle marmelos*) collected from different locations were examined. The results indicated that there are a few types suitable for commercial cultivation and processing in west Bengal (Ghosh et al., 2002).

The effect of the *Aegle marmelos* extract at a dose of 250 mg / kg was more effective than glibenclamide in restraining the values of diabetic parameters. (Kamalakkannan and Price, 2004).

A number of ethno medicinal plants and herbal preparations are used in traditional system of medicine for the management hepatic disorders. however many of them have not been investigated to valorize the traditional claims. *Aegle marmelos* is widely used in the treatment of hepatitis in folk medicine. Results indicate that ethanolic aqueous fruit pulp extracts of *A.marmelos* had moderate to significant activity over ccl4 treatment as compared to the control. Results of the present investigation suggest that Ccl4 induced liver damage in rats can substantially be ameliorated by treatment of ethnolic extracts from fruit pulp of *A.marmelos*. Also the study confirms the claim on this plant as a potential hepatoprotective agent in the traditional medicine (Rajasekaran et al., 2009).

Taxonomis description, Distribution, Pharmacognostical studies leading to establishment of correct identity if the raw drugs are to be followed for any herbal drug. Chemical analysis and propagation methods of *A.marmelos* was reported (Krishnan Nambiar et al., 2000) Pharmacognostical studies in *A.marmelos* are lacking and on fruit, is completely absent.
PHARMACOLOGICAL STUDIES

The aqueous and alcoholic obtained from the leaves of *A. marmelos* showed increase in amplitude and force of contractions of Frogs heart similar to that shown by digitoxin. Both these extract stimulated the ventricles of dog’s heart as seen from electrocardiograms. The alcoholic etract of the root and fruits of *A. marmelos* showed hypoglycemic activity in albino rats (Harvey, 1968).

Oral administration of aqueous extract of *A. marmelos* leaves given at 6 gm/kg B.W showed no antimplantation activity. Aqueous extract at 4g/kg B.W given orally from day 7 to day 9 of pregnancy exhibited 20 percent and 40 percent, abortifacient activity respectively (Gangerdhar and Lalitha Kumar, 1995).

Leaf extract of *A. Marmelos*, exhibited improved functional state of pancreatic beta cells and acenor cells from studies of light and electron microscope. At a smaller dose of 45 mg/kg B.W. The changes in the axonal cells were coarsening of E.R and alterations in their secretary function’s the changes observsd in the liver dilation of veins, loss od usual concentric arrangement of heptocytes, liver fibrosis’s and decrease in glycogen content. The kidney tubules were thickened and glomeruli were expended. The results indicate the potential hypoglycemic nature of the leaf extract (Das et al., 1996).

The aqueous and alcoholic extracts of the leaves of *Aegle marmelos* caused increase in amplitude and force of contractions of frog’s heart similar to that shown by digoxin. Both these extract stimulated the ventricles of
dog’s heart as seen from the electrocardiograms. The alcoholic extract of the root and fruits of Aegle marmelos showed hypoglycemic activity in albino rats (Haravey, 1968).

Methanolic extracts of Terminalia belerica (Combretaceae) and Aegle marmelos (Rutaceae) were given orally to male wistar rats, once daily for ten days and sacrificed and glucose uptake was studied by incubation of gastronemius muscle (GC – muscle) and diaphragm with D-L-\(^{14}\)C glucose. Insulin treated samples showed increased \(^{14}\)C glucose uptake by 21 and 44 percent for muscle and diaphragm respectively. Treatment with A. marmelos increased the \(^{14}\)C glucose uptake in the GC-muscles significantly (P less than 0.001). The concentration of the GLUT-4 protein was found to be significantly higher in the homogenate of GC-muscles of rats treated with A. marmelos compared to non-treated muscles. Administration of T. belerica did not increase the concentration of GLUT-4 protein (Sabu and Kuttan, 2007).

Methanol extract of A. marmelos and ethyl acetate extract of Atalantia monophyla showed significant anti-inflammatory activity at a dose of 100mg /kg (Gurulingappa et al., 2002). Methanolic extract of A.marmelos decreased alloxan induced lipid peroxidation (LPO) significantly in serum and liver. Liver superoxide dismutase (SOD) activity was increased significantly when compared with alloxan induced diabetic rates (Sabu and Kuttan, 2001). Alloxan induced diabetic animal model was used to evaluate the antidiabetic affect of alkaloid extracted from the leaves of Aegle marmelos (Pannachan et al., 1993).
The antifertility activity of polyherbal formulation consisting of dried aqueous extracts of *Aegle marmelos* leaf, *Carica papaya* seed, and *Coriandrum sativum* seed was studied. The extract exhibited 60% antifertility activity at 324mg/kg and 90% antifertility activity at 1620mg/kg dose level (Gnanasam et al., 2002).

The essential oil obtained from the leaves has shown a broad spectrum of anti-bacterial and anti-fungal activities (Benerji and Kumar, 1980; Pattnaik et al., 1996 and Rana et al., 1997). The aqueous decoction of the leaves has been reported to have a significant hypoglycemic effect (Karunanayake et al., 1984 and Ponnachan et al., 1993).

*Aegle marmelos* leaves extract also helps in the regeneration of damaged pancreas (β-cells) in diabetic rats (Das, et al., 1996) and is found to be as effective as insulin in restoration of blood glucose and body weight to normal levels (Seema et al., 1996). The hydro alcoholic extract of the leaves has been reported to have the chemo preventive potential, especially against chemical carcinogenesis (Singh et al., 2000). Fresh aqueous and alcoholic extracts of the leaves of *Aegle marmelos* have been reported to have a cardiotonic effect like digitalis and to decrease the requirements of circulatory stimulants (Haravey, 1968).

*Aegle marmelos* water extract given to mice showed considerable elevations in the leukocyte count and bone marrow cellularity. The flow cytometric analysis revealed significant increase in CD3, CD4, CD8 and NK cells. The MTS assay showed remarkable increase in lymphocyte proliferation in AME treated mice (George et al., 2007).
Essential oils from leaves of *A. marmelos* (Rutaceae) were analysed by GC-MS. Among the sixteen compounds in *A. marmelos* oil the major were alpha-Phellandrene (35.7%) d-limonene (29%), subinene (16.7%) and alpha-pinene (6.9%). Among the twenty six compounds of *feronia limonia* oil major compounds are methyl chavicol (74.6%) and anethole (20%) (Chowdhury *et al.*, 2007).

The triterpenoid lupeol (1) has been isolated from the leaves extract of *Aegle marmelos*. Few novel derivatives (2-13) were synthesized from the naturally occurring lupeol(1) and screened for their antihyperglycemic activity (2-11) and antidyslipidemic activity (2-4 and 12-13). The derivative 4 lowered the blood glucose levels by 18.2% and 25.0% at 5h and 24h, respectively, in sucrose challenged streptozotocin induced diabetic rats (STZ-S) model at the dose of 100mg/kg body weight. The compound 4 also significantly lowered 40%(P<0.001) in triglycerides, 30%(P<0.05) in glycerol, 24%(P<0.05) in cholesterol quantity and also improved the HDL – cholesterol by 5% in dyslipidemic hamster model at the dose of 50mg/kg b.wt (Papi Reddy *et al.*, 2009).

Chauhan and Agarwal, (2009) evaluate the contraceptive effect of an aqueous extract from the leaves *A. marmelos* (AMLAq) on the reproductive organs of male rats with an emphasis on reversibility. Biochemical analysis of the reproductive tissues for sialic acid, protein, glycogen, fructose, ascorbic acid and alkalinephosphatase indicated a significant decrease where as testicular cholesterol level significantly increased indicating alterations in the biochemical milieu of genital organs. Fertility and other effects on general metabolism were detected throughout the treatment, and after withdrawal, body weight gain was similar in all groups together with no
alterations in the weight of vital organs, hematological and serological parameters.

Lipid lowering effect of 50 percentage of ethanolic extract of the leaves of *A.marmelos* (L.) was evaluated in triton and diet induced hyperlipidaemic models of wistar albino rats. The extract at 125 and 250 mg/kg dose levels inhibited the elevation in serum cholesterol and triglycerides levels of triton WR 1339 administration in rats. The extract at the same dose levels significantly attenuated the elevated serum total cholesterol and triglycerides with an increase in the high-density lipoprotein cholesterol in high-fat diet-induced hyperlipidaemic rats. The standard drugs atorvastatin in the former and gemfibrozil in the latter studies showed slightly better effects (Vijaya *et al.*, 2009).

Chauhan and Agrawal, (2008) studied the effect of *A.marmelos* on the testicular reproductive system, a 50% ethanolic extract of *A.marmelos* leaves (AMLEt) was fed orally to male albino rats the dose levels of 200 and 300 mg/kg body wt./day for 60 days. Recovery was assessed for an additional 120 days. The level of serum testosterone also declined and spermatogenesis was impaired. The number of normal tubules and the height of epithelial cells of the caput and caudal were reduced significantly. The cross sectional surface area of Sertoli cells and mature Leydig cells was reduced along with a dose dependent reduction of preleptotene and pachytene spermatocytes. Thus the antifertility effects of A.marmelos seemed to be mediated by disturbances in structure and function in testicular somatic cells including Leydig and Sertoli cells resulting in an alteration in physio-morphological events of spermatogenesis.

Kar et al., (2002) studied the relative importance of *Bacopa monnieri* (200 mg / kg), *Aegle marmelos* and *Aloe vera* (125 mg/kg) leaf extracts in the regulation of thyroid hormone concentration in male mice was investigated.

Garg et al., (2003) studied the ‘Bowel care’ formulation consists of *Aegle marmelos, Plantago ovata* and *Lipidium sativum*, which are known gastro friendly.

The aqueous ethanolic extract from the fresh unripped fruits of *Aegle marmelos* showed potent antiulcer and anti diarrhoeal activity (Ammresh et al., 2003).

Sahare et al., (2008) studied that the methanolic extract of roots of *Vitex negundo* L. and extracts of leaves of *Vitex negundo* L., *Ricinus communis* L. and *Aegle marmelos* Corr. Were explored for possible antifilarial effects against Brugial malayi microfilariae. It was observed that among the herbal extracts, root extract of *A. marmelos* Corr at 100 mg/ml concentration showed complete loss of motility of microfilariae after 48 hr of incubation. Thin layer chromatography of the extracts revealed the presence of alkaloids, saponin and flavonoids in the roots of *Vitex negundo* L. and coumarin in the leaves of *A. marmelos* Corr.
Lai et al., (2009) observed that the antiulcer affects of pomegranate tannins in animal models. Pomegranate tannins (500, 150, 50 mg/kg) significantly inhibited ulcerative formation induced by both water immersion stress and pylorus ligation obviously decreased the gastric mucosa damages induced by intragastric absolute ethanol, in dose-dependent manner. Pomegranate tannins play a protective role against gastric ulcer. Its antiulcer effect is related to increasing secretion of adherent mucus and free mucus for the stomach wall, which may inhibit generation of oxygen derived free radicals, and decrease the consumption of GSH – PX and SOD, and maintain content of NO at normal level.

PHYTOCHEMICAL STUDIES

Many biological active compounds were isolated from various parts of Aegle marmelos. Presence of alkaloids, in the roots and leaves of Aegle marmelos, coumarins in the root and stem bark along with others constituents has been reviewed. Medicinal uses of the plant have been discussed (Das and Das, 1995).

The pulp contains mucilage, pectin, sugar, tannin (tannic acid), volatile oil, bitter principle, ash 2% and a balsamic principle resembling balsam of Peru. Fresh leaves yield marmelosin on distillation which is yellowish-green oil with a peculiar aromatic odour.

The dried pulp was exhausted by Henry & Brown, with boiling alcohol, the extract concentrated in vacuum and the thick syrup diluted with water to precipitate fatty acid and resinous matters (Nadkarani, 1927). A sterol Aegelin was isolated from the leaves. It was first described as a steroid
by earlier works, but a neutral alkaloid, with one methyl or diethyl groups with degradative studies the structure of Aegelin has been established (Chakravarthi and Dasgupta, 1955). The non-saponifiable fraction of the ether extract of the leaves on chromatography yielded a sterol having melting point 144-145°C and identified as aegelin from the leaves of *Aegle marmelos* has also been described (Chakravarthi and Dasgupta, 1956, 1958).

Aegelin on hydrolysis gave trans-cinnamic acid by UV studies of aegelin and comparison with those of trans-cinnamic acid, trans-cinnamide and Trans-N-methyl, trans-emfiguration of the cinnamoyal grouping in aegelin was confirmed (Chakravarthi and Dasgupta, 1958).

The alkaloid, crystallized from ethanol as pale yellow solid, melting point 245°C and analysis of the alkaloid showed a significant peak at m-32 (Chatterjee *et al.*, 1967a). Marmin a new coumarin with mp.123-124°C was isolated from the trunk park of *Aegle marmelos* (Chatterjee *et al.*, 1967b). *Aegle marmelos* has been found to be a phenolic base having an oxazole and a pyridine moiety from UV, IR, NMR and mass spectra and from degradative experiments (Chatterjee and Majunder, 1971).

Skimmianine has been isolated and characterized from the bark (Khaleque, *et al.*, 1978). The seed and seed oil was analysed for proteins and fatty acid components (Banerjee and Maiti, 1980). The leaves yield rutin and marmesinin, ripe fruits yield rutin and marmesinin, ripe fruits yield xanthotoxal and both parts yield β- sitosterol, β-D glycoside (Sharma *et al.*, 1980). Seeds yield glycoprotein (Mandal and Mukherjee, 1981). The fruit pulp yield polysaccharide (Basak *et al.*, 1981). Alkaloides and cumarin from fruits (Sharma and Sharma, 1981), Alkaloids and other components from
unripe fruits (Sharma et al., 1981), components from fruits (Tokitomo et al., 1982), and polysaccharides from cambium layer have been isolated and identified (Basak and Mukherjee, 1982). Seed kernel contains proteins, oils, carbohydrate and ash (Banerji et al., 1982). Alkaloids from the dry leaves have been isolated and identified by Govindachari and Premila (1983). Alkaloids, coumarins, fatty acid and sterols from the fruit pericarp (Reisch et al., 1985), and amino acid from fruits and seeds have been isolated and identified (Ali and Qadry, 1987). The leaves were analysed for dry matter, crude proteins, fiber, hemicellulose, cellulose, lignin and ash and silica (Chakrabarty et al., 1988). Furanocoumarin obtained from the plant exhibited tyrosinase accelerating and tryptophan inhibiting effects in Bufo melanostictus (Chakrabarty et al., 1978). The Seed-oil showed antibacterial activity (Banerjee and Kumar, 1980). Roots yield marmin which exhibited anti-inflammatory effects in carrageenin induced paw oedema in rats (Pitre and Srivastava, 1987).

Analysis of the leaf oil of Aegle marmelos afforded the identification of eighteen monoterpene hydrocarbons (71.85%), four sesquiterpene hydrocarbons (14.2%) and one oxygenated sesquiterpene (0.78%) (Garg et al., 1995). AC-glycosylated propelargoindin has been isolated from the aqueous extract of the pulp of the unripe fruit of Aegle marmelos. Structure determination was based on chemical degradation and $^{13}$C-NMR (Abeyskera et al., 1996).

The major constituents of the leaf extract were identified to be tannins, skimmianine, essential oil (mainly caryophyllene, cineole, citral, eugenol), sterols and or triterpenoids, including lupeol, β- and γ-sitosterol, α-
and β–amyrin, flavanoids (mainly rutin) and coumarins, including aegeline, marmesin and umbelliferone (Karawya et al., 1980).

The structures of marmenol and known constituents were established with the help of NMR spectroscopy from the methanolic extract of Aegle marmelos (Ali and Pervez, 2004).

The different methanolic extracts of Aegle marmelos plant parts like leaves, fruit, bark, pulp, flora parts were prepared and screened phytochemically by standard tests. All parts showed the presence of carbohydrates, aminoacids, proteins, anthocyanins, steroids, glucosides, etc. These extract were evaluated for antioxidant activity (Kallar et al., 2005).

The alkaloidal amides belonging to cinnamide class were isolated from the leaves of Aegle marmelos. Their chemical transformation and $^{13}$C-NMR has been reported (Shweta and Norender, 2005).

Phytochemicals and their Biological Activities in Aegle marmelos (Duke, 1992)

P – Cymene


Phellandrene
Hyperthermic, Irritant, Spasmogenic, Tumor-Promoter

**Skimmianine**


**Tissue Culture**

**Differentiation and Regeneration**

First report of somatic embryogenesis in *A. marmelos* by using zygotic embryos showed the somatic embryo (18 percent) and the number of somatic embryo per explants (12) was observed in the presence of 2,4-D (1 micro M) and BA (1 micro M) as per the observation after 42 days (Islam et al., 1995). High frequency regeneration system using callus culture from zygotic embryos of *A. marmelos* maximum number of shoots per explants were obtained from shoots per explants were obtained from 110-150 days old cotyledons of the seeds of the *A.marmelos* (Islam et al., 1995).

*A.marmelos* exhibited the changes in fatty acid, phospholipids and glycolipid during cellular and organ differentiation. The manoglaoctosyl, triglyceride the diaglaoctosyl, diglyceride ratio and linolenic acid level increased with degree of differentiation (Bharatwaj et al., 1995). Shoots of *A. marmelos* were cultured in M.S. Medium supplemented with BAP (0-5mg) showed better performance in most of the parameters elongated shoots were rooted on half strength M.S. Medium supplemented with 0.5mg/1, IBA.
and successfully transferred to soil. The highest shoot number and weight were observed after 8 weeks of culture on a medium supplemented with BAB at 0.5mg/lt (Hazrika et al., 1996).

**MICROBIOLOGICAL STUDIES**

Different parts of plants like leaf, fruit (both unripe and ripe) and their extracts have been reported to have anti-bacterial, anti-fungal, anti-viral activities.

**Antibacterial activity**

Fruits and leaves of *Aegle marmelos* were subjected to antibacterial screening but were found to be inactive (Valsraj et al., 1997; Sasidharan et al., 1998).

From the Indian traditional medicines 78 plants were selected on the basis of their use in the treatment of infectious disease. Different concentrations of 80%, ethanol extracts were tested, using the agar dilution method, against four bacteria: *Bacillus subtilis, Staphylococcus aureus, Escheritia coli* and *Pseudomonas aeruginosa*. Lowest test concentration of 1.6mg/ml, 10% of the plant extract were active, 44% in a concentration of 6.25mg/ml (Valsraj et al., 1998).

Extract obtained from leaves and fruits of *Aegle marmelos* showed antibacterial activity (Valsraj et al., 1998), leaf extract of *Aegle marmelos* showed antibiotic activity against *Staphylococcus aureus, Escheritia coli* at 0.5% concentration (Sasidharan et al., 1999).
Anti fungal activity

Antifungal activity of leaves and fruits of *Aegle marmelos* was screened by (Valasaraj *et al*., 1997 and Sasidharan *et al*., 1998). Different concentrations of 80% ethanol extract were tested, using agar-well diffusion method, against two fungi, *Candida albicans* and *Aspergillus niger*. The antifungal activity of essential oil isolated from the leaves of Bael has been evaluated using spore germination assay. The most resistant fungus, *Fusarium udum* was inhibited 8% at 400PPM (Rana *et al*., 1999). The aqueous extract of *Aegle marmelos* were screened against two rice fungal pathogens, *Magnaporthea grisea* and *Rhizoctonia solani* (Kausik and Aroro, 2003).

Methanol extract of leaves of *Aegle marmelos* significantly reduce the number of sclerotic, at the same time higher concentration used in the study no sclerotic were formed even after 21 days of incubation (Prithiviraj *et al*., 1995).

Antiviral activity

The fruit of *Aegle marmelos* showed antiviral activity against Ranikhet disease virus (Dhar *et al*., 1968). *Aegle marmelos*, *Ricinus communis*, *Solanum nigrum* and *Tinospora cardifolia* have been found to be used either singly or in combination with other plants for the treatment of viral Jaundice (Nagarajan and Rajareddey, 1986).
Badam et al., (2006) studied *in vitro* antiviral activity of series of compound from varies parts of *Aegle marmelos* the inhibition(IC50) for leaves (L1 and L2) stem and stem bark(S1,S2,S3and S4) fruit (F1)and root bark(R1and R2) and pure compound marmelide were 1000µg/m for (S1,S2,S3and S4),100 µg/m for (F1) and 500 µg/m for (R2) and 62.5 µg/m by plaque inhibition.

**TOXICITY STUDIES**

An aqueous extract of *Aegle marmelos* leaves exhibited significant hypoglycemic activity in streptozotocin diabetic rats. It also significantly (0.05%) increased the plasma insulin levels of diabetic rats. The extract did not show any signs of toxicity and the LD$_{50}$ was greater than 10.0 g/kg when given orally in rat (Sharma et al., 1996). In the liver with *Aegle marmelos* indicated that the treatment may neutralize H$_2$O$_2$ toxicity by its increased decomposition by CAT (Sabu and Kuttan, 2001).

Veerappan et al.,(2007) reported that chronic administration of *A.marmelos* leaf extract at a dose levels of 50,70,90 and 100 mg/kg b.w for 14 consecutive days to male and female Wistar rats did not induce any short term toxicity collectively and reported that the extracts of the leaves have a high margin of drug safety

Latica versa et al.(2005) evaluated the anti cancer potential used in Bangladesh folk medicine, extract of *Aegle marmelos* were tested for cytotoxicity using brain shrimp lethality eggs assay, and MTT assay using tumor cell lines.
The polyphenol extracts (PPES) from leaves of plants namely *Aegle marmelos*, *Coleus aromaticus* and *Ocimum santum*, were prepared and polyphenol content in each was estimated. The concentration required for 50% inhibition of incorporation, of radioactive tritium labelled thymidine into DNA of Dalton lamphoma ascetic cell lines was found to be higher than that required in the *in vitro* cytotoxicity assay. The LD$_{50}$ dose in this case was 30 micro g/l, 60 micro g/l for *C. aromaticus*, *O. santum*, and *A. Marmelos* respectively. (Annapurani and Priya, 1999).

**Formulation**

Polyphone extracts (PPES) prepared from the leaves of some medicinal plants like karpuravalli (*Coleus aromaticus*) tulasi (*Ocimum sanctum*) and A.marmelos PIPE exhibited significant antitumour and antimutagenic activities. The leaves are cause abortion and sterility in women. The bark is used as a fish poison in *Celebes*. (Annapurani and Priya, 2000).

Aritajat *et al.*, (2000) investigated the toxic effect of aqueous extract *A.marmelos* (AM), *Stevia reboudiana* (SR), *Pouteria cambodiana* (PC) by dominant lethal test for 8-week treatment. From the results testicular weights as well as in cauda epididyma notable changes in sperm morphology and motility were observed.

**CLINICAL STUDIES**

Role of *Aegle marmelos* in managing neonatal jaundice has been discussed (Gupta and Sharma *et al.*, 1999). Shriphal (*Aegle marmelos*) has
been considered as one of the effective medicine for the treatment of non-specific diarrhoea. Therefore, its efficacy for the treatment was tested in 25 patients. All the patient were treated with powdered unripe fruits of Shriphal (5gm thrice daily for 21 days) (Singh et al., 1993).

*A.marmelos* has been considered as one of the effective medicine for the treatment of non-specific diarrhea. Therefore, its efficacy for the treatment of dysentery was tested in 25 patients; all the patients were treated with powdered unripe fruits of *A.marmelos* 5gm thrice daily for 21 days (Singh et al., 1993). Drug from *A.marmelos* plays a vital role in diabetes in pregnant women and nursing mother (Bombarde et al., 1995). *A.marmelos* used as insertion of foreign body in vagina for reduction of vault in common practice in rural India. It also helps in stopping foul smell discharge from vagina (Kara et al., 1998).

**Formulations**

Y-spur is an Ayurvedic formulation consists of *A. marmelos* showed increased the sperm count in male (81.3%) (Mathur et al., 1999).

Bowl care formulation consists of *A. marmelos* it cures the chronic constipation and irregular bowl movements with diarrhea also disappeared in most of the cases even in case of 16 years old. (Garg et al., 2003). In taila formulation in sesame oil TLC methods were evolved for the detection of the ingredients (Thangamma et al., 2006).

**PEPTIC ULCER**
Peptic ulcer (PUD) is one of the common diseases. The causes of PUD are increased gastric acid secretion and reduced gastric cytoprotection. PUD occurs mainly due to consumption of NSAIDs, infection by *H. pylori* stress or due to pathological conditions such as Zoolinger – Ellison syndrome (Crawford, 2000).

Peptic ulcer is a term used to refer to a group of ulcerative disorders of the upper gastrointestinal tract involving principally the most proximal portion of the duodenum and the stomach, which have in common the participation of acid-pepsin in their pathogenesis. The major forms of common peptic ulcer are duodenal ulcer, Gastric ulcer (Peterson, 1991).

*Helicobacter pylori* (Formerly: *Campylobacter pylori*) was identified in 1983. *H. pylori* are a gram – negative bacteria found in a patchy distribution overlying the gastric epithelium. At present nine species of *Helicobacter* genus are available and all excluding *H. pylori* are of animal origin (Greenwood *et al*., 1992). *H. pyroli* has consistently been shown to have a high prevalence in patients with chronic gastritis and duodenal ulcers and may play a role in non-ulcer dyspepsia.

Information on its possible role in inflammation and damage to cells of the antral part of the stomach has rapidly accumulated (Bonnevie, 1977; Marshall and Warren, 1984; Lambert *et al*., 1985; Lambert, *et al*., 1987; Dooley *et al*., 1988).

The pathogenesis of peptic ulcer onset is multi factorial, while duodenal ulcer is related to high rate of gastric secretion not only after a
meal, but also in the fasting state. Normal acidity or hypoacidity is common in gastric ulcer (Ghosh, 1991).

_H. pylori_ were established as an important etiological factor for chronic gastritis (Dooley _et al._, 1988; Marshall and Wareen, 1984) and peptic ulcer disease (PUD) (Coghlan, 1987; Marshall _et al._, 1988; Rauws and Tytgat, 1990).

**HERBS USED FOR ULCER**

Al-Rehaily _et al._, (2002) carried out anti-ulcer studies using ethanol extract of amla (_Emblica officinalis_) for its antisecretory and antiulcer activities employing different experimental models in rats, including pylorus ligation rats, indomethacin, hypothermic restraint stress – induced gastric ulcer and necrotizing agents. Oral administration of amla extract at doses 250mg/kg significantly inhibited the development of gastric lesions in all test models used. It also significantly decreased the pyloric – ligation induced basal gastric secretion, titrable acidity and gastric mucosal injury. Besides, amla extract offered protection against ethanol – induced depletion of stomach wall mucous and reduction in non protein sulfhydryl concentration. The results indicated that amla extract possess antisecretory, antiulcer and cytophotective properties.

Bafna and Balaraman, (2003) reported the peptic are significantly reduced the ulcer index in both acute and chronic model decreased the volume, acidity and pepsin activity of gastric fluid and also increased the pH of gastric fluid (acute method) which proved its anti-ulcer activity.
Inhibition of lipid peroxidation and enhancement of antioxidant enzymes by peptic are was also observed.

Despemde et al., (2003) carried out the antiulcer activity of aqueous extract of the leaves of Basella rubra on ethanol and pylorus ligated induced gastric ulcers in rats. Aqueous extract of the leaves of Basella rubra (10 and 20 mg/kg p.o.) showed significant and dose-dependent antiulcer activity against ethanol and pylorus ligated induced ulcer in rats. Study was compared with ranitidine (50 mg/kg p.o.) as standard drug.

Trichosanthes anguina was investigated in rats to evaluate anti ulcer activity of alcoholic extract of Trichosanthes anguina by using pyloric ligation and aspirin induced ulcer models (Rajkaptor et al., 2003). The parameters taken for anti ulcer activity were volume of gastric secretion, free acidity, total acidity and ulcer index. The results indicated that alcoholic extract significantly decreased the volume of gastric and secretion, free acidity, total acidity and ulcer index with respect to control.

Siragnanum et al., (2003) reported anti-ulcer activity of Aloe vera An aqueous extract of Aloe vera leaf gel was administered orally to ethanol induced rats. Total number of lesions in the gastric area, total volume, and acidity, levels of protein and glycol protein components were determined in the gastric juice. The observed decrease in the number of gastric lesions in the treated rats suggested the cytoprotective and acid regulating properties of the leaf gel.

Venkatesan et al., (2003) reported that Eclipta Alba caused significant reduction in ulcer index in all animal models and significant inhibition was
also observed in aspirin induced gastric ulceration and secretion in pyloric ligated rats.

Rajkapoor *et al.*, (2003) reported the anti-ulcer activity of alcoholic extract of *Bauthinia variegata Linn* against gastric ulcer induced by pyloric ligation and aspirin induced ulcer model in rats. The stomach was incised along with greater curvature and examined for ulcer. Effect of alcoholic extract of *B. variegata* on volume of gastric secretion, total, free acidity and ulcer index in pylorus ligated and aspirin induced ulcer rat was determined. Oral administration of alcoholic extract of *B. variegata* decreased the volume of gastric secretion, total, free acidity and ulcer index with respect to control.

3. MATERIALS AND METHODS

**Collection of plant materials**

The leaves of two variants of *Aegle marmelos* was collected from different place of Thiruvarur district (Harithuvaramangalam Village, Town Amaravathi, Puliyakkudi).