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**ETHNOBOTANY AND PHARMACOGNOSY OF TURANJ (*CITRUS
MEDICA* LINN.): A COMPREHENSIVE REVIEW**

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ABSTRACT

Citrus medica Linn. commonly known as Turanj is the fruit of an evergreen shrub or tree mostly distributed in Khasia Hills, the South- West of India and parts of Northern India. It is also known by various other names like Citron, Mephal, Turanj, Baranimbu, Utraj, Bajura etc. around the globe. It belongs to the family Rutaceae and has been used in the management of several ailments and disorders like indigestion, loss of appetite, weakness of the heart, scorpion bite, palpitation, alongside these, it has additional pharmacological activities like antiemetic, liver tonic, spleen tonic, neuro and cardiac tonic: It contains alkaloids, flavonoids, triterpenes, saponins, coumarins, essential oils and cardiac glycosides. This review paper exclusively presents the morphological and microscopic structure, temperament, chemical constituents, pharmacological actions, uses in diseases, dose, important formulations and adverse effects of Turanj with the reference of not only ethnobotanical facts and

pharmacological studies but also with the reference of Unani literature in detail and gives a new stimulus to apply this drug in numerous disorders. Number of *in vivo* besides *in vitro* studies have too reported its antifungal, antioxidant, antibacterial activities.

Keywords: Turanj, *Citrus medica* Linn., Phytopharmacology, Unani Medicine

INTRODUCTION

Citrus medica Linn., Citron is a shrub or tiny tree that is commonly called Citron in English and Turanj in Unani literature. It has irregular thorny branches armed with short sharp thorns, considered to be indigenous to India. Leaves large, oval-oblong, serrate, rounded apex, petioles without wings; flowers large, axillary, in compact clusters of 3-10, white inside and purple outside; fruits lemon-yellow, large, oblong to oval, rough or warty, sometime ridged, rind thick, core hollow, pulp sparse, aromatic, sweet, juice sacs small, slender; seeds oval, numerous [1]. This plant is found actually wild in Kumaon, Sikkim, Pachamarhi, Garo Hills, Khasia Hills, Upper Yunzalin valley, Chittagong and Satpura range in Central India [2] Turanj in many parts are commonly employed in Indian traditional medicine. Ripe fruits are antiscorbutic, cardiac tonic, stomachic, sedative, stimulant and analgesic used in bilious vomiting, cold, dyspepsia, sore throat, palpitation, asthma, earache, hiccough, thirst and fever; root is antispasmodic, analgesic and used in constipation, piles ; seeds are stomachic, cardiac tonic, sedative ,anthelmintic and used in palpitation; [3] Fruit extracts have

also demonstrated high antioxidant activity [4] and Citron was cited in ancient literature as an antidote to every form of poison [5] and peels are anthelmintic, stomachic, stimulant, tonic, digestive and beneficial in loss of appetite, heart weakness and indigestion [6, 3].

Taxonomical Classification [7]

Kingdom: Plantae

Subkingdom: Tracheobionta

Division: Magnoliophyta

Class: Magnoliopsida

Subclass: Rosidae

Order: Sapindales

Family: Rutaceae

Genus: *Citrus*

Species: *medica*

Botanical name: *Citrus medica* Linn.

Vernacular Names [8, 9] Arabic: Utraj,

Urdu: Turanj, English: Citron, Hindi:

Bijaura, Persian: Turanj, Sanskrit: Begpura,

Bijaka, Tamil: Turanji.

Habitat

Citrus medica is originated in Southeast Asia, and extending to the Mediterranean and further continents through Persia [10]. It is cultivated throughout the moist regions of India. Wildly grown in Chittagong, Sitakund Hill, chiefly in Khasia Hills, [7]

the south-west of India, and parts of Northern India [8].

Morphology

Citrus medica is an evergreen tree or bush, 1.8-3.6-meter-high with stems up to 10 cm. in diameter. Young shoots glabrous. Bark smooth, yellowish brown. Blaze 2.5 mm., pale orange or pale yellow. Branches up to about 5 cm, armed with sharp, stout, straight, axillary thorns up to 7.5 cm. long. The branches often procumbent and rooting freely in contact with the ground. Leaves 7.5-15 by 3-7.5cm., oblong or elliptic with acute or rounded apex, rather obscurely crenate-serrate, coriaceous, glabrous, pellucid-punctate, dull dark green above. Petiole 5-12 mm. long, sometime very narrowly winged. Flowers 3.8-4.5 cm. diameter, scented, white tinged pink outside, often unisexual, in few flowered axillary cymes up to 2.5 cm. long, or solitary. Pedicels 3.8-6 mm. long [11]. Fruit 5-7.5 cm. long, globose, ovoid, or oblong, often obtuse mammillate at the apex, yellow, large, oblong to oval, rough or warty, sometimes ridged, core hollow, pulp sparse, aromatic, sweet, juice sacs small, slender. Seeds oval numerous. Rind usually warted and thick. They are yellowish brown in color. The exterior surface rough and dark, while the inner surface, which depicts the showy part of the rind, is light. The diameters of pieces, ranges from 5 to 7.5 cm. The medicine has

a strong aromatic scent that is quite nice. It has a bitter flavor [6]. Several varieties are known and they are broadly grouped into sweet and acid citrons. 'Birajora' is grown in domestic holding. This variety was tried as a rootstock for *Citrus reticulata*. The budded plant grows remarkably well in early years but after a period of about five years the plant shows symptoms of incompatibility and gradually declines. It is very popular among the hill tribes for its white carrot-like albedo portion which is eaten raw. 'Soh-manong' is met with everywhere in Assam but is incompatible as rootstock. 'Chhangura' with small rough fruits is devoid of pulp; 'Turanj' is a sweetish skinned variety with large fruits. 'Bijoura' or 'Bajoura citron' is a small fruited variety with acidic fruits, thick skin and abundant juice. It resembles the citron in its bushy habit, serration and rumpling of leaves, persistent style, flower characters and continuous flowering. The fruit is edible; the inner rind is also edible. The juice is used for making a refreshing drink. 'Kagzi Kalan' or 'Nepali Kagzi' are probably natural hybrid between sour lime and citron [1].

Microscopic study:

Transverse section of *Citrus medica* fruits shows the below mentioned tissue arrangement. Pericarp: It shows thick cuticle covering single layer of epidermis, sometimes paracytic stomata is present.

Hypodermis: underneath the pericarp, 2-3 rows of very small sized compactly arranged parenchymatous cells of the hypodermis found. Mesocarp: It contains large porous cells with wide oval to spherical lysigenous oil cavities. Vascular bundle: It is present in mesocarp. Endocarp: The cells of the endocarp layer have thin wall and are elongated. Several simple starch grains and tiny prismatic crystals of calcium oxalate are dispersed throughout the parenchymatous tissue of the section [12].

Peel: A cross section of the peel shows an outer most layer of small more or less isodiametric cells forming the epidermis which is disrupted at place. A fine cuticle covers the epidermal layer. The cells in the outer layer as well as in the following layer have coloured bodies which are probably crystals of hispiridin. This layer of cells encloses a ring of large oil cells which are surrounded by thin walled tubular cells. The rest of the inner tissue consist of loose parenchymatous, elongated, branched cells having vascular bundles, scattered in between [6].

Leaves: Petiole T.S. of the petiole revealed a thin epidermal layer with a cuticle. Many (12-16) layers of chlorenchymatous cells were seen beneath the epidermal layer. The first 3 to 4 layers of chlorenchyma, which contain chloroplast, were compactly organised, while lower-layer cells were

larger and more pentagonal in form, with more intercellular spaces. The vascular bundles were coated by a radially intermittently organised 5 to 7 layer of lignified sclerenchymatous pericyclic fibres positioned between endodermis and vascular bundles. Cortex cells containing chloroplast were stretched between two sets of pericyclic fibre tissue cortex cells. The vascular bundles are strengthened by these tissues. The vascular bundles were a conjoined, collateral and disbanded ring in the middle. Xylem fibres and xylem parenchyma made up the radially oriented vessels known as xylem. Thin-walled polygonal pitted paranchymatous cells occupied the central section, with intercellular space between them. The lysigenous cavities were discovered in the top section of the lamina.

Midrib and lamina Upper epidermis, lower epidermis, and a centrally situated vascular bundle were shown in a diagrammatic section through the mid-rib. Epidermis, hypodermis with prismatic crystals, chloronchymatous cells that were continuous with the palisade layer of lamina, chlorenchyma, fibrous ring of pericycle fibres, conjoint vascular bundles and pith were all visible in a detailed transverse section. The phloem tissues were encircled (from the outside) by an incomplete ring of thick-walled fibres around the vascular bundle (sclerenchyma).

This ring was made up of 1–5 layers of compact, donut-shaped fibre cells with thick secondary walls that appeared to be highly lignified. The fibrous ring was thicker (with more layers) in the centre, notably on the lower side of the midrib and tapered outwards, leaving a huge gap (devoid of these fibres) on both sides of the vascular bundle. In addition to the larger gaps on the sides, there were several smaller gaps on both the lower and upper sides of the fibrous ring, which were inhabited by plenty of thin walled cells similar to those of the ground parenchyma. Thin-walled polygonal pitted parenchymatous cells occupy the central section, with intercellular space between them. Mesophyll differentiated into top elongated compactly packed palisade cells and lower oval to round shaped spongy parenchyma of 5 to 6 layers with intercellular gaps, as seen in a transverse section of the lamina of the leaf. The lysigenous cavities were discovered in both the upper lamina and the ground tissue. Stomata were parasitic and only present on the lower surfaces. Vascular bundles formed a conjoined, collateral and disbanded ring at the centre. Xylem fibres and xylem parenchyma made up the radially organised vessels. Phloem is found on the lower side of the xylem and is made up of phloem fibres and sieve components

Surface study Epidermal cells with prismatic crystals and a lysigenous chamber with oil globules were seen in leaf peelings from both the abaxial (dorsal) and adaxial (ventral) sides. Only the lower epidermis had paracytic stomata, where the stoma is flanked by two subsidiary cells with long axes parallel to it [13].

Temperament (Mizaj):

Hot in 1st degree and dry in 1st degree [6]

Hot in 1st degree and dry in 2nd degree [14, 15, 16]

Hot in 3rd degree and dry in 3rd degree [17]

Parts Used (Ajzaye-mustamela)

Rind, juice and oil [8,14, 18]

Pericarp [9]

Leaves, seed [14, 18]

Chemical Composition

Fruits contains organic substance such as flavonoids, alkaloids, phenols, carbohydrates and mucilage [19]. The flavonoids present in the fruits are hesperidin, 3,5,6-trihydroxyl- 4,7-dimethoxy flavone, 3,5,6- trihydroxy-3, 4,7-trimethoxy flavones [20]. The **peels** contains flavonoids, alkaloids, steroids, phenols, carbohydrates, coumarins, scoparone, limettin, umbelliferone and scopoletin, while **seeds** contain limonol, limonin and nomilinic acid [21, 22].

The **leaves** contains alkaloids, flavonoid, steroids and glycosides [19]. The leaf oil contains linalool,

limonene, citronellal, citronellol, isopulegol and citronellyl acetate [23].

Constituents of essential oil of *Citrus medica* Linn. Leaves [24, 25]

Name of components	%
Erucylamide	28.43
Limonene	18.36
Citra	12.95
Meph	8.96
6-Octenal,3,7-dimethyl	4.39
1,2-Cyclohexanediol	3.98
Methoprene	3.51
Citronellal	4.39
1,2-Cyclohexanediol, 1-methyl-4-(1-methylethenyl)	3.98
Citronellol	1.72
Geranyl methyl ether	1.42
7-Oxabicyclo[4.1.0]heptane, 1-methyl-4-(1-methylethenyl)	1.18
3,7-Nonadien-2-ol- 4,8-dimethyl	1.16
2-Octen-1-ol,3,7-dimethyl-,isobutyrate,(z)	1.10
13-Heptadecyn-1-ol	1.05
2-Oxocycloheptyl acetate	0.87
1-Monolinoleoylglycerol trimethylsilyl ether	0.86
n-pentyl(1-propenyl)dimethylsilane	0.82

Constituents of essential oil of *Citrus medica* Linn. Peel [24, 25]

Name of constituents	%
Isolimonene	39.37
Citral	23.12
Limonene	21.78
Neryl acetate	2.51
Neryl Alcohol	2.25
β -cineMyr	2.70
Linalool	0.94
4-Terpineol	0.80
β -Bisabolene	0.71
Caryophyllene	0.59
β -Terpinyl acetate	0.52
α -Bergamotene	0.48
1,3,6-Octatriene,3,7-dimethyl-,(z)	0.43
Trimethylbicyclohept-2-ene	0.41
α -Pinene	0.41
Decanal	0.33
Carane,4,5-epoxy-,trans	0.30
Citronellal	0.29
Nonanal	0.25
Cyclooctyl alcohol	0.17
Terpinyl acetate	0.16
3-octyn-ol	0.10
Undecanal	0.10
Cis-verbenol	0.09
Dodecanal	0.08
α -Caryophyllene	0.08
Cis- α -Bisabolene	0.07
2-Acetyl-5-methylfuran	0.05
(Z,E)- α -Farnesene	0.05
Germacrene D	0.05
δ -Cadiene	0.05
1-Heptanol, 3methyl	0.04
Trans-p-Metha-2,8-dienol	0.04
1,6,10-Dodecatriene, 7,11-dimethyl-3-methylene,(z)	0.04
Tetrakis(trimethylsiloxy)silane	0.04
1,2-cyclohexanediol,1-methyl-4-1-methylethyl	0.03

Table 1: Pharmacological Actions (Afaal): Post Turanj (Peel of *Citrus medica*)

Actions of drug	Unani references	Ethno-botanical references
<i>Muqawwie-Qalb</i> (Cardio tonic)	[14,16,18]	[26]
<i>Muqawwie-Hawas</i> (Neuro tonic)	[18,15]	
<i>Muqawwie-Meda</i> (Stomachic)	[15,16,17,14]	[8]
<i>Muqawwie-Jigar</i> (Liver tonic)	[14,15,16,18]	
<i>Kasire-Riyah</i> (Carminative)	[14, 15,16,18]	[27]
<i>Mufarraah</i> (Exhilarant)	[17]	[8]
<i>Muhallile-Balgham wa Sauda</i> (Phlegm and black bile resolvent)	[14]	
<i>Dafe-Suddah</i> (Deobstruent)	[14,15]	
<i>Tiryaaq</i> (Antidote)	[17,14,15]	
<i>Muqawwie Azaye-Raeesa</i> (Vital organ tonic)	[6,18]	[26, 3]
<i>Dafe-Taffun</i> (Anti-septic)	[16]	
<i>Dafe-Suaal</i> (Anti-tussive)	[14]	
<i>Muhallile-Auram</i> , (Anti-inflammatory)	[18]	[19]
<i>Muattish</i> (Thirst alleviator)	[17,16]	

Table 2: Therapeutic uses of Post Turanj (Peel of *Citrus medica*)

Uses	Unani references	Ethno-botanical references
<i>Zofe-Ishteha</i> (Loss of appetite)	[6]	
<i>Khafqan</i> (Palpitation)	[18]	[13]
<i>Zofe-Qalb</i> (Weakness of the heart)	[18,6]	
<i>Darde-Shikam</i> (Pain in abdomen)	[18]	
<i>Haiza</i> (Cholera)	[18]	
<i>Sue-Hazm</i> (Indigestion)	[6]	
<i>Musakkine-Ghisiyan</i> (Antiemetic)	[17,16,18]	[13]
<i>Mufarrahe-Qalb</i> (Cardio exhilarant)	[18]	
<i>Bars</i> (Leucoderma)	[17,15,16]	
<i>Maar-Gazeedgi</i> (Snake bite)	[17,15,16]	
<i>Aqrab-Gazeedgi</i> (Scorpion bite)	[17,16]	
<i>Bawaseer</i> (Piles)	[15]	
<i>Hazime-Taam</i> (Digestive)	[15,16,18]	

Table 3: Pharmacological Actions (Afaal): Barge-Turanj (Leaves of *Citrus medica*)

Actions of drug	Unani references	Ethno-botanical references
<i>Kasire-Riyah</i> (Carminative)	[14,15,17]	
<i>Muqawwie-Meda</i> (Stomachic)	[18,17]	
<i>Hazime-Taam</i> (Digestive)	[14,15,17]	
<i>Dafe-Suddah</i> (Deobstruent)	[14,15,17]	
<i>Dafe-Waja</i> (Analgesic)	[15]	[8]
<i>Mulattif</i> (Demulcent)	[15]	
<i>Muhallil</i> (Resolvent)	[17]	
<i>Mushil</i> (Purgative)	[17]	

Table 4: Therapeutic uses of Barge-Turanj (Leaves of *Citrus medica*)

Uses	Unani references	Ethno-botanical references
<i>Muhallile-Auram</i> (Anti-inflammatory)	[17]	
<i>Zofe-Ishteha</i> (Loss of appetite)	[6]	
<i>Sue-Hazm</i> (Indigestion)	[6]	
<i>Aqrab-Gazeedgi</i> (Scorpion bite)	[15]	

Table 5: Pharmacological Actions (Afaal): Tukhme-Turanj (Seeds of *Citrus medica*)

Actions of drug	Unani references	Ethno-botanical references
<i>Qatile-Deedan</i> (Anthelmintic)	[3]	[26]
<i>Muqawwie-Meda</i> (Stomachic)	[18]	[3,13]
<i>Munawwim</i> (Sedative)	[3]	[26]
<i>Muqawwie-Qalb</i> (Cardiac Tonic)	[17]	[1]
<i>Muhallil</i> (Resolvent)	[18]	
<i>Tiryaaq-Sumoom</i> (Antidote)	[17]	[13]
<i>Aqrab Gazeedgi</i> (Scorpion bite)	[14]	
<i>Mudirre-Haiz</i> (Emmenagoge)	[18]	

Table 6: Therapeutic uses of Tukhme-Turanj (Seeds of *Citrus medica*)

Uses	Unani references	Ethno-botanical references
<i>Khafqan</i> (Palpitation)	[1]	[1]
<i>Bawasir</i> (Piles)	[15]	
Muhallile-Auram (Anti-inflammatory)	[18]	
<i>Maar-Gazeedgi</i> (Snack bite)	[18]	
<i>Aqrab-Gazeedgi</i> (Scorpion bite)	[18]	

Table 7: Pharmacological Studies

Studies	Form	After Treatment	References
Antioxidant	Ethanollic extract of peel and pulp	Various free radicals scavenging activity due to presence of alkaloid, glycoside, carbohydrate, triterpenoid, resins and tannins which work as antioxidants. Phenolic compounds and ascorbic acid are known as possible antioxidant. Radical scavenging activity is due to presence of phenolic compounds or vitamin C present in the fruits	[26,28]
Cardioprotective	Ethanollic extract of fruit	Demonstrates the phenolic and flavonoidal contents of <i>C. medica</i> , a Cardioprotective against Isoproterenol(ISO)-induced cardiotoxicity in rats. Extract of <i>C. medica</i> decreased the level of cholesterol, triglycerides, low density lipoproteins, very low density lipoproteins. Extract also protected against myocardial damage and increased the level of marker enzymes e.g. AST,ALT, CK,LDH	[29]
Antimicrobial	Ethanollic extract of peel Ethanollic extract of root, peel and pulp Root extract and fruit juice	Effective against <i>Staphylococcus aureus</i> , <i>Proteus vulgaris</i> , <i>Escherichia coli</i> , Effective against <i>Bacillus subtilis</i> , <i>Staphylococcus aureus</i> , <i>Enterococcus faecalis</i> , <i>Escherichia coli</i> , <i>Klebsiella pneumonia</i> , <i>Pseudomonas aeruginosa</i> and <i>Proteus vulgaris</i> . Effective against <i>Aspergillus flavus</i> , <i>Aspergillus niger</i>	[30]
Anticancer	Ethanollic extract of peel Extract of peel, fruit juice and fruit pulp	Reduced the incidence of tumours Protective role against anti-carcinogenic and anti-inflammatory agent and prevents lipid peroxidation	[31]
Antiulcer	Ethanollic extract of fruit	Decreased mucosal ulceration	[32]
Anthelmintic	Alcoholic extract of peel	Against human <i>Ascaris Lumbricoides</i> It has shown to possess anthelmintic activity against the Indian adult earthworms (<i>Pheretima posthumad</i>) probably due to its effect on inhibition of glucose uptake in the parasites and depletion of its glycogen synthesis.	[33]

Dosage (Miqdare-khurak)

3-5 gms [6, 9, 18]

3.5-4 gms [14]

3.5-4.5 gms [15]

Toxicity or Adverse effect (Muzir asrat)

Harmful for liver and stomach, also produce headache [18, 16, 15, 14]

Corrective (Musleh): Banafsha, (*Viola odorata* Linn.), Filfil siyah (*Piper nigrum* Linn.) and honey are used as corrective to

avoid its toxicity and adverse effects [18, 6, 15, 16]

Substitute (Badal):Orange (*Citrus sinensis*) and Lemon (*Citrus limon*) can be used as its substitute [18, 16, 15]**Compound Formulations (Murakkab):** [18, 6, 9]

Khameerae-Abresham Arshadwala, Jawarishe-Zarishk, Jawarishe-Ood Tursh,

Jawarishe-Anarain, Jawarishe-Tamar Hindi, Itrifal Zamani, Dawa-ul Misk Motadil, Mufarreh Dilkosha, Sharbate-Ahmed Shahi, Joshanda Aftimoon, Majoone-Najah.

CONCLUSION

As discussed earlier *Citrus medica* Linn. has been used by unani physicians in many diseases like palpitation, malencholia, headache, flatulence, indigestion, scorpion bite, inflammation, giddiness etc. Phytochemicals present in it are accountable for showing different pharmacological activities viz. antioxidant, antidiabetic, cardioprotective, antimicrobial, anticancer, antiulcer, anthelmintic effects etc. This vast pharmacological profile clearly indicates the correlation between mechanism of action and phytochemical profile, which provide clear evidences for its clinical uses. It is not only shown to be effective when given singly but also has promising effect when given along with other drugs or herbs. It has been used by traditional healers since antiquity for ailing humanity but further clinical studies should be conducted to understand its mechanism of action. Some activities have been proven by modern research but other activities like sedative, antipyretic, anti-tussive etc. needed scientific validation to support its therapeutic uses. The above detailed review will provide a base which help in

strengthening the research thus, promotes evidence based traditional knowledge of Unani medicine.

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