REVIEW OF LITERATURE

2.1 Ethno medicinal importance:

The concept of Ethnomedicine is evolved from the necessity for studies in the light of modern sciences on the drugs used in the traditional medicines. It is defined as the interdisciplinary science of biologically active agents traditionally observed by man (Bruhn and Holmstedt, 1981; Subramaniam and Pushpangandan, 1995). India has vast ethno botanical knowledge since ancient times. Origin of all such knowledge in India is from the great tradition of Ayurveda. Many plant-derived drugs used in modern medicine are developed through ethno botanical approach which leads to subsequent ethno pharmacological studies (Fransworth, 1990; Cox, 1994; Phillipson, 1989). Scientific studies available on a good number of medicinal plants indicate that promising bioactive constituents can be developed to solve many problems pertaining to health (Gupta, 1994).

A proper ethno pharmacological search and follow up studies can lead to many more useful drugs. Scientific studies available on a good number of medicinal plants indicate that promising phytochemicals (drugs) can be developed as an answer to many health problems. However, phytochemical approach of plant discovery emphasizes the development of pure phytochemicals as drugs. This method is expensive and time consuming as it requires detailed toxicological studies (Gupta, 1994).

In phytotherapeutic approach, the emphasis is on the development of new drugs whose extraction and fractionation have emanated based on
therapeutic activity. The standard fraction of an active extract or mixture of fractions may prove better therapeutically, less toxic and inexpensive. However crude standard preparations require modern standards of safety and efficacy.

In 1989, World Health Organization adopted that herbal medicine is of great importance to the health of individuals and communities. WHO developed guidelines for the assessment of herbal medicines and the same were ratified by the 6th International conference of Drug Regulatory Authorities held at Ottawa. The salient features of WHO guidelines are (WHO, 1993)

A) The quality assessment of crude materials.
B) The plant preparations.
C) The finished product
D) The Stability of the herbal product shelf-life, safety, efficacy, assessment, toxicological studies and the documented evidence of traditional use and activity determination.
Prof. P. Rajeswara Rao, Research Director Collecting the Cleome chelidonii plants with help of natives at Marturu, East Godavari (dt), Andhra Pradesh, India.
Cleome chelidonii Linn.

Botanical name : Cleome chelidonii

Family : Cleomaceae (Capparaceae)

Vernacular names :

   English : Celandine spider flower
   Telugu : Adavi Aavalu
   Tamil : Perunaikaduku

Cleome is the largest genus from family Cleomaceae comprising 180 to 200 species of herbaceous annual or perennial plants and shrubs widely distributed in tropical and subtropical regions. The major diversity of Cleome is restricted to tropical regions, where approximately 150 species have been recorded (Raghavan RS., 1993). In India, the genus is represented by fifteen species (Londhe, A.N., 2000). Earlier floristic workers like Hooker & Thomson, Cooke put Cleome and other allied genera under the family Capparidaceae, however, recently all these genera are separated taxonomically and put under a separate family i.e. Cleomaceae.

2.2 Distribution: Found in India, Maynmor, Malaysia. A weed in wet places.

2.3 External Characters:

30-50 cm tall, erect annual herbs, Leaves 5-9 foliate, leaflets 0.5-3.5x 0.2-1.5 cm across, Flowers solitary axillary, pink. Flower bisexual, tetramerous, stamens numerous on a disc; ovary sessile or short stalked; ovules many on 2 parietal placentas; capsule oblong linear, 40 times longer than width.
2.4 Ethnobotany:

Cleome chelidonii is generally known to be used for the treatment of colic, dysentery, headache, otitis, and rheumatism (Kirtikar, et al., 1991). It has also been found to possess multiple therapeutic properties such as its use as a vermifuge, the treatment of skin diseases (Chopra, 1958; Krishna Mohan & Bhirava Murthy.,1992.) and its anti-inflammatory, antinociceptive and antipyretic properties (Parimalakrishnan et al., 2007) and also used for rheumatism and even headache (Sungwarl and Supanee., 2006). Seeds of Cleome chelidonii are used as condiment (Flora of India vol 2).

Table. 2.1: Different pharmacological activities reported with C. chelidonii

<table>
<thead>
<tr>
<th>S.no</th>
<th>Part used</th>
<th>Activity</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Whole plant</td>
<td>Antioxidant, chemomodulatory efficacy</td>
<td>Parimalakrishnan et al., 2009.</td>
</tr>
<tr>
<td>2</td>
<td>Root</td>
<td>In vitro-antioxidant, Hepatoprotective activity</td>
<td>Gangarao Battu et al., 2012.</td>
</tr>
<tr>
<td>3</td>
<td>Aerial and root parts</td>
<td>Total Phenolic and Alkaloid content and in vitro antioxidant activity</td>
<td>Gangarao B et al., 2011.</td>
</tr>
<tr>
<td>4</td>
<td>Whole plant</td>
<td>Anti-inflammatory, antinociceptive and antipyretic activity</td>
<td>Parimalakrishnan et al., 2007.</td>
</tr>
</tbody>
</table>
2.5 Chemical constituents:

C. chelidonii contains glucocapparin and glucocleomnin (Songsak et al., 2004).

Seeds are rich in unsaturated fatty acid as linoleic acid and phytosterol (Rukmini C., 1978).
Gynandropsis gynandra Linn
**Gynandropsis gynandra Linn**

**Botanical name** : Gynandropsis gynandra  
**Family** : Capparidaceae  
**Synonym** : Cleome gynandra Linn, Gynandropsis pentaphylla D.C.

**Vernacular names**

- **English** : Dog Mustard
- **Hindi** : Hulhul, Hurhur, Kavalia
- **Sanskrit** : Pasugandha
- **Bengal** : Hurhuria, Shulte
- **Telugu** : Vaminta, Vayinta
- **Tamil** : Nal valai, Nal velai
- **Punjabi** : Bugra
- **Kannada** : Naram bele Soppu, Nayeetulasi
- **Marathi** : Tilvan, Bhatvan, Mabli, Tilavana, Tilvant
- **Oriya** : Anasorisia, anasorisa

**2.6 Distribution:**

Gynandropsis gynandra is used as a medicinal plant and can be found all over the world. It grows as a weed in paddy fields and also in road sides and in open grass lands. In India it is never cultivated but grows spontaneously everywhere. Different species of Gynandropsis can be found in all states of India.
2.7 Botanical Description:

It is an erect herbaceous annual herb, which is branched and rather stout. Depending on environmental conditions, it can grow up to 1.5 m in height, and is usually 0.5-1.0 m tall. It has a long tap root, with a few secondary roots with root hairs. Stems and leaf petioles are thickly glandular and rarely glabrous. They exhibit variable pigmentations, from green to pink, or violet to purple. Leaves are alternate, digitately palmate and petiolate. Each leaf has 3-7 leaflets, but most commonly 5 (rarely 3-4), which are pinnately dissected and sessile. They vary from obovate to elliptic in shape, and are usually 2-10 cm long and 2-4 cm wide. They are sparsely hairy, but this is variable, and they have finely toothed margins or round ends. The petioles are 3-23 cm long, the cotyledonary leaves have single leaflets, and leaves are oppositely arranged on the stem.

Inflorescence is quite showy, and is usually up to 30 cm in length. It has terminated and axillary determinate racemes, bearing flowers with long pedicels, which arise singly in the axils of small sessile and trifoliate-to-simple bracts. The bracts are much smaller than the leaflets. The flowers measure 1-2.5 cm in diameter, and have 4 sepals, 4 narrow clawed petals, and 6 stamens with long purple filaments, arising from a much elongated receptacle. The sepals are ovate to lanceolate, measuring up to 8 mm in length, and are glandular. The petals are white, pale, pink or lilac, and the floral formula is $K_4C_4A_6G(2)$. 
The fruit is a long-stalked, dry, dehiscent silique, which is a spindle-shaped capsule measuring up to 12 cm long and 8-10 mm wide. The capsules are green, turn yellow when ripe, and dehisce easily when dry, to release seeds. Seeds are small, suborbicular and sharply tuberculate, with many concentric ribs and irregular cross-ribs. They are rough and greyish-to-black in colour. The seed cleft is narrow. Each seed measures 1.0-1.5 mm in diameter. The seedling has oblong petiolate cotyledonary leaves, and petiolate trifoliolate almost elliptical leaflets, the terminal one being larger than the lateral ones. The petioles are often hairy.

2.8 Ethnobotany:

The medicinal application of this plant is also described in Ayurvedic pharmacopoeia of India and also in other ancient medical texts. In Ayurvedic medicine it is a chief constituent in Narayana Churna. In Ayurveda it is used as an Anthelmentic, in ear diseases, pruritis and several other diseases like gastrointestinal disorders and gastrointestinal infections etc.

The leaves and seeds of Gynandrosis gynandra are used in indigenous medicine in many countries (Purseglove 1943; Anonymous 1956a, 1956b; Kokwaro 1976; Baruah and Sarma 1984; Kumar and Sadique 1987; Opole et al. 1995). The following uses have been reported.

Leaves: Used as analgesic, Epileptic fits, earache, stomach-ache, to facilitate childbirth in pregnant women, constipation, conjunctivitis, severe thread-worm infection, relieving of chest pains, arthritis & inflammation, sap
from leaves may be used as an analgesic, particularly for headaches. Sap from pounded young leaves is squeezed into ears, nostrils and eyes to treat epileptic fits and earache. A decoction or infusion of boiled leaves and/or roots is administered to facilitate childbirth in pregnant women, treat stomach-ache and constipation, treat conjunctivitis, treat severe thread-worm infection, relieve chest pains, rubefacient, vesicant, neuralgia, rheumatism, as a poultice, boils, to prevent the formation of pus, anaemia, to cure recurrent malaria. Drops of the juice of the leaves, on its own or mixed with oil, are applied to the ear to treat ear-ache, to relieve pneumonia.

The seeds and roots are used as anthelmintic, for the expulsion of round worms, as a counter-irritant, poultice to maggot-infested sores, to treat head lice, to reduce coughing. The seeds are used by veterinarians, to treat stomach-ache in equines.

In India the plant has been traditionally used as an anthelmintic and rubefacient.
Table 2.2: Different Pharmacological Activities reported with *G. gynandra*.

<table>
<thead>
<tr>
<th>S.no</th>
<th>Part used</th>
<th>Therapeutic use</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Whole plant</td>
<td>Anticancer activity</td>
<td>Asis Bala et al., 2010.</td>
</tr>
<tr>
<td>2</td>
<td>Whole plant</td>
<td>Antibacterial</td>
<td>Francis Borgio et al., 2008.</td>
</tr>
<tr>
<td>3</td>
<td>Leaves</td>
<td>Antinociceptive and Anti-inflammatory activity</td>
<td>Mule et al., 2008.</td>
</tr>
<tr>
<td>4</td>
<td>Whole plant</td>
<td>Antimycotic and Antibacterial activities</td>
<td>Borgio et al., 2008.</td>
</tr>
<tr>
<td>5</td>
<td>Whole plant</td>
<td>immunotherapy with specific pollen</td>
<td>Latha et al., 2007.</td>
</tr>
<tr>
<td>6</td>
<td>Whole plant</td>
<td>Inhibition of lipid peroxidation and antioxidant defense mechanism</td>
<td>Sivanesa and Hazeema Begum, 2007.</td>
</tr>
<tr>
<td>7</td>
<td>Whole plant</td>
<td>Modulatory effect</td>
<td>Sivanesan and Begum, 2007.</td>
</tr>
<tr>
<td>8</td>
<td>Leaves and Stem</td>
<td>In vitro Anthelmintic property</td>
<td>Jalalpure et al., 2007.</td>
</tr>
<tr>
<td>11</td>
<td>Whole plant</td>
<td>Antitick activity</td>
<td>Lwand et al., 1999.</td>
</tr>
</tbody>
</table>

2.9 Chemical constituents of *G. gynandra*:

Glucosinolates, also known as mustard oil glycosides are characteristic chemical components of Capparidaceae plants. On enzymatic hydrolysis by
myrosinase (present in the plants), isothiocynates are produced from the glucosinolates. An example is Cleomin which has been isolated from G. gynandra (Ahmed et al., 1972). Sterols are also found in these plants.
Heliotropium indicum Linn
Helitropium indicum Linn

Botanical Name : Helitropium indicum Linn
Family : Boragenaceae

Vernacular names

- English : Indian Turnsole, Indian Heliotrope
- Hindi : Siriyari, Hatishura
- Kannada : Chelukondi Gida
- Tamil : Thel kodukku
- Telugu : Nagadanthi
- Bengali : Hatisur
- Oriya : Hati-sand

2.10 Distribution :

It is a coarse foetid herb distributed in the tropical and temperate regions of the world. The plant is a native of Asia and found in India, Bangladesh, Philippines. In India it is found sunny localities, on waste lands, and anthropogenic habitats, widely considered as a weed of fields (Y.R.Chadha, 1985; K.R.Kirtikar and B.D.Basu, 1994; R.stewart, 1997).

2.11 Botanical Description:

Indian Heliotrope is a herb, slightly woody at base, with a long taproot, stem erect, unbranched or branches few, 30-80 cm tall; leaves alternate or sometimes subopposite, distinctly petiolate, petioles to 5 cm long, blade long-decurrent on petiole from a subtruncate base, ovate-deltoid, margin slightly wavy-crisped, 2.5-10 cm long, 1-5 cm wide, acute (blunt), lateral veins 4-7 pairs. Inflorescence terminal, tip coiled, axis up to 20 cm long. The
inflorescence uncoils after the central flowers, which are the oldest, mature. The flowers are arranged on only one side of the inflorescence. Flowers are pale violet (lilac) with a yellow throat, but fading to dull white, calyx-lobes linear-lanceolate, ciliate, 2 mm long; corolla-tube 4-5 mm long; petals rounded. Fruit is 3.5 mm long, ovoid, ribbed, separating into 2 nutlets each 2-celled, 3-3.5 mm long.

**Table.2.3: Different Pharmacological activities reported with Heliotropium indicum**

<table>
<thead>
<tr>
<th>S.No</th>
<th>Part</th>
<th>Activity</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>leaves</td>
<td>Antianaphylactic activity</td>
<td>MS Ashoka and CS Shashidahar., 2011.</td>
</tr>
<tr>
<td>3</td>
<td>Aerial parts</td>
<td>Phytochemical and antimicrobial studies</td>
<td>Shoge Mansurat Oluwatoyi et al., 2011.</td>
</tr>
<tr>
<td>4</td>
<td>Stem</td>
<td>Analgesic Activity</td>
<td>Ashutosh Meher, 2011.</td>
</tr>
<tr>
<td>5</td>
<td>Root</td>
<td>Anti-inflammatory activity</td>
<td>Shalini et al., 2010.</td>
</tr>
<tr>
<td>6</td>
<td>Leaves</td>
<td>Diuretic activity</td>
<td>Meera and Devi., 2009.</td>
</tr>
<tr>
<td>7</td>
<td>Leaves and stem</td>
<td>Anti-inflammatory activity</td>
<td>Ramamurthy et al., 2009.</td>
</tr>
<tr>
<td>8</td>
<td>leaves</td>
<td>Histo - Gastroprotective and Antimicrobial activities</td>
<td>A A Adelaja et al., 2008.</td>
</tr>
<tr>
<td>9</td>
<td>Volatile oil of aerial parts</td>
<td>Antituberculosis activity</td>
<td>Machan et al., 2006.</td>
</tr>
<tr>
<td>10</td>
<td>Whole plant</td>
<td>Antimicrobial activity</td>
<td>Rao PR et al., 2002.</td>
</tr>
<tr>
<td>11</td>
<td>Whole plant</td>
<td>Wound healing activity</td>
<td>Reddy JS et al., 2002.</td>
</tr>
</tbody>
</table>
2.12 Traditional Uses:
It is used as local application for ulcers, sores, wounds, gum boils, skin affections, stings of insects and rheumatism. A decoction of the leaves is used in fevers and urticaria and that of roots in cough and fevers (Anonymous, 1952). It posses wound healing activity (Reddy et al., 2002), fertility control (Tiwari et al., 1982), antitumor activity (Kugelman et al., 1976; Ohnuma et al., 1982) and antiinflammatory effect (Sriniva et al., 2000). Seeds are stomachic. The flowers are considered emmenagogue in small doses and abortifacient in large doses.

2.13 Phytochemical Constituents:

The major constituents of the extract of Heliotropium indicum are tannins and alkaloids (Singh et al., 2003). Aerial parts contain pyrrolizidine alkaloids, indicine (principal), echinitine, supinine, heleurine, heliotrine, lasiocarpine, its N-oxide, acetyl indicine, indicinine and anti tumour alkaloid, indicine-N-oxide. The plant also contains rapanone and lupeol and an ester of retronecine. Volatile oil from aerial parts of H. indicum contains phytol , 1-dodecanol and β-linalool (Machan et al., 2006).

Root contain Estoadiol and seeds contain Heliotrine as chemical constituents (The Wealth of India, 1956). João Sammy N. Souza et al., 2005, isolated a new pyrrolizidine alkaloid with unusual structural features Helindicine, together with the known lycopsamine, from the roots of Heliotropium indicum.
2.14 OBJECTIVE AND SCOPE OF WORK:

The practice of herbal medicine dates back to the very earliest periods of known human history. There is evidence that herbs have been used in the treatment of diseases and for revitalizing the body system in almost all ancient civilizations. There is a rapid progress in various fields of human activity, the field of medicine and its allied sciences. All these have made rapid strides.

Majority of the present day diseases are due to the shift in the balance of the pro-oxidant and the antioxidant homeostatic phenomenon in the body. The antioxidant defense systems, can only protect the body when the amount of free radicals are within the normal physiological level; but when this balance is shifted towards more of free radicals, it leads to oxidative stress which may result in tissue injury and subsequent diseases (Rakesh and Rajesh, 2006).
The present study on three Traditional Indian medicinal plants has been aimed to focus for their antioxidant, anti-inflammatory, Hepatoprotective activity and antibacterial potentials. The idea stemmed from the following fact:

- According to folkloric knowledge these plants were not screened previously for the treatment of anti-oxidant and inflammatory, hepato protective and an antimicrobial activities.

- The species Cleome, Gynandropsis and Heliotropium were used in several formulations in ayurvedic system of medicine and this prompted the author to investigate the in-vitro antioxidant, anti-inflammatory, Hepatoprotective and anti bacterial studies.

- Different extracts (Hydro-alcoholic, Methanolic, Ethylacetate and Hexane) of Cleome chelidonii root, whole plant of Gynandropsis gynandra and Heliotropium indicum have not been screened for anti-inflammatory, Hepatoprotective activity.

On the basis of the survey of ethnomedical, folkloric information and literature, the following three plants were selected:

Cleome chelidonii, Gynadropsis gynandra and Heliotropium indicum.

2.15 The objective of the proposed work:

The purpose of this research work is to investigate the pharmacological activities of anti-inflammatory, hepatoprotective and antimicrobial activities and preliminary phytochemical screening, antioxidant activity of selected
plants in a scientific manner. The different steps adopted are given here under.

2.15.1 Collection of plant materials and extraction:

Collected plants were dried under shade and the dried powdered Cleome chelidonii roots, whole plants of Gynandrospis gynandra and Heliotropium indicum were separately extracted in a soxhlet apparatus for 6 h successively with Methanol, Ethanol 70% v/v, Ethyl acetate and Hexane for getting the Methanol, Hydro-alc (Ethanol 70% v/v), Ethyl acetate and hexane extracts. The concentrates are dried under vacuum in a rotary evaporator.

2.15.2 Phytochemical Studies:

The extracts were tested for presence of phytoconstituents by different chemical tests and also quantified the total phenolic and Alkaloid content.

2.15.3 Antioxidant studies:

The human body has inherent mechanisms to reduce free radical-induced injury by endogenous antioxidants and antioxidative enzymes. Sometimes these protective mechanisms are found to be insufficient. Hence, the search for exogenous antioxidants is continued. Recently, intensive research has been carried out to characterize the antioxidant properties of extracts from several plant materials. Hence the selected plant extracts were studied for in vitro antioxidant activities against Superoxide, Hydroxyl and DPPH free radicals.

2.15.4 Acute toxicity studies:

Toxicity studies conducted as per accepted protocol drawn under OECD guidelines in mice. The acute toxicity study was aimed at establishing
the therapeutic index i.e. the ratio between the pharmacologically effective dose and the lethal dose, and also to perform the primary screening.

2.15.5 Anti-inflamatory studies:

All the extracts were screened for anti-inflammatory activity using carrageenan-induced rat paw oedema method at three different doses (100 mg, 200 mg and 400 mg/ kg) to assess the folklore claims.

2.15.6 Hepatoprotective Studies:

All the selected three plants (different extracts) were screened for evaluation of hepatoprotective activity in rats at three different doses (100 mg, 200 mg and 400 mg/ kg) against CCl₄ induced hepatotoxicity prophylactically by measuring serum SGOT, SGPT, ALP & T.BIL levels.

2.15.7 Anti-bacterial studies:

Antibacterial activity of all the extracts were evaluated by determining the zone of inhibition (cup plate method) against the following strains procured from MTCC, IMTECH, and Chandigarh.

**Gram + ve organisms:** Bacillus pumilis, Bacillus megaterium, Staphylococcus epidermidis, Streptococcus pneumonia.

**Gram - ve organisms:** Escherichia coli, Pseudomonas aeruginosa, Klebsiella pneumonia, Salmonella typhimurium.