

## PHYTOCHEMISTRY DIVISION

### 1.OBJECTIVES :

- **Screening of plants for anti HIV activity: a step towards the development of microbicides.**
- **Bioprospecting natural products as antioxidant, antimicrobial ,antidiabetic and antifungal, in management of ENT disorders.**
- **Phytochemical studies of wild ,cultivated and GM plants/crops for secondary metabolites / phytochemicals /bio-molecules.Isolation & characterization of secondary metabolites / phytochemicals –an approach to identify novel biomolecules. to mimic the total or partial analogues of identified compounds .**
- **Development of health promoting herbal products as fortified foods and nutraceuticals and standardization of bioactive compositions.**
- **Bioprospection of dyes and gums.**

### 2.GOALS :

1. Biomolecules /Biocompositions/formulations as anti HIV.
2. Development of natural food colors and hair dyes.
3. Gums as food additive and stabilizer , as biodegradable natural films and fims for encapsulation.
4. Development of herbal remedies/ biocompositions for health management, as anti viral, antibacterial, antifungal, antitermite , fortified foods, biopesticides and biofuels.

### **Significance of the work :**

Plants have been utilized for treating various ailments for centuries in both developed and developing countries and are gaining popularity because of fewer side effects, better patient tolerance, relatively less expensive and acceptance due to long history of use. Many compounds of plant origin have been identified that inhibit different stages in the replication cycle of HIV. AIDS appeared in distant and various areas of the earth during second half of

20th century, at a moment when the immune systems of humans, as well as other bodily systems, were already saturated with exposure to a great variety of stressor agents. As an estimate, 70 million people, world wide were infected with HIV since 1980 and worldwide approximately 15,000 new cases of HIV infection are reported every day.

HIV, a retrovirus of the genus lentivirus that infects CD4<sup>+</sup> T lymphocytes, dendritic cells and macrophages is the causative agent of AIDS. In majority of the cases, HIV infection occurs through heterosexual route. Treatment options for HIV infection with highly active antiretroviral drugs have expanded during the past few years. However, it is likely that long-term use of chemical drugs either singly or in combination may lead to toxicity, especially to the bone marrow and suppression of CD8<sup>+</sup> T cells along with different unwanted secondary effects. Another major concern in long-term chemical anti-retroviral therapy is the development of HIV mutations leading to either partial or complete resistance to these therapies. One option for prevention of HIV transmission through hetero- or homo-sexual routes is to apply topically to the vaginal or rectal surface, a cream, gel, lubricant or even insert a tablet, which have incorporated anti-HIV compound(s) before sex. These are generically termed as **microbicides**, which will also be very useful for prevention of HIV infection.

Further antioxidants play a significant role in protection of immune system by reducing oxidative stress. In HIV infection, oxidative stress may be caused by both overproduction of reactive oxygen intermediates (free radicals) and a simultaneous deficiency of antioxidant defense. Higher level of antioxidant can slow down the virus and help repair e.g deficiencies of selenium is common among patients with HIV infections or AIDS. Different bio-molecules/ phytochemicals, essential oils and dyes from wild and cultivated plants could be identified as potential remedies of different infections.

Dyes and gums can be used in food, textile and also in cosmetics as new process / product for food colours, stability and their chemotaxonomy in wild and cultivated plants. Gums from wild sources and their derivatives may find use as biodegradable films and films for encapsulation. Analysis of some oilseeds of commercial importance for quality and surveillance. Oil obtained from the seeds are used globally in food, fuel, drugs, medicaments, laundry, soaps, detergents, beverages and cosmetics as important economic product. Further increasing prices, high demands, adulterations and substitutions has exaggerated the current problem of quality in terms of heavy metal toxicity. There were significant variations in heavy metal concentration in different components of the seeds, their studies are useful for safe usage of heavy metal free seeds and their components for specific utilization in quality natural products.

### 3. COMPETENCIES :

The group has an expertise in isolation and characterization of the different bio- molecules, essential oils, lipids, gums and dyes from wild and cultivated plants . The group has developed of new process for herbal biocompositions as anti HIV, fortified foods/ nutraceuticals, herbal dyes as cosmaceuticals ( hair dyes, herbal gulal , herbal sindoor etc), food colours, gums as food additive , as stabilizer and their use in encapsulation apart from chemotaxonomy in wild and cultivated plants

5. **FACILITIES :** Lypholiser, rotavapours, spray dryer, GLC, HPLC, Polarimeter, UV spectrophotometer, Viscometer,Rheometer, Centrifuge, Balance, UV cabinet for TLC, Balances, refractometer , deep freezer etc.

## 6. HIGH LIGHT CURRENT RESEARCH

*The group is engaged in :*

1) Screening of medicinal plants for anti HIV activity:Different extracts/ fractions/ biomolecules of selected medicinal plants are being evaluated for general cell toxicity by MTT assay. Lab adapted X-4 strain of HIV-1NL4-3 isolate was used to infect the TZM-bl cell line & CEM-GFP cell leading to identification of some bioactive fractions with significant anti HIV activity. Few compounds have been identified to possess significant anti HIV activity.

2). Bioprospecting natural products as antifungal antimicrobial and antioxidant :

A) Antifungal activity of different herbal extracts against *Rhizoptomia solanai* ,*Drechslera oryzae* and *Sclerotonia scleretium* leading to significant results.

B) Phytochemicals investigation lead to identification of as potent antioxidant, which may be explored as hepatoprotective , viral infection preventive and chemopreventive .Anti oxidant activity and estimation of total tannins & phenolic content of *Citrus* cultivars and other selected plants showed significant results. Antioxidant and total phenolic content , vitamins, lycopene estimation of the transgenic tomatoes utilizing have been carried out with significant results.

3) Isolation and characterization of phytochemicals from different bioactive fractions, which have been characterized by different spectroscopic techniques viz. NMR, MS, UV, IR and other spectroscopic tools etc.

#### 4) Study of GUMS & LIPIDS

i) Phytochemical evaluation of lesser known/novel gum sources /derivatives for natural products/additives was accomplished leading to identification gums with stabilizing property and biofilm utility. Interaction and derivatization studies of macromolecular polysaccharidic gums for improved functional properties and natural products. standardization, stability and lab scale development of films.

ii) Different species of *Acacia, Albizia, Bauhinia, Cassia, , Caesalpinia, Crotilaria, Desmodium, Indigofera, Milletia, Melilotus, Prosopis, Sterculia etc* were investigated for seeds, endosperm, gum quality and yield along with pentosan content and constituent sugars viz. different species of *Cassia*, has been identified for potential gum and as source of new formulations as additives and biodegradable films. *Dhaincha* gum from *Sesbania bispinosa* & Cassia gum for *Cassia tora* are adopted by gum industry. More than 20 natural gums/gum derivatives are identified for binding and stabilizing for colouring silk, cotton and wool for textiles.

#### 5) Dyes and oils

i) Food colours from different species of *Paprika, amaranthus, Celosia, Beta vulgaris, Brownia ariza, Cochosperrum vitifolium, Chrysanthamum, Curcuma, Indigo, and Bixa* etc.

ii). Study of essential oils from different aromatic plants and their utility as flavouring agents, insecticidal and insect repellent. Study of Oils and fatty acids in different edible and non-edible plant seeds, residual pesticides, lipids and fatty acids of traditional and non-traditional plant sources. Evaluations of lipids and fatty acids of different edible seeds of commercial importance.

### 6. LIST OF ONGOING PROJECTS

NBRI Project No. : OLP 0041/ DU7

- i) Phytochemical investigations in lipids, essential oils, gums and dyes with an approach to bio-prospecting natural products.
- ii) Screening plants for anti HIV activity: a step toward the development of microbicides

## 2. Name and Title of the Research Project : GAP Projects :

1. Identification and characterization of novel anti-viral compounds from medicinal plants: A step toward the development of microbicides and National Facility for screening of promising microbicides. GAP 245325.
2. Development of herbal formulations and characterization of their active components for prevention of HIV infection and National Facility for screening of compounds for anti-HIV activity GAP275535
3. Identification and biological studies of potential bio-active studies of potential bio-active constituents from important medicinal plants (*Aegle marmelos*) used in gastrointestinal disorders and their geographical variation in chemical markers. GAP 275025
4. Identification and biological studies of potential bio-active studies of potential bio-active constituents from important medicinal plants (*Aegle marmelos*) used in gastrointestinal disorders and their geographical variation in chemical markers. GAP 275025
5. Pilot scale demonstration of algal oil production upto 100 litres per month GAP-272154.

## 7. SIGNIFICANT ACHIEVEMENTS

1. Development of a process for **anti HIV composition**.
2. Identification of different bioactive extracts/ fractions/ biomolecules from natural sources as **significant Anti HIV & Virucidal (antiviral)**.
3. Isolation & characterization of **> 40 novel compounds** ( alkaloids, phenyl propanoids, flavone, anthraquinones , their glycosides, polysaccharides, mono & sesqui terpenes from essential oils and triterpenes etc) from different medicinal & aromatic plants.
4. Development of 10 Nutraceutical products viz. Nutra-Diab, Nutra-Antiox, Nutra-Preg, Nutra-Lact, Nutra-Wom GH, Nutra-Balyog , Nutra-Immune, Nutra-PanTon, Nutra-Speech & Nutra-Age.
5. Development of herbal dyes as herbal gulal, natural hair dye and herbal sindoor.
6. In vivo synthesis of t-anethole : “A process for t-anethole rich fennel oil”.

7. Bioprospection of natural gums and their derivatives as binder, moisture absorber, stabilizer biodegradable films and biopolymers

8. Major Technologies/product(s) developed

1. Development of process for anti hiv composition : plant extract for anti-human immunodeficiency virus ( HIV ) activity and preparation thereof" I
2. A process for t-anethole rich fennel oil : In vivo synthesis of biomolecule” .
3. Development of ten nutraceuticals viz. Nutra-Products viz. Nutra-Diab, Nutra-Antiox, Nutra-Preg, Nutra-Lact, Nutra-Wom GH, Nutra-Balyog , Nutra-Immune, Nutra-PanTon, Nutra-Speech & Nutra-Age. Commercialized – Nutra Diab.
4. Development of Herbal Gulal, Herbal Hair dyes and Herbal Sindoor.

## 8. Recent publications:

### A) PATENTS :

1. **“Plant extract for anti-human immunodeficiency virus (hiv) activity and preparation thereof”** S.K.Gupta,Manoj Modi, Nutan,Sweta Mallik, Rakesh Tuli, Swadesh Malhotra,A.K.S.Rawat ,S.Srivastava, del no. 242/DEL/2010.
2. **“A process for t-anethole rich fennel oil”** V.K.Garg, S. Malhotra, P.K.Singh, Tahseen Bano & P.Puspangadan. nf 0330/2004.
3. Herbal Black dye used in beautifying the hair and its applications.. Pal, M., Srivastava, M., Dixit, B.S. and Banerji, R. **An improved dye** [302NF2006]  
. Puspangadan, P; **Pal, Mahesh**; Dixit, B.S., Banerji, R. and Rao Ch.V.  
**0387NF2004, For PCT**
4. Mosquito Repellent Herbal Formulation Puspangadan, P.; Kumar, K., **Pal, Mahesh**; Chandrashekar, K., Rao, Ch. V.  
**0125NF2005, Places to be Filed- WO, US, GB, JP, CN**
5. Herbal Formulation for Mosquito Repellent Puspangadan, P.;Kumar, K., **Pal, Mahesh**; Chandrashekar, K., Rao, Ch. V **India No.920 DEL 2006**

6. "A composition of enhancement of herbal dye" **Pal Mahesh**. Srivastava, Manjoosha, Dixit, B.S. and Banerji, RFiled no. **302NF 2007** .
7. "Natural hair dye and its applications", **Pal Mahesh. Srivastava, Manjoosha, and Banerji**, RFiled no. 004NF 2008 Place to filed – Indiadana Venkateswara Rao.11/06/20072007-54511209/07/20104546540
8. A process for the preparation of custom made herbal health protective nutraceuticals for females / expectant mothers Pushpangadan; Palpu; Prakash; Dhan - 30/08/2001 0895DEL2001 10/02/2006 1943640/284NF2001/IN
9. Herbal health protective and promotive nutraceuticals for diabetics Pushpangadan P, Prakash D---17/02/20030135DEL200325/08/2010242387 /0168NF2002/IN
10. Herbal health protective and promotive nutraceuticals for diabetics Pushpangadan P, Prakash D-17/02/20030135DEL200325/08/2010242387 /0168NF2002/IN
11. Custom made herbal health promotive formulation for females/expectant mothers Pushpangadan; Palpu; Prakash; Dhan- 31/08/2001 09/944261 19/04/2005 6881425 USA
12. Herbal health protective and promotive nutraceuticals for diabetics Pushpangadan P, Prakash D --- 26/03/2002 10/108095 21/03/2006 7014872 USA
13. Process for the preparation of custom made herbal health protective nutraceuticals Pushpangadan; Palpu; Prakash; Dhan.28/02/20042004-700306425/08/200810-0855376 Republic Of Korea
14. Process for the preparation of custom made herbal health protective nutraceuticals Pushpangadan; Palpu; Prakash; Dhan 23/04/200401823681.205/08/2009ZL01823681.2 China
15. Herbal black dye used in beautifying the hair and its applications Palpu Pushpangadan, Mahesh Pal, Bhagwan Shankar Dixit, Ranjan Bannerji, ChanUSA- 30/12/2004 11/027575 06/03/2007 7186279.
- 16.. "Process for the preparation of a bioactive composition from *V. negundo*"

17.S.K.Banerjee, J.L.Suri, B.D.Gupta , S. Malhotra , B.Singh, A.Prabhakar ,  
B.K.Chandan, & K.L.Dhar.,del.No. 128/97/28597 ( Commercialized in 2005)  
Commercialized to Medley Pharmaceutical Pvt. Ltd., Mumbai , trade name LIV-1.

18.“Hepatoprotective activity of 2’-p--hydroxy benzoyl mussaenosidic acid”

A.Prabhakar, B.D.Gupta , K.A.Suri, N.K.Satti, S. Malhotra, K.K.Gupta, R.K.Johri,  
B.S.Jaggi, K.L.Bedi, O.P.Suri,& G.N.Qazi ,US Patent nf 189/2003

19.“Hepatoprotective activity of 10-O-p-hydroxy benzoyl aucubin”

A.Prabhakar, B.D.Gupta,K.A.Suri. N.K.Satti, S. Malhotra ,K.K.Gupta, V.K.Sharma,  
R.K.Johri,.S.Jaggi, S.Lal, K.L.Bedi, O.P.Suri,& G.N.Qazi US Patent nf 190/ 2003.

20. Herbal black dye used in beautifying the hair and its applications Palpu  
Pushpangadan, Mahesh Pal, Bhagwan Shankar Dixit, Ranjan Bannerji, Chandana  
Venkateswara Rao -4546540,2010; Japan

## **B) TECHNOLOGIES AVAILABLE FOR COMMERCIALIZATION :**

Herbal gulal ,Natural hair dyes, Herbal Sindoor,Nutradiab

## **C) RESEARCH PAPERS :**

### **List of publications:**

#### **1. Chemical constituents of *Citrus* cultivars**

**S. Malhotra**, K.N.Nair, A.A.Naquv, J.R.Behari & P.Puspangadan **Indian Perfumer J**; 47, 2004.

#### **2. Seasonal variation and SPME/GC-HSS studies of *Citrus sinensis***

**S. Malhotra**, R.Banerjee, A.Gupta, S.M.Jain & P.Puspangadan **Indian Perfumer**, 34-35, 51(3),  
2007.

#### **3. Response of *Nigella sativa L.* to fertilizers under sodic soil conditions**



V.K.Garg, **S. Malhotra JAMAP** to be published in vol 30,122-125,2008.

**4. Antioxidant activity of *Citrus* cultivars and chemical composition of *Citrus karna***

essential oil . **S. Malhotra**, S.Suri & R.Tuli, **Planta Medica** ,75(1), 62-65,2009 IF 1.9

**5. Comparison of qualitative and Quantitative in vitro ginsenoside production of callus cultures of three *Panax* sp.,** Archana Mathur, A. K. Mathur, Mahesh Pal, and G. C. Uniyal. *Planta Medica*, (1999), 65: 484-486

**6 Srivastava M**, Kapoor, VP - Seed galactomannan – An overview. *Chem & Biodiversity*, 2005, **2** : 295-317.

**7. Antifungal activity of wogonin,** Leena Chaurasia and P. Pushpangadan.Mahesh Pal, Harsha Joshi, V. P. Kapoor *Phytotherapy Research*, (2003), 17:1215-1217.

**8. Antifungal activity of *Alianthus excelsa*.** B.C. Joshi, Anuj Pande, Leena Chaurasia, Mahesh Pal, R. P. Sharma and Anakshi Khare. *Fitoterapia* (2003), 74:689- 691.

**9. Stereoselective reduction of arteannuin-B and its chemical transformations.** A. K. Bhattacharya, Mahesh pal, D.C.Jain, B.S. Joshi, Raja Roy, Urszula Rychewska and R. P. Sharma.*Tetrahedron*, (2003), 59:2871-2876.

10., Phytochemical investigation of *Jatropha carcus* seed cake, *International journal of pharmacy and life sciences* Srivastava Manjoosha, Kumar Ashok, and Pal Mahesh (2010), 1(6): 313-315.

**9. SCIENTISTS :**

1. Dr Swadesh Malhotra Sci F ( Sr Principal Scientist)
2. Dr Mahesh Pal Sci EI ( Sr Scientist)
3. Dr. Mrs. Manjoosha Srivastava Sci C (Scientist)

**10. Technical staff :**

1. Mr. F. B. Singh Gp II(V)
2. Mr.ChetRam Gp II(V)
3. Mr Bisheshwer Gp III

**11. Research Fellows / Project Assistants**

1. Ms Tanvi Goel PA II

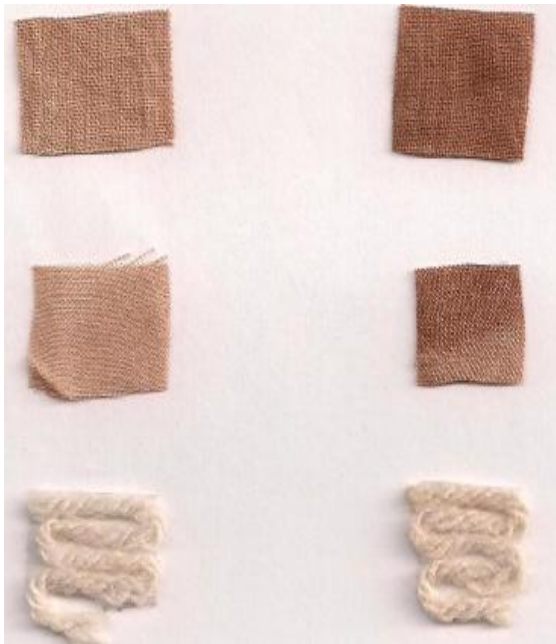
2. Ms sweta Kulshrestha PAII

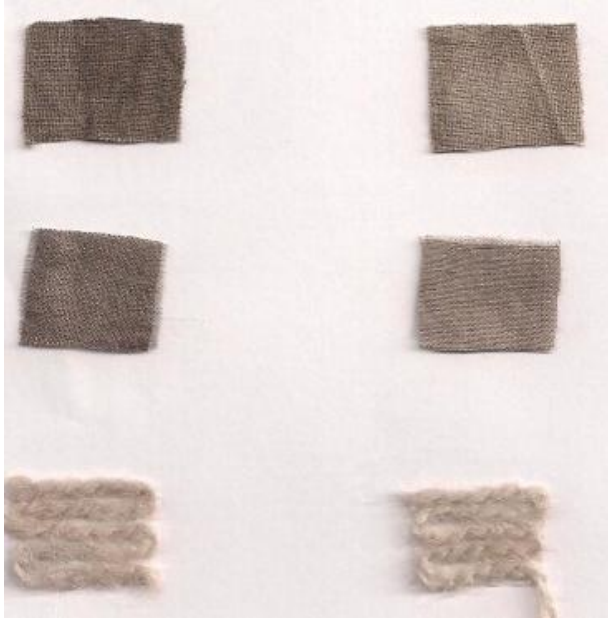
1. Research Papers : > 300

2. Chapters > 10

3. Popular articles > 40

**High resolution photograph(s)**



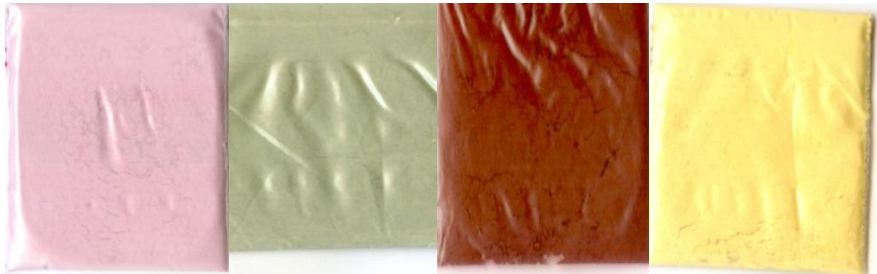


## COTTON SILK AND WOOL

### EXPERTISE

#### Development of Herbal Colour Technology:

##### A. *Herbal Gulal*



1. *M/S R.B. Herbal colours, Hathras (2003)*
2. *Forest department, Govt. of Haryana (2005)*
3. *M/S Sri Ganesh Herbal colours, Raipur, Chhattisgarh (2008).*
4. *M/S Ayur Herbal, Calcutta (2009)*

##### B. Herbal Sindoor:



1. M/S Sri Ganesh Herbal colours, Raipur, Chhattisgarh (2008).

2.M/S Ayur Herbal, Calcutta (2009)

C. Natural Hair dye:

▶ Patent granted-Japan- No.4546540 (2010)

Patent granted- US- No. 7186279 (2007)





**COLOURED RIC**

