SUMMARY

There has been global resurgence of interest in herbal drugs in the recent past. Though herbal medicines are effective in the treatment of various ailments very often these drugs are unscientifically exploited or improperly used. Therefore herbal drugs deserve detailed studies in the light of modern medicine. A majority of population in India suffer from hepatic and inflammatory disease due to various reasons. The modern system of medicine still lack in providing suitable medicament for a large number of disease conditions inspite of tremendous advances made in the discovery of new therapeutic compounds. The development of effective hepatoprotective, antiinflammatory drugs is one of the major thrust areas of research currently. The present research work has been undertaken with an objective to investigate selected herbal drugs for anti-inflammatory, hepatoprotective, anti oxidant and antibacterial activities.

Three selected plants namely C.chelidonii, G. gynandra and H.indicum, which are recorded in books and also used in traditionally for various disorders, were selected for the study. There is no scientific and systematic investigation carried out on these plants. Hence these three herbal drugs were selected for systematic investigation and detailed studies were carried out on:

(i) Preparation of (Hydro-alcoholic, methanolic, Ethylacetate and Hexane) extracts and phytochemical (qualitative and quantitative) investigation, acute toxicity studies. (ii) In vitro Free radical scavenging activity of individual extracts of selected plants. (iii) Evaluation of anti-inflammatory activity in
carragenan induced rat paw oedema model. (iv) Evaluation of each extract of selected plants for hepatoprotective activity against CCl₄ induced hepatotoxicity. (v) Evaluation of Antibacterial activity against four Gram +ve and Gram –ve bacteria.

Some of the features and important uses of selected plants are as follows

**C. chelidonii:**

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. Cleome chelidonii is generally known to be used for the treatment of colic, dysentery, headache, otitis, and rheumatism. It has also been found to possess multiple therapeutic properties such as its use a vermifuge, the treatment of skin diseases and its anti-inflammatory, antinociceptive and antipyretic properties and also used for rheumatism and even headache. Seeds of Cleome chelidonii are used as condiment.

**G. gynandra**

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

Leaves are 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. 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.

**H.indicum:**

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 in sunny and possesses localities, on waste lands, and anthropogenic habitats, widely considered as a weed of fields.

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. It posses wound healing activity, fertility control, antitumor activity and antiinflammatory effect. Seeds are stomachic. The flowers are considered emmenagogue in small doses and abortifacient in large doses.
The Hydro-alcoholic, methanolic, ethyl acetate and hexane extracts were prepared by soxhlation and maceration processes.

**Phytochemical Screening:**

All the selected plants (including various extracts) screened for the presence various phytoconstituents and quantified the total phenolic and alkaloidal content.

**Cleome chelidonii root**

Qualitative phytochemical screening of different extracts of Cleome chelidonii revealed the presence of steroids, terpenoids, glycosides, tannins, alkaloids, flavonoids, phenols, oils and carbohydrates and showed negative to quinines and amino acids. Methanolic extract showed positive to oils and saponins and the remaining extracts showed negative to oils and saponins.

The phenolic content of various extracts of Cleome chelidonii root was ranging from $14.56 \pm 0.86$ to $38.95 \pm 0.39$ (mg per gm). The methanolic extract possesses more phenolic content ($38.95 \pm 0.39$ mg per gm) than other extracts. Alkaloid content in extracts was ranging from $16.55 \pm 0.23$ to $36.86 \pm 0.52$ (mg per gm). The methanolic extract contains more alkaloid content ($36.86 \pm 0.52$ mg per gm) than other extracts.

**Gynandropsis gynandra**

Qualitative Phytochemical screening for different extracts of Gynandropsis gynandra whole plant revealed the presence of steroids, terpenoids, glycosides, tannins, alkaloids, flavonoids, phenols and carbohydrates. The methanolic, hydro-alcoholic extracts contain saponins and
the hexane, ethyl acetate extracts showed negative to saponins, oils and the all extracts are showed negative to quinines, amino acids.

The phenolic content of various extracts of Gynandropsis gynandra extracts were ranging from 13.21±0.66 to 72.80±0.22 (mg per gm). The Hydro-alcoholic extract contains more phenolic content (72.80±0.22 mg per gm) than other extracts. The alkaloidal content of extracts were ranging from 8.91±0.10 to 16.68±0.21 (mg per gm) and the methanolic extract contains more alkaloidal content (16.68±0.21 mg per gm) than other extracts.

**Heliotropium indicum**

Qualitative chemical tests indicated that the hydro-alcoholic extract H. indicum whole plant showed positive test for Steroids, Triterpenoids, Saponins, Flavonoids, Carbohydrates, Glycosides, Amino acids and oils. The methanolic extract of H. indicum showed positive test Triterpenoids, Saponins, Carbohydrates, Glycosides, phenols, flavonoids, Amino acids and oils. The ethyl acetate extract of H. indicum showed positive for Steroids, Saponins, Flavonoids, Carbohydrates, Glycosides, Amino acids and oils and the hexane extract of H. indicum showed positive to Saponins, Carbohydrates and Amino acids.

The phenolic content in hydro-alcoholic crude extract, methanolic, ethyl acetate and hexane extracts of H. indicum whole plant was found to be 2.32±0.25, 9.76±0.11, 2.96±0.55 and 5.49±0.17 mg per gm respectively. Among the selected plant extracts ethyl acetate extract of H. indicum showed high phenolic content. The alkaloid content in hydro-alcoholic, methanolic, ethyl
acetate and hexane extracts of H. indicum was found to be 10.56±0.55, 12.61±0.22, 7.32±0.35 and 8.96±0.16 mg per gm respectively. Among the selected extracts, ethyl acetate extract of H. indicum contains more phenolic content.

**Acute Toxicity Study:**

The acute toxicity study was conducted for Hydro-alc, methanolic, ethyl acetate and hexane extracts of Cleome chelidoni roots, whole plant of Gynandropsis gynandra and Helitroplium indicum as per OECD guidelines 420 (OECD.2001).

Acute toxicity studies in mice revealed that the extracts up to 2000 mg/ kg produced no sign of toxicity or mortality.

**Investigation on Free Radical Scavenging Activity of Selected Plants**

**Determination of Superoxide Radical Scavenging Activity:**

It was carried out by the method McCord and Fridovich method et al., 1969 and the percentage inhibition of superoxide radical production by the extract was calculated by following equation.

\[
\text{Inhibition ratio} = \frac{(A_0 - A_1) \times 100}{A_0}
\]

Where \(A_0\) is the absorbance control, \(A_1\) is the absorbance of plant extract/ ascorbic acid. The mean IC\(_{50}\) values of Hydro-alcoholic, methanolic, ethyl acetate and hexane extracts of selected plants were as follows:

**Cleome chelidoni:**

In the present study, the hydro-alcoholic, methanolic, ethyl acetate and hexane extracts of C. chelidoni root were found to possess concentration
dependent scavenging activity on superoxide radical scavenging activity. The mean IC\textsubscript{50} values for superoxide radical scavenging activity of hydro-alcoholic extract, methanolic, ethyl acetate and hexane extracts of *C. chelidonii* root were found to be 130.00±1.4, 101.00±1.2, 177.00±2.2 and 552.5±3.4 µg respectively. The mean IC\textsubscript{50} value of ascorbic acid was found to be 53.5±1.2 µg.

**Gynandropsis gynandra**

The hydro-alcoholic, methanolic, ethyl acetate and hexane extracts of *G. gynandra* whole plant were found to possess dose dependent superoxide radical scavenging activity. The mean IC\textsubscript{50} values for superoxide radical scavenging activity of hydro-alcoholic, methanolic, ethyl acetate and hexane extracts of *G. gynandra* were found to be 150.5±1.5, 126.5±1.3, 259.2±2.1 and 575.0±2.3 µg respectively.

**Heliotropium indicum**

The hydro-alcoholic, methanolic, ethyl acetate and hexane extracts of *H. indicum* whole plant were found to possess concentration dependent superoxide radical scavenging activity. The mean IC\textsubscript{50} values for superoxide radical scavenging activity of hydro-alcoholic, methanolic, ethyl acetate and hexane extracts of *H. indicum* whole plant were found to be 139.5±2.1, 110.2±1.5, 195.0±1.5 and 294.5±2.2 µg respectively.

Among the extracts methanolic extracts of *C. chelidonii* root and whole plant of *G. gynandra* and *H. indicum* produced better inhibition of superoxide anion.

**Hydroxyl Radical Scavenging Activity:**
Hydroxyl radical scavenging activity was measured by studying the competition between deoxyribose and the extracts for hydroxyl radicals generated from the Fe$^{2+}$/EDTA/H$_2$O$_2$ system (Fenton reaction). The hydroxyl radical attacks deoxyribose, which eventually results in the formation of Thiobarbituric acid reacting substances (TBARS) (Elizabeth and Rao, 1990).

**Cleome chelidonii**

The hydro-alcoholic extract, methanolic, ethyl acetate and hexane extracts of *C. chelidonii* roots were found to possess concentration dependent scavenging activity on hydroxyl radicals. The mean IC$_{50}$ values for hydroxyl radical scavenging activity of hydro-alcoholic extract, methanolic, ethyl acetate and hexane extracts of *C. chelidonii* roots were found to be 193.00±2.2, 136.5±1.2, 353.00±3.1 and 544.00±2.5 µg respectively. The mean IC$_{50}$ value of ascorbic acid was found to be 67.8±2.3 µg.

**Gynandropsis gynandra**

The hydro-alcoholic extract, methanolic, ethyl acetate and hexane extracts of *G. gynandra* whole plant were found to possess concentration dependent scavenging activity on hydroxyl radicals. The mean IC$_{50}$ values for hydroxyl radical scavenging activity of hydro-alcoholic extract, methanolic, ethyl acetate and hexane extracts of *G. gynandra* whole plant were found to be 226.5±2.1, 164.3±1.8, 452.0±2.5 and 709.5±3.2 µg respectively.

**Heliotropium indicum**

The hydro alcoholic extract, methanolic, ethyl acetate and hexane extracts of *H. indicum* whole plant were found to possess concentration
dependent scavenging activity on hydroxyl radicals. The mean IC$_{50}$ values for hydroxyl radical of hydro-alcoholic extract, methanolic, ethyl acetate and hexane extracts of H.indicum were found to be 195.2±1.6, 96.1±1.5, 249.5±2.3 and 387.5±2.5 µg respectively. The mean IC$_{50}$ value of ascorbic acid was found to be 67.8±2.3 µg.

Among the extracts, methanolic extracts of C. chelidonii root and whole plant of G.gynandra and H.indicum produced better inhibition of hydroxyl radical.

**Determination of DPPH radical Scavenging Activity:**

The determination of DPPH free radical scavenging activity carried out by the method Braca et al, 2003 et al and the percentage inhibition of DPPH free radical production by the extract was calculated by using equation mentioned earlier.

**Cleome chelidonii**

The hydro-alcoholic extract, methanolic, ethyl acetate and hexane extracts of C. chelidonii root were found to possess concentration dependent scavenging activity on DPPH radicals. The mean IC$_{50}$ values for DPPH radical scavenging activity of hydro-alcoholic extract, methanolic, ethyl acetate and hexane extracts of C. chelidonii were found to be 99.2±1.4, 74.8±1.4, 181.00±1.2 and 307.00±2.4 µg respectively. The mean IC$_{50}$ value of ascorbic acid was found to be 18.5±1.5 µg.

**Gynandropsis gynandra**

The hydro-alcoholic extract, methanolic, ethyl acetate and hexane extracts of G. gynandra whole plant were found to possess concentration
dependent scavenging activity on DPPH radicals. The mean IC\textsubscript{50} values for DPPH radical scavenging activity of hydro-alcoholic, methanolic, ethyl acetate and hexane extracts of G. gynandra were found to be 108.25\pm2.3, 87.9\pm1.1, 239.4\pm2.3 and 340.0\pm2.2 \mu g respectively.

Heliotropium indicum

The hydro-alcoholic (Ethanol 70% v/v) extract, methanolic, ethyl acetate and hexane extracts of H.indicum were found to possess dose dependent scavenging activity on DPPH radicals. The mean IC\textsubscript{50} values for DPPH radical scavenging activity of hydro-alcoholic extract, methanolic, ethyl acetate and hexane extracts of H.indicum were found to be 87.9\pm1.2, 69.7\pm1.5, 119.2\pm1.2 and 307.0\pm2.3 \mu g respectively.

Among the extracts, methanolic extracts of C. chelidonii root and whole plant of G.gynandra and H.indicum produced better inhibition of DPPH free radical.

Anti-inflammatory Activity of Selected Plants in Carragenan Induced Rat paw Oedema Model:

All three selected plants (including various extracts) were investigated for anti-inflammatory activity in carragenan induced rat paw edema model at three doses levels (100 mg, 200 mg and 400 mg/ kg). The rats were given doses orally with extracts at different dose levels 18 h and 2 h prior to the induction of carrageenan subcutaneously (SC) into the subplantar tissue of the hind paw of each rat, 0.1 ml of 1% carrageenan suspension. The drug effects were estimated by comparing the maximal oedema response during 6 h in the drug as extract treated group with that of vehicle treated group as control.
C. chelidonii root

The Indomethacin at a dose of 5 mg/kg and hydro-alcoholic crude extract of C. chelidonii root at doses 100, 200 & 400 mg/kg significantly inhibited the maximal oedema response and the percentage inhibition was found to be 62.92±1.5, 37.41±0.8, 44.65±1.2 and 50.28±1.2% respectively during the 6 h of the carrageenan-induced rat paw acute inflammation. The total oedema response (AUC) was inhibited by 68.4±1.2, 45.71±0.8, 47.81±1.3 and 51.25±1.1% respectively over 6 h when compared to the control group treated with drug vehicle.

Methanolic extract of C. chelidonii significantly inhibited the maximal oedema response and percentage inhibition was found to be 38.91±0.5, 47.76±1.1 and 53.39±1.2% respectively during the 6 h of the carrageenan-induced rat paw acute inflammation. The total oedema response (AUC) was inhibited by 47.15±1.2, 49.68±0.5 and 53.32±0.6% respectively over 6 h when compared to the control group treated with drug vehicle.

Ethyl acetate extract of C. chelidonii root significantly inhibited the maximal oedema response and percentage inhibition was found to be 34.92±1.1, 43.08±0.6 and 48.65±1.3% respectively during the 6 h of the carrageenan-induced rat paw acute inflammation. The total oedema response (AUC) was inhibited by 44.1±1.2, 46.04±0.5 and 49.45±1.2% respectively over 6 h when compared to the control group treated with drug vehicle.

Hexane extract of C. chelidonii root significantly inhibited the maximal oedema response and percentage inhibition was found to be 32.58±1.2,
36.92±1.1 and 44.17±1.2% respectively during the 6 h of the carrageenan-induced rat paw acute inflammation. The total oedema response (AUC) was inhibited by 41.55±1.2, 42.66±1.4 and 46.23±1.5% respectively over 6 h when compared to the control group treated with drug vehicle.

**G. gynandra**

The Indomethacin at a dose of 5 mg/ kg and hydro-alcoholic extract of Gynandropsis gynandra whole plant significantly inhibited the maximal oedema response and the percentage inhibition was found to be 62.92±1.5, 23.68±1.4, 31.09 ±2.1 and 34.63±2.4% respectively during the 6 h of the carrageenan-induced rat paw acute inflammation. The total oedema response (AUC) was inhibited by 68.4±1.2, 34.5±1.1, 39.94±1.5 and 44.82±2.1% respectively over 6 h when compared to the control group treated with drug vehicle.

Methanolic extract of Gynandropsis gynandra whole plant significantly inhibited the maximal oedema response and the percentage inhibition was found to be 29.52±1.1, 34.62±1.2 and 38.66±1.5% respectively during the 6 h of the carrageenan-induced rat paw acute inflammation. The total oedema response (AUC) was inhibited by 39.15±1.5, 43.02±2.1 and 46.86±2.1% respectively over 6 h when compared to the control group treated with drug vehicle.

Ethyl acetate extract of Gynandropsis gynandra whole plant significantly inhibited the maximal oedema response and the percentage inhibition was found to be 17.81±0.5, 22.95±1.2 and 28.9±1.4% respectively during the 6 h of
the carrageenan-induced rat paw acute inflammation. The total oedema response (AUC) was inhibited by 30.5±1.2, 35.22±1.1 and 39.84±1.5% respectively over 6 h when compared to the control group treated with drug vehicle.

Hexane extract of Gynandropsis gynandra whole plant significantly inhibited the maximal oedema response and the percentage inhibition was found to be 16.2±0.5, 21.11±1.2 and 26.41±1.5% respectively during the 6 h of the carrageenan-induced rat paw acute inflammation. The total oedema response (AUC) was inhibited by 28.23±1.2, 32.86±1.4 and 37.09±2.1% respectively over 6 h when compared to the control group treated with drug vehicle.

H. indicum

The Indomethacin and hydro-alcoholic extract of Heliotropium indicum significantly inhibited the maximal oedema response and the percentage inhibition was found to be 62.92±1.5, 30.84±0.8, 34.22±1.2 and 36.24±1.4% respectively during the 6 h of the carrageenan-induced rat paw acute inflammation. The total oedema response (AUC) was inhibited by 68.4±1.2, 40.53±1.5, 44.27±1.4 and 47.81±1.5% respectively over 6 h when compared to the control group treated with drug vehicle.

Methanolic extract of Heliotropium indicum significantly inhibited the maximal oedema response and the percentage inhibition was found to be 33.73±0.8, 37.45±1.2 and 41.45±1.5% respectively during the 6 h of the carrageenan-induced rat paw acute inflammation. The total oedema response
(AUC) was inhibited by 40.92±1.6, 45.35±1.5 and 49.51±1.5% respectively over 6 h when compared to the control group treated with drug vehicle.

Ethyl acetate extract of *Heliotropium indicum* significantly inhibited the maximal oedema response and the percentage inhibition was found to be 23.6±0.5, 28.36±1.2 and 32.26±1.5% respectively during the 6 h of the carrageenan-induced rat paw acute inflammation. The total oedema response (AUC) was inhibited by 35.45±1.5, 39.91±1.2 and 43.51±1.5% respectively over 6 h when compared to the control group treated with drug vehicle.

Hexane extract of *Heliotropium indicum* significantly inhibited the maximal oedema response and the percentage inhibition was found to be 19.43±0.5, 24.64±1.2 and 29.58±1.5% respectively during the 6 h of the carrageenan-induced rat paw acute inflammation. The total oedema response (AUC) was inhibited by 34.43±1.8, 36.86±1.5 and 40.11±1.5% respectively over 6 h when compared to the control group treated with drug vehicle.

The percentage inhibition of the maximal paw oedema during 6 h for the hydro-alcoholic (Ethanol 70% v/v) extracts of *C.chelidonii*, *G.gynandropsis* and *H.indicum* at 400 mg/ kg were in the following order *C. chelidonii* > *H.indicum* > *G.gynandropsis*.

The percentage inhibition of the maximal paw oedema during 6 h for the methanolic extracts of *C.chelidonii*, *G.gynandropsis* and *H.indicum* at 400 mg/ kg were in the following order *C. chelidonii* > *H.indicum* > *G.gynandropsis*. 
The percentage inhibition of the maximal paw oedema during 6 h for the ethyl acetate extracts of C.chelidonii, G.gynandropsis and H.indicum at 400 mg/kg were in the following order C. chelidonii > H. indicum > G. gynandropsis.

The percentage inhibition of the maximal paw oedema during 6 h for the hexane extracts of C.chelidonii, G.gynandropsis and H.indicum at 400 mg/kg were in the following order C. chelidonii > H. indicum > G. gynandropsis.

Among the selected three plant extracts, methanolic extracts of C. chelidonii root, whole plant of G.gynandropsis and H.indicum produced highly significant reduction of paw oedema than Hydro-alcoholic, ethyl acetate and hexane extracts.

**Hepatoprotective Activity of Selected Plants in Carbon Tetrachloride Induced Hepatotoxicity Model (Prophylactic):**

In the present work the hepatoprotective activity of Hydro-alcoholic, methanolic, ethyl acetate and hexane extracts of the selected herbal drugs were tested against carbon tetrachloride (CCl₄) induced hepatotoxicity by measuring biochemical parameters (SGOT, SGPT, ALP and T.BIL). An increase in the levels of these biochemical parameters is a sensitive index of hepatic damage.

The standard and test group animals were treated with 50 mg/ kg dose of Silymarin and 100, 200, 400 mg/ kg doses of hydro-alcoholic, methanolic, ethyl acetate and hexane extracts of C.chelidonii, G.gynandropsis, H.indicum for 6 days. On 6th day, 1hr after treatment with standard drug and selected plant extracts, the animals were intoxicated with CCl₄ in liquid paraffin (1:1
v/v, 0.75 ml of CCl₄/kg, i.p.). Serum was separated by centrifugation at 37°C and used for estimation of various biochemical parameters. Biochemical parameters like Serum Glutamic Oxaloacetic Transaminase (SGOT) and Serum Glutamic Pyruvic Transaminase (SGPT), Serum alkaline phosphatase (ALP), Serum Total bilirubin (T.Bil) were estimated by using commercial reagent kits in Autoanalyzer (RM4000, Biochemical systems International, Italy).

All the selected plant extracts showed a dose dependent hepatoprotection against CCl₄ induced intoxication. Among the extracts methanolic extracts of the selected plants produced maximum hepatoprotection at a dose of 400 mg/kg and based on SGPT levels the range of percentage protection offered by the methanolic extracts found to be lying in the range of 71.45% to 81.02%. The order of percentage protection as follows Cleome chelidonii root > Heliotropium indicum > Gynandropsis gynandra. Thus the study clearly indicates the selected three plants possess hepatoprotective activity and the protection produced by the extracts may be due to their free radical scavenging activities.

The percentage protection to the liver damage produced by the test preparation was calculated as per the following equation.

% Protection = 100 x \[
\frac{\text{SGOT/SGPT/ALP/T.BIL values of CCl₄ control} - \text{SGOT/SGPT/ALP/T.BIL values of treatment}}{\text{SGOT/SGPT/ALP/T.BIL values of before treatment on 6th day}}
\]
Anti - Microbial Activity:

All the selected three plants (including different extracts) that were screened for antimicrobial activity against various Gram +ve bacteria and Gram -ve bacteria. Anti microbial screening of the plant extracts was carried out by the cup plate method. All the extracts at a concentration of 150 µg, 300 µg, 600 µg and 1200 µg per each cup exhibited antibacterial activity against one or other organisms in dose dependent manner.

Cleome chelidonii:

Among all the tested extracts, methanolic and Hydro-alcoholic (Ethanol 70%v/v) extracts of Cleome chelidonii root have shown significant antibacterial activity as compared to that of hexane, ethyl acetate extracts. The extracts showed good zone of inhibition against Gram negative bacteria than Gram positive bacteria.

Hexane extract produced mild zones of inhibition against bacterial strains compared with other extracts. It showed zone of inhibition against one Gram +ve (Bacillus megaterium) and two gram -ve (Pseudomonas aeruginosa and Klebsiella pneumonia) bacterial strains at a concentration of 150µg/ cup and maximum zone of inhibition against Klebsiella pneumonia, Streptococcus pneumonia was found to be 9mm at a concentration of 1200 µg/ cup.

Hydro-alcoholic and Ethyl acetate extracts showed moderate zones of inhibition on tested bacterial strains. Hydro-alcoholic extract had showed zone of inhibition showed maximum zone of inhibition (13mm) on
Pseudomonas aeruginosa at a concentration of 1200 µg/cup and the Ethyl acetate extract showed maximum zone of inhibition (12mm) on Pseudomonas aeruginosa and Klebsiella pneumoniae at a concentration of 1200µg/ cup.

The methanol extract showed better activity against tested bacterial strains compared to other extracts and showed maximum zones of inhibition (17mm) on Klebsiella pneumoniae at a concentration of 1200 µg/ cup.

**Gynandropsis gynandra**

All the tested extracts at different concentrations have shown significant antibacterial activity against gram –ve organisms than gram +ve organisms along with standard drug.

Hexane showed highest zone of inhibition (16mm) against Pseudomonas aeruginosa at a concentration of 1200µg/ cup. Ethyl Acetate and Hydro-alcoholic (Ethanol 70% v/v) extracts showed moderate zones of inhibition on tested bacterial strains. Ethyl Acetate extract showed maximum zone of inhibition (15mm) on Escherichia coli at a concentration of 1200µg/ cup. Hydro-alcoholic extract showed highest zone of inhibition (13mm) Pseudomonas aeruginosa at a concentration of 1200 µg/ cup.

The methanolic extract showed zones of inhibition against tested bacterial strains and it showed maximum zones of inhibition (16mm) on Pseudomonas aeruginosa at a concentration of 1200 µg/ cup.

**Heliotropium indicum**

All the tested extracts at different concentrations have shown significant antibacterial activity against Gram -ve organisms than Gram +ve organisms along with standard drug.
Hexane extract produced very low zones of inhibition against bacterial strains compared with other extracts and it showed highest zone of inhibition (8mm) against gram +ve bacterial strains at a concentration of 1200 µg/ cup.

Ethyl Acetate and Hydro-alcoholic (Ethanol 70% v/ v) extracts showed moderate zones of inhibition on tested bacterial strains. Ethyl Acetate extract showed maximum zone of inhibition (14mm) on Klebsiella pneumoniae at a concentration of 1200µg/ cup and the hydro-alcoholic extract showed maximum zone of inhibition (13mm) on Pseudomonas aeruginosa and Klebsiella pneumoniae at a concentration of 1200 µg/ cup.

The methanolic extract showed better activity against tested bacterial strains compared to other extracts and showed maximum zones of inhibition (14mm) on Bacillus megaterium at a concentration of 1200 µg/ cup.
CONCLUSIONS

1. Qualitative investigation showed the presence of bioactive compounds like Flavonoids, Phenolic compounds, Tannins, Alkaloids, Glycosides, Sterols in selected plant drugs namely C.chelidonii, G. gynandra and H.indicum.

2. There is variability in phenolic content of hydro-alcoholic, methanolic, ethyl acetate and hexane extracts of the selected plant drugs.

3. The plant extracts showed no toxicity at a dose of 2000 mg/kg.

4. Among the hydro-alcoholic, methanolic, ethyl acetate and hexane extracts of C. chelidonii root, methanolic extract showed better superoxide anion scavenging activity (IC$_{50}$ 101.0±1.2 µg), hydroxyl radical scavenging activity (IC$_{50}$ 136.5±1.2 µg) and DPPH radical scavenging activity (IC$_{50}$ 74.8±1.4 µg).

5. Among the hydro-alcoholic, methanolic, ethyl acetate and hexane extracts of G. gynandra whole plant, methanolic extract showed better superoxide anion scavenging activity (IC$_{50}$ 126.5±1.3 µg), hydroxyl radical scavenging activity (IC$_{50}$ 164.3±1.8 µg) and DPPH radical scavenging activity (IC$_{50}$ 87.9±1.1 µg).

6. Among the hydro-alcoholic, methanolic, ethyl acetate and hexane extracts of H.indicum whole plant, methanolic extract showed better superoxide anion scavenging activity (IC$_{50}$ 110.2±1.5 µg), hydroxyl radical scavenging activity (IC$_{50}$ 96.1±1.5 µg) and DPPH radical scavenging activity (IC$_{50}$ 69.7±1.5 µg).
7. Based on percentage inhibition of maximal paw oedema during 6 hours and the percentage inhibition of total AUC paw oedema at a dose of 400 mg/kg, methanolic extracts showed better anti-inflammatory activity against carragenan induced rat paw oedema than the hydro-alcoholic, ethyl acetate and hexane extracts. The order of percentage inhibition of maximal rat paw oedema during 6 hours as follows: methanolic extract of *C. chelidonii* > methanolic extract of *H. indicum* > methanolic extract of *G. gynandra*.

8. Based on the SGPT levels at a dose of 400 mg/kg, among the extracts of three plants methanolic extracts showed better hepatoprotection against *CCl₄* intoxication. The order of percentage protection as follows: methanolic extract of *C. chelidonii* > methanolic extract of *H. indicum* > methanolic extract of *G. gynandra*.

9. The three plant extracts showed antibacterial activity against selected Gram +ve and Gram -ve bacteria. Among the extracts methanolic and Hydro-alcoholic extracts showed better antibacterial activity.

Thus the results of the present investigation clearly indicated that the selected herbal drugs possess good anti-inflammatory, hepatoprotective and antibacterial activities lead to support the folkloric claims scientifically.