



## AROMATIC PLANTS OF GORAKHPUR DIVISION: THEIR ANTIMYCOTIC PROPERTIES AND MEDICINAL VALUE

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### ABSTRACT

The present paper deals with survey and documentation of aromatic plants of Gorakhpur division in relation to their flowering/fruited periods, antimycotic property and medicinal value. During study various places of Gorakhpur division were surveyed periodically from 2006-2009. Forty two aromatic plant species belonging to 32 genera and 15 families were collected and identified. Out of 15 families Asteraceae was dominant having more aromatic plants followed by Lamiaceae and Rutaceae, while Acanthaceae, Apiaceae, Caesalpinaceae, Euphorbiaceae, Liliaceae and Lythraceae exhibited lower number of plant species. Flowering and fruiting in maximum aromatic plant species occurred during January–April. The collected aromatic plants were evaluated for their antimycotic activity against *Aspergillus flavus*, *A. niger*, *A. ochraceus* and *A. terreus*. Besides, medicinal importance of plants was also added.

**Keywords:** Aromatic plants, Gorakhpur Division, Antimycotic properties, Medicinal value.

### INTRODUCTION

Aromatic plants have been used in India since long for their medicinal and cultural practices and play an important role in human welfare. India is endowed with a rich wealth of aromatic plants, witnessing a good contribution to Indian materia–medica as well as their applications in perfumery, cosmetics and agricultural pest management<sup>1</sup>. Several curative properties of many plants have been listed in sacred vedas; the oldest known literature. It has been reported that in India a total of 17,500 species of flowering plants have been identified but nearly 1300 species of plants are of aromatic nature and used in traditional medicine system<sup>2</sup>.

The antimicrobial properties of aromatic plants have been recognized since prehistoric times. In ancient Egypt the mixture of certain vegetable oils were used for preservation of mummies. A wide variety of plant products possess varying degrees of pest controlling properties. The plant products (essential oil) have shown to exhibit their prominent toxicity towards all kinds viz., fungi, bacteria, insects and nematodes. They have proved as the best substitute of synthetic pesticides. Most of such studies were preliminary in nature indicating possible use of essential oils in actual disease control<sup>3-4</sup>.

The present work was carried out in order to survey and document the knowledge regarding the aromatic plants of Gorakhpur division, their flowering and fruiting periods along with medicinal importance. Further in this communication we report the extraction of essential oils from collected aromatic plants and their potentiality against some post-harvest fungi.

### MATERIALS AND METHODS

#### Study area and collection of aromatic plants

Some places viz., Banki, Bansgavn, Barahalganj, Campierganj, Gorakhpur, Khajani, Partawal, Pharendra, Ramgarh Tal Pariyojana, Sahajanava and Tilkonia occurring in Gorakhpur division were selected for collection of aromatic plants. Geographically Gorakhpur division is situated in one of the provinces of India i.e. Uttar Pradesh between latitude of 27°05' to 27°25' North and longitude of 83°20' to 84°10' East. The soil is gangatic alluvial and rainfall varies considerably from year to year. The monsoon rains commence during June and come to an end in September but may persist till October. The minimum temperature goes down to 6°C in the month of January & maximum up to 43°C in the month of June.

During present study periodical excursions of Gorakhpur division during 2006-2009; were made to collect aromatic plants in flowering and fruiting stage. The dominance of aromatic plants recorded on the basis of visual observations. The observations on habit, habitat, place of collection, flowering and fruiting periods of aromatic plants were recorded in field data book along with their collection number. During visits, discussions regarding medicinal and traditional uses of collected plants were made with native people and conformed to the help of various literatures<sup>5-6</sup>. The collected plants were brought to the laboratory and identified with the help of floras<sup>7-8</sup> as well as by matching with their specimens lodged in Departmental herbarium, DDU Gorakhpur University. The herbarium of collected plants was maintained along with their collection number.



### Extraction of the essential oils from plants

The volatile constituents in the form of essential oil from each collected aromatic plant were extracted separately through hydrodistillation by Clevenger's apparatus at  $90\pm 2^{\circ}\text{C}$ . Each essential oil was dried over anhydrous sodium sulphate and stored at  $4\pm 1^{\circ}\text{C}$  under sterilized condition for further experimentation.

### Antimycotic activity of essential oils

Essential oils extracted from collected aromatic plants were screened for their antifungal activity against fungi isolated from stored samples of pigeon pea seeds using Inverted Petri plate method of Bocher<sup>9</sup> with slight modification at 500ppm concentration. The test fungi were *Aspergillus flavus*, *A. niger*, *A. ochraceus* and *A. terreus*. The fungitoxicity was recorded in terms of per cent mycelial inhibition (PMI) of test fungi following the formula of Tripathi & Kumar<sup>3</sup>. All the experiments were carried out in triplicate and revised; data was statistically analyzed using standard deviation.

### Enumeration of aromatic plant species

A total of 42 aromatic plant species were collected from surveyed places of Gorakhpur division belonging to 32 genera are enumerated here alphabetically along with common name and medicinal uses.

#### ***Adhatoda vasica* Nees (Arusha)**

Decoction of leaves and bark is given in dose of 20 ml, twice a day for 2-3 days in cough and cold.

#### ***Aegle marmelos* Corr. (Bel)**

The roasted unripe fruits pulp is given in bowel complaints and ripe fruits are taken as cooling drinks, leaf paste is taken in jaundice with sugar.

#### ***Ageratum conyzoides* Linn. (Ajagandha)**

Decoction of leaves is applied externally on the affected part of the skin disease, leaf juice taken in menstrual.

#### ***A. houstonianum* Mill. (Ajagandha).**

Decoction of leaves is used in skin disease.

#### ***Anethum graveolens* Linn. (Sowa) syn. *Peucedanum graveolens* Linn.**

Seeds used as carminative and stomachic.

#### ***Anisomeles indica* (L.) Kuntze. (Basiga)**

The leaf juice is used twice a day for dysentery.

#### ***Annona squamosa* Linn. (Sitaphal or Sharifa)**

Thalamus is used in antifertility. Seeds are useful in abortion and menstrual. Paste of leaves is taken in jaundice.

#### ***Ashphodelus tenuifolius* Cav. (Banpiyazi)**

Seeds used as diuretic.

#### ***Azadirachta indica* A. Juss (Neem) syn. *Melia azadirachta* Linn.**

Leaves extract orally administered for blood purification & removal of intestinal worms. Leaf paste is applied on skin diseases, in small pox and in pyorrhoea.

#### ***Blumea lacera* (Burm.f.) DC (Kukuraunha)**

Leaf juice is applied on bruises of toe, cuts and wounds.

#### ***B. membranacea* DC (Kukuraunha).**

The essential oil obtained from the plants produced a marked and long lasting fall in blood pressure in anaesthetized dogs. The oil exerted a direct depressant action on frog heart and spasmolytic effect on rabbit ileum. Leaves used as antibacterial agent<sup>10</sup>.

#### ***Callistemon lanceolatus* (R.Br) DC (Bottlebrush)**

The extract showed strong elastase inhibition and radical scavenging activities, used for the development of skin anti-wrinkle ingredients in cosmetic formulation<sup>11</sup>.

#### ***Chrysanthemum indicum* (L.)DC(Guldaudi)**

Used as stomachic and aperients.

#### ***Citrus aurantifolia* (Christm) Swingle. Kaghzi-nimbu**

Fruit juice contains citric acids and is useful in stomach disorder and gastric trouble.

#### ***C. aurantium* Linn. (Khatta)**

Used in the preparation of confections and other drinks. It is cultivated for its nutritious fruits which is a cardio tonic and refrigerant.

#### ***C. limon* (L). Burm (Khattanimbu, Bara nimbu)**

The fruits are rich in acidic juice which is used medicinally in rheumatism, dysentery and diarrhoea.

#### ***Clerodendrum inerme* (L.) Gaertn (Sangkupy)**

Leaves used as febrifuge, poultice of leaves used to resolve buboes.

#### ***C. viscosum* (L) Vent. (Titbhant)**

Leaf paste rubbed over scalps, stops falling hairs, relieve headache and promotes hair growth. Roots used in gastric disorder, as well as pains and body aches.

#### ***Cosmos sulphureus*. (Cav.) syn. *Bidens sulphurea* (Cav.) Sch. Bip.**

Leaves and aerial part used in jaundice, intermittent fever, splenomegaly. Tonic, hepatic, hepatoprotective.

#### ***Cotula anthemoides* Linn. (Babuna)**

The whole plant heated with mustered oil and decoction is applied externally on affected parts 2-3 times a day in rheumatism.



***Eucalyptus citriodora* Hook (Eukalyptus) syn. *E. maculata* Hook.**

Oil used in perfumery, wood used in preparation of furniture.

***Hyptis suaveolens* (L.) Poit. (Wilayati tulsi)**

Root paste is applied to relieve pain in scorpion stings. Pastes of leaves are applied in skin infection.

***Lawsonia inermis* Linn. (Mehndi) syn. *L. alba* Lam.**

The pastes of leaves are used by local inhabitants to dye nails, palm and soles and to relieve burning of palm and soles. Barks are given in jaundice and enlarge spleen.

***Melia azedarach* Linn. (Bakain)**

Fruits are used in leprosy and bark as anthelmintic.

***Mentha arvensis* Linn. (Pudina)**

Stimulant and carminative, infusion of leaves used as digestive and in rheumatism.

***Murraya koenigii* Spreng. (Kurry patta)**

Stomachic and carminative, leaves used in diarrhoea and dysentery & for checking vomiting.

***M. paniculata* (L.) Jack (Kamini) syn. *M. exotica* Linn.**

Powdered leaves applied to cut, root & bark used in cough and hysteria.

***Ocimum basilicum* Linn. (Kalitulasi) syn. *O. minimum* Linn.**

Juices of leaves used for ringworm, seeds are used in habitual constipation, diarrhoea.

***O. gratissimum* Linn. (Ramtulsi)**

Plant used as mosquito repellent, in aromatic baths of fumigations for rheumatism and paralysis.

***O. sanctum* Linn. (Krishnatulsi).**

Leaf is given in cough, decoction of roots given as diaphoretic in malarial fever.

***Piper longum* Linn. (Pipli)**

Sun dried unripe fruits are used as stimulant, carminative and tonic.

***P. methysticum*. Frost.**

The branches are used in remedy for sore throats. Convulsions and stiffness in children are treated with liquid pressed from the leaves. The leaves are chewed as treatment for bronchitis<sup>14</sup>.

***Polyalthia longifolia* Sonner. (Asoka)**

Fruit eaten in times of scarcity. Bark febrifuge.

***Psidium guajava* Linn. (Amrud)**

Leaves used as an astringent for bowel trouble, decoction of bark given in diarrhoea.

***Putranjiva roxburghii* Wall. (Jiaputa).**

Wood used for house building, leaves and stones given in decoction for cold fever and rheumatism.

***Saraca indica* (L) (Sita ashok). syn. *S. asoca* (Roxb.) De wilde.**

Astringents used in uterine infection<sup>11</sup>.

***Syzygium cumini* (L) Skeels (Jamun) syn. *Eugenia jambolana* Lam.**

The powder of stem bark mixed with curd and taken for treatment of blood dysentery.

***Tagetes erecta* Linn. (Genda)**

Infusions used in rheumatism, cold and bronchitis. Leaves used in muscular pains.

***Vitex negundo* Linn. (Nirgundi)**

Used as insect repellent, leaves in hot water applied on the body to relieve pain and swelling, also used in dermatological problems.

***Xanthium strumarium* Linn. (Lapetua)**

Fruits used as tonic and are given in small pox.

***Zingiber officinale* Rosc. (Adarak)**

The raw ginger is acrid, carminative and stimulant. It is useful in dropsy, asthma, cough, diarrhoea and inflammations.

***Z. zerumbet* Rosc. ( Ban Adarak) syn. *Amomum zerumbet* Linn.**

Rhizome employed against cough, stomach ache and asthma and also a vermifuge. The decoction also used in leprosy and skin diseases.

## RESULTS AND DISCUSSION

It was observed that aromatic plants collected from Gorakhpur division belong to 15 families of higher plants, out of which maximum number of aromatic plants were member of Asteraceae followed by Lamiaceae and Rutaceae, while Acanthaceae, Apiaceae, Caesalpinaceae, Euphorbiaceae, Liliaceae and Lythraceae showed only one species from each (Table 1). Out of 42 aromatic plants collected, 18 plants were wild nature. It is interesting to note that some species have restricted distribution. *P. longum* was reported from Banki and Gorakhpur, while *P. methysticum* and *Z. zerumbet* were reported from Gorakhpur only. *A. tenuifolius* was only reported from cultivated field of Banki. However, other remaining species were common at all the places surveyed. Some genera like *Ageratum*, *Anisomeles* and *Hyptis* were found to be abundantly distributed in the places surveyed. Flowering and fruiting in maximum aromatic plant species occurred during January–April.

Further as is evident from above findings that most of aromatic plants were used in treatment of respiratory disorder (cough, bronchitis, cold etc.), generally



administered by drinking a decoction or by gargling. For skin problems either fresh or dried plants parts are applied to skin directly or in the form of pastes. Leaves of *A. conyzoides* are applied externally on the affected part of the skin disease.

exhibited absolute toxicity (at 500 ppm) inhibiting the mycelial growth of all the test fungi completely. The oils of *A. vasica* and *O. basilicum* exhibited higher (90%) antifungal activity, while other oils at this concentration showed lower level of fungitoxicity.

Table 2 indicates that the essential oils of *C. aurantifolia*, *C. aurantium*, *C. limon*, *M. arvensis* and *O. sanctum*

**Table 1:** Aromatic plant species of Gorakhpur Division

| Plant name (common name)                                    | Family          | Occurrence               | Place of collection/Collection no.           | Flowering & fruiting |
|---|-----------------|--------------------------|--|----------------------|
| <i>Adhatoda vasica</i> Ness (Arusha)                        | Acanthaceae     | Common                   | Tilkonia, Gorakhpur, Barahalganj/GKU4334     | Feb-Apr.             |
| <i>Aegle marmelos</i> (L) Corr. (Bel)                       | Rutaceae        | Common                   | Partawal, Pharenda, Tilkonia/ GKU4313        | Apr-Aug.             |
| <i>Ageratum conyzoides</i> Linn. (Ajagandha)                | Asteraceae      | Abundant                 | Gorakhpur, Tilkonia, Banki/GKU4328           | Nov-May.             |
| <i>A. houstonianum</i> Mill. (Ajagandha)                    | "               | "                        | Partawal, R.T. Pariyojana, Gorakhpur/GKU4333 | Aug-May.             |
| <i>Anethum graveolens</i> Linn. (Sowa)                      | Apiaceae        | Uncommon                 | Campierganj, Bangsavn, Pharenda/GKU4367      | Jan-Mar.             |
| <i>Anisomeles indica</i> (L)Kuntz (Basiga)                  | Lamiaceae       | Common                   | Gorakhpur, Tilkonia Barhalganj/ GKU4301      | Nov-Feb.             |
| <i>Annona squamosa</i> Linn. (Sitafal)                      | Annonaceae      | Uncommon                 | Gorakhpur, Tilkonia, Partawal./ GKU4349      | Apr-Aug.             |
| <i>Ashphodelus tenuifolius</i> Cav (Banpiyazi)              | Liliaceae       | Occasionally distributed | Banki/ GKU4356                               | Dec-June.            |
| <i>Azadirachta indica</i> A. Juss (Neem)                    | Meliaceae       | Common                   | Gorakhpur, Khajani, Sahajanava/ GKU4321      | Mar-Jul.             |
| <i>Blumea lacera</i> (Burm.f.)DC (Kukuraunha)               | Asteraceae      | Common                   | Tilkonia, Partawal, Banki/ GKU4337           | Feb-May.             |
| <i>B. membranacea</i> DC (Kukuraunha)                       | "               | Abundant                 | Bangsavn, Gorakhpur, Sahajanava/ GKU4388     | Jan-May              |
| <i>Callistemon lanceolatus</i> (R.Br)DC (Bottlebrush)       | Myrtaceae       | Uncommon                 | Campierganj, R.T. Pariyojana /GKU4373        | Dec-Mar.             |
| <i>Chrysanthemum indicum</i> (L)DC (Guldaudi)               | Asteraceae      | Uncommon                 | Barahalganj, Khajani, Gorakhpur/GKU4319      | Dec-Mar.             |
| <i>Citrus aurantifolia</i> (Christm) Swingle (Kaghzi nimbu) | Rutaceae        | Common                   | Gorakhpur, Pharenda, Campierganj/GKU4315     | Nov-Jul.             |
| <i>C. aurantium</i> Linn. (Khatta)                          | "               | "                        | Sahajanava, Tilkonia/ GKU4317                | "                    |
| <i>C. limon</i> (L) Burm (Bara nimbu)                       | "               | "                        | R.T.Pariyojana, Barhalganj/ GKU4318          | "                    |
| <i>Cosmos sulphureus</i> Cav.                               | Asteraceae      | Uncommon                 | Gorakhpur, Banki./GKU4389                    | Dec-Mar.             |
| <i>Cotula anthemoides</i> Linn. (Babuna)                    | "               | Uncommon                 | Tilkonia, Partawal /GKU4390                  | Nov.-Mar.            |
| <i>Clerodendrum inerme</i> (L) Gaertn (Sangkupy)            | Verbenaceae     | Uncommon                 | Gorakhpur, Tilkonia, Banki/GKU4374           | Apr-Nov.             |
| <i>C. viscosum</i> (L) Vent. (Titbhant)                     | Verbenaceae     | Uncommon                 | Sahjanava, Bangsavn. R.T.Pariyojana/GKU4330  | Feb-May.             |
| <i>Eucalyptus citriodora</i> Hook (Eucalyptus)              | Myrtaceae       | Uncommon                 | Tilkonia, Partawal/GKU4361                   | Mar-May.             |
| <i>Hyptis suaveolens</i> (L) Poit (Wilayati tulsi)          | Lamiaceae       | Abundant                 | Gorakhpur, Sahajanava/GKU4308                | Nov-Feb.             |
| <i>Lawsonia inermis</i> Linn. (Mehndi)                      | Lythraceae      | Common                   | Partawal, Khajani/GKU4364                    | Jun-Nov.             |
| <i>Melia azedarach</i> Linn. (Bakain)                       | Meliaceae       | Uncommon                 | Banki, Partawal, Tilkonia/ GKU4323           | Feb-May.             |
| <i>Mentha arvensis</i> Linn. (Pudina)                       | Lamiaceae       | Common                   | Gorakhpur, Pharenda, R.T.Pariyojana/ GKU4302 | Jun-Aug.             |
| <i>Murraya koenigii</i> Spreng. (Kurry patta)               | Rutaceae        | Common                   | Banki, Gorakhpur, Tilkonia./ GKU4339         | Feb-Apr.             |
| <i>M. paniculata</i> (L)Jack (Kamini)                       | "               | Uncommon                 | Tilkonia, Gorakhpur/ GKU4304                 | Jun-Aug              |
| <i>Ocimum basilicum</i> Linn. (Kali tulsi)                  | Lamiaceae       | Common                   | Gorakhpur, Partawal, Tilkonia/ GKU4342       | Aug.-Mar.            |
| <i>O. gratissimum</i> Linn. (Ramtulsi)                      | "               | "                        | Campierganj, Pharenda, Barhalganj/ GKU4352   | Oct-Feb.             |
| <i>O. sanctum</i> Linn. (Krishnatulsi)                      | "               | "                        | Gorakhpur, Khajani/ GKU4360                  | Aug-Feb.             |
| <i>Piper longum</i> Linn. (Pipli)                           | Piperaceae      | Occasionally distributed | Gorakhpur, Banki/ GKU4324                    | Jul-Aug., Dec-Jan.   |
| <i>P. methysticum</i> Frost                                 | "               | "                        | Gorakhpur/ GKU4325                           | "                    |
| <i>Polyalthia longifolia</i> Sonner (Asoka)                 | Annonaceae      | Common                   | Tilkonia, Pharenda/ GKU4358                  | Apr-Jul.             |
| <i>Psidium guajava</i> Linn. (Amrud)                        | Myrtaceae       | Common                   | Barhalganj, Campierganj/ GKU4362             | Dec-Sep.             |
| <i>Putranjiva roxburghii</i> Wall. (Jiaputa)                | Euphorbiaceae   | Uncommon                 | Gorakhpur, Banki, R.T.Pariyojana/ GKU4340    | Nov-Apr.             |
| <i>Saraca indica</i> (auct).non Linn. (Sitaasoke)           | Caesalpiniaceae | Common                   | Khajani, Gorakhpur, Barhalganj/GKU4384       | Mar-Apr.             |
| <i>Syzygium cumini</i> (L)Skeels (Jamun)                    | Myrtaceae       | Common                   | Bangsavn, Banki, Sahajanava/ GKU4332         | May-Jul.             |
| <i>Tagetes erecta</i> Linn. (Genda)                         | Asteraceae      | Common                   | Campierganj, Gorakhpur, Pharenda/ GKU4369    | Nov-Apr.             |
| <i>Vitex negundo</i> Linn (Nirgundi)                        | Verbinaceae     | Uncommon                 | Banki, Gorakhpur, Tilkonia/ GKU4310          | May-Sep.             |
| <i>Xanthium strumarium</i> Linn. (Lapetua)                  | Asteraceae      | Common                   | Banki, Pharenda, Barhalganj/ GKU4311         | Sep-Jun.             |
| <i>Zingiber officinale</i> Rosc. (Adarak)                   | Zingiberaceae   | Uncommon                 | Khajani, Campierganj, Sahajanava/ GKU4371    | Sep-Dec.             |
| <i>Z. zerumbet</i> (L) Rosc. (Banadrak)                     | "               | Occasionally distributed | Gorakhpur/GKU4359                            | July- Oct.           |

**Table 2:** Screening of essential oils of aromatic plant species of Gorakhpur division for their toxicity against fungi

| Plant species (essential oils)*             | Part used  | Percent mycelial inhibition of test organisms(PMI±SD) |                 |                     |                   |
|---|------------|---|-----------------|---------------------|-------------------|
|   |            | <i>Aspergillus flavus</i>                             | <i>A. niger</i> | <i>A. ochraceus</i> | <i>A. terreus</i> |
| <i>Adhatoda vasica</i> Ness                 | Leaf       | 96.86±1   | 94.52±8.6       | 98.39±2.02          | 90.78±4.53        |
| <i>Aegle marmelos</i> (L)Corr.              | ..         | 16.6±5.68   | 45.0±3.0        | 20.78±2.47          | 17.35±4.26        |
| <i>Ageratum conyzoides</i> Linn.            | Whole part | 53.3±3.90   | 75.6±0.76       | 74.11±0.76          | 65.28±3.5         |
| <i>A. houstonianum</i> Mill.                | ..         | 61.6±2.45   | 72.6±1.10       | 4.66±2.08           | 37.20±1.80        |
| <i>Anethum graveolens</i> Linn.             | Shoot      | 42.6±3.21   | 21.4±1.15       | 22.2±2.01           | 64.31±2.14        |
| <i>Anisomeles indica</i> (L)Kuntz           | Leaf       | 18.15±0.42  | 17.32±0.91      | 65.64±1.44          | 57.69±1.44        |
| <i>Annona squamosa</i> Linn.                | ..         | 67.14±1.53  | 19.33±3.5       | 31.22±1.27          | 22.13±2.5         |
| <i>Ashphodelus tenuifolius</i> Cav.         | Whole part | 45.31±1   | 40.0±1.15       | 53.3±3.90           | 61.04±1.2         |
| <i>Azadirachta indica</i> A. Juss           | Leaf       | 28.34±5.0   | 67.57±6.21      | 41.21±1.03          | 19.84±0.05        |
| <i>Blumea lacera</i> (Burm.f.)DC            | Whole part | 17.23±1   | 61.21±2         | 30.56±2.10          | 13.19±1.10        |
| <i>B. membranacea</i> DC                    | ..         | 87.85±6.23  | 17.34±1.12      | 64.85±1.44          | 72.48±2.88        |
| <i>Callistemon lanceolatus</i> (R.Br)DC     | Leaf       | 40±2.21   | 32.4±1.23       | 19.95±1.15          | 19.72±5.01        |
| <i>Chrysanthemum indicum</i> (L)DC          | ..         | 38.78±2.51  | 22.61±5.35      | 55.44±1.15          | 31.38±3.2         |
| <i>Citrus aurantifolia</i> (Christm)Swingle | ..         | 100±0.00  | 100±0.00        | 100±0.00            | 100±0.00          |
| <i>C. aurantium</i> Linn                    | ..         | 100±0.00  | 100±0.00        | 100±0.00            | 100±0.00          |
| <i>C. limon</i> (L)Burm                     | ..         | 100±0.00  | 100±0.00        | 100±0.00            | 100±0.00          |
| <i>Cosmos sulphureus</i> Cav.               | ..         | 20.78±2.47  | 53.3±3.90       | 32.21±0.65          | 0.00±0.09         |
| <i>Cotula anthemoides</i> Linn              | ..         | 30.56±4.31  | 41.23±1.15      | 53.3±3.90           | 40.31±4.5         |
| <i>Clerodendrum inerme</i> (L)Gaertn        | ..         | 23.21±0.15  | 34.0±1.94       | 39.04±1.15          | 10.56±1.93        |
| <i>C. viscosum</i> (L) Vent.                | ..         | 44.59±1.16  | 13.89±3.95      | 14.49±2.16          | 48.13±1.32        |
| <i>Eucalyptus citriodora</i> Hook           | Leaf       | 30.60±4.5   | 23.8±1.21       | 81.41±4.64          | 78.60±2.36        |
| <i>Hyptis suaveolens</i> (L)Poiil           | Twig       | 48.5±3.23   | 38.4±5          | 24±1.041.02         | 44.34±0.58        |
| <i>Lawsonia inermis</i> Linn                | Leaf       | 40.69±1.5   | 19.2±3.21       | 20.31±1.5           | 17.34±1.15        |
| <i>Melia azedarach</i> Linn.                | Twig       | 18.75±1.67  | 38.31±1.26      | 56.50±0.87          | 76.92±1.60        |
| <i>Mentha arvensis</i> Linn                 | Leaf       | 100±0.00  | 100±0.00        | 100±0.00            | 100±0.00          |
| <i>Murraya koenigii</i> Spreng.             | ..         | 0.00±0.09   | 9.4±2.0         | 62.42±1.26          | 35.74±1.0         |
| <i>M. paniculata</i> (L)Jack                | ..         | 39.4±2.23   | 42.4±1.11       | 39.39±1.80          | 29.87±1.04        |
| <i>Ocimum basilicum</i> Linn                | Twig       | 90±2.0  | 93.13±1.2       | 98.13±2.30          | 91.32±1.23        |
| <i>O. gratissimum</i> Linn                  | ..         | 18.14±2.21  | 68.29±3.0       | 23.44±1.0           | 15.75±3.5         |
| <i>O. sanctum</i> Linn                      | ..         | 100±0.00  | 100±0.00        | 100±0.00            | 100±0.00          |
| <i>Piper longum</i> Linn                    | Leaf       | 3.14±1.12   | 17.17±2.41      | 66.67±2.0           | 49.36±1.44        |
| <i>P. methysticum</i> Frost                 | ..         | 32.1±4.0  | 41±1.12         | 43.55±0.76          | 55.36±0.86        |
| <i>Polyalthia longifolia</i> Sonner         | ..         | 79.86±3.25  | 54.38±2.30      | 76.86±2.0           | 46.54±3.05        |
| <i>Psidium guajava</i> Linn                 | ..         | 60.86±2   | 52.42±2.36      | 59.09±1.89          | 68.06±0.76        |
| <i>Putranjiva roxburghii</i> Wall.          | ..         | 48.48±1.75  | 38.75±2.18      | 15.71±2.64          | 48.23±0.58        |
| <i>Saraca indica</i> (auct).non Linn.       | ..         | 67.93±3.32  | 57.89±1.26      | 54.94±2.29          | 71.26±5.01        |
| <i>Syzygium cumini</i> (L)Skeels            | ..         | 10±1.12   | 9.5±0.09        | 61.39±2.51          | 58.56±2.56        |
| <i>Tagetes erecta</i> Linn                  | ..         | 21.49±1.15  | 20.78±2.47      | 22.2±2.21           | 13.23±0.15        |
| <i>Vitex negundo</i> Linn                   | Twig       | 8.54±1.32   | 11.23±1.26      | 11.18±2.29          | 13.22±0.29        |
| <i>Xanthium strumarium</i> Linn             | Leaf       | 74.74±1.60  | 57.12±1.44      | 49.50±2.36          | 54.84±4.82        |
| <i>Zingiber officinale</i> Rosc             | Rhizome    | 45.43±2.36  | 59.61±2.18      | 79.76±2.64          | 63.92±4.04        |

This study reveals that family Asteraceae occupies top most position in aromatic plant diversity in this area. *P. methysticum*, *P. longum* and *Z. zerumbet* were not reported from Gorakhpur by earlier workers<sup>7, 12</sup>. The seasonal variation in flowering and fruiting period of aromatic plants in present investigation did not follow the earlier records<sup>13-14</sup>. The seasonal variation in flowering and fruiting conditions may be due to change in climatic condition<sup>14</sup>.

The present findings showed that several families have proven to be promising source of biological activity. Three families viz., Acanthaceae, Rutaceae and Lamiaceae exhibited more than 90% antifungal activity against all the

test fungi. The members of these families have also been recorded as strong antifungal agents by earlier workers<sup>15-16</sup>.

Through excessive or unsustainable harvesting practices, plant species may be put at a risk e.g. *A. tenuifolius*, *P. longum*, *P. methysticum* and *Z. zerumbet* were found to be occasionally distributed in Gorakhpur division, and restricted to some places. To resolve these problems the local people should have acquired knowledge of plants around them especially regarding to their applied value. The conservation of aromatic plants needs establishment of network area and corridors which should be effectively managed and should not be under anthropogenic

pressure. Hence it is necessary to provide the valuable knowledge of aromatic plants and their medicinal uses before people unless they are lost forever from the community.

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## REFERENCES

1. Baser KHC, New Trends in the utilization of Medicinal and Aromatic Plants, *Acta Hort*, 2005, 676, 11-23.
2. Uniyal SK, Awasthi A, Rawat GS, Current status and distribution of commercially exploited medicinal and aromatic plants in upper Gori valley, Kumaon Himalaya, Uttaranchal, *Current Science*, 2002, 82, 1246-1252.
3. Tripathi NN, Kumar N, *Putranjiva roxburghii* oil- A potential herbal preservative for peanuts during storage, *J Stored Prod Res*, 2007, 43, 435-442.
4. Wogiatzi E, Gougoulas N, Papachatzis A, Vegelas I, Chouliaras N, Greek oregano essential oil production, phytotoxicity and antifungal activity, *Biotechnol & Biotechnol*, 2009, 23, 1150-1152.
5. Ambasta SP, *The useful plants of India*, (Publishers National Institute of Science Communication Dr K S Krishnan Marg New Delhi) 2006.
6. Bedi S, Tanuja, Vyas SP, *A Hand Book of Aromatic and essential oil Plants Cultivation, Chemistry, Processing and Uses*, (AGROBIOS Publishers, India) 2008.
7. Srivastava TN, *Flora Gorakhpurensis*, (Today & Tomorrow Printers and Publishers, New Delhi), 1976.
8. Singh NP, Karthikeyan S, Lashminarasimhan P, Prasanna PV, *Flora of Maharashtra State*, (Botanical Survey of India, Calcutta), 2000.
9. Bocher OE, *Antibiotics In: modern methods of plant analysis* eds Peach K and Tracey MV Vol III Springer Verlag Berlin, 1938, p 651.
10. Vanila D, Ghanthikumar S, Manickam VS, Ethnomedicinal Uses of Plants in the Plains Area of the Tirunelveli-District, Tamilnadu, India, *Ethnobotanical Leaflets*, 2008, 12, 1198-1205.
11. Kim JH, Byun JC, Bandi AKR, Hyun C, Lee NH, Compounds with elastase inhibition and free radical scavenging activities from *Callistemon lanceolatus*, *J Med Plant Res*, 2009, 3, 914-920.
12. Srivastava RC, Srivastava C, Diversity and economic importance of wetland flora of Gorakhpur district (U. P.), *J of Econ and Taxon Bot*, 2007, 31, 70-77.
13. Ali SJ, Dixit SN, Phenological observation on the flora of A Sub-Himalayan Forest, *Res J PI Environ*, 1986, 3, 37-44.
14. Bhatt B, Bhatt N, Floristic and Phenological analysis of ground vegetation grown under *Eucalyptus* hybrid and *Dalbergia sisso* plantation, *J Indian Bot Soc*, 2007, 86, 123-128.
15. Bouchra C, Achouri M, Hassani LMI, Hmamouchi M, Chemical composition and antifungal activity of essential oils of seven Morrocon labiateae against *Botrytis cinerea*, *J Ethnopharmacol*, 2004, 89, 165-169.
16. Garcia R, Alves ESS, Santos MP, Viegas AGF, A Alberto R, Dos santos RBV, Jose A, Fernandes PMB, Antimicrobial activity and potential use of monoterpenes as tropical fruit preservation, *Braz J Microbiol*, 2008, 39, 163-169.

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