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Review

RASNA: BOTANICAL CONTROVERSY, PHARMACOLOGICAL SIGNIFICANCE, AND PHYTOCHEMICAL STANDARDIZATION OF AYURVEDIC MEDICINAL PLANTS.

Kathirvel. B[*1], Dr. L.V. Vigneshwaran[2], Abinayah. S[3], Muskan. K[4], Adhithya. S[5], Govindraj. C[6], Manikandan. C[7]

[1,2,3,4,5,6,7]RKP College of Pharmacy, Krishnagiri, Tamil Nadu -635001

*Author for Correspondence: Kathirvel. B
Email: kathirvel9443@gmail.com

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Abstract

Rasna is a crucial Ayurvedic drug used to manage inflammatory disorders like arthritis, rheumatism, and respiratory diseases. However, the term "Rasna" refers to a group of medicinal plants, leading to controversy in identification and usage across India. Multiple plants like *Pluchea lanceolata, Alpinia galanga*, and *Vanda tessellata* are used as Rasna, causing issues with authenticity, standardization, and conservation. This review highlights the reasons behind Rasna's controversy, its botanical descriptions, habitat, and therapeutic uses. *Pluchea lanceolata*, a classical source of Rasna, is emphasized, including its pharmacognostical characteristics and pharmacological activities. The study also focuses on standardizing the Ayurvedic polyherbal formulation Rasna Saptak through various evaluations like HPTLC fingerprinting, FTIR analysis, and antioxidant activity assessment.The results confirm the presence of bioactive phytoconstituents, with the hydro-alcoholic extract showing superior antioxidant activity.

Keywords: Rasna, Controversial Ayurvedic plant, multiple sources

INTRODUCTION:

Herbal medicine has a long history in India, particularly through systems like Ayurveda, Siddha, and Unani. These methods primarily treat a variety of illnesses with medicinal plants. Because they are thought to be inexpensive, safe, and effective, herbal medications are utilized extensively. Rasna is a significant Ayurvedic medicinal plant that is frequently used to treat respiratory problems like bronchitis and asthma as well as inflammatory ailments including rheumatism, arthritis, and joint pain. It is an essential component of many Ayurvedic remedies, such as Rasnadhi Taila, Maharasnadi Kwath, and Rasna Saptak Kwath. However, because Rasna is derived from multiple plant sources, it is regarded as a contentious medication. In various regions of India, Rasna is made from a variety of plants, including *Pluchea lanceolata*, Alpinia galanga, *Vanda tessellata*, Rauwolfia serpentina, *Withania coagulans*, and *Viscum album*. This leads to inconsistent therapeutic effects, identification

confusion, and challenges in upholding quality and uniformity

THE PRIMARY AIM OF THIS TOPIC:

examining the botanical identity, phytochemical components, and pharmacological significance of Rasna and Rasna Saptak, the main goal of this study is to scientifically assess and standardize their formulation in order to validate their traditional use in the treatment of inflammatory, arthritic, and wound-healing conditions.

INTRODUCTION

India has a vast array of traditional medicinal plants that have been used for thousands of years. Our country's traditional medical systems include Ayurveda, Siddha, and Unani. "Ayur" (life) and "Veda " (science) are the roots of the word "Ayurveda". Thus, the literal translation of Ayurveda is "the science of life." For some conditions, such as asthma and rheumatoid arthritis, Ayurveda is self-sufficient and independent. Herbal medicines play a significant role in every traditional medical system. They are essential to both human health care and our food supply. According to a WHO report, between 70 and 80 percent of the world's population is treated with plant medicines [1].

Rasna is an ayurvedic medication used in various traditional medicine systems, such as *Alpinia galanga* (L) willd, *Pluchea lanceolate* (DC.) C.B. Clark, and *Vanda tessellate (Roxb.) Hook.* ex G. Don't, both domestically and internationally. The roots of *Acampe praemorsa* and *Vanda tessellata* are used in Eastern Indian markets under the name Rasna, while *pluchea lanceolate* is used in Central and Northern India and *Alpinia galanga* is used in Southern India.Rasna is a potent anti-rheumatic and anti-arthritic medication that is widely used in our traditional medical system. In addition, it is used to treat upper respiratory conditions like bronchitis and asthma as well as gastrointestinal issues like flatulence and dyspepsia [2,3].

The Ayurvedic medical system has identified about 34 plants as rasna. Numerous pharmacological qualities of this plant include immunostimulant, antiviral, antibacterial, antiinflammatory, anti-cancer, and anti-rheumatic etc [1]. The term "controversial plants," also known as "Sandigdha dravays," refers to medicinal herbs that, according to Ancient Indian literature, have questionable botanical sources. According to a wealth of knowledge gleaned from Ayurvedic and other Sanskrit literature, there are multiple instances in the old system of medicine when one common name is used for two or more completely distinct and diverse plant species. "Sandigdha dravyas," or controversial plants, have historical roots. With its many dialects, languages, and personas, India is a very remarkable nation [4].

Rasna plants, such as Acampe praemorsa, *Alpinia galangal, Pluchea lanceolata*, and *Vanda tessellata*, are under intense pressure to be exploited from their natural habitat because they are pharmaceutically significant drugs that could go extinct. In order to meet the demand MKIUGUKTFN for pharmaceuticals and prevent extinction from the natural habitat, it has taken time to develop methods for the conservation and cultivation of these species because the root is the main component of the propagules for cultivation, and traders are gathering the drugs without taking any precautions for future generations.[6]

REASONS FOR CONTROVERSY [7]:

1.Disruption in traditional teaching & training
2. Same synonyms for different plants
3. Documentation defects in the manuscripts.
4. Non availability of raw - materials.
5. Unwanted dependency over substitutes
6. Fake-vaidyas allowed to identify.

Rasna is a medication that comes from several botanical sources and is used in the formulations such as *Rasnadhikasayam,RasnadhiChurna, Rasnadhitailam, Aswagandarishtam*, *Devadarvyarishtam, Karpasthyadhitailam*, and Kasayas such as *Rasnaerandadhi, Rasnasaptakam, RasnaPanchakam, etc* [8].

TYPES OF RASNA PLANTS:

These plants are being utilized: as Rasna in many regions of India [8]:

1. Keralan Alpinia galanga (*Scitaminaceae)*
2. *Vanda roxburghii (Vanda tessellata)* (Bengal) Orchidaceae
3. North India: *Pluchea lanceolata* (Asteraceae)
4. Apocynaceae's *Rauwolfia serpentina* All over India
5. *Viscum album* (Loranthaceae): Nepal and Kashmir
6. Punjab: *Withania coagulens (Solanaceae)*

I. ALPINIA GALANGA SWARTZ

Figure1: Alpinia galanga swartz

FAMILY:Zingiberaceae

BOTANICAL SUMMARY: *Alpinia galanga* is Greater Galangal is the common name for it. Its source Leaves are tuberous and somewhat fragrant. are green, glabrous, acute, and oblonglanceolate. Sheaths are long and glabrous, ligules are short and rounded, and the surface is paler above and faintly callused white [9].

SYNONYMS: Gandhamoola, Malaya, Kulanjana

HABITAT: The plant is found throughout India's southern Western Ghats and the Himalaya [10]. It is frequently grown in Konkan and North Kanara [11].

THERAPEUTIC USES: The plant's rhizome has carminative, anti-emetic, digestive tonic [12], antifungal, anti-helmintic, antitumor, anti-ulcerative, anti-diuretic, and anti-dementia properties [13]. Hypothermia, antitubercular activity, tonic, bronchial catarrh, stomachic, and stimulant properties are all demonstrated by the rhizome extract [14]. In addition, it is used as a pungent, bitter, hot, stomachic, heart illness, aphrodisiac tonic, expectorant, appetite enhancer, healer, rheumatic pains, lumbago, chest pain, diabetes, burning of the liver, kidney disease, and disinfectant [15]. Additionally, the rhizome has antibacterial [16], antimicrobial, anti-inflammatory, and Flavoring properties [17].

II. VANDA TESSELLETA HOOK

Fig:2 Vanda Tessellata Hook

FAMILY – Orchidaceae

BOTANICAL DESCRIPTION: It is an epiphytic perennial with a stem that is 30 to 60 cm long, sturdy, and scandent due to its simple or branched aerial roots. Succulent, long, linear, recurved, and complex leaves measuring 15 to 20 cm. 6–10 flowered racemes on a peduncle that is 15–25 cm long. Yellow

sepals with white borders and tessellated brown lines. The yellow petals are shorter than the sepals and have white borders and brown lines. 16 mm long, blue lip with purple dots. 7.5–9 cm long, narrowly clavate-oblong capsules with sharp ribs[18].

HABITAT: Bengal, Bihar, Ceylon, Chota Nagpur

THERAPEUTIC USES: Dyspepsia, inflammations, bronchitis, rheumatic pains, sciatic, tumors, hiccups, and abdominal diseases are all treated with the plant's juice [19]. In cases of fever, paste is utilized [20]. It has analgesic, aphrodisiac, and nervine tonic properties [21,22]. In addition to being helpful for dyspepsia, bronchitis, inflammations, piles, and hiccups, the plant's roots have antipyretic and alexiteric properties. The root is applied externally to rheumatism, related conditions, and neurological problems. It is also used as a treatment for scorpion stings and secondary syphilis. The leaf juice is applied topically to treat otitis, while the leaf paste is used as a febrifuge. This plant's roots have strong anti-inflammatory properties [23].

III. PLUCHEA LANCEOLATE (DC.) Oliv

Fig 3: *Pluchea Lanceolate (DC).OLIV*

FAMILY - Asteraceae

BOTANICAL DESCEIPTION: 30–60 cm tall, this perennial herb grows in Indo-Gangetic plains. The branches and stem are slender, terete, and gently pubescent. The leaves are sessile, 2–6 cm long, oblanceolate or oblong, coriaceous, delicately silky, and pubescent on both surfaces; the edges are either completely dentate or slightly dentate toward the apex. In manyheaded compound corymbs, flowers are white, purple, yellow, or lilac. In compound pubescent and corymbs, the capitulum is ovoid or campanulate, measuring 6-7 mm. The outer Involucralscale i 2.5–4.0 mm long, 2 mm broad, 5–3 serrated, obtuse, silky pubescent, and tinted with purple outside the apex. The involucre is ovoid or broadly campanulate with imbricated scales. The innermost scales are few, linear, scarious, subacute, somewhat narrower, and longer than the outside ones; they are all stiff when dry, and the tips of the outer one frequently split into one or two shallow lobes. The container is naked and flat [24].

SYNONYMS- Rasya, Rasana

HABITAT- Gangetic plain. Punjab, Kanpur, Kathiawar.

HISTORY OF PLUCHEA LANCEOLATA:

Pluchea lanceolata, also known as Rasna, has long been used in Ayurvedic medicine. Classical Ayurvedic writings including Charaka Samhita, Sushruta Samhita, and Bhavaprakasha Nighantu have references to Rasna, mostly for the treatment of Vata-related diseases. In the past, the herb has been used to treat inflammatory diseases, fever, sciatica, rheumatism, arthritis, and muscle pain. The entire plant and roots have been used in decoctions and oils in traditional medicine in North and Central India. Its anti-inflammatory and anti-arthritic properties were confirmed by scientific studies over time, increasing its therapeutic significance.

BACKGROUND OF (PL):

Pluchea lanceolata is a member of the Asteraceae family and is found throughout India's IndoGangetic plains. It is one of the traditional botanical sources

of Rasna, however there is botanical debate on the usage of many other plants as Rasna in other locales. Flavonoids, phenolic chemicals, terpenoids, and sterols are abundant in the plant and contribute to its therapeutic qualities. Pluchea lanceolata is frequently used in Ayurvedic formulations like Rasna Saptak Kwath and Maharasnadi Kashayam because of its efficacy in treating inflammatory conditions and chronic joint illnesses.

CURRENT STATUS:

- Currently, the Ayurvedic Pharmacopoeia lists *Pluchea lanceolata* as a significant source of Rasna.
- It is widely utilized in polyherbal remedies for inflammatory conditions like arthritis.
- Its anti-inflammatory, analgesic, antioxidant, and anti-arthritic properties are confirmed by experimental and preclinical research.
- For standardization and quality control, contemporary analytical methods such HPTLC, FTIR, TLC, and physicochemical analysis are employed.
- But there are still few large-scale clinical studies and conservation tactics, which emphasizes the need for more study and sustainable farming.

MECHANISUM OF ACTION:

Pluchea lanceolata's bioactive phytochemicals are primarily responsible for its medicinal properties.

- Among the mechanisms are: suppression of inflammatory mediators including cytokines and prostaglandins
- inhibition of the lipoxygenase (LOX) and cyclooxygenase (COX) pathways
- Scavenging free radicals and lowering oxidative stress lysosomal membrane stability, avoiding tissue injury
- Enhancing microcirculation to reduce edema and pain
- Rheumatoid arthritis and other autoimmune diseases can benefit from immunomodulatory effects.

CLASSIFICATION OF (PL):

Scientific Classification:

Rank	Classification
Kingdom	Plantae
Subkingdom	Tracheobionta
Division	Magnoliophyta
Class	Magnoliopsida
Order	Asterales
Family	Asteraceae
Genus	Pluchea
Species	Pluchea lanceolata (DC.) Oliv. & Hiern

THERAPEUTIC USES:

Whole plant is conducted in Ayurvedic medicine. For arthritis, *Pluchea lanceolata* is accepted as classical drug. Its decoction is given in muscular pains, rheumatic conditions, oedema, and fever and also externally applied as oil for massaging. The

leaves are used as a laxative, antipyretic and analgesic [25].

IV. RAUWOLFIA SERPENTINA LINN

fig:4 *Rauwolfia Serpentina Linn*

FAMILY- *Apocyanaceae*

BOTANICAL DESCRIPTION- The plant usually grows to a height between 60 and 90 cm and has pale green leaves that are 7 to 10 cm long and 3.5 to 5.0 cm wide. The leaves are elliptical or lanceolate shaped and occur in world of 3 to 5 leaves. The plant has many shiny, black or purple, round fruits that are approximately 0.5 cm in diameter. It also has small pink or white flowers. The plant has a prominent tuberous, soft taproot that reaches a length between 30 and 50 cm and a between 1.2 and 2.5 cm [26].

SYNONYMS- Chandramara, Dhavalavitapa.

HABITAT- R. Serpentine is cultivated in many parts of the country as it is in great demand.

THERAPEUTIC USES- Rauwolfia has been studied for the treatment of mental diseases which include schizophrenia and bipolar disorder, epilepsy and seizures, and also in insomnia and problems in sleep [27]. One experiment found that Rauwolfia has effective solutions to the treatment of anxiety [28]. In another experiment, Rauwolfia was studied to test its benefits in improving psychogenic and pruritic dermatoses [29]. It has also been reported to enhance psoriatic outbreaks.

V. WITHANIA COAGULANS DUNAL in Dc

Fig:5 Withania Coagulans Dunal

FAMILY- *Solanaceae*

BOTANICAL DESCRIOTION: W. Coagulants dunal is a rigid, grey-whitish small shrub, about 60-120 cm tall. The leaves are about 2.5-7.5 cm long and 1.5 cm broad, usually lanceolate oblong, Sometimes ovate, obtuse, narrow at the base and very short stalked. The flowers are about 7-12 mm across, yellowish, and are dioecious and polygamous in nature. The flowers are found in axillary cymose clusters. The berries are about 7-12 mm in diameter, red, smooth and enclosed in leathery calyx. The seeds are dark brown, ear shaped, glabrous with sharp fruity s smell [30].

HABITAT Sindh, Punjab, Baluchistan, Afganistan.

THERAPEUTIC USES- *W. coagulants* is used to medicate nervous exhaustion, insomnia, disability, impotence, failure to thrive in children. Its fruits are used in treatment of asthma, liver complaints and biliousness. Flowers of the plant are used for diabetes [31]. The fruits of the plant are sweet and are reported to be sedative, diuretic, emetic and alterative. A composite Ayurvedic medicine 'Liv 52', which is a hepatoprotective herbal preparation containing extracts from both *Withania coagulants* and *W. somnifera*. They are also used in flatulent colic, dyspepsia and other intestinal infections. In some parts of Pak-Indian sub-continent, the berries of this plant are used as a blood purifier. The twigs of this plant are often chewed for cleaning the teeth and the smoke of the plant is breathed in for relief in toothache [32,33].

VI. VISCUM ALBUM Linn

Fig:6 *Viscum Album Linn*

FAMILY- *Loranthaeceae*

BOTANICAL DESCRIPTION- It is a hemi parasitic shrub, which grows on the stems of other . It has stems 30–100 centimetres (12–39 in) long with dichotomous branching. The leaves are in opposite pairs, strap-shaped, entire, leathery texture1, 2-8 centimetres long, 0.82.5centimeters (0.31–0.98 in) wide and have a greenish-yellow hue. The insect-pollinated flowers of this dioecious species are small, yellowish-green, and measure two to three millimeters (0.079 to 0.118 inches) in diameter. The fruit is a white or yellow berry with a single (rarely many) seed embedded in the glutinous, extremely sticky fruit pulp [34].

HABITAT: 3000–7000 feet in Waziristan, Punjab; temperate Himalaya from Kashmir to Nepal.
THERAPEUTIC USES: For ages, mistletoe preparations have been used medicinally in Europe to treat infertility, hypertension, epilepsy, and arthritis [35]. Mistletoe is used as a herbal sleep aid, to reduce blood pressure and pulse rate, and to reduce anxiety. Throughout the nation, the plant has long been used to treat headaches, fatigue, light headedness, and irritability. Additionally, it has been used as a traditional herbal cure to treat asthma attacks brought on by psychological stress, bronchial asthma, and convulsive cough. The herb is used in traditional herbal therapy as a natural remedy for arthritic pain and is thought to be a useful external remedy for sciatica, gout, and leucorrhea [36].

BRIEF EXPLANATION ABOUT PLUCHEA LANCEOLATE

Pluchea lanceolata (DC.) Oliv. & Hiern belongs to the family Asteraceae Rheumatoid arthritis has been trefated. arthritis in Indians. Additionally, the medication is utilized for the inflammatory diseases like bronchitis, arthritis, piles and cough. It is a key component in the well-known Ayurvedic decoction "Maharasnadi Qwath," which has anti-inflammatory properties. As an alternative to sight, leaves are utilized. P. lanceolata ethanolic extract demonstrated strong anti inflammatory properties, which were further examined following fractionation. The outcome demonstrated that The hexane fraction was where the activity was concentrated. After being separated, taraxasterol acetate turned out to be one of the active ingredients [35,36,37].

Pharmacogenetic studies

Macroscopic characters:

The plant is an upright, allelopathic, perennial under shrub that can reach heights of 30 to 100 cm. Its cylindrical stem has a diameter of 2 to 3 mm. The stem is cylindrical, herbaceous, hairy, and has a smooth exterior. The branches are pubescent, terete, and ashy. Simple (0.6–1.6 x 2.5– 2.7 cm), alternate coracious, sessile, oblong or lanceolate leaves have a round apex, an entire border, and an obtuse apiculate narrowing base. The complex corymbs that make up the inflorescence typically have purple-tinged blooms. The roots are roughly 10 to 20 inches long, 3 to 20 mm in diameter, slightly twisted, and gradually tapering. When it is young, the exterior surface is white; when it is old, it is light to dark brown, and the wood is brownish. Longitudinal rough striations were seen on the exterior surface. The fracture is brief and the Odor is vague.

MICROSCOPIC CHARACTERS

LEAF: The leaf's isobilateral nature is revealed by a transverse section that passes across the midrib. The leaf's top and lower epidermis have thick cuticles and are crossed by stomata. The leaf has both glandular and covering trichomes; the glandular trichomes were sessile and stocked, while the covering trichomes were uniseriate, multicellular (2–5 cells of around 90 µm in size), and lignified**.** Although collenchyma Tous tissues lie under both upper and lower epidermis, it is strongly developed towards the upper side. Vascular bundles are collateral, centrally located; meristele is encircled by a parenchymatous bundle sheath. Transverse section of the leaf passing through lamina reveals a row of small-sized palisade under both upper and lower epidermis in continuation within midrib. The remaining mesophyll comprises spongy parenchymatous cells partially filled with oil globules, small sized cluster and rosette calcium oxalate crystals; vessels are traversing mesophyll was seen in the section.

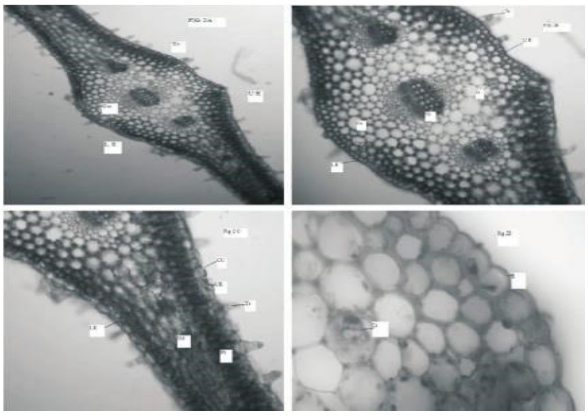


Figure :7 microscopic view of pluchea lanceolate leaf.

STEM: Stem: A thick cuticle covers the nearly circular transverse part of the stem. The epidermis is made up of covering and glandular trichomes in addition to a single layer of cells with thick walls. While glandular trichomes are sessile and stalked, covering trichomes are uniseriate, multicellular, and have two to many thick-walled cells. Collenchymatous hypodermis sits underlying the epidermis, followed by 5-7 parenchymatous cortex with layers. An open ring of collateral The outer cortical area exhibits vascular bundles. Every single The vascular bundle is made up of mature phloem and xylem. Phloem is composed of companion cells, sieve tubes, and parenchyma. Cambium has two to three separate layers, however the center Collenchymatous pith occupies this part.

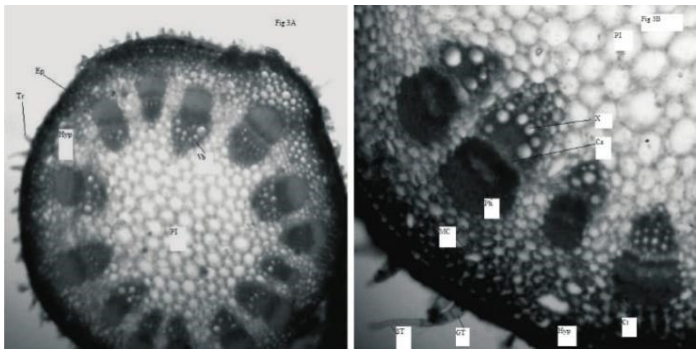


Figure :8 microscopic view of pluchea lanceolate stem.

ROOT: Root: The root's transverse section has an outline that is nearly round. The epiblema is a single outermost layer composed of uniseriate multicellular root hairs and parenchymatous cells. The cortex, which is adjacent to the epiblema, is made up of parenchymatous cells with enough space between them. The cortex's cells include lignified cells, oil cells, and starch grains. The endodermis and pericycle come after the cortex**.** There are phloem fibers and phloem parenchyma. Phloem fibers come in bundles of ten to fifty fibers, have thick walls, and are lignified. Every bundle is encased in a parenchymatous sheath. Cambium has five or more layers of thin walls. Trachieds, vessels, xylem fibers, and xylem parenchyma are examples of xylem. Large, thickened, and lignified vessels

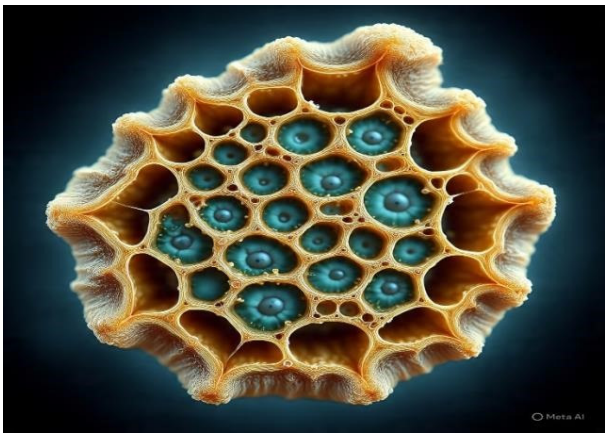


Figure:9 microscopic view of pluchea lanceolate root

POWDER MICROSCOPY: Patches of polygonal, thin-walled parenchymatous cells, lignified thicker phloem fibers, pieces of lignified reticulate, annual, and spiral vessels, starch grains, unicellular and multicellular uniseriate root hairs, and calcium oxalate crystals were all visible under root powder microscopy.

Physical-chemicalexamination

Ash's value: For both medications, air-dried material was utilized for the quantitative assessment of physiochemical parameters. As a result, it is important to calculate the loss that occurs when plant materials dry and to regulate the water content. This particularly crucial for materials that quickly disintegrate in the presence of water or readily absorb moisture. Ash that was water soluble, acid insoluble, and total was measured five times and recorded. Ethanol, alcohol, methanol, and water-soluble extractives were also measured five times. Likewise, alcohol, methanol, ethanol, and water-soluble Extractives were measured and recorded five times. Alcohol and water extractive was established in accordance with WHO suggestions.

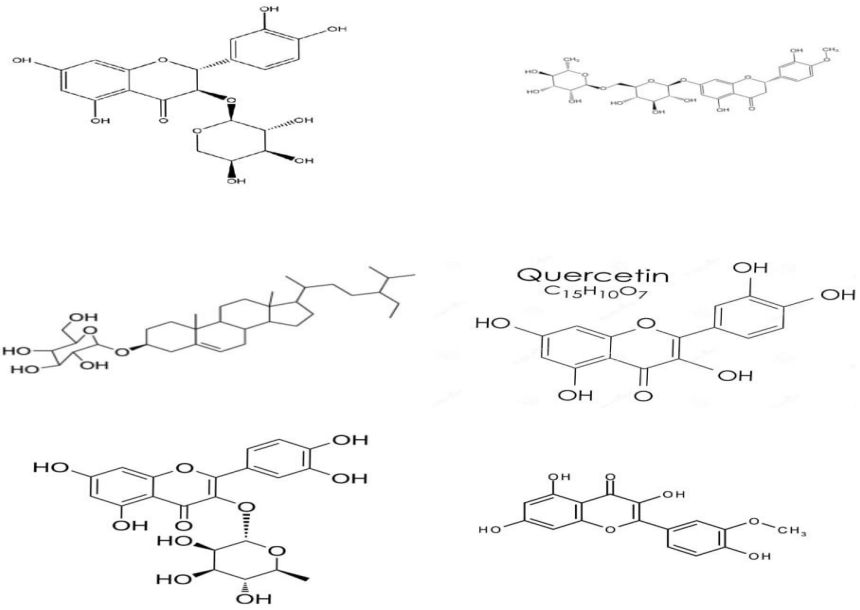
Extractive Value: The chemical is assessed using the extractive values. components found in the raw

medication and also aid in estimation of individual components that are soluble in a given solvent [38].

THE CHEMICAL CONSTITUENTS OF THE PLUCHEA LANCEOLATA:

The *pluchea lanceolata* are rich in several class of secondary metabolites that contribute to its anti inflammatory, antimicrobial, and anti rheumatic reputation. The most frequently reported constituents include ;

I. Pluchine
II. Quercetin
III. Quercitrin
IV. Isorhamnetin V. Hesperidin
VI. Taxifolin-3-arabinoside



RASNA: Ayurvedic uses, Formulations, Dosage And side effect

Rasna applications.

- In chilly climates, a paste made from Rasna leaves is applied to the body to raise body warmth.
- To treat cough and asthma, a 40–50 ml dose of the cold infusion made from the leaves or rhizome is administered.
- A dose of 30 to 40 milliliters of the decoction made from *Pluchea lanceolata* rhizome is administered to treat indigestion, fever, and stomach pain.
- taken daily in a dose of 20–30 ml, the decoction functions as a blood purifier. Plant toxins are combated by the leaf and rhizome decoction.
- The swollen and painful area is covered with a paste made from rasna leaves and rhizomes [39].

Rasna Formulations: Rasayana is a concept in Indian medicine that is comparable to antioxidant therapy [40]. In Ayurveda, Rasna *(Pluchea lanceolata*), Guduchi *(Tinospora cardifolia*), Punarnava (*Boerhhia diffusa)*, and Aragvadha (*Cassia fistula*) are used as Rasayana in Rasna saptak kwath [41], a formulation of eight herbs that includes Zingiber officinale, an adjuvant. In modern science, these herbs are reported to have antioxidant activity [42]. There have been reports of anti-inflammatory [43], analgesic [44], and anti-arthritic [45] properties associated with RS plant preparations.

Table 1: **INGREDIENTS OF RASNA SAPTAK FORMULATION**

Ingredients of Rasna Saptak	Scientific name	Part used	Amount taken (gm)
Rasna	Pluchea lanceolata Clarke.	Leaf	50
Gokshura	Tribulus terrestris Linn.	Fruit	50
Guduchi	Tinospore cortifolia (Wild) Miers	Stem	50
Punarnava	Boerhhia diffusa Linn.	Root	50
Eranda	Ricinus communis Linn.	Root	50
Devdaru	Cedrus deodara (Roxb.) Loud	Stem	50
Aragvadha	Cassia fistula Linn.	Fruit	50
Sunthi	Zingiber officinalae Rose.	Rhizome (dry)	50

MATERIAL AND METHODS

***Procurement of Herbs*:**

With the exception of Eranda and Guduchi, which were gathered from the botanical garden of Banaras Hindu University, all of the formulations' ingredients were purchased from the local market in Goladinanath, Varanasi, Uttar Pradesh, India. The Department of Dravyaguna, Faculty of Ayurveda, Institute of Medical Sciences, Banaras Hindu University (BHU), Varanasi, India, validated plant materials, and voucher specimens were stored for future reference in the Museum of the Laboratory of Dravyaguna, BHU, Varanasi, India.

***Chemicals*:**

HiMedia Laboratories Pvt. Ltd., located in Mumbai, India, supplied chloroform, methanol, absolute ethanol, toluene, ethyl acetate, acetic acid, potato dextrose agar (PDA) medium (potato 200 g; dextrose 20 g; agar 18 g and distilled water 1000 ml), sucrose, magnesium, potassium, and 2,2-diphenyl-1-picrylhydrazil (DPPH). Thin layer chromatography (TLC) silica gel G was purchased from SRL in Mumbai, India. Gallic acid (quality >97%) was purchased from Natural Remedies in Bengaluru, India.

preparation of plant extract :

After the entire RS plant material was dried and ground into kwath churna, or coarse powder (mesh size #60), it was extracted using two distinct methods. The classical approach was used for one of the extractions [46]. According to Ayurvedic principles, the temperature was kept between 8 and 85°C during the decoction process. Another extraction was carried out using the Soxhlet technique at 80 °C in hydro-alcoholic media (50:50), that is, distilled water and 100% ethanol [47].

Evaluation Physico-Chemical Parameter :

The Ayurvedic pharmacopeia of India states that in order to determine their strandization, the manufactured Kwath churna (coarse powder for decoction) and extract must undergo an evaluation of specific physico-chemical criteria. Thus, the kwath churna was assessed based on specific criteria. Using standard pharmacopoeial techniques, various physicochemical analyses of the kwath churnaas and both extracts were conducted on each of the three batches. These analyses included measurements of pH, loss on drying, total ash, acid insoluble ash, water soluble extractives, and alcohol soluble extractives [48,49].

High performance thin-layer chromatography (HPTLC) analysis:

Before chromatography, 10x10 cm Silica Gel 60F254 pre-coated aluminum plates (Merck KGaA) with a thickness of 0.2 mm were prewashed with methanol and activated at 60° for five minutes. Up to a concentration of 1 mg/ml, the extracts were diluted. The Camag Linomat auto sampler system applied two microliters of each extract sample with an 8 mm width. HPTLC plates were created in a 20 x 10 cm Cama glass twin-through chamber that had previously been saturated with the solvent for 60 minutes while being kept at 60° and 40% relative humidity (RH). Seven centimeters was maintained as the development distance. Toluene, methanol,

ethyl acetate, and acetic acid at a ratio of 3:0.5:5.5:1 (v/v) make up solvent systems [50].

Spectrophotometric profiling using Fourier transform infrared:

After calibrating the spectrophotometer (Varian 640 IR) for FTIR scanning, the dried extract of RS was combined with KBr (FTIR grade) at a ratio of 1:100, crushed into a fine powder, and compressed using hydraulic pressure to create a pellet. The spectra was recorded in the 4000-400 cm−1 region as soon as the pellet was placed in the FTIR sample holder. Two RS extracts' FTIR profile spectra were collected [51].

Analysis of the marker component using thin-layer chromatography (TLC):

The two extracts were obtained for TLC profiling using a marker component that provides information about the extract's phytoconstituent content [52]. Since eranda (Ricinus communis) is one of the components of RS, gallic acid was considered a marker component [53].

Microbial limit Test : The Ayurvedic Pharmacopeia of India's standard protocol for microbial analysis was followed. It comprised the overall number of bacteria and fungi as well as the presence of pathogens such as Salmonella ebony, Escherichia coli, Pseudomonas aeruginosa, and Staphylococcus aureus [54].

Extract fingerprinting with HPTLC :

The quantity and strength of phytoconstituents in extracts are somehow confirmed by the HPTLC fingerprinting of phytoconstituents. The fingerprints of the phytoconstituents in the HA and AQ extracts were shown in Figures 7 and 8, respectively. The HPTLC spectra's peak regions provide information about the amount of phytoconstituents. Figure 1's peak area is significantly larger than Figure 8, indicating that the HA extract contains more phytoconstituents [55]. The existence of three phyto-constituents in both extracts(table 2) is confirmed by the Rf values of 8 in HA extract and 6 in AQ. The Rf value showed regarding the hydrophilic and lipophilic properties of phytoconstituents. Because it does not adhere to the stationary phase as long as the polar compound, a compound with a higher Rf value is less polar or non-polar than one with a lower Rf. Extracts contain both hydrophilic and lipophilic components [56].

Table 2: Rf value for extract of Rasna Saptak formulation

Samples	No. of spots	Rf value
Hydro-alcoholic	8	0.21, 0.26, 0.37, 0.49, 0.63, 0.73, 0.83, 0.96
Aqueous extract	6	0.23, 0.37, 0.45, 0.55, 0.73, 0.96

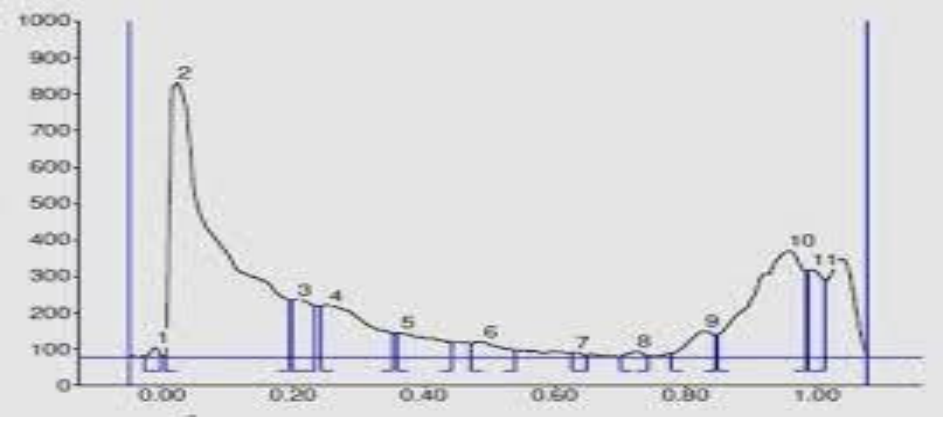


Fig 10: HPTLC fingerprinting of HA extract of Rasna Saptak formulation

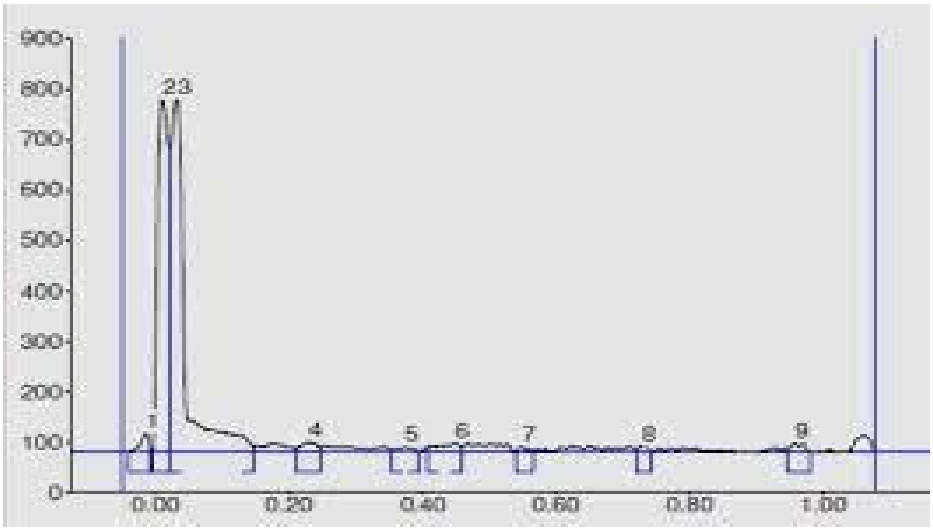


figure 11:HPTLC fingerprinting of aqueous extract of rasna saptak formulation

FTIR analysis of the two samples: Based on the peak values in the IR radiation band, the FTIR spectrum is used to determine the functional groups of the constituents found in plant extracts. Based on the peak values in the IR radiation band, the FTIR spectrum is used to determine the functional groups of the constituents found in plant extracts [57]. Figure 9 bands were displayed using the AQ extract. The results show that bands at 3449 cm-1 are associated with the amine group (N-H). Hydrogen bonding is shown as bands at 2929 cm-1, which may be identified in alcohol, phenols, acids, and tannins. A band was found at 1646 cm-1. This band could be due to stretching vibration of C=C groups, due to aromatic ring deformations, due to flavonoids and amino acids: stretching vibration of C=C, asymmetric bending vibration of N-H.A band at 1413 cm-1, C=C ring stretching or because of N=O bonding which represents nitro compounds. A band at 1104 cm-1 was considered to occur due to lipids and alcohol groups (stretching of C-O and bending of C-OH) [58,59]. Figure 10's bands were displayed by the HA extract. Bands associated to OH wagging (OH of phenolic substances) can be seen at 3432 cm-1. This suggests the existence of polyphenols and flavonoids or verifies the presence of N-H, such as amines or alkaloids. 2928 cm-1 and most likely associated with ethanol; ethanol bands may be present in FTIR spectra because the sample extracts were alcoholic. The O-H bond associated with acid groups is indicated by the band at 2664 cm-1. A band at 1701 cm-1, most likely associated with: carboxyl group stretching vibration, stretching of lipids and flavonoids' C = O. A band at 1454 cm-1 was likely caused by an aromatic -C=C bond or by N-O bending vibration, which denotes the presence of nitro compounds. The presence of polyphenols and phenols is indicated by peaks of 1264, which correlate to CN bonding vibration. C-O alcohol and ester are indicated by the band at 1067. The band at 825 cm-1 may be caused by ethanol and ether or aromatic ring vibration [60,61].

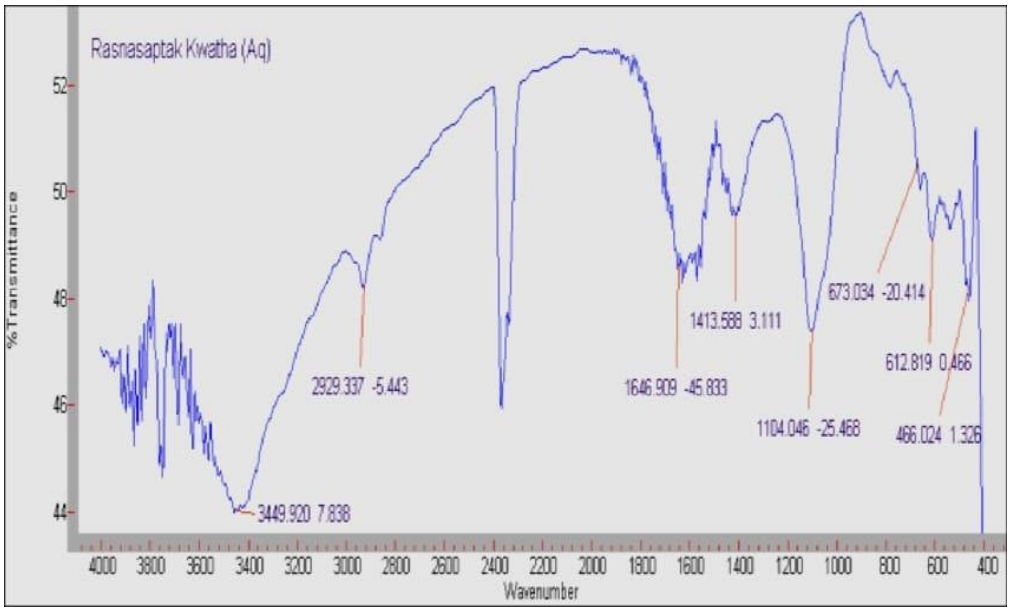


Fig 12: FTIR Spectra of aqueous extract of Rasna Saptak formulation

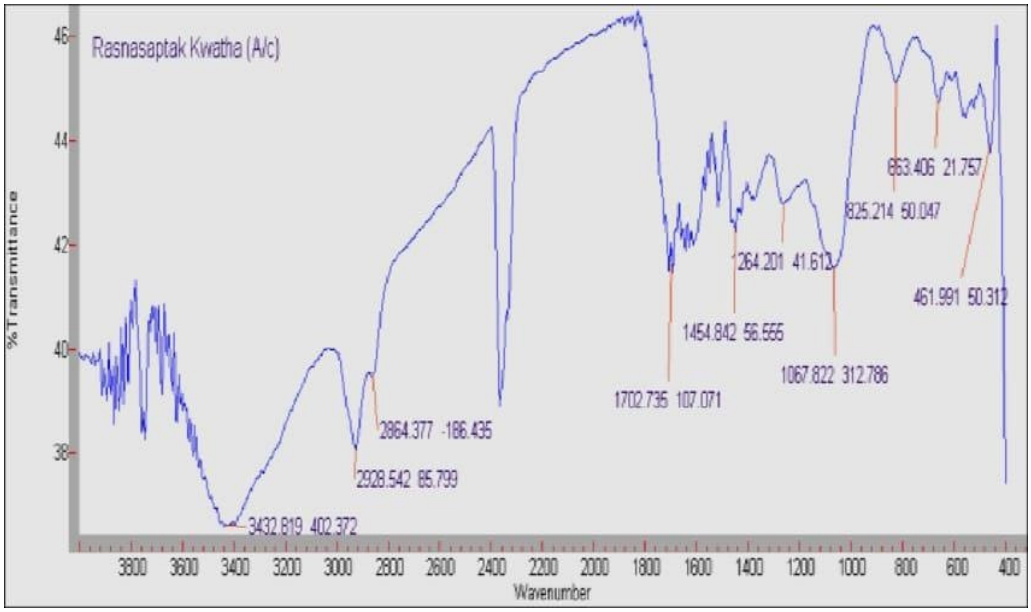


Fig 13 : FTIR Spectra of hydro-alcoholic extract of Rasna Saptak formulation

Alkaloids due to N-H stretching, polyphenols and flavonoids due to O-H stretching, and terpens due to C-H groups were all identified by FTIR analysis. The groups O-H, N-H, C-H, and C-O C=C were anticipated to be present in both extracts by the FTIR spectrophotometer analysis. Alkaloids, phenols, alcohols, aldehydes, carboxylic groups, alkenes, amines, amides, aromatics, and ethers are among the functional groups found in both plant extracts.

Table 3: **FTIR SCREENING OF EXTRACTS OF RASNA SAPTAK FORMULATION**

Aqueous extract	Peak characterization	Hydro-alcoholic extract	Peak characterization
612.819	Characteristic peak of Alkane	663.406	Characteristic peak of Alkane
673.034	Characteristic peak of Alkane	825.214	Characteristic peak of Alkane
1104.046	Alcohol and ether	1067.822	Alcohol and ether
1413.588	Nitro compounds	1264.201	Amines C-N
1646.909	Alkane and Alkene deformation or C-O-H bending or alpha-CH2 bending vibration	1454.842	Nitro compounds
2929.337	Hydrogen bonding in alcohol, Phenol and acid	1702.735	C=O, Aldehyde, ketone, ester, carboxylic acid
3449.920	Amines	2664.377	Hydrogen bonding in alcohol, Phenol and acid
		2928.542	C-H bonding, Hydrogen bonding in alcohol, phenol and Hydrogen bonds in acids
		3432.819	N-H, amines

TLC using components of markers: Because it is one of the parameters listed in the PLIM that the Ministry of Ayush issued. Gallic acid was used as the standard component in this investigation. The presence of marker components , such as gallic acid, in both extracts was verified by the identical Rf value. Our TLC with marker component's primary goal was to identify each ingredient in the formulation by creating distinct spots, or Rf values (fig.11). Additionally, they aid in determining if individual herbs are present in combination herbal compositions or not [62].

Table 4: Rf value of marker component in extract of Rasna Saptak formulation

Sample	Rf
Gallic acid	0.58
Aqueous extract	0.18, 0.58, 0.69, 0.72
Hydro-alcoholic extract	0.18, 0.34, 0.58, 0.69. 0.72,

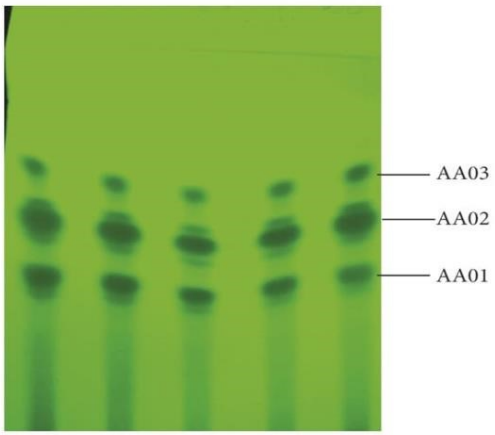


Fig 11: cavenging activity of free radical

Scavenging activity of free radicals: The DPPH's purple hue was discolored, confirming both extracts' beneficial antioxidant activity. These all demonstrated concentration-dependent free radical scavenging. Figures 6 and 7 show the free radical inhibitory action of hydro-alcoholic and aqueous extracts at various concentrations. The IC50 values are compiled in the table. AQ extract demonstrated inadequate antioxidant activity with the highest IC50 at 480 µg/ml, whereas HA demonstrated significant antioxidant activity with the lowest IC50 at 33.2 µg/ml. The significant antioxidant activity of HA extract is attributed to the presence of several phytoconstituents.

Table 5: **IC**50 of different sample of Rasna Saptak formulation

Parameter	Hydro-alcoholic extrect	Aqueous extract
IC50	33.2 (µg/ml)	480 (µg/ml)

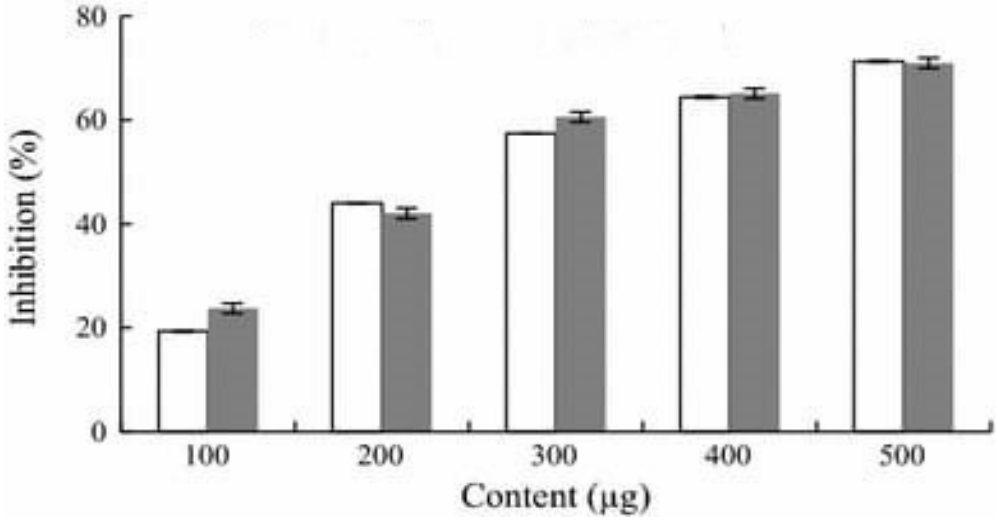


Fig 12: Antioxidant activity of aqueous extract of Rasna Saptak formulation

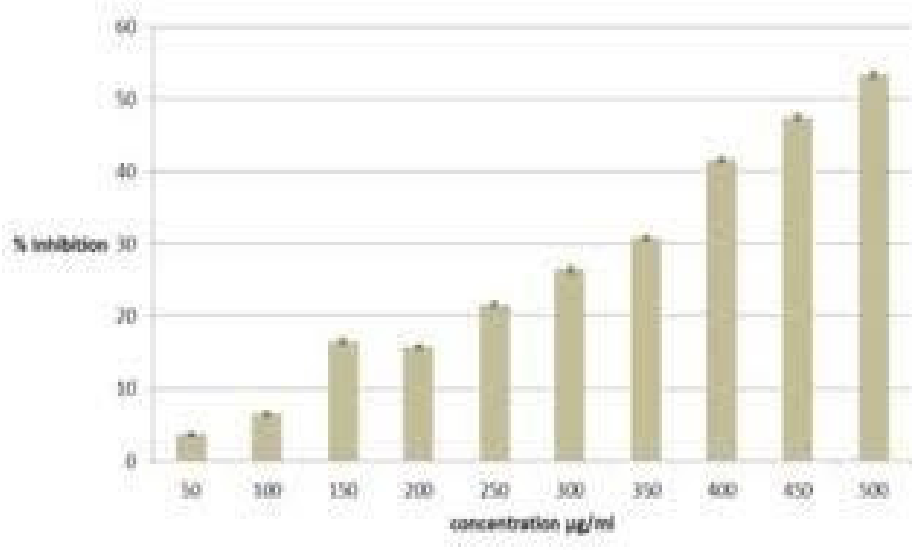


Fig 13: Antioxidant activity of hydro-alcoholic extract of Rasna Saptak formulation

The antioxidant activity of the herbals is associated with their ability to scavenge DPPH. DPPH functions as a free radical, and the herbals' capacity to scavenge these radicals demonstrates their antioxidant properties. The quantity of phenolic chemicals in plants has historically been linked to antioxidant function. Although flavonoids may also be in charge of this impact, phenolic substances would be directly linked to the antioxidant activity [63]. Their ability to donate is connected to their mode of action. scavenging free radicals and hydrogen. Polyphenols' propensity to function as free-radical scavengers (antioxidants) is predicted by their chemical activities in terms of their reducing characteristics as hydrogen or electrondonating agents [64]. The enzymes that produce superoxide anion, including xanthine oxidase, protein kinase C, glutathione S-transferase, mitochondrial succinoxidase, and NADH oxidase, are all inhibited by flavonoids [65]. It has been proven that free radicals/reactive oxygen species play an important role in inflammation. Recent studies show the evidences for the involvement of free radical or reactive oxygen species in the pathogenesis of rheumatoid arthritis. In rheumatoid arthritis and juvenile idiopathic arthritis, increased oxidative stress and decreased levels of antioxidants have been found. An antioxidant combination to the treatment schedule of the disease revealed that the symptoms of arthritis were better controlled from the first month itself. Number of studies had confirmed that antioxidant intake help to reduce free radical generation and recover antioxidant status in RA patient [66].

Rasna dosage: The type of ailment and the intensity of the patient's symptoms determine how much Rasna should be taken internally. In order to properly cure bone and joint diseases, improve respiratory, kidney, and digestive functions, and avoid any side effects, it is always advised to speak with a qualified Ayurvedic practitioner to make sure you are taking the right dosage of Rasna herbal extracts and formulations [39].

Adverse Reactions to Rasna: When Rasna is used in accordance with specified dosages, no negative side effects have been documented. However, consuming too much of this herb might cause nausea, vomiting, and indigestion, so it's important to take Rasna-based Ayurvedic formulations exactly as directed by the Ayurvedic physician. In order to prevent dangerous drug interactions and health issues in the body, the patient should also let the medical expert know if they are taking any additional prescription drugs or herbal supplements for other underlying chronic conditions [39].

CONCLUSION:

Rasna occupies a prominent position in Ayurvedic medicine due to its wide range of therapeutic applications, particularly in inflammatory, rheumatic, and respiratory disorders. However, the existence of multiple botanical sources under a single name has created considerable controversy regarding its authenticity, standardization, and conservation. This study highlights the botanical diversity of Rasna plants and emphasizes Pluchea lanceolata as a classical and pharmacologically significant source.The pharmacognostical, phytochemical, and analytical evaluation of Rasna Saptak formulation demonstrated the presence of various bioactive compounds such as flavonoids, phenols, alkaloids, and terpenoids, which contribute to its antiinflammatory and antioxidant properties.

HPTLC and FTIR analyses provided characteristic fingerprints useful for quality control and standardization. The hydro-alcoholic extract exhibited significant antioxidant activity, supporting its therapeutic relevance in inflammatory conditions like rheumatoid arthritis. Overall, the study validates the traditional use of Rasna and Rasna Saptak formulation through modern scientific techniques. Proper identification, standardization, and conservation strategies are essential to ensure the safety, efficacy, and sustainable use of Rasna-based Ayurvedic medicines in the future.

REFERENCES:

1. Bapalal. Some controversial drugs in Indian medicine. Chaukhambha Orientalia, Varanasi, 1982.
2. Kirtikar KR, Basu BD. Indian Medicinal Plants, International Book Distributor Dehradun. 1975;2:1344-1345.
3. Vidal J. Les Plantes Utiles de Laos. J Agric Trop Bot Appl. 1960;7:417-46.
4. Sethiya NK, Thakore SG, Mishra SH Comparative evaluation of commercial sources of indigenous medicine Shankapushpi for anti-stress potential preliminary study. Pharmacologyonline2, 2009: PP 460-467
5. SOME CONTROVERSIAL DRUGS IN INDIAN MEDICINE, Bapalal Vaidya, Chaukhambha Orientalia, Varanasi, 2014
6. Joshi Pravin R, Patel BR, Shukla VJ. An overview of the causes of current practices in Pratinidhi Dravyas (substitution of drugs) in Ayurveda including newer techniques for their evaluation AYU. 2012;33(4):81-485.
7. JLN Sastry, A Text book on Dravyaguna, Volume 5, Edition 2001 Chaukambha Publications,Varanasi, p 120.
8. Bapalal G. Vaidya, NighantuAdarsh,Varanasi, Chaukhambha Bharati Academy, Vol 1, 3rd edition-2002; p 31
9. R.K. Gupta, Medicinal And Aromatic Plants. CBS Publisher & Distributors Pvt. Ltd. NewDelhi, Edition I, 2010, 468-469.
10. C.P. Khare, A Dictionary of Indian Medicinal Plant, Published by Springer India Pvt. Ltd., 2007, 37.
11. Ram P. Rastogi, B.N. mahrotra, Compendium of Indian Medicinal Plant. CDRI & National Institute of Science Communication and Information, New Delhi, IV, 6-37.
12. Ben-Erik Vanwyk, Micheal Wink. Medicinal Plant of The World. Published by BrizPublication, South Africa, Edition I, 2009 (7), 43.
13. "Research Guidelines for Evaluating the Safety and Efficacy of Herbal Medicines", World Health Organization, Regional office for the Western Pacific, Manila, 1993, 1-2.
14. V.B. Rajpal, D.P.S. Kohli, "Herbal Drug Industry", Published by Business Horizons, New Delhi, Edition II, 2009, 100-101.
15. K.R. Kirtikar, B.D. Basu, "Indian Medicinal Plants", Published by International Book Distributors, Dehradun (Uttranchal), Edition IV, 2444-2447.
16. Ram P. Rastogi, B.N. mahrotra, "Compendium of Indian Medicinal Plant", CDRI, & National Institute of Science Communication and Information, New Delhi, IV:6-37.
17. R.N. Chopra, S.L. Nayar, I.C. Chopra, "Glossary of Indian Medicinal Plant", Published by NISCAIR Press, New Delhi, Edition VII, 2006, 16.
18. https://en.wikipedia.org/wiki/Vanda_tessellata [Cited on 08-04-18]
19. K Biswas. Indian Medicinal plants. Dehradun Publisher Ltd India.Vol 4, pp.1140-1141,1973
20. R K Kirtikar and B D Basu.Indian medicinal plants, Second Ed., Lalit Mohan Basu, 49, Leader road, Allahabad, India,Vol 3,pp.1668 , 1987
21. N S Chauhan. Medicinal and Aromatic Plants of Himachal Pradesh. Indus
22. M R Uniyal and G C Joshi.Historical view of the basic principles of the identification of controversial drugs, problems and suggestion, Sachitra Ayurveda,Vol 45 pp.531536,1993
23. Ghani, 2003

24 . plants/pluchea-lanceolata-1 [Cited on- 08-04-18]

25. Brijesh KS. Rauwolfia: cultivation and collection. Biotech Articles Web site. [Accessed September 25, 2014] Collection-892.html. Published May 23, 2011.
26. Healy D, Savage M. Reserpine exhumed. Br J Psychiatry. 1998 May;172:376– 27. Ferrara RJ, Pinkus H. Alseroxylon in the treatment of pruritic and psychogenic dermatoses. AMA Arch Derm. 1955;72(1):23–28.
28. Bown D. Encyclopedia of Herbs and their uses, Dorling Kindersley, London: 1995, pp. 500.
29. https://www.researchgate.net/publication/286747008_Withania_coagulans_Dunal_An_overview

30. Dymock W, Waden C J H and Hopper D. Pharmacographia Indica, Institute of health and TB Research, Karachi: 1972, pp. 306. Dymock W, Waden C J H and Hopper D. Pharmacographia Indica, Institute of health and TB Research, Karachi: 1972,pp. 306.

31. Krishnamurthi A. The Wealth of India, Vol VIII, Publication Information Directorate, CSIR, New Delhi: 1969, pp.582.

32. https://en.wikipedia.org/wiki/Viscum_album [Cited on- 08-04-18]

33. https://www.drugs.com/npc/mistletoe.html [Cited on- 08-04-14]

34. [Cited on- 08-04-18] 4(5):1417-1432.

35. Chopra RN, Chopra IC, Handa KL, Kapur LD. In: The Use of Drugs in Arthritis and Bronchitis Indigenous Drugs of India. UN Dhur and Sons Ltd, Calcutta, 1958, 20.

36. Srivastava V, Varma N, Tandon JS, Srimal RC. Antiinflammatory activity of Pluchea lanceolata: isolation of an active principle. Pharm Biol. 1990; 28:135-137.

37. Srivastava V, Varma N, Tandon JS, Srimal RC. Antiinflammatory activity of Pluchea lanceolata: isolation of an active principle, Int. JCrude Drug Res. 1990;28(2):135

38. Namdeo AG, Kale VM. Comparative pharmacognostic and phytochemical investigation of two : Alpinia species from Zingiberaceae family. World Journal of Pharmaceutical Research. 2015

39. .Dr JV Hebbar MD(Ayu) it is in Anuvasanopaga.

40. Govindarajan R, Vijayakumar M, Pushpangadan P. Antioxidant approach to disease management and the role of Rasayana herbs of Ayurveda. Journal of Ethnopharmacology 2005;99(2):165-178.

41. Ilavarasan R, Mallika M, Venkataraman S. Antiinflammatory and antioxidant activities of Cassia fistula Linn bark extracts. Afr. J. Trad. CAM 2005:2(1):70-85.

42. Shruti Pandey, Anand Kumar Chaudhary. A review on Rasna saptak kwath: An Ayurvedic polyherbal formulation for arthritis. Int. J Res. Ayurveda Pharm 2017;8(1):4-11. gana-of charaka/.

43. Thabrew MI, Dharmasiri MG, Senaratne L. Antiinflammatory and analgesic activity in the polyherbal formulation Maharasnadhi Quathar. Journal of ethnopharmacology 2003;85(2):261-7.

44. Shruti Pandey, Anand Kumar Chaudhary. Probable pharmacology of Rasna saptak kwath in Amavata (Rheumatoid arthritis): A review. Int. J Res. Ayurveda Pharm 2017;8(2):50-55.

45. 45. Mishra NK, Biswal GS, Chowdary KA, Mishra G. Antiarthritic activity of Tribulus terrestris studied in Freund's Adjuvant induced arthritic rats. Journal of Pharmaceutical Education and Research 2013;4(1):41-44.

46. Sharangdhara Acharya, Sharangdhar Samhita. by Adhamalla and Gudharth Dipika by Kasiram, Edited by Pandit parasuram shastri, Varanasi, Chaukhamba Orientalia Publishers, 5th ed, Madhyam Khand,2nd chapter 2002, 154.

47. Anuradha M, Pragyandip PD, Richa K, Murthy PN.Evaluation of Neuropharmacological Effects of Ethanolic Extract of ClitoreaTernatea Flowers.Pharmacologyonline 2010;1:284 292.

48. Ayurvedic Pharmacopoeia of India. Part 2. 1st ed., New Delhi: Ministry of Health and Family Welfare, Department of AYUSH, Government of India, 2008, 2. http://plimism.nic.in/Protocol_For_Testing.pdf

49. New Delhi: Indian Council of Medical Research; Quality Standards of Indian Medicinal 2005;3:208.

50. Ying Zhu, Augustine Tuck Lee Tan. Discrimination of Wild-Grown and Cultivated Ganoderma lucidum by Fourier Transform Infrared Spectroscopy and Chemometric Methods, American Journal of Analytical Chemistry 2015;6:480-491.

52 .https protocol for testing with their activities.

53. Shruti Pandey, Anand Kumar Chaudhary. A review on Rasna saptak kwath: An Ayurvedic polyherbal formulation forarthritis. Int. J. Res. Ayurveda Pharm 2017;8(1):4-11.

54. Borde VU, Pangrikar PP, Tekale U. Gallic acid in Ayurvedic Herbs and Formulations. Recent ResSci Tech. 2011-2015;3(7):51-54.

55. Anonymous. The Ayurvedic Pharmacopoeia of India, 1st ed, Govt. of India: Ministry of Ayush; Appendix 3.22016;I:IX.

56. Shawky E, Dina AS. Evaluation of the effect of extraction solvent and organ selection on the chemical profile of Astragalus spinosus using HPTLCmultivariate image analysis. Journal of Chromatography B 2017;1061-1062:134-138.

57. https://www.chem.wisc.edu/deptfiles/OrgLab/handouts/CHEM%20344%20TLC%20info.pdf

58. Kumar KJ, Prasad DAG. Identification and comparison of biomolecules in medicinal plants of Tephrosia tinctoriaand Atylosia

albicansby using FTIR. Romanian. J Biophys 2011;21:63-7.
59. Mot A, Silaghi RD, Sarbu C. Rapid and effective evaluation of the antioxidant capacity of propolis extracts using DPPH bleaching kinetic profiles, FT-IR and UVvis spectroscopic data. Journal of Food Composition and Analysis 2011;24(4):516-522.
60. Benth KK, Dhivya SM. Screening of phytoconstituents, UV-VIS Spectrum and FTIR analysis of Micrococca mercurialis (L.) International Journal of Herbal Medicine 2017;5(6):40-44.
61. Baccarin T, Mitjans M, Ramos D. Photoprotection by Punica granatum seed oil nanoemulsion entrapping polyphenol-rich ethyl acetate fraction against UVBinduced DNA damage in human keratinocyte (HaCaT) cell line. Journal of Photochemistry & Photobiology, B: Biology 2015;153:127-136.
62. Joshi DD. FTIR Spectroscopy: Herbal Drugs and Fingerprints. In: Herbal Drugs and Fingerprints. Springer, India 2012.
63. Ayurvedic Pharmacopoeia of India. Part 2. 1st ed., New Delhi: Ministry of Health and Family Welfare, Department of AYUSH, Government of India 2008, 2.
64. Oliveira RN, Mancini MC, Oliveira FCS, Passos TM, Quilty B, Guinness GBM. FTIR analysis and quantification of phenols and flavonoids of five commercially available plants extracts used in wound healing. Matéria (Rio J.) 2016;21(3).
65. Pier-Giorgio Pietta. Flavonoids as Antioxidants. J Nat. Prod 2000;63:1035-1042.
66. Oliveira RN, Mancini MC, Oliveira FCS, Passos TM, Quilty B, Guinness GBM. FTIR analysis and quantification of phenols and flavonoids of five commercially available plants extracts used in wound healing. Matéria (Rio J.) 2016;21(3)