2. Review Of Literature
2.1  *Albizzia lebbeck*:

2.1.1 Family – Mimosaceae\(^97,98\)

Mimosaceae family consists of about 56 genera and 2800 species, which are distributed in tropical and subtropical parts of the world. In India, it is represented by 15 genera and 72 species.

Most of the plants of this family are perennial tree, shrubs, herbs or climbers. Many of the plants are mesophytes, some show xerophytic character while *Neptunia oleracea* is an aquatic herb. **Roots** are tap with side branches; **Stem** is erect, woody and solid sometimes, spiny usually with gummy exudates; **Leaves** are compound bi-pinnate, petiolate, stipulate, alternative sometimes stipules are modified in to spines; with reticulate venation. In certain genera like *Mimosa*, *Neptunia* etc. the leaves shows seismonastic movement.

**Inflorescence** is head or spike; **Flowers** are bracteate, ebracteolate, sessile, complete, hermaphrodite, actinomorphic, cyclic, perigynous, pentamerous; **Calyx**- Sepal five: (Four in Mimosa), generally gamosepalous, valvate, half- inferior; **Corolla**- Petals four or five, mostly gamopetalous, valvate half- inferior; **Androecium**- Stamen mostly numerous [Four in Mimosa], polyandrous in many whors, sometimes united at the base. Anthers are basifixed, dithecouc, introrse and dehisce longitudinally, half-inferior; **Gynoecium**- normally ovary is monocarpellary, half-inferior, unilocular with many ovules, marginal placentation, style long and cylindrical, stigma capitae; **Fruits** are Legume or lomentum and **Seeds** are Exalbuminous.
2.1.2 Genus: Albizzia

The genus *Albizzia* comprises approximately 150 species. Mostly trees and shrubs are native to tropical and subtropical region of Asia and Africa.

**Leaves:** Bi-pinnate, deciduous & alternate; **Flowers:** In globose heads sessile or pedicellate, hermaphrodite, usually pentamerous; **Calyx**- campanulate or infundibuliform shaped, distantly toothed; **Corola**- infundibuliform shaped, the petal connate below the middle; **Stamen**- indefinite, monoadelphous at the base, filament much longer than corolla, anther minute; **Gynoecium**-ovary is sessile or short stalked; **style**- heads filiform, stigma- minute capitate; **Fruits:** A large strap shaped pod without pulp.

Fig. 2 Tree of *Albizzia lebbeck*
There are various species of *Albizzia* available in India.

*Albizzia lebbeck*  
*Albizzia chinensis*  
*Albizzia amara*  
*Albizzia carbanaria*  
*Albizzia lucida*  
*Albizzia procera*  
*Albizzia odoratissima*  
*Albizzia distachya*  
*Albizzia falcata*  
*Albizzia ferruginea*  
*Albizzia jullibrissin*  
*Albizzia moluccana*  
*Albizzia myriophylla*  
*Albizzia richardiana*  
*Albizzia saponaria*

### 2.1.3 Species: *Albizzia lebbeck* Benth (Mimosaceae):

**Veraclular names:** 103-104

- **Hindi:** Siris, Kako
- **Sanskrit:** Sirisha, Bhandi, Sitapuspa, Sukapriya
- **English:** Woman tongue tree
- **Gujarati:** Pilo sarasio
- **Bengali:** Sirish
- **Kannad:** Bagemaro
- **Mallyalam:** Vaka, Nenmenivaka
- **Marathi:** Chichola, Sirisha
- **Tamil:** Vakai
- **Telegu:** Dirisena
- **Punjabi:** Sirish, Sareehn
- **Urdu:** Siris

**Distribution** 105-106

*Albizzia lebbeck* is native to deciduous and semideciduous forests in Asia from eastern Pakistan through India and Sri Lanka to Burma. It has been introduced as an ornamental and plantation tree through the
tropics and sub-tropics, including the greater and lesser Antilles, Central America, Colombia, Venezuela, and Brazil. It can grow well under a wide range of rainfall region (600-2500mm) yet can be seen in area with only 400mm. It may be established in area of highly variable rainfall but in its natural habitat probably requires a reliable wet season. In the Himalayas, it is found to 1600m altitudes. It is founds on a wide range of soil types including those that are alkaline and saline types.

Description

Habitate: It is a large deciduous tree with a spreading crown (2p). The plant flowers in the hot season, usually March, April and May and fruits are formed from September onwards but usually persist on the tree even up to next March.

Roots: Branched taproot.

Stem: The stem and branches are covered with deeply irregularly cracked dark grey to brownish bark.

Leaves: About nine inches long, alternate, stipulate, evenly bipinnate, stipules are small and fall off early, main rachis round, grooved on the upper side, tapering, glabrous or slightly pubescent with a large gland about 2mm in diameter, one third to half an inch above its base, and gland between the lowest or basal pair of pinnae; small glands also present near the base of the partial petioles and between the leaflets, but their presence and number is not always certain; pinnae two to four pairs, even pinnate; leaflet four to eight pairs, opposite short stalked, one to two inches long and half to three qtrs. Of an inch broad, rigidly subcoriaceous, entire, broadly obliquely oblong, broader
on the lower side of the midrib, slightly curved upwards, rounded at base, obtuse, retuse or emarginated at apex, paler, glabrous or finely grey pubescent beneath, with a prominent midrib and nearly equally prominent secondary nerves. The terminal leaflet is semicordate.

**Inflorescences:** It arise from the axil of the upper most leaves and are short-peduncled, crowded, corymbose fasicles of a few or limited number of fairly large, many flowered globose heads; peduncles slightly downy.

**Flowers:** Sessile or short pedicelled, all bisexual, pentamerous, regular, whitish or yellowish white and very fragrant; calyx about 0.125 inch long, slightly downy outside; petals five, greenish yellow or yellowish white, connate below the middle to form a funnel-shaped corolla with short lanceolate teeth; stamens- indefinite; filaments long several times the length of the corolla, united at base and bearing comparatively very small anthers which are not gland-crested. Ovary-sessile or very short stalked and many ovuled with filiform style ending in a minute stigma.

**Fruits:** Very characteristic of the species. It is a large straight or slightly curved, thin but firm, flat strap-shaped linear oblong, straw-coloured to yellowish brown, shiny, indehiscent or sub-indehiscent pod, six inches to one foot long and three quarters to one and a half inches broad, with a continuous cavity and enclosing six to twelve seeds. The fruits remain attached to the tree for a long time, often for than a year. Seeds- nonendospermic, yellowish brown about a quarter to one third inch long, ovate or orbicular, flat, with a horse shoe-shaped compression near the margin; testa very hard; funicles slender and filiform.
**Medicinal uses:**\textsuperscript{104, 109}

Seeds and bark used as an astringent and tonic, in leucoderma, bronchitis, piles; Leaves as remedy for night blindness; root bark used to strengthen gums, applied externally as a plaster in leprous ulcers; Flowers are given in asthma and in the treatment of snake bite.
2.1.4 Phytochemical Review:

Table 5 Phytochemical review of *Albizia lebbeck*:

<table>
<thead>
<tr>
<th>Plant part</th>
<th>Chemical constituent</th>
<th>Ref.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bark</td>
<td>D- catechin; Isomer of leucocyanidin [5, 7, 3', 4'-tetrahydroxy flavon -3,4 diol]; Melacacidin; Leucoanthracyanidin; Lebbecacidin [8, 3', 4'- tri hydroxyl flavon -3,4-diol]; Friedelin; β- Sitosterol; Betulinic acid and its glycocides. Albizia saponins A, B and C. Albizinin (Phenolic glycoside) and Procyanidin B-2, B-5, C-1.</td>
<td>101, 110</td>
</tr>
<tr>
<td></td>
<td></td>
<td>111</td>
</tr>
<tr>
<td></td>
<td>Albiziahexoside A(1) &amp; A(2).</td>
<td>113</td>
</tr>
<tr>
<td>Leaves</td>
<td>Caffeic acid; Flavanoid- Kaempferol and Quercetin; Caffeic acid. Albiziahexoside A(1) &amp; A(2).</td>
<td>101, 110</td>
</tr>
<tr>
<td>Flowers</td>
<td>p- nitrobenzoate; Benzyl alcohol; Benzoic acid; Lupeol; α and β–amyrin; Pigment similar to crocetin</td>
<td>101, 110</td>
</tr>
<tr>
<td>Seeds</td>
<td>Saponin; Macro cyclic alkaloids Budmunchiamine (1-3); N-demethylbudmunchiamine; Histidine; Leueine; Isoleueine; Lysine; Methionine; Phenylalanine; Threonine; Tyrosine; Valine. Budmunchiamines 13-13 Budmunchiamines L4, L5, L6</td>
<td>101, 110</td>
</tr>
<tr>
<td></td>
<td></td>
<td>114</td>
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<td></td>
<td></td>
<td>115</td>
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<tr>
<td></td>
<td></td>
<td>116</td>
</tr>
<tr>
<td>Fatty acid</td>
<td>Heart Wood</td>
<td>Pod</td>
</tr>
<tr>
<td>------------</td>
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<td>-----</td>
</tr>
<tr>
<td>Melanoxetin; Okanin; Leucopelarogonidin; (+)-pinitol; Lebbecacidin; Stereoisomer Melacacidin</td>
<td></td>
<td>Acyclic ester; Lupeol; Oleanolic acid; Docosanoic acid β - sitosterol</td>
</tr>
</tbody>
</table>

| | |
| | 101, 110 |
| | 117 |

### 2.1.5 Pharmacological and Toxicological Review:

- **Thenmozhi et al.**\textsuperscript{118} reported anti-inflammatory activity of some Indian – medicinal plant and they were assayed at a dose of 1000mg/kg body weight on male albino rats using carrageenan induced rat paw edema. This was found to be significantly effective.

- **Nabachandra et al.**\textsuperscript{119} observed electrophoretic changes on the protein profiles of semniferous tubules and epididymal fluid from caput and caudo regions on administration of alcoholic extract of dry seeds in rats.

- **Vayas**\textsuperscript{120} discussed botanical identity and chemistry of the antidotes described by Charka viz. *Curcuma longa, Rubia cordifolia, Elettaria cardamomum, Operculina tuberptithum, Hemidesmus indicus, Cryptolepia buchani or Ichnocarpus frutescens, Santalum album, Stychnos potatorum* and *Albizia lebbeck*.

- **Ganguli and Bhatt**\textsuperscript{121} showed that glycosidic fraction of stem bark was active against *Staphylococcus aureus* and proposed
mode of action is that glycoside caused leakage of the cytoplasmic constituents.

- **Iyenger et al.**\(^{122}\) detected composite drug was quite safe even in the dose of 1600mg/kg body weight both in acute and subacute toxicities. It produced dose dependent depression response in isolated frog heart. In lower doses the drug behaved like acetylcholine but in higher doses direct action was predominant. Same effect was also observed in isolated rabbit heart. Further kada produced dose dependent fall in blood pressure, associated with bradycardia.

- **Kasture et al.**\(^{123}\) reported anticonvulsant activity of *Albizia lebbeck* leaves. The chloroform fraction of methanolic extract protected mice against maximal electroshocks.

- **Baruach et al.**\(^{124}\) reported dose dependent anti anaphylactic and mast cell stabilizing activity of various fractions of drug in albino rats and could protect the sensitized guinea pig from antigen induced anoxic convulsion.

- **Baruah**\(^{125}\) studied on the immune response of the extract of the drug. Preimmunised BALB/c mice were administered orally with extract at 25 mg / kg body weight for 7 days from the 14 day onwards but did not get significant humoral immune response.

- **Swamy et al.**\(^{126}\) conducted clinical evaluation of Sirisa Twak Kvatha in the management of Tamaka Shwasa [bronchial asthma]. The decoction of stem bark was found to be effective against bronchospasm induced by histaminic acid phosphate and exerted di-sodium cromoglycate like action on mast cells.
Baruah et al.\textsuperscript{127} studied for immunomodulatory effect of the butanolic fraction of the aqueous extract of the bark at the dose level tested [6.25, 12.5 and 25mg / kg p.o/ week] in mice. Treated mice developed higher serum antibody while delayed hypersensitivity response was suppressed.

Baruah et al.\textsuperscript{128} reported comparative study of the anti-PCA and mast-cell stabilizing activity of hot aqueous extracts and butanolic fractions in mice and rats at a dose rate of 50 mg / kg p.o. using guinea pig and rat anti-sera and found to be 74 and 66 percent activity respectively.

Haque et al.\textsuperscript{129} studied anti-tumor activity of the ethanolic extracts of twelve medicinal plants of Bangladesh using the potato disc bioassay technique. Out of these ten plant extract of 25μg/disc exhibited significant inhibition of crown gall tumors caused by \textit{Agrobacterium tumefaciens}.

Une et al.\textsuperscript{130} reviewed phytochemical constituents present in different parts of the plant and pharmacological profile and major therapeutic uses of \textit{Albizia lebbeck}.

Brahmankar et al.\textsuperscript{131} studied nootropic effect of saponin containing n-butanolic fraction [ALBF] obtained from dried bark of drug in albino mice using passive shock avoidance paradigm and elevated plus maize and object recognition. The ALBF was also studied for sodium nitrite induced respiratory arrest, clonidine and baclofen induced hypothermia, haloperidol induced catalepsy and lithium induced head twitches. Saponin fraction exhibited nootropic activity, reversed amnesic effect of scopolamine and decreased noradrenergic and serotonergic
transmission without any effect on cholinergic and
dopaminergic transmission.

> **Chintawar et al.**\(^{132}\) studied nootropic effect of saponin containing n-butanol fraction extracted from dried leaves of *Albizia lebbeck* on learning and memory enhancement in albino mice using passive shock avoidance paradigm and elevated plus maze. Significant improvement was observed. The mice treated with 100 mg/kg of BF showed 50 percent mortality

> **Besra et al.**\(^{133}\) showed the anti-diarrhoeal activity of aqueous methanolic extract of the seeds in five rodent diarrhoeal models.

> **Dwivedi et al.**\(^{134}\) studied compound preparations such as Vasadikwath, Vasavaleha, Vyaghrihāritki, Talisadi, Lavangandi and Karpurashtaka Churna and Eladivati for management of asthma and are found effective.

> **Gupta et al.**\(^{135}\) studied the anti fertility effect of saponins in male albino rats on oral administration at the dose level of 50mg/kg per day for 60 days and significant decrease in the weight of testes, epididymes, seminal vesicles, ventral prostates, sperms motility and sperms density. The population of preleptotene spermatocytes and spermatogonia were reduced by 65.07% and 47.48% respectively and secondary spermatocytes by 73.41%. It reduced the fertility of male rats by 100%.

### 2.1.6 Clinical study Review:

> **Mukhopadhyay et al.**\(^{136}\) studied clinical trials on 60 cases of various types of allergic conjunctivitis to assess the role of drug
in form of eye drops and capsule for a period of 60 days for treatment and further 90 days for follow up and observed significant effect.

- **Iyenger et al.** studied an antiasthma kada; a proprietary herbal combination, part I, clinical study on 14 patients of asthma in a dose of 30 ml t.i.d. or b.i.d. Significant improvement in peak expiratory flow rate and eosinophil count were observed after 28 days of treatment. All patients showed clinical improvement in their symptoms of breathlessness cough and wheezing. The combination is effective in the prophylaxis of asthma.

- **Mahesh Chandra et al.** compared the effect of Swasakuthararasa 250mg twice daily and Sirisadikasaya 25ml twice daily for 45 days on patient of Tamaka swasa. Sirisadikasaya found to be better effective than Swasakuthararasa.

2.1.7 **Pharmacognosy Review:**

- **Mehta et al.** standardized vaginal tablet from alcoholic extract of panchvalkal (mixture of five bark powders namely *Ficus bengalensis, Ficus religiosa, Ficus glmoerata, Ficus infectoria* and *Albizzia lebbeck.*) The phytosterols in the panchvalkal were analysed from tablet using HPTLC technique.

- **Sensarma** reported that in Arthasastra of Kauityya it has been given that in emergency a man can work without food for a period varying from one fortnight to a month if, he consumes some herbal preparation containing this drug. He gives four recipes for such emergency food.
Misra and Jaiswal\textsuperscript{141} reported that positive effect of indole butyric acid on the rooting and survival of air layers on some agroforestry tree species including \textit{Albizia lebbeck}.

Abdul Rashed Miah and Rao\textsuperscript{142} reported regeneration of plantlets from excised roots of \textit{Albizia lebbeck}.

Chauhan and Agrawal\textsuperscript{143} studied accelerated stability of a poly herbal preparation in capsule form at elevated temperature 40\degree C and 45\degree C with 75\% relative humidity and reported its stability for more than three years at room temperature.

Saleem and Singh\textsuperscript{144} evaluated response of coppicing \textit{Albizia lebbeck} at different height on biomass production. Results showed that coppicing at 90 cm height increased biomass production and highest regeneration.

Mathew et al.\textsuperscript{145} evaluated various tree species for their growth and productivity. \textit{Albizia lebbeck} shown slow initial growth rate up to some extent.

Tripathi and Tripathi\textsuperscript{146} studied the differential action of heavy metals such as Ni (II), Cr (VI), and Hg on biochemical and chemical parameters of \textit{Albizzia lebbeck} leaves. Significant reduction in chlorophyll, protein, carbohydrates and sugar contents was observed.

Singh et al.\textsuperscript{147} evaluated seasonal variation in chemical composition of important tree leaves of Bundelkhand region.

Basu and Mukherjee\textsuperscript{148} reported that twelve types of ethnic groups and 17 plant species generally used for rearing insects and producing lac by the tribals of Purulia in West Bengal. One of them was \textit{Albizzia lebbeck}. Among these 17 plants, \textit{Ziziphus}
Review of literature

*mauritiana, Schlechera oleosa* and *Butea monosperma* were considered best for lac production

- **Yadav** and **Agrawal**\(^{149}\) estimated ascorbic acid content of four exotic plant species and three indigenous plant species growing in Jayant Opencast Coal Mine. It was noted that content of ascorbic acid decreased with increased pollution load. Ascorbic acid was recorded maximum in rainy season followed by winter and minimum in summer season.

- **Thangadurai**\(^{150}\) reported ethnobotanical survey and studied among the Kanis and Palliyans, a jungle tribal people of Southern Western Ghats region of the Tirunelveli district of Tamil Nadu revealed valuable information in discovering new uses of some medicinal plants for treating leach-bite, snake-bite, scorpion-sting, rat-bite and insect-bite. Among those 28 plants one of them was *Albizzia lebbeck*.

- **Siddiqui** et al.\(^{151}\) reported folk medicinal claims of plants of *Albizzia lebbeck, Calotropis procera, Equisetum debile, Withania somnifera* of Western Uttarpradesh, India.
2.2 *Euphorbia hirta:*

2.2.1 **Family: Euphorbiaceae**

The family consists of 7000 species of which 374 species are observed in India. Most distinctive features are the milky or colored latex exuded by all species and the specialized inflorescence termed as a ‘Cyathium’.

The plant of this family consists of herbs, shrubs, trees or lianas with succulent stem and hairy; **Leaves** are simple, (rarely compound), alternate, opposite or whorled. **Inflorescences** is cymose, may vary, but often in a specially compacted form; the cyathium, which has petal-like bracts (an involucre). **Flowers** are actinomorphic and unisexual (monoecious or dioecious), hypogynous; **Calyx**- five, polysepalous or gamosepalous, regular; **Corolla**—polypetalous, regular; **Stipules**: present and often gland-like; **Androecium**—fertile. Stamens 1-1000; anthers dehiscious, extrose or introse, bilocular or tetra locular; **Gynoeicum**—carpel 3-40, syncarpous and superior. **Fruits** are small and schizocarp or rarely a berry, drupe or samara; **Seeds** are often with a fleshy outgrowth and with abundant endosperm, explosively dehiscence.

2.2.2 **Genus: Euphorbia**

Habit: Herbs, shrubs or small trees

**Leaves:** Alternate, opposite and stipulate. **Flowers:** Monoecious, many male flowers and single female flower all are enclosed in a perianth. **Stamen**—2-celled anther articulated filament, **Gynoecium**: Stipitate, 3-celled ovary, styles 3, stigma bifid. **Fruit:** Capsule
Fig. 3 Plant of *Euphorbia hirta*

There are various indigenous species available.\(^{163}\)

*Euphorbia hirta*, *Euphorbia resinifera*, *Euphorbia antiquorum*,
*Euphorbia atoto*, *Euphorbia lathyrus*, *Euphorbia hypericifolia*,
*Euphorbia pilosa*, *Euphorbia granulate*, *Euphorbia dracunculoides*,
*Euphorbia rosea*, *Euphorbia royleana*, *Euphorbia nerifolia*,
*Euphorbia nivula*, *Euphorbia sanguinea*, *Euphorbia helioscopia*,
*Euphorbia acaulis*, *Euphorbia longifolia*, *Euphorbia microphylla*,
*Euphorbia peplus*, *Euphorbia thymifolia*, *Euphorbia thomsosiana*,
*Euphorbia tirucalli*, *Euphorbia trigona*, *Euphorbia turcomanica*. 
2.2.3 Species: *Euphorbia hirta* Linn (*Euphorbia pilulifera* L.; *Chamaesyce hirta* (L.) Millsp)

**Vernacular Name:** \(^{159,160,164}\)

- Hindi: Bahidudhi, Dudhi, Laldudhi
- English: Asthma herb, Snake weed, Pill-bearing spurge, Australian asthma herb.
- Sanskrit: Nagarjuni, Pusitoa
- Gujarati: Dudheli, Dudh, Nagladudheli
- Unani: Doodhi.
- Malayalam: Nelapalai,
- Telugu: Bidarie, Nanabala, Nanabiyan
- Tamil: Amumpatchaiyarissi, Ammanpacho haris.
- Marathi: Dudhi, Dudnali, Govardhan, Mothidudhi
- Bengal: Borakerui, Burakeru, Kharen

**Distribution:** \(^{160,161,164}\)

*Euphorbia hirta* is distributed throughout the world most widely in tropical and subtropical countries. It is distributed throughout the hotter parts of India.

**Description:** \(^{159,160}\)

It is an annual, erect or ascending herb.

**Stem:** Hairy 15 – 60 cm long.

**Leaves:** Small, opposite, elliptic, oblong or oblong lanceolate, acute or subacute, toothed or serrulate, dark green above, pale beneath, base
usually unequal-sided, acute or rounded; main nerves few, distinct; petioles distinct, 1.5-3mm long; stipules pectinate, soon falling.

**Inflorescence:** Involucres numerous, less than 1.25mm long, on a stalk of about the same length, crowded in small axillary shortly pedunculate globose cymes; gland minute, globose, either without a limb or with a very small orbicular white entire one (Cyathium). Male flowers: a stalked stamens without floral envelop. Female flowers: Ovary 3-celled on an ultimately exerted stalk in the center of the involucre; ovule solitary in each cell; style three, free or connate.

**Fruits:** Small capsules dehiscing ventrally or both ventrally and dorsally.

**Seeds:** Albuminous, Smooth, blue colored, cotyledons broad and flat.

**Medicinal Uses:**

*Euphorbia hirta* is known as Australian Asthma Weed and so all the parts of plant in different countries used to treat asthma.\(^{165-171}\)

Traditionally it is used in Asia to treat bronchial asthma and laryngeal spasm. Plant is also used as galactogogue,\(^{172}\) in eye diseases\(^{173}\), to treat athelet’s foot\(^{171}\), for backache, in the fever\(^{174}\), in bowel complaints\(^{175}\), with palm oil to treat to regulate heavy menstruation,\(^{176}\) for malaria,\(^{177}\) decoction is gargled in toothache,\(^{178}\) as an anthelmintic,\(^{179}\) in the liver diseases,\(^{179}\) as a cardiotonic,\(^{180}\) externally used for gonorrhea and scabies.\(^{181}\)

Inflorescence of plant is also used to promote fertility in women.\(^{182}\)

Latex of the shoot applied externally in pimple\(^{183}\), in fissured lips\(^{184}\), in arthritis and rheumatism.\(^{185}\)
Dried leaf in China is used as anti diarrheal, expectorant, in bronchitis, in asthma, in gastrointestinal ailments in children and in the skin diseases. In India fresh leaves are rubbed or dried leaves are inhaled in migraine. Dried leaves in India used to treat diabetes, as a vermifuge, for intestinal complaints, for bronchial and respiratory diseases and to cure dysentery.

Most of the species of Euphorbia genus are dangerous and poisonous. The main signs and symptoms are; spurge contain sap that is highly irritating upon contact, especially to the eyes and mouth, and on skin upon prolonged exposure. Latex of Euphorbia hirta acts as an antidote against toxicity produced by other species.

### 2.2.4 Phytochemical Review:

**Table 6 Phytochemical review of Euphorbia hirta:**

<table>
<thead>
<tr>
<th>Part of plant</th>
<th>Chemical constituent</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Latex</td>
<td>β-amyrin, Lupeol</td>
<td>188</td>
</tr>
<tr>
<td>Stem</td>
<td>Flavone, iso:3-5-7 trihydroxy- 3’ 4’ isoflavone; Methoxy- 3’-prenyl friendlein triterpene; Hentriacintane; Myricyl alcohol; Quercitrin; β-sitosterol; Taraxerol</td>
<td>189, 190</td>
</tr>
<tr>
<td>Aerial parts</td>
<td>β-amyrin; Euphorbol hexacosanoate; Hexacosan-1-Ol; Ingenol Triacetate; Ingenol 16-</td>
<td>191</td>
</tr>
<tr>
<td>Substance</td>
<td>References</td>
<td></td>
</tr>
<tr>
<td>------------------------------------------------</td>
<td>------------</td>
<td></td>
</tr>
<tr>
<td>O-Alpha-Methyl-Butyrate: 20-Acetate; Tinyatoxin</td>
<td>194</td>
<td></td>
</tr>
<tr>
<td>Phorbol, 12-Deoxy: 4 Beta hydroxyl-13 3-Dodecanoate-20-Acetate; Phorbol, 12-Deoxy: 13-Dodecanoate-20; β-sitosterol</td>
<td>166 192 193</td>
<td></td>
</tr>
<tr>
<td>Choline; Cycloartenol; Shikimic Acid</td>
<td></td>
<td></td>
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<tr>
<td>Leucocyanidin; Quercitrin</td>
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<td></td>
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<tr>
<td>Linoleic Acid; Melissic Acid; Oleic Acid</td>
<td></td>
<td></td>
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<tr>
<td>Palmitic Acid; Quercetin</td>
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<tr>
<td>Entire plant Fructose; Galactose; L-Inositol</td>
<td>195 196</td>
<td></td>
</tr>
<tr>
<td>Quercitrin</td>
<td>197 198 199</td>
<td></td>
</tr>
<tr>
<td>Tannic acid</td>
<td>200</td>
<td></td>
</tr>
<tr>
<td>Leaves Chlorogenic Acid; Geraniin; Glucose,β-D:</td>
<td>169</td>
<td></td>
</tr>
<tr>
<td>1-2-3-4-6-Penta-O-G; Glucose,β-D: 1-3-4-6-Tetra-O-Gal; Glucose, D: 2-4-6-Tri-O-Galloyl Octacosan-1-Ol</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Euphorbin A,B,C,E</td>
<td>169 202</td>
<td></td>
</tr>
<tr>
<td>Euphrobianin</td>
<td>203 204</td>
<td></td>
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</tbody>
</table>
### Review of literature

<table>
<thead>
<tr>
<th>Part</th>
<th>Compound</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Root</td>
<td>Quercitrin 170, 204, Cyanidin-3-5-O-Beta-D-Diglucoside; Pelargonidin-3-5-O-Beta-D-Diglucoside; Phenyl-Acetate-16-O-Alpha-Methyl-Butyrate: 20-Acetate; Phorbol,12-Deoxy: 4-Beta-Hydroxy: Dodecanoate-20-Acetate; Resiniferonol,20-O-Acetyl: 9-13-14-Phenyl-Acetate, Ortho; Taraxerone</td>
<td>191</td>
</tr>
<tr>
<td>Flowers</td>
<td>Ellagic Acid, Rutin; β-sitosterol, Terchebin</td>
<td>190</td>
</tr>
<tr>
<td></td>
<td></td>
<td>170</td>
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<td>169</td>
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</tbody>
</table>

#### 2.2.5 Pharmacological and toxicological Review:

- **Carlo et al.**\(^{204}\) reported that aerial parts of drug was having immunostimulant activity in mouse at dose 100 mg/kg intravenously.

- **Hazleton and Hellerman**\(^{205}\) reported that aerial parts of drug had shown antihistaminic activity.

- **Naggar et al.**\(^{166}\) reported smooth muscle relaxant activity in guinea pigs of the aerial parts of drug.
Hazleton and Hellerman\(^{205}\) studied toxicity of fluid extract of the aerial parts on mouse and LD\(_{50}\) was found to be 7.4 ml/kg, i.v.

Glele-coete and Senet\(^{206}\) reported that aerial parts of plant were having strong antiamoebic activity.

Martines-Vazquez et al.\(^{207}\) reported that hexane extract of aerial parts were having anti-inflammatory effect on mice.

Hiermann and Bucar\(^{208}\) reported that aerial parts of plant inhibited platelet aggregation activity and also inhibited prostaglandin synthesis.

Kaij-a-kamb et al.\(^{209}\) reported that entire plant was having antiviral activity in water-cell culture and was active against virus fowl pox and virus vaccinia.

Dhar et al.\(^{210}\) reported that ethanol: water (1:1) extract of entire plant of \(E.\ hirta\) was having antispasmodic activity on isolated guinea pig ileum against acetylcholine and histamine induced spasms, anti-tumor activity in mouse (i. p.) using model leuk friend virus-solid; hypoglycemic activity on rat (p. o.) at the dose 250 mg/kg, hypotensive activity at the same dose.

Tona et al.\(^{211}\) reported that decoction of entire plant of \(E.\ hirta\) was having antibacterial activity, agar plate Mic 31.25mg/ml active against \(Klebsiella\ pneumonia,\ Shigella\ flexneri,\ Staphylococcus\ aureus,\ Carnobacterium\ gallinarum,\ Citrobacter\ diversus,\ Escherichia\ coli,\ Pseudomonas\ aeruginasae,\ Salmonella\ enteritid\)s.

Tona et al.\(^{212}\) reported that entire plant of drug having antimalarial activity. Dichloromethane extract 6 \(\mu g/ml\); ethanol
extract 6 µg/ml were found to be active against *Plasmodium falciparum*.

- **Lanhers** et al.\(^{213}\) reported that lyophilized extract of entire plant was having analgesic activity when administered to mouse at the dose 20 mg/kg (i. p.) against acetic acid induced writhing and antipyretic activity (i. p. / rat) at dose of 100 mg/kg against yeast induced pyrexia.

- **Reddy** et al.\(^{214}\) reported that water extract of entire plant was having CNS depressant activity at dose 46 mg/kg, i. p. on mouse.

- **Lanhers** et al.\(^{215}\) reported that infusion of entire plant was having CNS activity (i. p. /mouse male) at the dose-400 mg/kg and reduced locomotor activity rearings and platform crossings in open field test.

- **Vlietinck** et al.\(^{181}\) reported that entire plant was having antiviral activity in ethanol (80 %) extract cell culture 0.2 ml/well against herpes and polio virus.

- **Griffith**\(^{216}\) reported that acetone extract of fresh latex was having cytotoxic activity. Cell culture concentration used 1:125 achieved Melanoma, fibroblasts-Human-skin.

- **Williams** et al.\(^{217}\) reported that methanolic extract of dried leaves and stems was having angiotensin converting enzyme inhibition 160 µg/plate-active.

- **Hiermann** and **Bucar**\(^{218}\) studied the influence of some traditional medicinal plants including *E. hirta* of Senegal on prostaglandin biosynthesis.
Review of literature

- Hore et al. and Anjaria et al. observed the effect of aqueous *Euphorbia hirta* leaves extract on gastrointestinal motility.

- Galvez et al. reported antidiarrhoeic activity of *Euphorbia hirta* extract and isolated a flavanoid as a phytoconstituent.

- Vijaya et al. proved antibacterial effect of methanol extract of *Euphorbia hirta* L. studying against dysentery causing *Shigella* spp. using the Vero cell line.

- Galvez et al. reported analgesic, antipyretic and anti-inflammatory properties of *Euphorbia hirta*.

- Hokanson et al. and Williams et al. examined the methanol extract obtained from the leaves and stems of *Euphorbia hirta* which inhibited the activity of angiotensin converting enzyme (ACE) by 90% and 50% at 500 mg and 160 mg respectively using enzyme linked immunosorbent assay (ELISA).

- Galvez et al. studied the aqueous extract of leaves of *Euphorbia hirta* (Dudhi) on blood pressure and ECG in albino rats.

- Johnson et al. reported that *Euphorbia hirta* leaves extracts increase urine output and electrolytes in albino rats.

- Galvez et al. found antidiarrhoeic activity of quercitrin in mice and rats.

- Sundararajan studied the control of Caterpillar *Helicoverpa armigera* using *Euphorbia hirta*.
 Singh et al.\textsuperscript{228} reported toxic effect of two common Euphorbiales latices on the fresh water snail \textit{Lymnaea acuminata}.

\textbf{2.2.6 Agricultural Review:}

- Gupta and Ghouse\textsuperscript{229} studied effects of coal-smoke pollutants from different sources on the growth, chlorophyll content, stem anatomy and cuticular traits of \textit{Euphorbia hirta}
2.3  *Sphaeranthus indicus:*

2.3.1  **Family: Asteraceae**

This family includes about 14,000 species, out of which 674 species are observed in India. The plants of this family are herbs and shrubs, rarely twiners; **Leaves** are simple, alternate or opposite, rarely compound; **Inflorescence** is Head or capitulum with an involucre of bracts; **Flowers** are of two kinds—the central ones are tubular and the marginal ones are ligulate, sometimes all florets are of one kind, either tubular or ligulate, disc flowers are regular, tubular, bisexual and epigynous, each usually in the axil of a bracteole; **Calyx**—often modified into a cluster of hairs called pappus; **Corolla**—five petals, gamopetalous and tubular; **Androecium**—5-4 stamens, epipetalous, syngenesious; **Gynoecium**—carpels 2, syncarpous; Ovary inferior, 1-celled with one basal, anatropous ovule; stigma bifid; **Fruits** are achene, articulated to the common receptacle, generally sessile, provided with a basilar or lateral areole indicating its point of insertion, often prolonged into a beak at the top, naked above or crowned by the persistent sessile or stipitate pappus. **Seeds** are erect, testa membranous, exalbuminous; embryo straight; cotyledons pleno-convex; radicle short.230
2.3.2 Genus:

The genus *Sphaeranthus* comprises approximately 25 species. Divaricately branched herbs.

**Leaves:** alternate, toothed, decurrent along the stem. **Inflorescence:** Heads small, very numerous, sessile, crowded on a large common receptacle into more or less globose terminal compound heads with or without a general involucre of empty bracts at the base; **Flowers:** outer flowers female, few or many, fertile; disc flowers hermaphrodite solitary or few, fertile or sterile. Involucre bracts are few or many, narrow, acute, subpaleaceous, slightly unequal. Receptacle is small and naked. Corolla of the female flowers slender, tubular, minutely 2-3 toothed; those of the hermaphrodite flowers, regular, the tube thickened the limb 4-5 toothed. Anther-bases are sagittate, auricles acute or tailed. Style-arms of hermaphrodite flowers are filiform or connate. Pappus are absent. Achenes oblong, compressed.\(^{230}\)

![Plant of *Sphaeranthus indicus*](image)

**Fig. 4** Plant of *Sphaeranthus indicus*
There are mainly six species available, which include:  

\[ Sphaeranthus \text{ indicus} \quad Sphaeranthus \text{ suaveolens} \]

\[ Sphaeranthus \text{ hirtus} \quad Sphaeranthus \text{ amaranthoides} \]

\[ Sphaeranthus \text{ moli} \quad Sphaeranthus \text{ africanus} \]

2.3.3 Species: *Sphaeranthus indicus* auct. non L. (*Sphaeranthus senegalensis* DC.):

**Vernacular Name:**

- Hindi: Gorkhmundi, Mundi
- English: East indian globe thistle
- Sanskrit: Mahamundi, Shravani, Tapasvini
- Gujarati: Bodiokalara, Gorkhmundi
- Bengali: Chagulnadi, Gorkhmundi
- Marathi: Barasavodi, Gorkhmundi
- Telugu: Bodatarupu, Bodasoram
- Tamil: Kottakkarandai
- Malyalam: Mirangani
- Punjabi: Ghundi, khamadrus, Mundibuti
- Kannada: Gorkhmundi

**Distribution:**

It grows in rice fields, dry waste places and cultivated lands throughout India, Sri Lanka, Africa and Australia from sea level to 1200m altitude.  

\[ 232, 233 \]
Description:
It is a much branched, strongly scented annual erect herb most commonly grows as a weed in rainy season. The plant flowers in October- January and fruits are formed from December - April.

Roots: Branched tap root

Stem: Cylindrical with toothed wings,

Leaves: Sessile, decurrent, 1-5 by 0.45-2.2cm, obovate-oblong, rounded or subacute, glandular-hairy, spinous-serrate or dentate, narrowed at the base.

Inflorescence: Heads small, heterogamous, involucre, capitate cluster 5-6 in across; peduncle winged, pubescent.

Flower: In each head outer flowers are female, few or many, fertile, the central flowers bisexual, fertile or sterile; Involucre narrow; bracts paleaceous, spathulate, acute, ciliate; receptacle small, naked. Corrola of female flowers purple, slender, tubular, minutely 2-3 toothed; of hermaphrodite flowers purplish white, tubular or funnel-shaped, 4-5 toothed; anther-base sagittate, auricles acute or tailed; Style-armed, filiform, sometimes connate.

Fruit: Angular, sub-glabrous achenes in which Pappus absent.²³₀,²³²

Parts used: Root, bark, leaves, flowers, and seeds.

Medicinal Properties and Uses:²³₀
According to Ayurveda, this herb is hot, laxative, digestible, tonic, fattening, alterative, anthelmintic and alexipharmic. It is used in insanity, tuberculosis, indigestion, bronchitis, spleen diseases, elephantiasis, anemia, pain in uterus and vagina, piles, asthma, leucoderma, dysentery, vomiting, hemicrania, etc. All the parts of the
plant find medicinal uses. The juice of the plant is stypic and said to be useful in liver and gastric disorders. The paste of the herb made with oil is applied in itching. The powdered seeds and roots is used in chest-pains, cough and bowel complaints. The bark, ground and mixed with whey, is said to be a valuable remedy for piles. Leaf juice is boiled with milk and sugar-candy and prescribed for cough and tuberculosis. They are mixed with paddy and rice to prevent damage by insect pests during storage. The herb is employed as a fish-poison. It is also stuffed into holes of crabs to kill them. Aqueous extract is poisonous to American cockroaches.

Ayurvedic Preparations:
Mundi Churna, Mundi panchang swarasa, Mundi kvatha.234

2.3.4 Phytochemical Review:

Table 7 Phytochemical review of *Sphaeranthus indicus*:

<table>
<thead>
<tr>
<th>Part of plant</th>
<th>Chemical constituent</th>
<th>References</th>
</tr>
</thead>
<tbody>
<tr>
<td>Leaves</td>
<td>Arabinose; Fructose; Galactose; Glucose; Lactose; Maltose; Raffinose; Rhamnose</td>
<td>235</td>
</tr>
<tr>
<td></td>
<td>Biochanin</td>
<td></td>
</tr>
<tr>
<td>Entire plant</td>
<td>Costic Acid; Cryptomeridiol; Eudesm-4-En-6-12-Olide,7-A-Hydroxy; β- Eudesmol; Ilicic Acid</td>
<td>237</td>
</tr>
<tr>
<td></td>
<td>Eudesm-4-Enolide,6-β-7: 11-A - 13-Dihydro: 7-α-Acetox-3-β-Hydroxy;; Eudesmanolide,6-β-7:</td>
<td>238</td>
</tr>
</tbody>
</table>
### Review of literature

<table>
<thead>
<tr>
<th>Compound Type</th>
<th>Description</th>
</tr>
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<tbody>
<tr>
<td>11-α-13-Dihydro: 3-α-7-α-Dihydrox-4-5-Epoxy; β-Eudesmol:3-Keto</td>
<td></td>
</tr>
</tbody>
</table>
α-Hydroxy-13-Methoxy: frullanolide, 11-α-13 dihydro; Sphaeranthus eudesmanolide 1 and 2 |
|                        | Sphaeranthus Sesquiterpene 1 Frullanolide, 7-α-Hydroxy                        |
| Flowers                 | Frullanolide, 11-α-13-Dihydro: 3 α-7-α-Dihydroxy; Frullanolide, 11-α-13-Dihydro: 7 α-13-Dihydroxy; Frullanolide, 11-α-13-Dihydro: 7 Frullanolide, 7-Hydroxy Sphaeranthanolide Sphaeranthus Peptide Alkaloid I and II |
| Essential oil           | Cadinene, Delta; Cinnamaldehyde, Para-Methoxy; Citral; Estragole; Geraniol; Geraniol Acetate; Ilicic Acid; Indicusene; α and β Ionone; Ocimene; Sphaeranthene; Sphaeranthol; α-Terpinene; β-Caryophyllene |
| Flowering tops          | Sphaeranthus Lactone 1, 2 and 3                                              |

References:

- 239
- 240
- 241
- 242
- 243
- 244
- 245
- 246
2.3.5 Pharmacological Review:

➢ Sadaf et al.\textsuperscript{247} studied healing potential of cream containing extract of \textit{Sphaeranthus indicus} on dermal wounds in Guinea pigs. The cream significantly enhanced the rate of wound contraction and the period of epithelialization comparable to neomycin.

➢ Bafna and Mishra\textsuperscript{248} reported that petroleum ether extract of the flower heads of drug was effective in increasing phagocytic activity, hemagglutination antibody titer and delayed type of hypersensitivity when tested in mice at different dose level against cyclophosphamide induced suppression of humoral immunity. Optimum activity was found in 200mg/kg dose.

➢ Jain and Basal\textsuperscript{249} studied inhibition of \textit{Propionibacterium acnes}-induced, mediators of inflammation by Indian herb \textit{Spharaenthus indicus}. It showed maximum suppression.

➢ Shekhani et al.\textsuperscript{250} isolated immunostimulant sesquiterpene glycoside from \textit{S. indicus}.

➢ Ali \textsuperscript{251} studied polyherbal preparation containing mundi and was found to be very effective in patient suffering of scabies

➢ Tiwari and Saxena\textsuperscript{252} reported that methanolic extract of plant showed repellent and feeding deterrent activities of \textit{Tribolium castaneum} at 1\% concentration at 3 different doses.

➢ Hameed and Shah\textsuperscript{253} reported that acetone extract of root and leaves of plant at the concentration of 750 and 1000ppm showed more than 50\% mortality in a predominant Indian mosquito species which act as vector of filarial worm. Larvicidal activity was found to be higher in root extract than leaves extract.
Sharma and Saxena reported that purified fraction of acetone extract showed toxic effect to the 2nd and 4th instar larvae of calex quinquefasciatar mosquito at 100-500ppm concentration. 4th instar larvae were more susceptible than the 2nd instar larvae.

Lalla et al. reported antibacterial and antifungal activities of petroleum ether, acetone, methanol(90%) and water extracts of flowers by diffusion method in test bacterial and fungal cultures. All extracts showed considerable antibacterial and strong anti fungal activity.

Dubey et al. reported antimicrobial activity on different pathogens of alcohol and water extracts of the plant in different dilutions. Both extracts were highly effective against Alternaria solani, Fusarium oxysporum and Penicillium pinophilum by preventing their growth to a great extent.

Mhetre and Ambavade reported that Sphaeranthus indicus showed inhibition of Propionibacterium acne-induced ROS and pro-inflammatory cytokines, the two important inflammatory mediators in acne pathogenesis.

Shirwaikar et al. showed that ehanolic extract of Sphaeranthus indicus (1000 μg/ml) showed antioxidant activity.

Mhetre and Ambavade evaluated neuroleptic activity of petroleum ether; alcohol and water extracts of flowers at the dose 300mg/kg (i. p.) in mice by apomorphine induced cage climbing and catalepsy. Significant results were obtained in petroleum ether extract only.

Tiwari and Saxena reported that methanolic extract of Sphaeranthus indicus showed repellent and feeding deterrent activity of Tribolium castaneum at 1% concentration at 3
different doses. Complete feeding deterrent activity was observed at 5 ml dose while repellent activity was noticed at 4 ml dose.

- Dhar et al.\textsuperscript{260} showed hypoglycemic activity of ethanol : water (50\%) extract when given to rats by oral route.

- Vijaya and Ananthan\textsuperscript{261} have reported that ethanol extract of drug had antibacterial activity against enteropathogens.