

Pharmacognosy

1	Objectives
	(a) Standardization and quality evaluation of herbal raw drugs/ formulations. (b) Preparation of monographs of medicinal plants. (c) To develop scientifically validated standardized herbal products.
2	Goals:
	<ul style="list-style-type: none">• Quality control and standardization of raw drugs and herbal formulation.• Development of scientific validated standardized single herbal drugs.• Validation of ethnonedicinal claims.
3	Competencies :
	<p>The group have experienced team of scientists and technical staff specialized in Pharmacognosy, Pharmacology, Chemotaxonomy, Chemistry and Pharmacy. The team has following expertise.</p> <p>To carry out detailed pharmacognostic studies which includes –</p> <ul style="list-style-type: none">• Taxonomic identification of plants and it parts,• Macro- & microscopical details• Histochemical analysis of the plant parts used as medicine.• To develop chemical markers for –• Identification,• Quality and batch-to-batch consistency with the help of - HPTLC, HPLC, GLC & DNA finger printings etc.• To develop physico-chemical standards viz.• Foreign matter• Total ash, acid soluble and insoluble ash• Water and alcoholic extracts• Total phenolics, tannins, sugars, starch and protein etc. of crude as well as finished herbal drugs/products.• To detect the microbial contamination including the detection of mycotoxins and heavy metals and pesticide residue in herbal drugs (raw as well as finished) in accordance with the latest WHO guidelines.• To develop medicinal plants monographs and formulations.• Pharmacological evaluation to cover the safety aspects or toxicity• Antistress• Antioxidant• Hepatoprotective• Diuretic• Immunomodulating• Antimicrobial activities
4	Facilities:
	<ul style="list-style-type: none">• Authentication of raw drugs.• Quality control of standardization of herbal drugs/products.• Pharmacological screening of herbal drugs/formulations.• National Accreditation Board for Testing and Calibration Laboratories (NABL) Accreditation Lab.
5	Highlights of Current Research:

The Pharmacognosy and Ethnopharmacology division, CSIR-NBRI, Lucknow is a multidisciplinary and applied research division with the objective of establishing a state-of-the-art expertise facilitating in plant product research with special reference to standardization & quality evaluation of ASU drugs and plant-based herbal drugs/products.

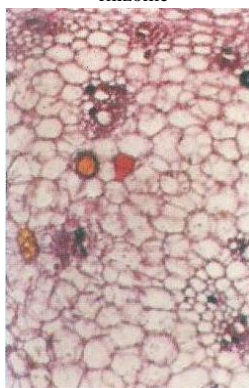
- Over 350 raw single herbal drugs and about 40 polyherbal formulations have been standardized. Some of the pharmaceutical important raw drugs evaluated are 'Amra haridra', 'Ashoka', 'Arjuna', 'Ativisha', 'Bala', 'Bhuiamla', 'Bilva', 'Brahmi', 'Chiraita', 'Dashmoola', 'Daru Haridra', 'Deodara', 'Dronpushpi', 'Gokshru', 'Jivanti', 'Kali Musali', 'Kalmegh', 'Kesar', 'Khatmi', 'Kulanjana', 'Kurchi', 'Punarnava', 'Safed Musli', 'Salam Panja', 'Sapan', 'Satawar', 'Siris', 'Talispatra', 'Vacha', 'Vidarikand', etc.



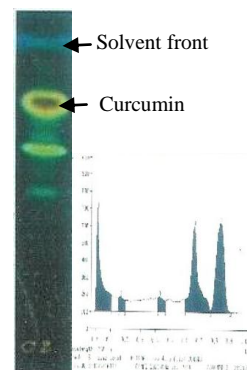
A flowering stalk with rhizome



TS rhizome showing stellate region (x400)



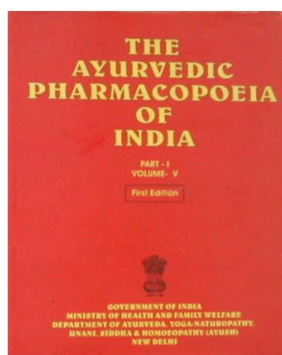
TS rhizome showing cortical region (x400)



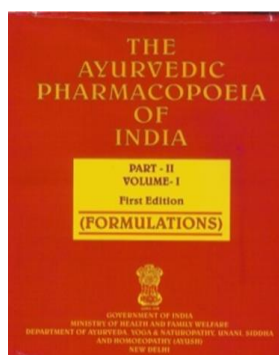
HPTLC Profile

Pharmacognostical studies of *Curcuma zedoaria* rhizome

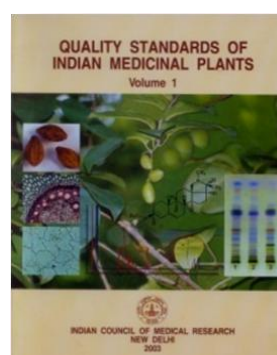
- 33+52 Monographs on Quality Standards of Important Indian Medicinal Plants and 17 polyherbal formulations published in The Ayurvedic Pharmacopoeia of India and Quality Standards of Indian Medicinal Plants (ICMR).



Part-I, Vols-I- V
NBRI's contribution:
33 Plants



Part-II, Vols-I – II
17 Formulations



Vols-I – VIII
52 Monographs

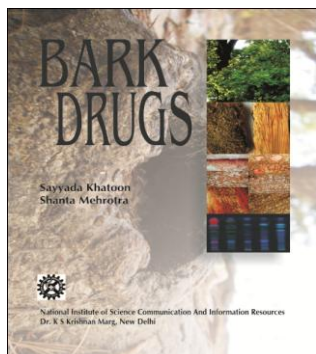
- HPTLC/HPLC methods have been developed for estimation of biomarkers in several important medicinal plants/formulations for their standardization and quality control. Some of them are *Mangifera indica*, *Heracleum candicans*, *Syzygium aromaticum*, *Strychnos nux-*

vomica, *Myrica esculenta*, *Dendrophthoe falcata*, *Bergenia* sps., *Sida* sps., *Phyllanthus* sps., *Adiantum* sps., *Terminalia* sps., 'Chyavanprash', 'Triphala', 'Kalmeghasava', 'Ashokarishta' etc.

- SOP's and standardization of some Ayurvedic formulations such as 'Chyavanprash', 'Puga khand', 'Ashtangavaleha', 'Kalmeghasava', 'Chitraka Haritaki', 'Hingawastaka Churna', 'Kaiśhora guggulu', 'Punarnava guggulu', 'Mahakalyanaka Grita', 'Vidariyadi Grita', etc. have been done.
- Pharmacological and toxicological screenings of herbal extracts/formulations in various experimental animal models were performed. Around 50 medicinal plants were screened for Antiulcer and antidiarrhoeal activities in various animal models. Plant extracts showed significant antiulcer potential are *Musa sapientum*, *Ficus racemosa*, *Annona squamosa*, *Urtica salicifolia*, *Aegle marmelos*, *Cinnamomum tamala*, *Buchanania lanzan* etc. Plant extracts were subjected for the screening of anti HCC in Nitrosodiethylamine induced hepatic damage in experimental rats and *Fumaria indica* showed significant activity. Throat soothing anti-cough herbal syrup was prepared and standardized the method for manufacturing. The extracts were processed and formulated as anti-ulcer herbal combination and wound healing ointment.
- Antioxidant activities by both *in vitro* and *in vivo* models of around 80 plants and formulations have been carried out. Developed a photochemiluminescent based assay for the screening of antioxidant activity of colored plant extracts using the Photochem apparatus. Plant extracts showed significant antioxidant potential are *Acorus calamus*, *Asparagus racemosus*, *Anogeissus latifolia*, *Desmodium gangeticum*, *Piper longum*, *Piper cubeba*, etc.,
- Under the CSIR Inter-Laboratory network project 250 parts of 135 plants were collected in bulk and extracted with 95% ethanol, 50% aqueous ethanol and hot water. 12750 samples were sent to various CSIR labs for bio-evaluation. Six plant extracts/fractions were found promising for anti-dementia, anti-filarial, anti-malarial, anti-tuberculosis, anti-psychotic activities and 14 extracts showing anti-termite activity. The work is still in progress for the isolation of active molecule or development of herbal product.
- Jointly with other CSIR Labs prepared standardized novel herbal based formulations for degenerative disorder viz. Osteoarthritis and Rheumatoid Arthritis, Diabetes mellitus type II (NIDDM) and Common hepatic disorders under NMITLI projects.
- Established Indian Herbal Garden at WHO (Hq.) Geneva (Switzerland) during the year 2007 with the aim to popularize plants of Indian Traditional Systems of Medicine, under National Medicinal Plants project.



- During the last one decade, the division has developed a range of novel, scientifically validated standardized 22 herbal drugs/products based on traditional and ethno-botanical knowledge and patents are filed. Total 20 patents were awarded from India and 75 from Abroad.
- Two books namely 'Package of Practices for Organic Cultivation & Utilization of Important Medicinal Plants' (Part-I) and 'Bark Drugs' under also published by the Division.



Vol-I 40 Plants

Technology transferred:

- Anticough Syrup transferred to M/s. Toral Herbals, Lucknow (U.P.)
- Herbal colours for cosmaceuticals transferred to M/s. Ayur Herbals, Alwar (Raj.)
- Fermented health drink transferred to M/s. ANJS Exports, Kanpur (U.P.)
- Anticig transferred to M/s. MIR Holistics Pvt. Ltd., Kochi (Kerala)

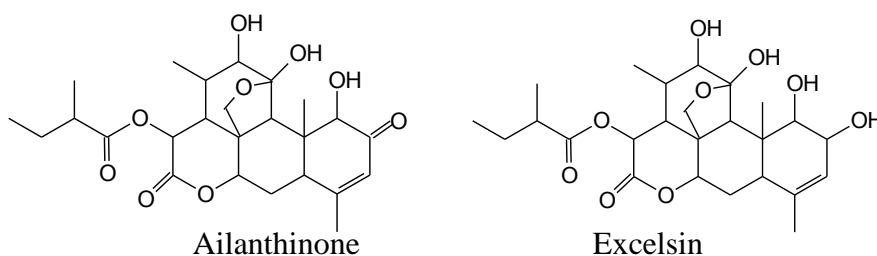
Network Projects

DEVELOPMENT AND COMMERCIALIZATION OF BIOACTIVE MOLECULES FROM PLANTS

Discovery and preclinical studies of new bioactive molecules (Natural and semi-synthetic) & traditional preparations. NWP-0037. (CSIR)

Five parts belonging to five plants were collected in bulk and extracted with 95% ethanol, 50% aqueous alcohol and hot water. The extracts were freeze dried and concentrated. A total of 245 samples of 18 extracts were sent to different CSIR Labs for biological evaluation. The work on various discovery groups is as follows -

Antimalarial - The anti-malarial lead (NBR-1220-P10-D002) was fractionated with chloroform (F005), butanol (F006) and water (F007). The fractions were freeze dried and sent to CDRI, Lucknow for confirmation of activity whereby the activity was localized in F006 fraction. The active fraction F006 was subjected to column chromatography over silica gel and seven fractions (F006A to F006G) were obtained. Two sub-fractions showed promising activity. Fractions corresponding to the active sub-fractions (F006A and F006B) were obtained in larger quantities and their column chromatography was carried out. Two single compounds, K001 and K002, were isolated in pure form and were found to be active. They were identified as known quassinoids, ailanthinone and excelsin, by comparison of their NMR (1H, 13C) data.



Antifilarial - Earlier, the active antifilarial fraction (NBR-010-P04-D001-F001) was resolved into 8 sub-fractions (F001a-F001h) by column chromatography. All the fractions were sent to CDRI for biological evaluation. 2 fractions, F001e and F001f, showed activity but to a lesser extent. Also, work was carried out to standardize F001 with respect to its ingredients using HPTLC. Different batches of the active hexane fraction were found to comprise of wax (60-70% w/w dry basis); lupeol (0.50 to 1.10%), β -sitosterol (0.20 to 0.55%), tricentanol (1.50 to 2.50) and other components.

Antidementia- NBR-015-P03-D001 exhibiting antidementia activity was taken up under Fast Track mode for detailed studies. The extract exhibited significant preventive potential. In order to enhance the curative potential of the active fraction F001, a well known plant showing antioxidant activity (NBR-AO-1) was selected and its 50% hydroalcoholic extract was submitted to CDRI for combination studies. It was found that the combination exhibited preventive as well as curative properties. Work was carried out to standardize NBR-015-P03-D001 with respect to its ingredients using HPTLC.

Non-Network Projects

REVITALIZATION OF TRADITIONAL MEDICINE FOLLOWING INDIAN ETHNO-PHARMACOLOGICAL APPROACH & DEVELOPMENT OF PLANT BASED HERBAL PRODUCTS (HEALTH CARE, NUTRACEUTICALS, COSMACEUTICAL ETC.) WITH LEAD FROM TRADITIONAL SYSTEM

- **Pharmacognostic evaluation of *Curcuma caesia* Roxb. rhizome.**

Curcuma caesia Roxb. (Zingiberaceae) is commonly known as 'Black turmeric' which grows in West Bengal, Madhya Pradesh, Orissa, Bihar, North-East and Uttar Pradesh and is widely used by ethnic communities for various ailments. Rhizomes of the plant are used for sprains and bruises and are also employed in cosmetics. In West Bengal it finds an important place in traditional system of medicine and is also used as a substitute for turmeric in fresh stage. Detailed pharmacognostical evaluation of the rhizome sample was done to develop pharmacopoeial standards of this species.

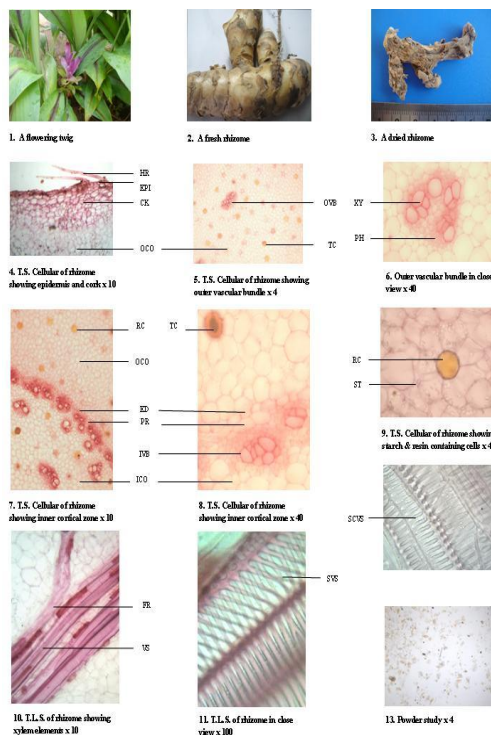


Plate 1- Macro and Microscopic characters of the rhizome of *Curcuma caesia*

OCO, Outer cortex, ICO, Inner cortex, EPI, Epidermis, CK, Cork cells, OVB, Outer vascular bundle, IVB, Inner vascular bundle, FR, Fibre, ST, Starch, VS, Vessel, XY, Xylem, PH, Phloem, ED, Endodermis, PR, Penicyle, HR, Hair, TC, Tannin containing cell, RC, Resin containing cell, SVS, Spiral vessel & SCVS, Scalariform vessel

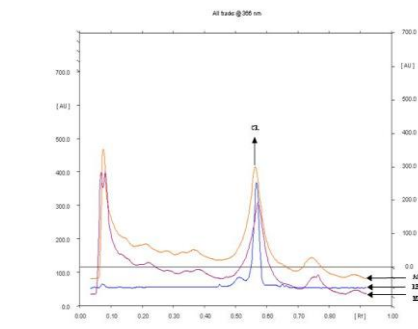
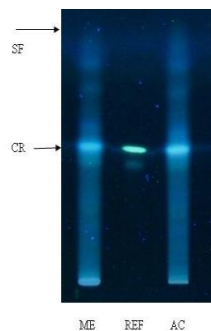


Plate-2 HPTLC profile of *Curcuma caesia* rhizome and reference sample (Under UV- 366 nm). SF, Solvent front, CR, Curcumin, REF, Reference sample, AC, Acetone extract and ME, Methanol extract

Analysis of Stem Barks

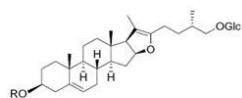
- Twenty five stem barks viz. *Acacia arabica*, *A. nelotica*, *Bombax ceiba*, *Buchanania lanzan*, *Caesalpinia bonduc*, *Calotropis procera*, *C. gigantea*, *Carissa carandas*, *C. bispinosa*, *Cassia fistula*, *Commiphora mukul*, *Dalbergia sissoo*, *Delonix regia*, *Ficus bengalensis*, *F. carica*, *F. glomurata*, *F. religiosa*, *F. retusa*, *Lawsonia innermis*, *Madhuca longifolia*, *Mangifera indica*, *Melia azedarach*, *Mimusops elengi*, *Tinospora cordifolia*, and *Ulmus wallichiana* were collected/procured for the second volume of the book 'Bark Drugs'. Macro-microscopic studies along with microphotography of the TS and TLS and HPTLC fingerprint profiling have been done for the aforesaid bark drugs.
- Four *Nephrolepis* species viz. *N. exaltata*, *N. tuberosa*, *N. biserrata* and *N. cordifolia* were studied through macroscopic description of fronds, microscopy characteristic of pinnule surface and HPTLC fingerprint profile. These can be identified on the bases of shapes and size of fronds, pinnules, epidermal cells, palisade cells and type of stomata. HPTLC fingerprint profile of the hexane extract showed common as well as differentiating bands in these four *Nephrolepis* species. It is also interesting to note that ursolic acid, β -sitosterol and lupeol was present in all the species but β -sitosterol found maximum in *Nephrolepis tuberosa*; ursolic acid and lupeol were found maximum in *N.biserrata*. The aforesaid four species were also screened for antimicrobial and antioxidant activities.
- **Simultaneous determination of Picrosides (Picroside-I and Picroside-II) in two *Picrorhiza* species through High Performance Thin layer Chromatography.**

Picrorhiza contains picroside-I and picroside-II, which are known bioactive metabolites. In our study a simple highly precise method has been established for the simultaneous determination of picrosides (picroside-I and picroside-II) in two different *Picrorhiza* species viz. *P. kurroa* and *P. scrophulariiflora*. This method was also validated for accuracy, precision, robustness, limit of detection and quantification (LOD and LOQ), repeatability, recovery, according to International Conference of Harmonization (ICH) guidelines. Separation and quantification was achieved by HPTLC using mobile phase chloroform: methanol (88:12, v/v) on pre-coated silica gel 60F₂₅₄ aluminium plates. Densitometric determination of Picroside-I & Picroside –II was also carried out at wavelength (λ max -254 nm) in absorption-reflectance mode.

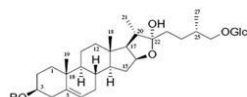
- **Comparative antioxidant activity and HPTLC method for quantification of Protodioscin & Prototribestin in fruits of *Tribulus terrestris* collected from different phyto-geographical zones of India**

Tribulus terrestris is a valuable herb known for its medicinal and dietary applications in India and all over world. The various chemical constituents of *Tribulus terrestris* have been found to possess various medicinal properties. Protodioscin and Prototribestin are steroidal saponin compounds present in the *Tribulus* species. A simple, rapid, cost-effective and accurate high performance thin layer chromatographic method has been developed for quantification of Protodioscin and Prototribestin in the fruit of *T. terrestris*. The collected accessions were successfully analyzed and depending on origin, a significant difference in the concentration of the Protodioscin & Prototribestin was observed. Separation and quantification was achieved by HPTLC using ternary mobile phase of n butanol: glacial acetic acid: water (8.0:0.6:2.0 v/v/v) on pre-coated silica gel 60F₂₅₄ aluminum plates with 45 min TLC chamber saturation. densitometric determination was carried out after derivatization with anisaldehyde-sulphuric acid reagent in absorption-reflectance mode.

The antioxidant activity of *T. terrestris* fruits was performed by using PCL method on Photochem instrument and results were expressed as equivalent units of trolox (standard) and highest antioxidant activity is observed in Pali (Rajasthan) sample of Arid zone.



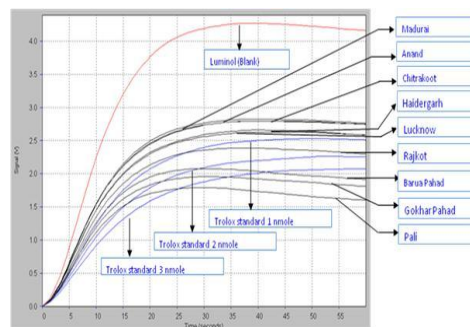
R - β -Glc²- α -Rha
OSO₃Na
Figure 1(a). Prototribestin (PT)



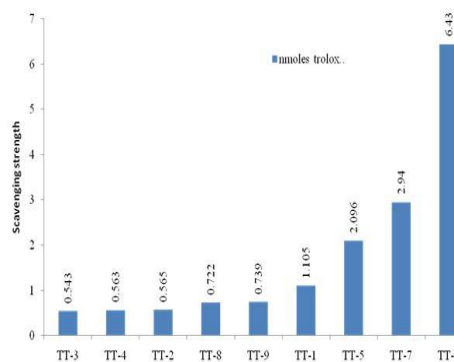
R - β -D-Glc⁴- α -L-Rha
 α -L-Rha
Figure 1(b). Protodioscin



HPTLC profile of *Tribulus terrestris* accessions with Protodioscin (PD) & Prototribestin (PT) (after derivatization with vanillin-sulphuric acid and visualized under λ 366 nm)



Antioxidant activity of *Tribulus terrestris*



Antioxidant activity of *Tribulus terrestris* accessions

● Phytochemical Standardization of *Decalepis hamiltonii* Wight & Arn. Root

Decalepis hamiltonii Wight & Arn. (Asclepiadaceae) is widely used in the traditional systems of medicine for many ailments. Roots are claimed to be useful as anti-inflammatory and antipyretic, antiulcer, antioxidant, hepatoprotective, neuroprotective, anxiolytic, antifungal and antibacterial. Tuberos roots are used as a cooling agent and blood-purifier. In our market survey it was observed that the plant is sold as a substitute of *Hemidesmus indicus*.

HPTLC, physico-chemical, fluorescence analysis and phytochemical evaluation presented as parameters to establish the authenticity of *Decalepis hamiltonii* root. This possibly helps to differentiate the drug from its allied species. The present communication deals with the detailed phytochemical standardization of the root sample.

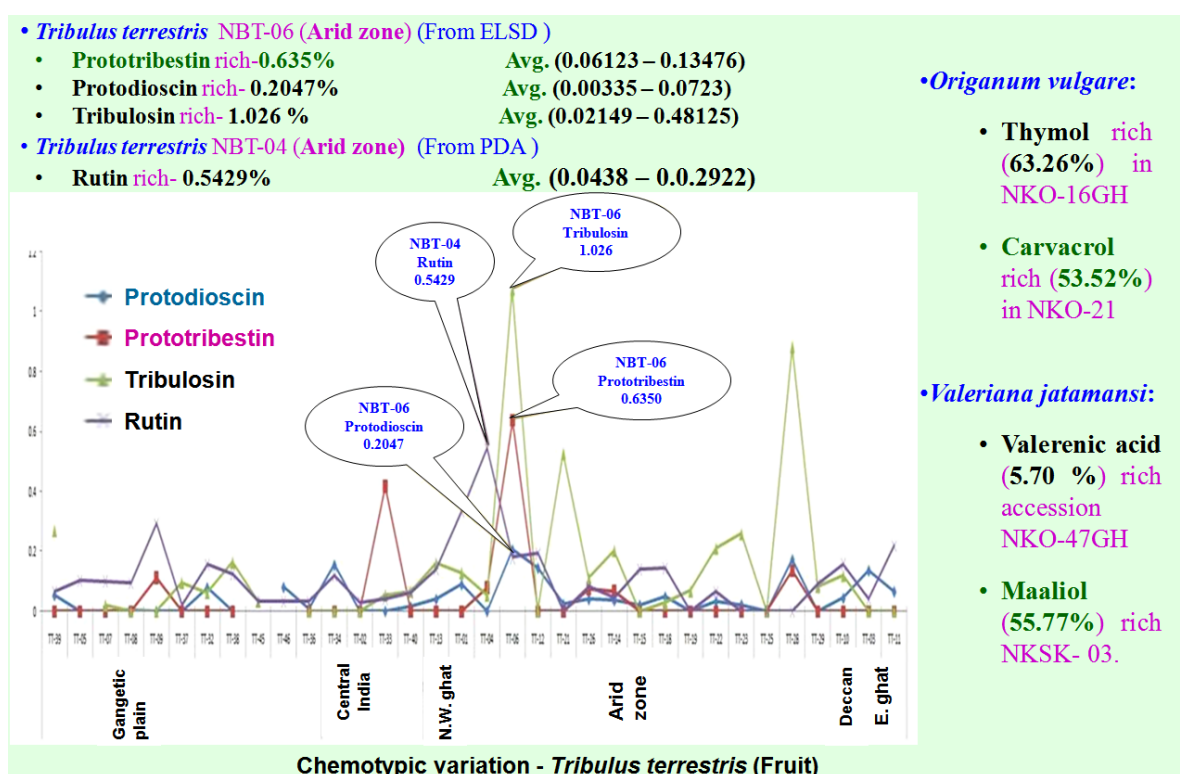
Physico chemical values viz. total ash, acid insoluble ash, alcohol and water-soluble extractives are observed. The Moisture content (18.23%), total ash (8.08%) and acid insoluble ash (0.77%) are considered to be an important and useful parameter for detecting the presence of moisture and inorganic substances. Similarly the alcohol-soluble extractives (15.00%) and water-soluble extractives (30.25%) are indicators of the total solvent soluble components, sugars (0.16%), starch (1.20%) and tannins (4.64%) were also shows quantity of different metabolites in this plant. Successive solvent extractions are carried through soxhlet apparatus and are indicators of the total soluble component at different polarity viz. hexane, chloroform, acetone, ethanol and water respectively (Fig. 1 &2).

In HPTLC analysis composition of mobile phase was optimized by testing different solvent systems of varying polarity and the best results were obtained by using Toluene:

Ethyl acetate (90:10 v/v) for Vanillin ($R_f=0.42\pm 0.02$). The R_f value of Vanillin in the sample track was found to be 0.42 ± 0.02 (Fig. 3-6). In the present study, vanillin content was found to be 0.094% w/w.

Study of herbal acaricides as means to overcome the development of resistance in ticks to conventional acaricides". GAP-274825 (NAIP/ICAR)

- New accessions of *Gymnema sylvestre* - (09); *Desmodium gangeticum* - (06); *Asparagus adscendence* - (21); *Tribulus terrestris* - (05); *Acorus calamus* (1); *Hedychium spicatum* - (02); *Oreganum vulgare* - (01); *Valeriana jatamansi* - (02) has been collected from different phytogeographical zones of the country.
- Quantification of biomarkers viz. Protodioscin, Prototribestin & Tribulosin in fruits of different accessions of *Tribulus terrestris* by HPLC-ELSD method.
- Quantification of gymnemic acid & gymnemagenin biomarkers in accessions of *Gymnema Sylvestre* by HPTLC method.
- Extraction of oil and gas chromatographic analysis of above collected accessions of *Hedychium spicatum*, *Oreganum vulgare*, *Valeriana jatamansi*, *Acorus calamus*.



Identification and biological studies of potential bioactive constituents from important medicinal plants (*Aegle marmelos*) used in gastrointestinal disorders and their geographical variations in chemical markers. GAP-275025 (NMPB, Dept. of AYUSH, New Delhi)

The Dried plant parts of *Aegle marmelos* viz fruits (10 Kg), roots (5 Kg), leaves (10 Kg) and bark (5 Kg) was collected from Delhi, Lucknow and Trivandrum respectively. The plant parts were shade dried and processed for extraction using 50% ethanol (EtOH). The percent yields of extract were 4.63, 9.65, 5.29 and 6.45 of leaves, fruits, bark and root respectively. The 50% ethanolic extract were subjected to qualitative tests for the identification of various active constituents viz. carbohydrate, glycoside, alkaloid, amino acids, flavanoids, fixed oil, tannins, gum and mucilage, phytosterols etc in all the sample

part extracts of *Aegle marmelos*. In continuation of the studies the 50 % ethanolic extract of leaves, fruit, bark and root of *Aegle marmelos* of Delhi, Lucknow and Trivandrum samples were subjected for HPTLC profiles on pre coated silica gel plate (Merck 60 F 254) the extract was spotted using a Camag Linomat IV spotter. Plates were scanned on TLC scanner III using WINCATS software and the chemical marker quantification was done of gallic acid and Rf values were recorded. The biological effects of the 50% EtOH extract of *Aegle marmelos* fruit was subjected in rats at doses of 50-200 mg/kg, twice a day for 5 days prevented the acute gastric ulcers in a dose related manner. The range of percent protection were pylorus ligation (PL) 14.48-51.03% (P< 0.01), aspirin (ASP) 28.80 – 56.52% (P< 0.05), ethanol (EtOH) 13.22 – 60.74% (P<0.05 – 0.001) and cold restraint stress (CRS) 21.22 - 77.14 % (P<0.05 - <0.001), respectively. The percent protection of ranitidine ranged from 57.44 – 80.0% (P< 0.05 – < 0.001), respectively in various gastric ulcer models. The present study showed that the ethanolic extract of *Aegle marmelos* possess gastroprotective activity as evidenced by its significant inhibition in the formation of ulcers induced by various physical and chemical agents. Further studies are under investigation on leaves, bark, and root in gastric ulcer studies and anti-diarrhea activity of *Aegle marmelos* fruit, leaves, bark, and root.

Preparation and supply of Botanical References Substances (BRS) to Indian Pharmacopoeia Commission (IPC) New Delhi. GAP-275425

Under the BRS programme two drug samples (viz. *Boerhaavia diffusa*, *Eclipta alba*,) were collected in bulk. Their quality strength was confirmed using physicochemical parameters (Alcohol and water extractives, ash values and qualitative HPTLC profile). These samples (BRS) have been sent to the IPC, Ghaziabad along with their passport data sheet and compliance results.

Novel Approaches for Production of Nutraceuticals from Milk and Indian Herbs for Potential Use in Functional Dairy Foods. GAP-275325 (NAIP/ICAR)

Three Indian herbs (NBD-1, NBD-2 and NBD-3) were selected for incorporation in functional dairy foods in a form compatible to milk systems. All three plant materials were procured in bulk and their hot water extracts and ethanolic extracts were prepared and sent to NDRI, Karnal for studies. Prominent biomarkers for chemical standardization for these herbs were identified. HPLC method developed for standardization of NBD-3 using puerarin as standard.

To study the feasibility of using the cattle rumen system to enhance productions of the nutraceutical Conjugated Linoleic acid (CLA) directly in milk by adding suitable herbs/herbal extracts in the feed, 5 new plant materials were collected, extracted and sent to NDRI, Karnal. One of them has shown good results.

Identification of substitutes for traded drug Chirayata (*Swertia* species) using pharmacognostic and pharmacological parameters. GAP-275125 (NMPB, Dept. of AYUSH, New Delhi)

Comparative Pharmacognostic Evaluation of Three species of *Swertia* L. (Gentianaceae)

Swertia spp. (Gentianaceae) commonly known as *Chiraita* in herbal drug markets of India are used to protect liver and a wide range of diseases. The official species *Swertia chirayita* (Roxb.) Karsten is known for its potent activity against malaria, liver-disorder, fever, diabetes and also as appetite stimulant. However, several other species of *Swertia* viz. *S. alata* (Royle ex D. Don) Clarke and *S. paniculata* Wall. are being used as substitutes /adulterants for *S. chirayita* in India, Japan, China, Pakistan and other Asian Countries.

The detailed morphological and anatomical studies revealed that there are marked differences in morphological characters such as shape of leaves (elliptic or ovate -lanceolate

in *S. chirayita*, linear or linear-lanceolate in *S. paniculata* and ovate-oblong in *S. alata*) and stem (narrowly winged in *S. alata*, while cylindrical to obtusely 4-angled in *S. chirayita* and *S. paniculata*). However, the main distinguishing features among these species are: flowers pentamerous in *S. paniculata* and tetramerous in *S. chirayita* and *S. alata*, and each petal in *S. chirayita* have 2 glands, whereas in other two species there is single gland on each petal.

There are some minor variations in the microscopic characters as calcium oxalate crystals are absent in *S. alata*. No appearance of cavity in the pith region of stem in *S. alata* and *S. paniculata* while cavities present in premedullary region of *S. chirayita*. Besides, there is also variation in physicochemical parameters and Oleanolic acid concentration among these species.

Development of herbal formulation used in treatment of hepatic cellular carcinoma. GAP-274625.

The herbal drugs, *Cissampelos pareira*, *Tephrosia purpurea*, *Fumaria indica*, *Rubia cordifolia* and *Hemidesmus indicus* were selected to treat hepato cellular carcinoma (HCC). Fresh plant materials were collected and dried materials were extracted with 50% ethanol. HPTLC fingerprints of extracts of *T. purpurea* and *R. cardifolia* were recorded. Extracts of *F. indica* was fractionated with different solvents. HPTLC fingerprints of different fractions of *F. indica* were recorded. Extracts were treated with N-nitrosodiethylamine (NDEA) induced HCC rats. *T. purpurea* treated rats showed as significant and dose dependent alteration in serum levels of SGOT, SGPT, ALP, BL and GGT. The levels of antioxidant enzymes CAT, SOD and GSH showed dose dependent increase in *T. purpurea* treated HCC rats. The whole plants of *Fumaria indica* (Hausk) Pugsley, (Family: Fumariceae), commonly known as parpat, pitpapda and shahterah, forms a constituent of many Ayurvedic, Unani medical preparations and marketed polyherbal liver formulations. The plant has been used in the indigenous system of medicine and literature in the treatment of the hepatocellular damage and biliary obstruction. In this study, 50% ethanolic extract of the *Fumaria indica* and methanolic fraction treatment showed a significant and dose dependent alteration in levels of SGOT, SGPT and ALP in serum which were recuped back to near normal in HCC bearing animals which shows the anticarcinogenic activity of the plant. The levels of CAT, SOD and GSH-Px showed dose dependent increase with 50% ethanolic extract of the *Fumaria indica* and methanolic fraction in HCC rats. Whereas the levels of GST showed significance at the higher dose levels of the 50% ethanolic extract of *F. indica*. Changes in the architecture of liver cells were observed in NDEA induced changes in liver as evidenced by fatty acid infiltration, variation in mitotic figures and focal necrosis. All these histopathological changes have shown the architecture of liver cell to near normal by the administration of *F. indica* and ferulic acid. These observations and description of mechanism of *Fumaria indica*, which interplay with cancer biology and pharmacology lead to rapid development in cancer treatment.

Role of selected flavonoid on gastroesophageal reflux disease (GERD) and gastric ulcers in rats. GAP-274925

Induction of reflux oesophagitis

Oesophagitis were produced in fasted rats of 24 h under light ether anaesthesia, The abdomen of the animal was opened by a median incision of about 2cm; Then the transitional region between the fore stomach and corpus was then ligated very carefully with a 2-0 silk thread, and continuously the pylorus portion was ligated. A longitudinal cardiomyotomy of about 1cm length across the gastro-oesophageal junction was performed to enhance reflux from the stomach contents into the oesophageal body. Immediately the incised regions were sutured and returned to their home cages. After 6 h, The animals were sacrificed by cervical dislocation and the chest was opened with a median incision and the tissue oesophagus and stomach was removed opened along the greater curvature of the stomach, and the

oesophagus was dissected out by extending the dissection line along the major axis. The tissues were washed with physiological saline and were examined for ulceration. The entire area of oesophagus damages was then fixed in 10% formalin for the histological evaluation.

The herbal drugs selected for the investigation(s) were *Argyreia speciosa* (flowers), *Aegle marmelos* (fruits), *Annona squamosa* (leaves) and *Moringa oleifera* (leaves) based on the concept of traditional texts from Ayurveda, Siddha as well as from the folk remedies practiced by villagers and tribals. These selected plant parts were collected, authenticated, dried and processed for the extractive yields and showed significant activity against GERD in rats.

Gastric Ischemia-Reperfusion

The celiac artery was occluded with a micro bulldog clamp for 30 minutes. At the end of the ischemic period, the clamp was released and three drops of lidocaine were applied directly on the celiac artery to facilitate reperfusion. Immediately after reperfusion the surgical wound was sutured with the treatment of protecting suppuration. Then rats were treated with test compounds at 14, 48 and 72 h after the I/R and control animals received physiological saline (0.9% NaCl in double distilled water). The rats were killed at one hour after the last dose of administration by exsanguinations via the abdominal aorta, and the stomach was removed and total area of ulcers (mm²) at 72h after I/R was recorded.

Short term validation of traditional knowledge (particular emphasis on diarrhea. MLP-000525.

Ethyl acetate fraction of *Azima tetraacantha*, *Solanum trilobatum* and *Gynandropsis pentaphylla* showed dose dependent and significant antidiarrhoeal activity in castor oil –induced diarrhea and gastro-intestinal propulsion in rats and no effect on normal defecation. However, HPTLC and HPLC finger prints of the bioactive fractions were standardized for the bioactive chemical markers. The antidiarrhoeal activity of NIF 6, NIF 9 were studied in standardized experimental models and the results showed dose dependent activity in castor oil- induced diarrhoea,. (+)-Catechin was examined for gastric ulcer protection on ischaemia- reperfusion (I/R) and the results suggested that (+)-catechin protected gastric mucosa against ischaemia-reperfusion-induced gastric ulcers by its antioxidant activity and mucus protection

6	<p>List of Ongoing projects:</p> <p>Network project</p> <p>Discovery and preclinical studies of new bioactive molecules (Natural and semi-synthetic) & traditional preparations. NWP-0037. (CSIR)</p> <table style="width: 100%; border: none;"> <tr> <td style="width: 5%;">1.</td> <td style="width: 60%;">Director</td> <td style="width: 35%;">Coordinator</td> </tr> <tr> <td>2.</td> <td>Dr. A.K.S. Rawat</td> <td>Principal Investigator</td> </tr> <tr> <td>3.</td> <td>Dr. Ch.V. Rao</td> <td>Co-PI</td> </tr> <tr> <td>4.</td> <td>Dr. Sayyada Khatoon</td> <td>„</td> </tr> <tr> <td>5.</td> <td>Dr. Sharad Kumar Srivastava</td> <td>„</td> </tr> <tr> <td>6.</td> <td>Dr. Sanjeev Kumar Ojha</td> <td>„</td> </tr> <tr> <td>7.</td> <td>Dr. Subha Rastogi</td> <td>„</td> </tr> <tr> <td>8.</td> <td>Dr. M. Vijayakumar</td> <td>„</td> </tr> </table> <p>1. Rural School Health Education programme integrating with diverse inputs Reaching the Unreached. MLP-0006 (sponsored by CSIR)</p> <p>(Project Duration – April 2008 to Contd...)</p> <table style="width: 100%; border: none;"> <tr> <td style="width: 5%;">1.</td> <td style="width: 60%;">Director</td> <td style="width: 35%;">Coordinator</td> </tr> <tr> <td>2.</td> <td>Dr. A.K.S. Rawat</td> <td>Principal Investigator</td> </tr> </table>	1.	Director	Coordinator	2.	Dr. A.K.S. Rawat	Principal Investigator	3.	Dr. Ch.V. Rao	Co-PI	4.	Dr. Sayyada Khatoon	„	5.	Dr. Sharad Kumar Srivastava	„	6.	Dr. Sanjeev Kumar Ojha	„	7.	Dr. Subha Rastogi	„	8.	Dr. M. Vijayakumar	„	1.	Director	Coordinator	2.	Dr. A.K.S. Rawat	Principal Investigator
1.	Director	Coordinator																													
2.	Dr. A.K.S. Rawat	Principal Investigator																													
3.	Dr. Ch.V. Rao	Co-PI																													
4.	Dr. Sayyada Khatoon	„																													
5.	Dr. Sharad Kumar Srivastava	„																													
6.	Dr. Sanjeev Kumar Ojha	„																													
7.	Dr. Subha Rastogi	„																													
8.	Dr. M. Vijayakumar	„																													
1.	Director	Coordinator																													
2.	Dr. A.K.S. Rawat	Principal Investigator																													

3. Dr. Sanjeev Kumar Ojha Co-PI

2. Studies on relationship between ecogeography of the chemotypic variation of nine important but highly threatened medicinal plant species and prospects of their cultivation". GAP-274725 (Sponsored by NAIP/ICAR, New Delhi)

Project Duration – Sept. 2008 to March 2012)

1.	Dr. A.K.S. Rawat	Consortium Leader & PI
2.	Dr. S.K. Tiwari	Co-PI
3.	Dr. Sharad Srivastava	„
4.	Dr. Subha Rastogi	„

3. Study of herbal acaricides as means to overcome the development of resistance in ticks to conventional acaricides". GAP-274825 (Sponsored by NAIP/ICAR, New Delhi)

Project Duration – Sept. 2008 to March 2012)

1.	Dr. A.K.S. Rawat	Principal Investigator
2.	Dr. Ch.V. Rao	Co-PI
3.	Dr. Sharad Srivastava	„
4.	Dr. Subha Rastogi	„

4. Novel Approaches for Production of Nutraceuticals from Milk and Indian Herbs for Potential Use in Functional Dairy Foods. GAP-275325 (Sponsored by NAIP/ICAR, New Delhi)

Project Duration – Jan. 2009 to March 2012)

1.	Dr. A.K.S. Rawat	Coordinator
2.	Dr. Subha Rastogi	Principal Investigator

5. Identification of substitutes for traded drug Chirayata (*Swertia* species) using pharmacognostic and pharmacological parameters. GAP-275125 (Sponsored by NMPB, Dept. of AYUSH, New Delhi)

Project Duration – August 2008 to October 2011

1.	Dr. A.K.S. Rawat	Principal Investigator
2.	Dr. Ch.V. Rao	Co-PI
3.	Dr. Sharad Srivastava	„
4.	Dr. Sanjeev Kr. Ojha	„
5.	Dr. Bhaskar Dutt	„

6. Preparation and supply of Botanical References Substances (BRS) to Indian Pharmacopoeia Commission (IPC) New Delhi. GAP-273425 (Sponsored by Indian Pharmacopoeial Commission, Govt. of India, Ghaziabad, U.P.)

Project Duration – April 2009 to March 2012

1.	Dr. A.K.S. Rawat	Principal Investigator
2.	Dr. Sharad Srivastava	Co-PI
3.	Dr. Subha Rastogi	„

	<p>4. Dr. M.M. Pandey „</p> <p>7. Identification and biological studies of potential bioactive constituents from important medicinal plants (<i>Aegle marmelos</i>) used in gastrointestinal disorders and their geographical variations in chemical markers. GAP-275125 (Sponsored by NMPB, Dept. of AYUSH, New Delhi)</p> <p>Project Duration – August 2008 to October 2011</p> <p>1. Dr. Ch.V. Rao Principal Investigator 2. Dr. A.K.S. Rawat Co-PI 3. Dr. M. Vijayakumar „</p> <p>8. Role of selected flavonoid on gastroesophageal reflux disease (GERD) and gastric ulcers in rats. GAP-274925</p> <p>1. Dr. Ch.V. Rao Principal Investigator 2. Dr. A.K.S. Rawat Co-PI 3. Dr. M. Vijayakumar „</p> <p>9. Short term validation of traditional knowledge (particular emphasis on diarrhea. MLP-000525.</p> <p>1. Dr. Ch.V. Rao Principal Investigator 2. Dr. A.K.S. Rawat Co-PI</p> <p>10. Search for elite chemotype (s) of industrially valuable threatened medicinal species and their relationship with ecogeography” OLP-077 (Sponsored by CSIR, New Delhi)</p> <p>1. Dr. Sharad Srivastava Principal Investigator</p>
7	<p>Significant achievements:</p>
	<ul style="list-style-type: none"> • Quality parameters of over 150 raw single drugs were developed and out of which 52 monographs have been published in 1 to 8 volumes of ‘Quality Standards of Indian Medicinal Plants’. The monographs are on the pattern of WHO guidelines and incorporate the diagnostic features, phytochemical studies including marker compound, information on pharmacological, clinical, toxicological aspects, dosage, adulterants/substitutes etc. The finger print profile (TLC/GLC/HPLC), as also quantification of the marker compound may serve as guiding line to the phytochemical profile of the drug in ensuring the quality. • Technology developed –

- **Health Protective Herbal Soft Drink**



- **Antiulcer Herbal Composition(S)**



- **Wound Healing Herbal Composition(S)**



- **Herbal Cough Formulation (Dosage form Syrup)**



- **Herbal Lipstick from Plant Resources (*Herbal Colours & Aroma Useful for Cosmeceuticals*)**



8. Recent Publications:

1. Khatoon Sayyada, Singh Harsh, and Goel A.K. (2011) Use of HPTLC to Establish the Chemotype of a Parasitic Plant, *Dendrophthoe falcata* (Linn. f.) Etting. (Loranthaceae), Growing on Different Substrates. *Journal of Planar Chromatography*, 24 (1) 60-65. **(IF-1.115)**
2. Tiwari Shashi, Pandey Madan Mohan, Srivastava Sharad and Rawat AKS (2011). TLC densitometric quantification of picrosides (picroside-I and picroside-II) in *Picrorhiza kurroa* and its substitute *Picrorhiza scrophulariiflora* and their antioxidant studies. *Biomedical Chromatography* (Online available) (wileyonlinelibrary.com) DOI 10.1002/bmc.162. **(IF-1.639)**
3. Verma Arti R., Vijayakumar M., Rao Ch.V., Mathela Chandra S. (2010). In vitro and in vivo antioxidant properties and DNA damage protective activity of green fruit of *Ficus glomerata*. *Food and Chemical Toxicology* 48(2): 704-709 **(IF-2.114)**
4. Begum S, Saxena B, Goyal M, Ranjan R, Joshi VB, Rao Ch.V. (2010). Krishnamurthy S, Sahai M; Study of anti-inflammatory, analgesic and antipyretic activities of seeds of *Hyoscyamus niger* and isolation of a new coumarinolignan. *Fitoterapia*. 81(3): 178-84 **(IF-1.363)**
5. Srivastava Amit, Tiwari Shashi Shankar, Srivastava Sharad and Rawat A.K.S. (2010). HPTLC method for quantification of Valerenic acid in Ayurvedic drug Jatamansi and its substitutes. *Journal of Liquid Chromatography & Related Technique* 33(18): 1679-1688.
6. Verma Durgesh, Srivastava Sharad, Singh Vineet and Rawat A.K.S. (2010). Pharmacognostic evaluation of *Curcuma caesia* Roxb. rhizome. *Natural Product Sciences* 16(2): 107-110.

	<p>7. Srivastava Sharad Kumar, Rawat Ajay Kumar Singh and Mehrotra Shanta (2010). Pharmacognostic evaluation of the roots of <i>Berberis lyceum</i> Royle. <i>Oriental Pharmacy and Experimental Medicine (OPEM)</i> 10(3): 184-190.</p> <p>8. Rastogi Subha, Pandey Madan Mohan, Rawat Ajay Kumar Singh (2011). An ethnomedicinal, phytochemical and pharmacological profile of <i>Desmodium gangeticum</i> (L.) DC. and <i>Desmodium adscendens</i> (Sw.) DC. <i>J Ethnopharmacol</i> 136(2): 283-96. (I.F. – 2.322).</p> <p>9. Eswaran M. Bavani, Surendran S., Vijayakumar M., Ojha S.K., Rawat A.K.S., Rao Ch.V. (2010). Gastroprotective activity of <i>Cinnamomum tamala</i> leaves on experimental gastric ulcers in rats. <i>J. of Ethnopharmacology</i> 128: 537–540. (IF-2.260)</p> <p>10. Singh Meenakshi, Singh Shweta, Nath Virendra, Sahu Vinay and Rawat Ajay Kumar Singh (2011). Antibacterial activity of some bryophytes used traditionally for the treatment of burn infections. <i>Pharmaceutical Biology</i> 49(5): 526-530. (I.F. – 0.672).</p>
9	<p>Scientists:</p> <ol style="list-style-type: none"> 1. Dr. A.K.S. Rawat - Principal Senior Scientist & HOD 2. Dr. Ch.V. Rao – Senior Scientist 3. Dr. Sayyada Khatoon – Senior Scientist 4. Dr. Sharad Srivastava – Senior Scientist 5. Dr. Sanjeev Kumar Ojha - Senior Scientist 6. Dr. Subha Rastogi – Senior Scientist 7. Dr. M. Vijayakumar – Scientist
10	<p>Technical Staff</p> <ol style="list-style-type: none"> 1. Dr. Madan Mohan Pandey (T.O.) 2. Mr. Ram Gopal Pandey (Helper)
11	<p>Research Fellows/ Project Assistants:</p> <ol style="list-style-type: none"> 1. Dr. Amit Srivastava 2. Mr. Antariksha Katara 3. Mr. Digvijay Verma 4. Ms. Shweta Singh 5. Ms. Deepa Bisht 6. Mr. Pradeep Kushwaha 7. Mr. Abhishek Gupta 8. Mr. Shikhar Verma 9. Ms. Vartika Khare 10. Mrs. Monika Sharma