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A Review on Plant from Rutaceae Family available in Satpuda Region.

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Abstract: To the north, the core alluvial plain rises into a rugged mountainous environment. It is surrounded by the heavily forested Satpuda ranges, which also serve as the aboriginal population's home. It is around 30 kilometres broad and extends through five talukas, including Akkalkuwa, Taloda, Shahada, and Shirpur. Approximately 150 genera and 1,500 species make up the Rutaceae family, which is defined by the regular occurrence of spines and winged petioles that result in pungent-smelling herbage and hesperidium fruit. *Aegle marmelos*, *Citrus aurantifolia*, *Citrus sinensis*, *Limonia acidissima*, *Murraya koenigii*, *Murraya paniculata*, *Zanthoxylum rhetsa* are available in Satpuda region. This article covers ethnopharmacology and pharmacological chemical data of above plants.

Keywords: Satpuda, Rutaceae Family,

INTRODUCTION

Satpuda region

To the north, the core alluvial plain rises into a rugged mountainous environment. It is surrounded by the heavily forested Satpuda ranges, which also serve as the aboriginal population's home. It is around 30 kilometres broad and extends through five talukas, including Akkalkuwa, Taloda, Shahada, and Shirpur.

The Toranmal hill is the district of Nandurbar's special geographical feature. It is a significant hill that spans 41.5 sq. km and rises to a height of roughly 1,155 m. It is situated at 21°52' north latitude and 74°34' east longitude. There is an old crater lake that is 2.70 km around and 594.360 m wide. Its depth is

reportedly 40 metres. There is a smaller lake not far from the larger one. In the "Sitakund " or "Sitakhai" valley, the overflow from both lakes flows in a straight, 152-meter-deep cascade. West of Toranmal Hill, two hill ranges of the Satpuda separate. A hemispheric tableland that is up to 50 km long and 25 km wide is enclosed by these ranges. Numerous tribal hamlets dot this terrain. The area west of Toranmal Plateau, which would be roughly 12.5 km away, has no hamlets, though. There are a few small hamlets on the banks of the Narmada, which forms the state border of the Nandurbar district. Between 300 and 600 metres above mean sea level, the entire area is quite stony. Boksa Dongar is 1,208 metres tall, whereas the two peaks near to Nandwan are 1,208 and 1,233 metres tall, respectively. One of the highest peaks is the Ashtamba Dongar, which is revered and associated with Ashwatthama.

Rutaceae family

Approximately 150 genera and 1,500 species make up the Rutaceae family, which is defined by the regular occurrence of spines and winged petioles that result in pungent-smelling herbage and hesperidium fruit.

Habit:

Trees, shrubs, and herbs that produce essential oils are typically autotrophic, mesophytic, or xerophytic in nature.

Leaves:

Some of the plant leaf kinds include simple or compound, fragrant, alternate and opposite, usually spiral, herbaceous or leathery, petiolate, almost always gland-dotted leaves. Simply split, complete, and occasionally linear describe lamina (and ericoid). No leaves are permitted. Stipules are characterised by intra petiolar glands when they are present. using schizogenous or lysigenous oil in secretory organs.

Stem:

The stem was composed of superficial cork cambium that was rarely visible and secretory chambers. There are oil-filled secretory cavities. interior phloem absence Secondary thickening is occurring in the conventional cambial ring. Along with libriform fibres and vessels, there is an abundance of phloem but a paucity of xylem. Simple vessel end walls fill in any gaps in the vessels' vesture.

Reproductive type and pollination :

Plants can be hermaphrodite, monoecious, andromonocious, dioecious, or polygamous and use entomophilous pollination.

Flower:

Normal, hypogynous, bisexual flowers are arranged singly or in inflorescences. The blossoms are typically delightfully scented and come in a variety of colours, including yellow, white, pink, and scarlet. The lower disc of the ovary is conspicuous and ring- or cap-shaped.

Floral formula: to K45C4or 5to60 G 4 to5.

Calyx (sepals):

It is made up of numerous tiny green units called sepals and is the flower's outermost part. It has four to five imbricate or distinct sepals.

Corolla (petals):

It has four to five distinct petals, with the possibility of connate or imbricate petals on rare occasions. From yellow to brown, it varies.

Androecium

It has two whorls of usually diplostemonous, separate, or connate stamens, with the outer whorl facing the petal. But on rare occasions, there could be three or four whorls or even up to sixty stamens.

Gynoecium :

It has a simple compound pistil with one to several styles, each bearing one to many axile ovules, and a simple compound pistil with normally four to five incompletely connate carpels that may be linked basally or apically. Normally, there is an intra staminal nectary disc present between the stamens and the ovary.

Fruit:

Fruit can be in the shape of capsules, berries, or hesperidium and can be fleshy or non-fleshy, dehiscent or indehiscent, aggregate or not aggregate in nature, and have smaller segments divided by a septum.

Seedling:

Germination is phanerocotylar or cryptocotylar.

Example: citrusfruit, lemonpeel, bitter orange peel, pilocarpus.

Rutaceae Family Plants available in Satpuda Region (Dhule and Nandurbar district):

Aegle marmelos , *Citrus aurantifolia*, *Citrus sinensis* *Limonia acidissima*, *Murraya koenigii*, *Murraya paniculata*, *Zanthoxylum rhetsa*.

1. AEGLE MARMELOS

Biological Source:

Bael consists of the unripe or half-ripe fruits or their slices or irregular pieces of *Aegle marmelos* belonging to family Rutaceae.

Taxonomy:

Kingdom: Plantae

Family:Rutaceae.

Subfamily:Aurantioideae

Genus:Aegle.

Species:Marmelos

Synonyms:

English:Bengal quince, Beal fruit, Golden apple, Indian quince, Stone apple.

Tamil:Aluvigam, Iyalbudi, Kuvilam, Mavilangai,Vilwam, Villuvam.

Telugu:Bilvamu, Maluramu, MareduSailushamu,Sandiliyamu, Sriphalamu.

Hindi:Bel, Bili, Sirphal, and Bela,

Sanskrit:Adhararutha, Asholam, Atimangaliya, Bilva.

Bengal:Bael, Bel,

Gujarat: Billi,

Kannada:Bela, Bilva

Malayalam:Koovalam, Vilwam. (5)

Orissa :Belo.

Chemical constituents:

Leaf:Aurantioideae.,Skimmiamine, Aegelin, Lupeol, Cineol, Citral, Citronellal, Cumin aldehyde, Eugenol, Marmesin, Anti-cancer, cardio active, Anti-inflammatory, Anti-septic, Antiallergic etc.

Bark-Immature-Marmin, Skimmiamine Mature- Fagarine Abortifacient, Anti-ulcer, antidiarrheal remarkable

Unripe fruit:Tannin Astringent

Fruit: Marmelosin, luvangetin, Aurapten, Psoralen, Marmelide.(4)

Pharmacological uses of Aegle Marmelos

Activity	Part of plant	Chemical constituent	References
Antidiabetic activity	Fruits	Coumarins	6
Antiulcer activity	seed	Pyranocoumarin luvangestin.	3
Anticancer activity	Bael extract	lupeol	3
Antibacterial activity	leaves	chloroform	5
Antiviral activity	fruits	Marmelide	6
Antifungal activity	fruit	Essential oil	6
Antihyperlipidemic activity	Aqueous bael extract	Saponin and coumarin	3

Ethnopharmacology of Aegle marmelos

Part of plant	Use	References
Leaves	In asthma and jaundice	9
Root bark	In heart palpitation, intermittent fever etc	13
Fruits	Laxative	3
Flower	As diuretics and local anaesthetics	13

2. CITRUS AURANTIFOLIA

Taxonomy

Kingdom: plantae

Family:Rutaceae

Order: Sapindales

Genus: citrus

Species: c × aurantifolia

Chemical constituents:

Chemical constituents:

The peculiar phytochemical composition of the peel and leaf oils of *C. aurantifolia* suggest use of the essential oils as a characteristic taxonomic marker for species. The phytochemistry of citrus oil has been studied extensively by many researchers. GC-FID and GC-MS of hydrodistilled essential oil of *C. aurantifolia*, shows presence of limonene (58.4%), β - pinene (15.4%), β -terpinene (8.5%), and citral (4.4%) as the major constituents. Some exclusive terpenes such as the sesquiterpene santal-10-en-2-ol have been identified in the lime peel oil . An oxygenated monoterpene, fenchol, has also been isolated in *C. aurantifolia* .Some other mono- and sesquiterpene hydrocarbons and oxygenated monoterpenes such as β -pinene, neryl acetate, geranyl acetate, β -bisabolene, (E)- α -bergamotene, germacrene D and β -caryophyllene have also been reported in *C. aurantifolia*. In addition, lime oil also contain coumarins which are known to cause phototoxic reaction in humans. In experimental animals, these coumarins were found to promote tumour formation on skin and abdominal epithelium of mice induced by 9,10-dimethyl-1,2-benxanthracene and benzo-[a]-pyrene.(12)

C. aurantifolia peel oil:

The chemical composition of *C. aurantifolia* peel oil is very similar to that of *C. hystrix*, a Malaysian citrus species with presence of monoterpenes (94.6%). The two most abundant compounds were limonene (39.3%) and p-pinene (28.4%). However, the former can be distinguished by the presence of relatively high concentrations of geraniol (7.5%), neral (5.3%) and geranial (2.1%), citronellal (0.1%) with absolute absence of citronellol. GC-MS analysis of some species of citrus, *C. hystrix* D.C. *C. aurantifolia* Swingle, *C. maxim* Merr. and *C. microcarpa* Bunge, revealed that *C. hystrix* peel oil comprises mainly of monoterpenes (97.2%) with p-pinene (39.3%), limonene (14.2%), citronellal (11.7%) and terpinen-4-ol (8.9%) as the major components. Other monoterpenes present in appreciable amounts include α -terpineol (3.0%), terpinene (2.4%), α -pinene (2.0%), linalool (1.9%) and furanoid cis-linalool oxide (1.9%). 17 sesquiterpenoids in small quantities constituting 2.6% of the oil have also been identified in the lime essential oil. Myrcene, is present at 1.6% and 1.8% concentrations in the peel oils of *C. maxima* and *C. microcarpa*. In comparison, peel oils of *C. maxima* and *C. microcarpa* contained more than 94% of monoterpene hydrocarbon, limonene, and could be one of the important natural sources of limonene.(12)

pharmacological uses of citrus aurantifolia

Activity	Part of plant	Chemical constituent	references
Antibacterial activity	root	root	13

Antifungal activity	fruit	monoterpene	13
Anticancer activity	essential oil	flavonoid	13
Antioxidant activity	fruit	flavonoids	13
Cardiovascular activity	fruit	Methanolic extract	13

3. CITRUS SINENSIS

Taxonomy

Scientific classification:

Kingdom: Plantae

Family: Rutaceae

Genus: Citrus

Species: Citrus sinensis

Synonym

Hindi : Orange

Bengali : Kamla

Malayalam: Nagaranga

Punjabi : Malta

Marathi : Mosambi

Telugu : Sathgud

Gujarat : Naringi

Kannada : Kittalu

Chemical constituent:

C. sinensis is a rich source of secondary metabolites which contribute to the pharmacological activities attributed to this plant. Several types of chemical compounds have been identified in fruits, peel, leaves, juice and roots of *C. sinensis*, which include the following groups: flavonoids 1–54, steroids 55,56, hydroxyamides, alkanes and fatty acids 57–60, coumarins [61–67], peptides 68–70, [carbohydrates 71–74, carbamates and alkylamines 75–78, carotenoids 79–82], volatile compounds 83–148, and nutritional elements such as potassium, magnesium, calcium and sodium(14)

Pharmacological uses of citrus sinensis

Activity	Part of plant	Chemical constituent	Reference
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Antibacterial activity	Essential oil	Eugenol	17
Antioxidant activity	Fruit	Carotenoid	15
Antifungal activity	Crude plant extract	Secondary metabolites	16
Antiparasitic activity	Peel extract	Essential oil	16
Antiobesity activity	Juice extract	pectin	16

4. LIMMONIA ACCIDESSIMIA

Taxonomy

Kingdom: Plantae

Family: Rutaceae

Genus: Limonia L

Species: acidessimia⁽²³⁾

Synonym

English: Wood Apple, Elephant Apple, Curd fruit, Monkey fruit

Hindi: Kaitha, Kath Bel or Kabeet

Oriya: Kaitha

Sanskrit: Kapittha or Dadhistha.

Telgu: Vellaga Pandu

Bengal: Koth Bel

Gujarat: Kothu

Malaysia: Belinga²⁶

Chemical constituent :

The examination of primary phytochemicals in Limonia acidissima tree, demonstrated through the occupancy of flavonoids, alkaloids, terpenoids, phenols, fats steroids, tannins, glycosides, saponins, gum, mucilage, and settled oils. Leaves of the tree accommodate psoralen, stigmasterol, orientin. Bergapten, vitedin, saponarin, tannins, with some essential oils. Root consists of feronia lactone, bargapten, geranylumbelliferone, isopimpinellin, osthol, marmesin and marmin and seeds contain carbohydrates, proteins, fixed oil and amino acid. (23) The original home of wood apple is South India and Sri Lanka. (19

Ethnopharmacological uses of limmonia acidessimia

Part of plant	Uses	References
Fruit	Treat liver and cardiac condition	25

Leaves	asringent	25
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Pharmacological uses of *limmonia accidessemia*

Activity	Part of plant	Chemical constituent	References
Anticancer activity	Leaves	flavonoid	25
Antidiabetic activity	Fruit	Ethanollic extract	8
Antihyperlipidemic activity	Fruit powder	Ascorbic acid	8
Antimicrobial activity	Leaf extract	Essential oil	8
Analgesic activity	Fruit	Fruit peel extract	3
Antioxidant activity	Leaf	Every extract	25

5. MURRAYA KOENIGII

Taxonomy

Kingdom:Plantae

Family:Rutaceae

Genus:MurrayaJ.Koenigii

Species: MurrayaKoenigii L. Spreng

synonym

Bengali: Barsunga

Gujarati :Mitholimdo

Hindi: Meetha neem, Karipatta, Kathnim, Bursunga

Kannada: Karibevu

Malayalam: Kariveppilei,Kareapela

Marathi :Karipat,Karhipatta,Karhinimb,Jhirang

Oriya: Bansago

Sanskrit: Girinimba,Suravi

Tamil: Karivempu, Karuveppilei,Karivepila

Chemical constituent:

The plant extract generated from *Murraya koenigii* contains a variety of organic components with varied chemical compositions, including alkaloids, flavonoids, carbohydrates, and sterol. These solvents include petroleum ether, ethyl acetate, chloroform, ethanol, and water (37). The principal chemical components are described. Numerous experiments were carried out to confirm the phyto-constituents in the plant extract. (40)

Pharmacological activity of *Murraya koenigii*

Activity	Part of plant	Chemical constituent	references
Antibacterial activity	Leaves	mahanimbine	32

Antifungal activity	Leaf	acetone	33
Antioxidant activity	Leaf extract	gluthathione	34
Antidiabetic activity	leaves	alkaloid	34
Anticancer activity	bark	carbazon	35

6. MURRAYA PANICULATA

Taxonomy

Kingdom: plantae

Family: Rutaceae

Genus: murraya

Species: *M. paniculata* (47)

Synonym

Camunium exoticum (L.) Kuntze

Chalca scammuneng Burm.f.

Chalcas exotica (L.) Millsp.

Chalcas intermedia M.Roem.

Chalcas japonensis Lour.

Chalcas paniculata L.

Chalcas sumatrana M.Roem.

Connarus foetens Blanco

Connarus santaloides Blanco

Murraya exotica L.

Murraya omphalocarpa Hayata(47)

Chemical constituent

Many research teams have looked into the bioactive chemicals in *M. paniculata*. To date, many different substances have been discovered, including indole alkaloids, coumarins, phenols, terpenoids, and flavonoids. Additionally, 60 substances were found in the volatile and essential oils isolated from *M. paniculata* leaves. Utilizing chromatographic methods, the chemical components from various *M. paniculata* portions were identified, and spectroscopic methods were used to clarify the structures. The biological significance of a few of these chemicals provides scientific support for the traditional use of *M. paniculata*. Yuehcukene, also known as 1-(3,-indolyl-7,9,9,10-trimethyl-5,8,9,10-tetrahydroindano-[2,3-b] indole, was also discovered from *M. paniculata* leaves in 1986. Additionally, the root bark and flowers of *M. paniculata*, respectively, were used to isolate the two indole alkaloids known as murrayacarine and murrayaculatine. Early in the 1980s, multiple research teams extracted the flavonoids 3,3',4',5,5',7,8-heptamethoxyflavone and 3,3',4',5,5',7,8-hexamethoxyflavone from a methanolic extract of *M. paniculata*

leaves. Later, a flavone known as 3,5,7,3',4',5'-hexamethoxyflavone was discovered in the flower of *M. paniculata*. Other research teams identified ten flavonoids from the peel and pulp of *M. paniculata* fruits and eight flavonoids from the leaves of the plant.(46)

Pharmacological uses of *murraya paniculata*

Activity	Part of plant	Chemical constituent	references
Antimicrobial activity	leaf	Alkaloid, flavonoid	46
Analgesic and anti-inflammatory activity	bark	Ethyl acetate Methanol petroleum ether	45
Antioxidant activity	leaf	Reactive oxygen species	46

7. ZANTHOXYLUM RHETSA

Taxonomy:

Kingdom: plantae

Family: Rutaceae

Genus: zanthoxylum

Species: z. rhetsa

SYNONYM:

In the Kanikkar Tribes of Tamil Nadu's Western Ghats' Agasthiarmalai Biosphere Reserve, it is often referred to as "Malvapouu." Bazna and Bazinali are the local names in Bangladeshi. The tree is locally called as "batangberduri" (Malay), "tirphal" (Indian), and in some parts of India, "mullilam" (51)

Chemical constituent :

A crystalline compound obtained from the oil of *Zanthoxylum rhetsa*, called mullilamdiol and formulated as p-menthane-2,3-dihydroxy-1,4-oxide has been conclusively verified to possess a revised structure, (\pm)-p-menthan-1 α ,2 β ,4 β -triol 13. Volatile constituents of *Zanthoxylum rhetsa* leaves and seeds were analyzed by GC and GC/MS which resulted in the identification of 118 compounds from the leaf oil and 77 compounds from the seed oil. Caryophyllene oxide (12.7%), β -caryophyllene (9.6%), β -copaene (5.3%) and spathulenol (3.3%) were the main components of the leaf oil while sabinene (66.3%), α -pinene (6.6%), β -pinene (6.3%) and were analyzed by GC and GC/MS which resulted in the identification of 118 compounds from the leaf oil and 77 compounds from the seed oil (14). Effect of extraction methods on the composition of *Z. rhetsa* seed essential oil was examined. The steam distilled essential oil from the seeds of *Z. rhetsa*, (52)

Ethnopharmacological uses of *Zanthoxylum rhetsa*

Part of plant	Uses	References
Stem	Malaria	49

Fruit	Diarrohea, rheumatism	51
Root bark	Loss of stomach tone	51

Pharmacological uses of *Zanthoxylum rhetsa*

Activity	Part of plant	Chemical constituent	References
Antibacterial activity	Stem bark	Alkaloid	51
Anticancer activity	stem	Coumarins	58
Anti-inflammatory activity	fruit	Methanolic extract	57
Antioxidant activity	Bark extract	Phenolic compound	52

CONCLUSION

In Satpuda Region, 7 plants have been found which belong to Rutaceae family and they are scientifically proven. Also they are used by Tribal people. The importance of each plant are listed below.

1) *Aegle marmelos*:

Various part of aegle marmelos like root, leaves, flower, fruit etc have been found with diarrhea, gastric troubles, constipation, laxative, tonic, digestive, stomachic, dysentery, brain and heart tonic, ulcer, antiviral, intestinal parasites, gonorrhoea, epilepsy. But unfortunately, many people are unaware about it except tribal people. Ant-diarroheal activity, ant-bacterial activity as well as anti-viral activity are scientifically proven.

2) *Citrus Aurantifolia*:

Various plant part of *Citrus aurantifolia* has following properties like antiseptic, anti-oxidant, antispasmodic, aromatic, astringent, carminative, digestive, stimulant, stomachic and tonic. Tea prepared from fruit is used to relieve headache. The seed and the pericarp are used in the treatment of anorexia, chest pains, colds, coughs etc. The traditional uses of these plant are anti-inflammation, anti-lipidemia, antioxidant, anti-parasitic, and antiplatelet, activities. It is used for the treatment of cardiovascular, hepatic, osteoporosis, and urolithiasis diseases and acts as a fertility promoter. Moreover, it can be used for insecticide activity.

3) *Citrus Sinensis*:

C. sinensis is consumed all over the world as an excellent source of vitamin C, which is a powerful natural antioxidant that builds the body's immune system. It has been used traditionally to treat ailments like constipation, cramps, colic, diarrhea, bronchitis, tuberculosis, cough, cold, obesity, menstrual disorder, angina, hypertension, anxiety, depression and stress. Studies shows that it has anti-bacterial activity, Anti-obesity activity, Anti-parasitic activity, Anti-oxidant activity as well as Anti-fungal activity and they are scientifically proven.

4) *Limmonia accidessimia*:

Various parts of wood apple have been used for more than thousands of years in traditional medicines. Both ripe and unripe fruits have reputation for its medicinal properties. In traditional system it is used to cure dysentery, diarrhea, asthma, wounds, tumors, hepatitis and cardiac debility. Ripe fruit also cure liver disease and heart problems. It has role on lowering cholesterol levels in blood. Scientifically it has been proven that it has anticancer activity ,antidiabetic ,Anti-hyperlipidemic activity, anti-microbial as well as anti-oxidant activity.

5)Murraya Koenigii:

This plant is used as essential oils, fresh leaves and powder of dried leaves are widely used for curries, flavouring fish, soups and meat dishes, eggs dishes, ready to use and seasoning other food preparations. Also used as a Antimicrobial agent., Antipyretic activity, Antidiabetic Agent, Antiulcer property Also useful for Wound Healing. Scientifically it has been proven that plant possess Anti-cancer, Antifungal, Antioxidant as well as Antibacterial activity.

6)Murraya paniculata:

The ethnobotanical uses of murraya paniculata is as follows like in china the decoction of leave is used to treat bruises, chronic dysentery, stomach ache, swellings and skin irritations. It is also used to relieve pain. Leaves are also used in many countries as a tonic, to cure toothache and herpes and to expel tapeworms in Malaysia; as a stimulant in Indonesia; to increase the menstrual flow and to treat diarrhoea and dysentery in the Philippines; and for fever and dysentery in Indochina. The fruits and barks are sometimes also used medicinally. Scientifically proven properties are anti-nociceptive, antioxidant and anti-diabetic, to antimicrobial and analgesic activities.

7) Zantoxylum rhetsa:

The tribal people uses the part of plant Zantoxylum rhetsa to apply the paste prepared by rubbing the hard spines on a rock along with water on the breast to give relief from pain and increase lactation in nursing mothers. It is used as a deworming remedy. Stem bark and root bark of Z. rhetsa are used to treat malaria, rheumatism, loss of stomach tone; fruit could be used in the treatment of diarrhea and rheumatism. Anti-cancer, Ant-oxidant, Anti- bacterial and Anti-inflammatory activity of zantoxylum rhetsa has been proven scientifically. By knowing the properties of these 7 plants we conclude that in future many more research will give a gateway to explore more information of other properties of these plants. Awareness is too needed so that more and more will come to know about it.

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