PREVIEWS
(AYURVEDIC)
तुलसी सूरसागर वास्मा भूलभा बहुमुखिजी।
अपेन्द्रकांसी गोळी शृङ्गदी देवदूर्दृकृ।।
भावप्रकाश पुष्प वर्ष ६१

तुलसी सूरसागर नीरा पालती विष्णुवाल्लभा।
सुत्रेवं गुरुसा मेया कायस्था मुरुबूर्दृकृ।।
सूरकाम बहुप्रसो हंसमकर मसा हकरप्रिया।
अपेन्द्रकांसी संयासा शौरी विहारमंजरी।।
शृङ्गदी पूर्णप्रीति च रोभा यैवकेल विश्रामसः।

राजपितांदु, करवीरांदी वर्ष, २१३५-१५६६

तुलसी सूरसागर गोळी पापस्वी विष्णुवाल्लभा।
अचूरा संयोज्य सूरप्रेमा देवदूर्दृकृ।।
शृङ्गप्रिया नागमसता चक्रपंडी सूरमंजरी।
विद्यावृंदहलकर शृङ्गप्रियापेन्द्रकांसी।

कैप्सिक लिखदु / पुष्प वर्ष / १६२४ - १६२५

परमात्मा दूंका कठिनाजा कुंदरका। श्रवश्रवसालिली

तुलसी सैण्डकी दूंका सूरगाम वंजाहकंधिणी।
अजुता प्रसिद्धता च पवित्रा मुखविल्ली।
शृङ्गवाली सुवहा प्रेमत्रांकनी विष्णुपनकी।
भालश्रेष्ठा पापस्वी लक्ष्मी श्रीकृष्णवाल्लभा।

श्लोकबुद्धि लिखदु, भूषण, पृष्ट ५२४
कृष्णान् कृष्णतुलसी कृष्णपर्णी करालकः ।
राजवल्लभ निघंटु

सुरसा तु तुलसी कृष्ण कायरथ्या बहुमंजरी ।
चक्रपर्णी नागमाता सुरभि: देवदुर्बिभि: ॥

फणिन्जको मंजरीक: तीक्षणगंधः सुगंधिकः ।
पर्णशो बिल्वगंधश्च वनपत्रः कुठेरकः ॥

कृष्णार्जुकः कालमालः करालः कृष्णमलिकः ।
अभिधान रत्नमाला (षट् रसनिघंटु)

तुलाम् सादृश्यम् स्तति नाशयतीति ।
सर्वोत्तमत्वादेव सादृश्याभावाविद्यास्तहात्वम् ।
वधा - वरसा देव्यासुला नारिति विष्टेषु च ।
अरिवेलेषु च तुलसी तेन विरुपाता ।
ब्रह्मवेत्तां पुराणः प्रकृति, २२२-२४

नरा नार्याश्च ताम् दृष्टवा तुलनाम् दातुम् अक्षमा: ।
तान नान्मवा च तुलसीम् ताम् विद्यति पुराविदः ॥
ब्रह्मवेत्तां पुराणः प्रकृति, २५

def: १-५, ८-१०, १२, १४
The meaning of the word ‘Tulasi’ is explained in Ayurvedic texts is thus.

The word ulasi means ‘matchless’. It may also mean ‘uncomparable’. This points out to the fact that the plant Tulasi is so important for its properties that very plants can match its properties. Tulasi is useful in many diseases. This shows its importance in therapeutics, and therefore it is considered as matchless.

The word Tulasi contains a word - ‘Tula’. Tula means to weigh or balance. The plant Tulasi when compared to any other medicinal plant is always superior in its action and properties. Therefore it has received the name Tulasi.

The word Tulasi also contains another word. ‘Tu’ meaning death. Since Tulasi plant is said to possess an ability to ward off death it has received the name Tulasi.

All these explanations point out to one thing that since time immemorial, the plant Tulasi is identified as one of the important medicinal plant. It is used in many formulations and in the treatment of many types of diseases.
Tulas is an ancient plant. It is first mentioned in 'Rigvedas' the oldest Indian Sanskrit text. The plant Tulas is non-toxic. It grows everywhere in the Indian continent. It is known to all the peoples of India. It is used widely by the villagers and is administered for various ailments in a crude form like the juice or the decoction. The plant is well identified and is not a controversial plant.

Ayurved is an ancient Hindu science of Medicine. It is said that Ayurved was evolved before the environment was created. The simple meaning is that in this universe, everything exists. It is only after we notice it or find it out, we say it is 'new'. In fact it is not new. It was there, already. Therefore Ayurved precedes everything. Ayurved precedes the whole world. It was decided through Ayurved, how the human beings be produced on the earth. How the embryos of all the living creatures be developed. Thus the natural physiological laws were prepared first and then animal kingdom was developed, the human beings being only one of the thousands of different living creatures. Ayurved is as old as the history of mankind. It is a natural science.
BOTANY OF KRISHNA TULAS
OCIMUM ALBUM

(N O.-Labiatae)

Sanskrit - Sukla tulasi, Ajaka, Gambheram, Gandha-panirajaka

Bombay & Maharashtra - Ran-tulasi

Telugu - Kukka-tulasi

Tamil - Ganjankorai

Malalam - Kattarama-tulasi

Cannada - Nayi-tulasi

Konkani - Ran-tulasi

This is a species indigenous of Southern India. The plant is aromatic, carminative, diaphoretic and stimulant. During fever when the extremities are cold, leaves made into a paste are applied to the finger and toe-nails. The same preparation is used to cure parasitical diseases of the skin, such as ringworm etc. Leaf juice is given to children in cold, catarrh and bronchitis in doses of \( \frac{1}{2} \) to 2 drachmas

OCIMUM BASILICUM, Linn.

(N O.-Labiatae)

Also called as Ocimum anisatum or Basilicum citratum

Sanskrit - Bisva Tulasi, Varavara, Manjariki, (seeds: Rehan)

English - Sweet Basil

French - Basilic Cultive
Habitat: This small annual shrub or herb, indigenous to Persia and Sind, is cultivated in gardens in India.

Parts Used: Herb and seeds.

Constituents: Leaves contain a yellowish green essential oil which if kept for a time crystallizes and is then known as Basil-camphor. Essential oil contains a new terpene. Seeds contain a large amount of mucilage.
Action - Diaphoretic, carminative and stimulant. Seeds are mucilaginous, demulcent, aphrodisiac and diuretic. Leaves are fragrant and aromatic. Juice of the plant is anthelmintic. Root is febrifuge. Antidote to snake poison. Whole plant is aromatic, leaves and leafy tops have a pungent taste and clove-like odour.

Uses - Leaves are used for flavoring purposes. Seeds are useful in catarrh, chronic diarrhoea, dysentery, gonorrhea, nephritis, cystitis and internal piles. They also relieve the after pains of parturition. They are as an aphrodisiac in doses from 1 to 3 drachmas. A teaspoonful of seeds steeped in a glass of water swell into a mucilaginous jelly and with some sugar forms an excellent drink in the above-named diseases. Following compound powder of seeds is recommended for dysentery in Jauhar Hikmat: Take seeds of Ocimum pilosum 5 tolas, seeds of Murd 3 1/4 tolas, Plantago psyllium, Simeg (Arabic), Armenian Bolos, Poppy Seeds, each 3 1/4 tolas, Portulaca oleracea, Tukhm Khimaz, and Nishashta each 1 1/4 tolas. Mix and make a powder. Dose is 8 to 12 mashas. Juice of the leaves is dropped into the ear in earache and dullness of hearing. Mixed with a little ginger and black pepper the leaf juice is given during the cold stages of ague. Leaves dried and powdered and used like snuff dislodge maggots from the nose. A 12 per cent decoction of the plant used as irrigation in nasal myosis produces anesthesia and acts as a parasiticide and antiseptic, so that the larvae which causes the disease are rendered inactive and expelled. It has long been in use in Bengal with like effect for a similar affection known as Pinash. (K.L. Day). Following is recommended for asthma by Bhishagratna J.L. Duveji: Take in equal parts each of long Zedoary, stem of the Lily, Gulancha, cinnamon, Basil leaves, cardamom, Cyperus rotundus, long pepper, Costus specious, Phyllanthus neruri, dried ginger, Bhimseni camphor and black eagle-wood, and pound them in a mortar and sift through a clean piece of cloth and mix double the quantity of sugar. Dose is 1/2 a tola to be taken morning and evening.
OCIMUM CANUM Sims

(Sanskrit - Gramya, Thiksnamanu

English - Rosary, Tulasi

Hind. & Bengali - Kala tulshi

Santal - Bharbhari

Telugu - Thulasi, Kuppatulasi

Tamil - Kukka-tulasi, Gunjamkori, Naitulasi

Malyalam - Kattu Ram tulasi Bengali - Tulsi

Cannada - Nayitulasi

A species closely related to O. basilicum, is met with on the plains and lower hills of India. This is also used in skin diseases. Its uses are like those of O. album.

OCIMUM CARYOPHYLLATUM Roxb.

Sanskrit - Marubaka

Hind - Gola-tulasi

Bengali - Gandha-tulasi

This is a species found in Bengal. It has two varieties - white and black, the former is used for medicinal purposes. "It is bitterish acrid, stimulant, light, palatable, generative of digestive fire, fragrant, bilious, and alleviative of wind, phlegm (Vata, Kafa), worms, leprosy, sula pains, flatulence, loss of appetite, scorpion stings and diseases of skin." -(Kaviraj N N Sen Gupta). Constituent - Essential Oil. Action - Stimulant, stomachic, carminative and
OCIMUM GRANDIFLORUM
O longiflorum and orthosiphon stamineus

OCIMUM GRANTISSIMUM Linn.
O Frutescens or Citratum zeylanicum

English - Shrubby Basil.
French - Basilic de-Ceylon.
Sanskrit - Ajeka, Vantulasi
Hindi, Bengali, Bombay & Dukkan - Ramtulasi. Cualior - Bantulasi
Hindi - Banjari
Gujrati & Maharashtra - Ajavala
Telugu - Nimma-tulasi
Malyalam - Kattei-tulluva.
Tamil - Elumicham tulasi
Arabic - Fraranjmishk.
Persian - Raihance Qaranfulli; seeds - Balanki - khurd.

This is a species indigenous to Ceylon and South Sea Islands, is also met with in Nepal, Bengal, Chittagong and Deccan. It is styptic, stimulant, demulcent, diuretic and carminative; it is generally combined with expectorants in cough mixtures. Infusion of the seeds is used in doses of \( \frac{1}{2} \) to 1 ounce in urinary disorders, such as gonorrhoea, scanty and scalding urine etc.

Leaf - juice missed
OCIMUM LONGIFOLIUM (OCIMUM LONGIFLORUM):
It is a species found in Assam and Southern India. Leaves are made into a tea and used in the treatment of disease of the kidneys and bladder and other urinary organs.

OCIMUM MINIMUM
Sanscrit: Maruvaka
English: Bush Basil
It is a species found all over India and its flowers and leaves are aromatic and are used for seasoning (flavoring purposes).

OCIMUM PILOSUM (O. HISPIDUM or O. BASILICUM INDICUM):
Sanscrit: Khara Pushpa
English: Green Basil
Hindi: Babestul.
Persian: Tukhma - I - rehana
The seeds of O. pilosum are mucilaginous, demulcent, and nutrient. They are given in gonorrhea, strangury, spermatorrhoea, and kidney diseases, also in the dysentery and cough and to relieve pains of parturition. Jelly is given in spermatorrhoea.

OCIMUM SANCTUM, LINN. (O. HIRSUTUM, O. TOMANTOSUM, and O. VIRIDE):
Sanscrit: Vishnupriya. Tulasi, Divya, Bharati, Krishnamul
This small herb is found throughout India and cultivated near Hindu houses and Temples

Parts Used: Leaves, flowers, seeds and roots (entire plant)

Constituents: Essential oil, it is similar to O. basilicum

Action: It is demulcent, expectorant, and anti-periodic. Root is febrifuge. Seeds are mucilagenous and demulsant. Dried plant is stomachic and expectorant. Leaves are anti-catarrhal, expectorant, fragrant and aromatic.
External characteristics of the Pune variety of "Krishna Tulas" (Ocimum sanctum)

T.S. of the Tip of the leaf (near the margin)
Spongy mesophyll cells

Glandular multicellular trichomes

Mid rib
TS of leaf passing through the mid-rib.

Peleum
Xylem
Collenchyma

Epidermis

Pulvinae
cells.

Multicellular trichomes
There is very little published literature available on the subject of Pharmacognosy of Ocimum species and especially on O sanctum var. Niger (Krishna Tulas). The plant has been studied to some extent by some of the Indian authors. It is not clear from their studies if they have particularly studied the black (dark purple) variety.

In the Ayurvedic texts both the white and black (purple) varieties have been claimed as equipment, it is mentioned that the black variety is better than white and should be preferred to white one. The dark purple variety (black) is supposed to have better therapeutic effects.

It is also the experience of some workers (Dr. B.R. Mardikar, personal communication) that the black variety is more stable even if it is dried and kept for a long time (more than 8 years). The back variety retains its full aromatic nature for a long time (8 years as recorded by Prof. Dr. B.R. Mardikar), under the ordinary tropical conditions of temperature, humidity - 40°C and relative humidity of 45 to 70%.

This fact needs further investigations and experiments to find out what makes the dark purple variety more stable as compared to other species of genus Ocimum. Krishna Tulas is said to emit ozone during day time, as against the other plants which emit only oxygen. This makes the study of stomata inevitable. Stomata of Krishna Tulas were found to be unique having three guard cells.
which are further encircled by one more layer of cells. This makes an efficient arrangement for their gases exchanges. It is believed that the dark purple pigment also plays some important role in the photosynthesis and the Sun’s rays which pass through this layer and this layer will allow one particular wave length of light to the cell layers down below. This filtered light then participates in the photosynthesis of this plant. This fact deserves more careful experimentation and further study.

The euginol contents of Krishna Tulas are more as compared to any other variety of Tulas. Euginol is known to be germicidal and especially against the various viruses. Euginol is probably present in the aromatic glands over the leaves and the young stems of the plant. The number of glands appear to be more in Krishna Tulas as compared to other varieties of Tulas. Also, the size of the glands is larger than the other varieties.

Some authors believe that the white or the ordinary variety of Tulas get transformed according to the geographical conditions of the Sunlight, soil humidity, ambient temperature etc. The dark purple variety, they consider, as not a separate variety. This fact also deserves careful study before coming to a definite conclusion.

Presently Krishna Tulas has attracted the attention of many manufacturers of drugs as well as cosmetic and toiletries. Tulas is being extensively used in the formulations indicated for appetite, liver trouble, and cardiac conditions. It is being incorporated into local rubefacient agents and in mouth washes, so also in perfumery.
Industries need scientific background to sale the products in the domestic as well as in foreign market. From this angle there is every need that Krishna Tulas should be studied in details and thoroughly from various angles of Pharmacognostic and other disciplines.
The reference to the Medicinal herb Krishna Tulas is found in the available ancient Ayurvedic literature, excluding that of Vedic Period. It is surprising that the name ‘Tulas’ is used only in Ayurvedic Sanhitas (texts) of middle and recent periods i.e. Bhava Prakash, Raj Nighantu, Dhanvantari Nighantu and Kåiyyadev Nighatu. The name ‘Tulas’ is not mentioned in ancient Samhitas of Charakaacharya, Sushruta and Wagbhat.

Nagarjuna, the first redactor of Sushrut Samhita belonging to the 1st century A.D. has used the terminology ‘Tulas’ for the first time. This shows that the herb was not known by this name before these periods.

In the 12th century commentary of Dalhanacharya on Sushrut Samhita - introduces the plant as ‘Tulasi’. Other species of Tulasi are also mentioned in these texts. This shows by 12th century the name Tulas was well known. Dulhanacharya has not mentioned the names of herb as mentioned in Bhavapraeksah, such as ‘Vishnu Vallabha’, ‘Haripriya’, Maadhavhee’, ‘Amruta’.

Thus, we can conclude that in between 12th century and 16th century the term ‘Tulas’ was accepted and exclusively used to identify the present Tulas plant.

Bhavapraeksah written in the latter period, mentions the name ‘Tulas’ at the top of the list of synonymonims while describing the herb Tulasi and other names are mentioned afterwards. It appears that the name Tulas was chosen by the authors of religious texts (Puranas) due to its extraordinary medicinal and household usefulness which are incomparable. It is assumed that
the religious texts "Puranas" were written at the time of "Buddha" period. This period is definitely after the period of Charaka and Sushrata.

In the same period, Wagbhatta wrote 'Ashtanga Hrudaya', but he has not used the word 'Tulas'. This shows that the word 'Tulas' was not acceptable to the medical profession. The name Tulas had not become popular by then. It is well known that Wagbhatta's Ashtanga Hrudaya.

Taking into consideration the mythological importance of Tulas, we find stories of Tulas's origin in the Samudra Puran and Brahma Vaivarta Puran.
<table>
<thead>
<tr>
<th>Century</th>
<th>Text</th>
<th>Reference as</th>
<th>Reference with</th>
</tr>
</thead>
<tbody>
<tr>
<td>45th BC</td>
<td>RUG VED</td>
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<tr>
<td></td>
<td>ATHARVA VED</td>
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<tr>
<td>30th BC</td>
<td>MAHABHARAT</td>
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<tr>
<td>03rd BC</td>
<td>PURANAS</td>
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<tr>
<td>01st BC</td>
<td>CHARAK BHEL SAMHITA</td>
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<tr>
<td>02nd AD</td>
<td>SUSHRUTA SMHITA</td>
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<td>05th AD</td>
<td>SUSHRUTA NAGARJUNA</td>
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<td>ASHTANGA HRUDAYA</td>
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<td>GADANIGRAHA</td>
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<td>16th AD</td>
<td>BHAVAPRAKASHA</td>
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<td>14 5AD</td>
<td>KAIYYADEV NIGHANTU</td>
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<td>1431AD</td>
<td>MADANAPAL NIGHANTU</td>
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<td>10 - 13 AD</td>
<td>DHANVANTARI NIGHANTU</td>
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<td>14th AD</td>
<td>RAJ NIGHANTU</td>
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<td>18th AD</td>
<td>RAJA VALLABHA NIGHANTU</td>
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<td>1867 AD</td>
<td>NIGHANTU RATNAKAR</td>
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<tr>
<td>1896 AD</td>
<td>SHALIGRAM NIGHANTU</td>
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</table>

N.B.: (-) means reference not available

(*) means reference available
PREVIEWS

(PHYTO-CHEMISTRY)
Cleaned, washed and shade dried authentic and botanically identified leaves along, with some Arial parts of Krishna Tuias plant (Ocimum sanctum), were supplied by M/S SHARP ENTERPRISES, 3232, “Shanti-Sdan”, Shivaji Nagar, PUNE 411 005.

The above plant material (15 Kg) was powdered to about 40 mesh size and steam distilled to obtain an essential oil which was extracted with diethyl ether. On concentration the essential oil weighed 14.8 g. It was light yellow, and highly aromatic.

In a separate experiment the above plant material (15 Kg) was powdered in a Wiley mill and extracted successively with petroleum ether and 95% ethanol. The extracts were concentrated separately to yield pet. Ether extract and ethanol extract, 42 g and 39 g respectively.

The essential oil obtained by the steam distillation was chromatographed over neutral aluminum grade III, impregnated with silver nitrate (10%) sing petroleum ether 40-60°C and benzene as the elution to collect following six fractions as shown in the Table:

[Please see next page............]
Table showing the various fractions and its characteristics

<table>
<thead>
<tr>
<th>Fraction</th>
<th>Volume</th>
<th>Weight</th>
<th>Remarks</th>
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</thead>
<tbody>
<tr>
<td>1. (A)</td>
<td>50 ml x 2</td>
<td>0.52 g</td>
<td>Mixture of two compounds by TLC</td>
</tr>
<tr>
<td>2. (B)</td>
<td>50 ml x 2</td>
<td>0.65 g</td>
<td>Mixture of three compounds by TLC</td>
</tr>
<tr>
<td>3. (C)</td>
<td>50 ml x 2</td>
<td>1.02 g</td>
<td>Mixture of two compounds by TLC</td>
</tr>
<tr>
<td>4. (D)</td>
<td>50 ml x 2</td>
<td>1.28 g</td>
<td>Mixture of two compounds by TLC</td>
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<tr>
<td>5. (E)</td>
<td>50 ml x 2</td>
<td>0.25 g</td>
<td>Mixture of three compounds by TLC</td>
</tr>
<tr>
<td>6. (F)</td>
<td>50 ml x 2</td>
<td>0.89 g</td>
<td>Mixture of three compounds by TLC</td>
</tr>
</tbody>
</table>

Fraction (A) was chromatographed by preparative TLC on silver nitrate impregnated silica gel using 3 % acetone in bezoine as the solvent system to obtain two pure compounds viz.: 1,8-cineole and carvacrol.
The various compounds obtained are as follows:

1.8 Cineole

Boiling point: 170-174 °C, density: 1.4571

IR: 1376, 1265, 1230, 1172, 1080, 1050, 982, 921, 845 cm⁻¹

NMR: (CDCl₃) 1.05, 1.20, 6H

By comparing the reported data, the compound was identified as 1,8 Cineole.

The second compound with boiling point: 237 °C to 239 °C

UV \ max (ethanol): 277.5 (ε 1820)

IR: 3450, 1630, 1260, 1120, 1058, 988, 880, 810, 760

NMR: (CCl₄) 1.10 (6H, d), 2.10

Olefin protons at 6.42 (d), 6.88 (d), 6.50

The compound was identified as Carvacrol by comparing the data reported.

Fraction C on preparative thin layer chromatography as mentioned above yielded a major compound with the following characteristics:

Boiling Point: 250 °C

Density: 1.0620

Refractive Index: 1.5439

Further, by analyzing the IR and NMR spectra, a compound was identified as Eugenol.
Fraction D: Also, contained fairly good quantity of eugenol as revealed by TLC on silver nitrate impregnated with silver nitrate, yielded a compound with the following characteristics:

- Boiling Point: 195°C - 198°C
- Refractive Index: 1.4621 (11)
- Specific Rotation: -20.61

IR: 3435, 1672, 1634, 1114, 992, 918 (8)

NMR: 1.24, 1.65, 1.70: Olefinic protons: 4.90 - 5.60 (3H, m) (9)

The compound was identified as Linalool.

Fraction F: Fraction F was subjected to preparative thin layer chromatography as described above to obtain a pure compound with:

- Boiling Point: 102°C to 105°C
- Refractive Index: 1.4969 and
- Specific Rotation: -13.8

The compound was identified as Caryophyllene by comparing its physical characteristics and spectral data.
Chromatography of Petroleum Ether Extract:

Petroleum Ether Extract (30 g) was chromatographed on silica gel grade II, using acetone petroleum ether as the Alcuitan gradient to isolate 2 flavonoids with the following characteristics:

Compound I: UV (λ max Methanol) 242 sh, 253, 267, and 336

Compound II: UV (λ max Methanol) 242 sh, 253, 267, 291 sh, and 349

Compound I and Compound II were identified as Apigenin and Luteolin by comparing the above UV data along with the shifts with different reagents as described in the reference (14).
The genus Ocimum of the labiateae family contains plants which are all non-poisonous and non-toxic. They have good medicinal properties. The pharmacological properties depend upon the chemical constituents, their concentration and the species of the genus Ocimum. In India there are 9 species of the genus Ocimum are recorded. All are aromatic and contain almost the same constituents with varying proportions. They have most of the pharmacological actions which are common.

The pharmacological actions could vary to a certain extent depending upon the geographical conditions and the age of the plant. In this chapter, the chemical composition of the plant Ocimum sanctum is compiled.

**STEAM DISTILLATE:**

For the steam distillation the whole plant is used many times only the terrestrial part i.e. all the plant except the root system is used. The whole plant is not uprooted but
only the upper part is chopped and cut into small pieces for the steam distillation.

Only the freshly cut plant is good for the purpose of steam distillation. Steam distillation yields essential oil which is almost about 0.7% and which contain two major compounds, viz. Methyl cinnamate and Citral. It also contains Camphor, Linalool, Geranial, Citronellol, Citral, and geraniol esters, methylheptanone, eugenol, and Citronellic acid. Methyl Chavicol (4-methoxyallylbenzene), Ocimene.

The seed oil contains

**Fatty Acids**

- Palmitic acid: \([\text{CH}_3(\text{CH}_2)_{14}\text{COOH}]\),
- Stearic acid: \([\text{CH}_3(\text{CH}_2)\text{COOH}]\),
- Arachidic acid: \([\text{CH}_3(\text{CH}_2)_{18}\text{COOH}]\),
- Oleic acid: \([\text{CH}_3(\text{CH}_2)_{7}\text{CH} = \text{CH}(\text{CH}_2)&\text{COOH}]\),
- Linoleic acid: \([\text{CH}_3(\text{CH}_2)_{4}\text{CH} = \text{CH} - \text{CH} - \text{CH} = (\text{CH}_2)_{7}\text{COOH}]\)
- Beta sitosterol
- Oleanolic acid: A triterpene
- Ursolic acid: A triterpene

Seed oil also contains Thymol which is known to possess antibacterial properties.

The essential oil of Krishna Tulas especially is rich in Eugenol, Methyleugenol and Ascorbic acid. The leaves contain the highest essential oil contents. The inflorescence
and the tender stems contain these constituents to a little lesser extent. The roots do not contain such essential oil.

The oil contents of the leaves varies with the season and it increases from August to November and reaches its curx by November end. Till January end the essential oil contents decline and again rise moderately after February.

Other lesser constituents are Carvacol, Methyl chavicol, Cineole, Caryophyllene, Orientine, Flavones Apigenin, Apigenin-7-glucoside, Luteolin and Molludistin.

Krishna Tulas leaves also contain Carotene (2.5mg/100g)

Some alkaloids, saponins, glycosides and tannins are also reported. The important chemical constituents of Krishna Tulas are shown in charts at the end of this chapter.
6

7

8
13

14
PREVIEWS

(Pharmacology)
Many authors have screened the Krishna Tulas extracts in animal experiments to screen the effects on various systems. These are summarized below:

**MOTOR CONTROL ON AN INCLINED PLANE**

Krishna Tulas did not have any effect on the Motor control on inclined plane when it was administered intraperitonially in the doses of 0.2 ml and 0.5 ml per mouse of a 10% decoction.

**MOTOR DEFICIT (MOTOR WEAKNESS)**

In the doses of 0.2 ml, 0.4 ml, and 0.8 ml per oral of 10% aqueous decoction of Krishna Tulas did not show any Motor Deficit in albino mice of the weight range of 30 - 32 g. When the drug was injected intramuscularly in the doses of 0.2 ml, and 0.4 ml it also did not show any Motor Deficit.
It was noticed that administration of Krishna Tulas 10% decoction intraperitoneally in the maximum dose of 0.2 ml. did not show any significant difference in between the controls and Krishna Tulas treated female albino mice.

TESTS FOR ANALGESIA IN ALBINO RATS:

Application of the metal clip to the root of the rats treated with Krishna Tulas show decrease in pain threshold as compared to the control group of rats. The increase in the time to make an attempt to remove the clip in Krishna Tulas group was 50% more than the control. Krishna Tulas appears to increase the threshold of the pain sensation.

THERMAL STIMULATION:

When Krishna Tulas treated albino mice were placed on a heated iron plate at 50-52°C, they respond quicker to the thermal stimuli as compared to control mice. This also shows that the pain threshold in albino mice is increased when Krishna Tulas is administered per oral in the dose of 0.2 ml. Indicating that Krishna Tulas has mild analgesic effect. This effect was not seen when Krishna Tulas was administered subcutaneously in the same dose.
CAUDAL IMMERSION IN HOT WATER

Krishna Tulas treated (Dose 0.2 ml and 0.4 ml by oral route) albino mice of the weight range of 30 to 34 g and which were fasting over night, they showed better tolerance to the hot water as compared to the control groups.

OXYTOCIN CRAMPING

Albino rats of both sexes when treated with doses of 0.2 ml by intramuscular route and 0.4 ml by oral route, the drug did not have any modifying effect on Oxytocin induced cramps.

ELECTRICAL ACTIVITY OF HEART IN ALBINO MICE

In these experiments it was noticed that Krishna Tulas has a positive inotropic activity at the same time it does not change the heart rate. Only the power of contraction increases. The doses employed were 0.2 ml of 10% decoction by intramuscular route.

CHIMNEY TEST

Krishna Tulas treated albino mice of both the sexes and of the weight range of 30 to 35 g, in the dose of 0.2 ml per oral showed better efficiency to climb up the chimney as compared to control mice.
SWIMMING TEST (NATATORY EXHAUSTION)

When the female albino mice treated with a dose of 0.2 ml per oral dose of Krishna Tulas it was noticed that they could not swim for longer time as compared to control group.

ROTATING ROD TEST

When Krishna Tulas treated (Maximum dose : 0.2ml per intraperitoneal route per mouse) albino mice were placed over a rotating rod, rotating at a speed of 12 revolutions per minutes, they did not show any better performance as compared to the control groups.

MAMMALIAN BODY TEMPERATURE

When Krishna Tulas is administered to albino male mice in the dose of 0.2 ml per mouse of the 10% decoction by intraperitoneal route then it increases the body temperature as compared to the control untreated albino mice.