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Comparative Pharmacognostic and Phytochemical Analysis of Three Market Samples of *Rasna*: *Pluchea lanceolata*, *Alpinia officinarum*, and *Alpinia calcarata*

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ABSTRACT

Introduction: Ayurveda, an ancient system of medicine, utilizes a vast array of medicinal plants, each offering unique therapeutic properties that contribute to holistic health and well-being. However, misidentification of species is most common which comes in the way of authenticity. To cite an example - *Pluchea lanceolata* when mixed with varieties of *Alpinia* can lead to inconsistencies in their medicinal use. This underscores the need for accurate identification and standardization to ensure the efficacy of treatments and the safety of stakeholders. This research paper explores the botanical and medicinal profiles of *Pluchea lanceolata*, *Alpinia calcarata*, and *Alpinia officinarum*, emphasizing the importance of proper classification and the need for quality control in Ayurvedic herbal remedies. **Materials and Methods:** Raw materials were collected from Thrissur market and organoleptic, pharmacognostic and phytochemical analysis were done. **Results and Discussion:** Three varieties of Rasna (*Pluchea lanceolata*, *Alpinia calcarata*, and *Alpinia officinarum*) share common physical characteristics, such as scaly, rough rhizomes that are fibrous and tough, making them suitable for drying, grinding, or slicing (for medicinal use.) All three species exhibit starch grains, fibers, and stone cells in their rhizomes, contributing to energy storage, structural support, and resilience. *Pluchea lanceolata* has the highest total ash content, indicating a richer mineral composition, while *A. calcarata* and *A. officinarum* show lower mineral content. All three species contain phenols, sugars, carbohydrates, flavonoids, glycosides, steroids, and other bioactive compounds, contributing to their therapeutic properties. **Conclusion:** Standardization in preparation and use of Ayurvedic remedies is critical for preserving the integrity of Ayurveda, ensuring reliable therapeutic benefits, and positioning Ayurvedic medicine as a credible and effective global health solution.

Key words: *Rasna, Pluchea lanceolata, Alpinia calacarata, Alpinia officinarum, Pharmacognostic, Thin layer chromatography*

INTRODUCTION

Ayurveda, an ancient Indian system of medicine, uses a wide range of medicinal plants, each with unique properties and uses. Medicinal plants are the heart and soul of Ayurveda, providing a natural, holistic, and personalised approach to health and well-being. This integration of ancient wisdom with modern understanding continues to be relevant in today's medical environment. Acharya Charaka states that "*Jagathyeva Anousadam*" which means that all matter in the universe falls into the category of medicine in some way.[1]

The demand for Ayurvedic herbal remedies has increased due to its increasing acceptability on a global scale. But this quick expansion highlights how important it is to standardise the manufacturing and application of these natural remedies. Standardisation is a crucial component of contemporary Ayurvedic treatment since it guarantees the efficacy, safety, and quality of Ayurvedic medicines. Products sold under the name *Rasna* may contain different plant species or

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different concentrations of active compounds, which may affect their overall safety and efficacy. Because active ingredient levels might vary depending on plant parts, growing conditions, and processing methodologies, it can be challenging to determine and quantify the active chemicals that have therapeutic benefits. Standardised herbal medications are put through a thorough testing process to determine their active ingredients ensuring quality standards. This lowers the possibility of adulteration which is essential for consumer safety.

Alpinia is the largest and most widely distributed genus in the ginger family, with about 230 species. It is widely distributed in the Sri Lanka, Western Ghats of India, China, Japan, and throughout South Asia.[2]

Pluchea lanceolata (D.C.) Oliver & Hiern, (belonging to the genus *Pluchea*) from the Asteraceae family, is a small shrub typically found in sandy and saline soils. It grows in the hotter regions of India, including Punjab, Rajasthan, Upper West Bengal, Uttar Pradesh, as well as in the neighbouring Asian countries and North Africa. This plant is an erect, allelopathic, perennial subshrub, reaching a height of 30-100 cm. Its stems are cylindrical, measuring 2-3 mm in diameter, with a whitish-green outer surface, and the branches are pubescent and branched.[3]

Alpinia calcarata Rosc., commonly known as lesser galangal in English and *Rasna* in Sanskrit, is a rhizomatous perennial herb belonging to the Zingiberaceae family. It is found throughout tropical and subtropical regions of Asia, including India, Bangladesh, Sri Lanka, and Malaysia. The rhizome of this plant is widely used in many traditional medicinal formulations. These rhizomes are used in indigenous medicine to treat a variety of conditions, including throat inflammation, digestive issues, blood purification, and to enhance the voice. The rhizome extract is commonly employed in the treatment of respiratory problems like cough, asthma, bronchial catarrh, as well as conditions such as arthritis, diabetes, rheumatism, and pain relief.[4]

Alpinia officinarum is a perennial herb from the Zingiberaceae family, native to China and predominantly cultivated in Southeast Asia. It is also grown in the plains of West Bengal and Assam, located in the Eastern Himalayas. The plant typically reaches a height of about ten feet, with lanceolate leaves and reddish-white flowers. Its rhizomes, known as galangal, are slender and tough, with orange flesh inside and a brownish coating. These rhizomes are aromatic, with a pungent flavour and distinct scent, and are highly valued for their spicy taste and fragrance. *Alpinia officinarum* has a long history of traditional use due to its significant medicinal properties. It is known to possess potent anti-inflammatory, antibacterial, antifungal, antiviral, diuretic, and anticancer effects.[5]

"*Sandigdha Dravyas*" is a term referring to medicinal plants whose identity is unknown. This uncertainty arises from issues such as the complex Sanskrit nomenclature system, inaccessibility of specific plants, and the development of parallel knowledge systems. However, the plant has also become a source of controversy, especially regarding its botanical identity.[6] Among *"Agrya Dravyas*", *Rasna Vataharanam Sreshtam* ie. the Rasna plant is considered as the best remedy in the treatment of Vata Pradhana diseases. *Rasna* stands out for its wide range of applications, especially in the treatment of musculoskeletal disorders, respiratory disorders and inflammatory conditions.[7] *Rasna* is often confused with other species in the genus *Alpinia* and its related families. Varieties such as *Pluchea lanceolata, Alpinia calcarata and Alpinia officinarum* may be misidentified or erroneously used interchangeably, which may lead to inconsistencies in therapeutic uses.

MATERIALS AND METHODS

Collection of raw materials

The three market samples of *Rasna*, (*Pluchea lanceolata, Alpinia calcarata & Alpinia officinarum)* were collected from the South Indian market that is from Thrissur, Kerala. The collected raw materials were identified and authenticated at pharmacognosy department of Sitaram Ayurveda Pvt. Ltd. The specimen samples were stored at Quality Control division of Sitaram Ayurveda Pvt. Ltd for further reference with the reference numbers, SAPL/QC/CS/015, SAPL/QC/CS/016, and

SAPL/QC/CS/243 respectively. The samples are notes as per the short forms in the further studies, *Pluchea lanceolata* as PL, *Alpinia clacaratta* as AC, *Alpinia officinarum* as AO for the easiness of the presentation.

Pharmacognostical analysis

Organoleptic analysis[8]

Organoleptic characteristics provide an initial assessment of the authenticity of a sample which is a crucial aspect in Ayurveda. Parameters such as colour, odour, and taste were evaluated in this analysis.

Macroscopical analysis[8]

Macroscopic traits are crucial for identifying and classifying plant species. These are visible traits that can be observed without a microscope. The key macroscopic features of rhizome are identified and classified in this study.

Powder Microscopic analysis[8]

Slides were prepared using chloral hydrate, glycerine, phloroglucinol, and iodine in potassium iodide solution. Observations were made with a Magnus trinocular microscope, and images were captured with a Sony digital camera.

Physico-chemical Analysis[8]

Physico-chemical analysis of raw materials, such as total ash, acid insoluble ash, water soluble extractive, and alcohol soluble extractive, were performed in accordance with the standard protocol outlined in the Ayurvedic Pharmacopoeia of India.

Preliminary Phytochemical Analysis[9]

Phytochemical analysis of three *Rasna* species were examined for the presence of phytochemical elements such as sugar, reducing sugar, ketose, amino acid, protein, starch, quinone, glycoside, flavonoid, phenol, saponin, alkaloid, tannin and coumarin.

Thin Layer Chromatography (TLC)[9]

Thin Layer Chromatographic fingerprint analysis was carried out for the separation of bands. 20 ml sample refluxed with 40 ml chloroform for 1 hour; filtered and evaporated completely by water bath and the residue was dissolved in 1 ml chloroform. TLC was carried out with a slurry of the adsorbent silica gel G coated uniformly on clean glass plates (10 x 5cm) using a commercial spreader. The Chloroform extract of sample drug was applied (same sample as T-1 and T-2) into the silica gel surface with a fine capillary tube at 2 cm above the lower end of the plate and allowed to evaporate. The sample plate was carefully placed at an angle of 450 in the development chamber with the developing solvent keeping the capillary spotted area above the level of the solvent.

The plate was developed in Toluene: Ethyl acetate (9:1) mixture as mobile phase; the developed plate was visualized under UV 254 and 366 nm and derivatives with Anisaldehyde- Sulphuric acid reagent and the images were captured.

Observations and Results

Organoleptic analysis

The organoleptic analysis of three kinds of *Rasna* rhizome from market samples were studied and compared in table no: 1 for the analysis. *Pluchea lanceolata* (PL) rhizome has a light brown color, making it lighter in hue compared to the other two species. *Alpinia calcarata* (AC) and *Alpinia officinarum* (AO) have a reddish brown colour, with AO possibly being slightly more intense in colour due to its stronger aroma and taste. While considering the taste, AC is described as having a bitter taste, which makes it quite distinct from the other two species. AC has a sweet spicy taste, offering a milder, balanced flavour with both sweetness and spiciness. AO offers a citrusy flavour, providing a sharp, tangy note. AC also has an aromatic scent, but its flavour suggests a sweet spicy tang may be due to its it may have a more subdued or balanced fragrance than the stronger, more pungent species. AO is described as having a pungent aromatic odour, which indicates it is stronger and sharper in scent. This pungency is reflective of its more pronounced flavour profile, making it stand out in dishes where a potent aromatic note is desired.

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Table 1: The Organoleptic features of the rhizomes of three *Rasna* species.

Features	*Pluchea lanceolata* (PL)	*Alpinia calcaratta* (AC)	*Alpinia officinarum* (AO)
Colour	Light brown	Reddish Brown	Reddish Brown
Taste	Bitter aromatic taste	Sweet spicy	Citrusy flavour
Texture	Scaly, rough	Scaly, rough	Scaly, rough
Odour	Aromatic	Aromatic	Pungent aromatic

Macroscopic analysis

The macroscopic features of the three rhizomes of *Rasna* species in fig. no. 1, 2 and 3 were studied. The rhizomes of AO are branched and dense, with a light to dark brown colour. The dense branching could contribute to a more extensive underground network, allowing the plant to spread effectively. AO has rhizomes with a larger diameter (8–10 cm) and a pseudo-stem length up to 3 meters. This indicates that AO has a more developed underground and aerial structure compared to AC and PL, contributing to its larger stature. The rhizome of AC is reddish-brown, cylindrical, often curved and branched and smaller in diameter (1–1.5 cm). The smaller size and curved nature may indicate a different growth form or ecological niche compared to the other species.

Figure: 1, 2 & 3 show the morphological pictures of rhizomes of three types of *Rasna*.

1: Rhizomes of *Pluchea lanceolata*

2: Rhizomes of *Alpinia calcarata*

3: Rhizomes of *Alpinia officinarum*

Powder Microscopic analysis

The rhizome powder of *Rasna* was subjected to microscopic analysis to observe its diagnostic features and are presented in Figs. 4, 5 and 6 and the contents in table no: 2. All three types of Rasna — PL, AC, and AO-commonly share the presence of starch grains, fibers, stone cells, and parenchyma cells. Tracheids are present in AC and AG but are absent in AO**.** Spiral vessels are present in PL but absent in AC and AO. Rosette crystals of calcium oxalate are found in PL but are absent in AC and AO. Pitted vessels are present in PL but absent in both AC and AO.

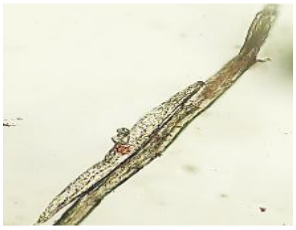
Table 2: Powder microscopical data for the three types of *Rasna*

Compounds	PL	AC	AO
Starch Grains	+	+	+
Fibres	+	+	+
Stone cells	+	+	+
Parencyma cells	+	+	+
Tracheids	+	+	-
Spiral Vessels	+	-	-

Rosette Crystals of Calcium Oxalate	+	-	-
Pitted Vessels	+	-	-

1. *Pluchea lanceolata* (*Chuvannarattha*)

Figure 4: Powder microscopy of *Pluchea lanceolata*

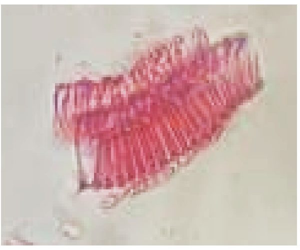


A

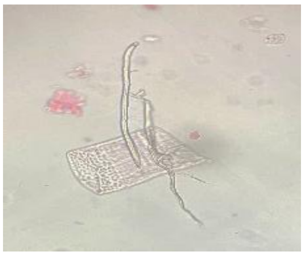
B

C

D



E



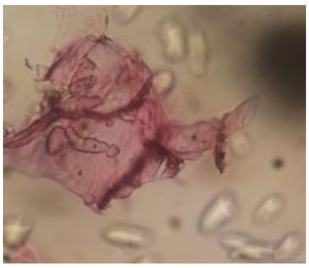
F

A: Fibers, **B:** Tracheids, **C:** Rosette crystal of calcium oxalate **D:** Stone cells, **E:** Spiral vessels, **F:** Fibre and Pitted vessels,

2. *Alpinia calcarata* (*Chittaratha*)

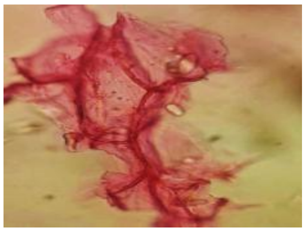
Figure 5: Powder microscopy of *Alpinia calcarata*

A



B

C



D

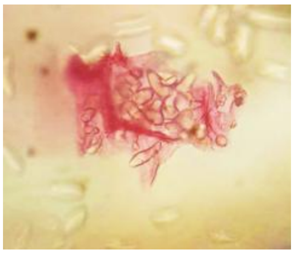
E

A: Stone cell, **B:** Parenchyma cell with fibre and starch grains, **C:** Starch cells, **D:** Parenchyma cell, **E:** Tracheid

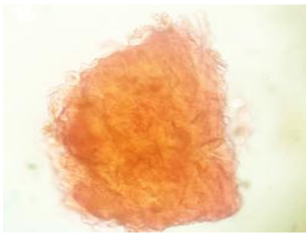
3. *Alpinia officinarum* (*Aratha*)

Figure: 6: Powder microscopy of *Alpinia officinarum*

A



B



C

D

A: Parenchyma cells, **B**: Cell with starch grains, **C**: Stone cells, **D**: Starch cells (oval and muller shaped).

Physicochemical Analysis

Table no. 3 provides a comparative analysis of the Loss on Drying**,** Total Ash**,** Acid Insoluble Ash**,** Water Soluble Extractive, and Alcohol Soluble Extractive content in PL, AC, and AO**.** These parameters are typically used to

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assess the quality, composition, and potential medicinal properties of plant materials. PL has the highest total ash content at 8.50%, indicating a relatively higher amount of minerals compared to AC (4.53%) and AO (5.64%). PL has the highest water-soluble extractive content (31.11%), indicating the presence of water-soluble bioactive compounds compared to AC (19.20%) and AO (14.92%). PL again shows the highest value in this category (16.19%), indicating that it may have a higher concentration of alcohol-soluble bioactive compounds. This could make PL more suitable for tinctures or alcohol-based extracts.

Table 3: The Physicochemical analysis of the three *Rasna* species

SN	Parameters	Results		
		PL	AC	AO
1.	Loss on Drying	10.12%	10.30%	10.50%
2.	Total Ash	8.50%	4.53%	5.64%
3.	Acid insoluble ash	1.85%	1.64%	0.93%
4.	Water soluble extractive	31.11%	19.20%	14.92%
5.	Alcohol soluble extractive	16.19%	8.84%	3.10%

Phytochemistry

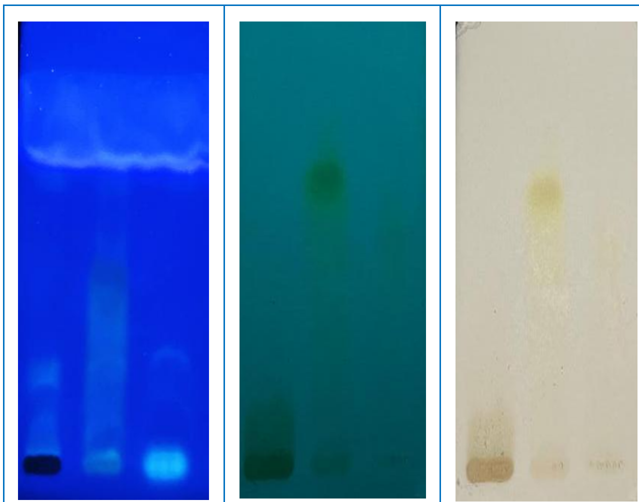
Table no. 4 shows the comparative analysis of the presence or absence of various phytochemicals in the water and alcohol extracts of three species: PL**,** AC**,** and AO**.** These compounds include carbohydrates, sugars, proteins, glycosides, steroids, flavonoids, phenols, and others that are of interest in herbal medicine and phytochemistry.

Table 4: The phytochemical analysis of three *Rasna* types

SN	Tests	Water Extracts			Alcoholic Extracts		
		PL	AC	AO	PL	AC	AO
1.	Carbohydrate	+	+	-	-	-	+
2.	Sugar	+	+	-	+	+	+
3.	Ketose	-	-	-	-	+	-
4.	Protein	-	-	-	-	-	-
5.	Starch	-	+	+	-	-	+
6.	Glycoside	-	-	-	+	+	+
7.	Steroid	-	-	-	+	+	+
8.	Terpenoid	-	-	-	-	-	-
9.	Flavonoid	-	-	-	-	+	+
10.	Phenol	+	+	+	+	+	+
11.	Saponin	-	-	+	+	+	-
12.	Alkaloid	-	-	-	-	-	-
13.	Tannin	-	-	-	+	+	-
14.	Coumarin	-	-	-	-	+	+

Thin Layer Chromatography

Thin Layer Chromatography (TLC) is a laboratory technique used to separate and identify compounds within a mixture. TLC is a relatively simple, inexpensive, and effective method for monitoring the progress of reactions, analyzing mixtures, and purifying compounds. The mobile phase is a solvent or mixture of solvents that moves up the stationary phase by capillary action. Here the chosen solvent is a mixture of Toluene & Ethyl Acetate in the ratio (Toluene: Ethyl Acetate) 9:1.



Under 366nm	Under 254nm	Under Visible Light

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Spots	Rf Value		
	P.L	A.C	A.O
A	0.22	0.22	0.22
B	-	0.43	-

Discussion

Rasna is a significant medicinal plant highlighted in Ayurvedic texts and classical literature. According to the descriptions in Samhita texts, *Rasna* is stated as an ayurvedic medicinal herb or shrub with a distinct aroma, leaves being similar to that of possessing a bitter taste (*Tikta Rasa*), a heating potency (*Ushna Veerya*), and properties that balance Kapha and Vata doshas (*Kapha-Vatashamaka*).[10]

All three *Rasna* varieties have a scaly**,** rough texture, often tough and fibrous. This is characteristic of the rhizomes of the *Alpinia* species. *Pluchea lanceolata* also shows the same features in texture. This texture makes them suitable for drying, grinding into powders, or slicing for medicinal use.

Starch grains are present in PL, AC, and AO, indicating that all three species have starch storing cells within. Starch grains are typically found in plant cells as a form of energy store, and their presence across these species suggests a common function of energy reserve in the rhizomes or other vegetative parts.[11] Fibers are also present in all three species. Fibers are long, tough cells that provide structural support to the plant. Their presence suggests that these plants have developed a well-structured vascular system to support the rhizomes and other organs.[12] Stone cells (also known as sclereids) are present in PL, AC, and AO. These cells provide mechanical support and toughness to plant tissues. They are often found in rhizomes or other tissues and may contribute to the plant's resistance to herbivory or stress.[13] Parenchyma cells are present in all three species. These are the most common type of plant cells, responsible for photosynthesis, storage, and secretion. In rhizomes, they serve as storage cells for starch and other compounds. These common features indicate that the plants have similar structural and functional adaptations, primarily in their rhizomes, where these compounds play crucial roles in energy storage, structural support, and resilience. These cellular features are important for the rhizomes' medicinal properties, as starches and fibers may contribute to their health benefits, while stone cells might influence the texture or bioactivity of the rhizomes. The parenchyma cells, involved in storing active compounds, could also be linked to the rhizomes' efficacy in traditional medicine. Tracheids (water-conducting cells) are present in AC and PL but are absent in AO**.** Their presence in AC and PL suggests that these species may have a more developed vascular system for transporting water, which is essential for larger or more structurally complex plants. Spiral vessels are present in PL but absent in AC and AO. These vessels are characterized by spiral or helical wall thickening, which provides flexibility and strength to the vascular tissue. The presence of spiral vessels in PL may suggest that it is adapted to specific ecological conditions that require more flexible water transport.[14] Rosette crystals of calcium oxalate are found in PL but are absent in AC and AO. These crystals are often involved in the plant's response to excess calcium or serve as a defence mechanism against herbivory due to their sharp edges. The presence of these crystals in PL may be an adaptation for managing excess calcium or as a protective feature.[15] Spiral vessels, are present in PL but absent in AC and AO. These vessels are characterized by spiral or helical wall thickening, which provides flexibility and strength to the vascular tissue. The presence of spiral vessels in PL may suggest that it is adapted to specific ecological conditions that require more flexible water transport. Pitted vessels xylem vessels with pits in their walls for lateral transport of water and nutrients are present in PL but absent in both AC and AO. The presence of pitted vessels in PL suggests a more complex vascular system, allowing for better lateral water movement between adjacent cells, which may support its larger size or more vigorous growth.

Total ash indicates the inorganic components (like salts, metals, etc.) remaining after the plant material is burned. Higher values suggest a greater mineral content in the plant. PL has the highest total ash content at 8.50%, indicating a relatively higher amount of minerals in this plant compared to AC (4.53%) and AO (5.64%). AC has the lowest total ash, suggesting it may contain fewer minerals, while AO is in between. This could reflect different ecological conditions or plant metabolic functions that affect mineral uptake. Loss on drying measures the amount of moisture present in a sample after it is dried at a specified temperature. A higher percentage suggests higher moisture content in the raw plant material. All three samples show similar loss on drying percentages, with AO showing the highest moisture content (10.50%), followed closely by AC (10.30%) and PL (10.12%). These results suggest that all the plant materials contain a similar moisture level, with AO having slightly more water content than the others. Acid insoluble ash refers to the inorganic materials (such as silica) that are not soluble in an acidic solution. High acid-insoluble ash can indicate the presence of non-digestible or hard mineral particles, which can affect the plant's digestibility or bioavailability of nutrients. PL and AC show higher acid-insoluble ash values (1.85% and 1.64%, respectively) compared to AO (0.93%). This suggests that AO may contain fewer indigestible or hard mineral particles, potentially making it more bioavailable than the other two plants. The differences in this parameter may suggest varied tissue compositions, with PL and AC possibly having more fibrous or silica-rich materials. The water-soluble extract represents the compounds that can be dissolved in water, such as sugars, organic acids, and certain plant metabolites. This parameter gives insight into the plant's potential medicinal properties, as water-soluble compounds are often bioactive. PL has the highest water-soluble extract content (31.11%), indicating the presence of a higher concentration of water-soluble bioactive compounds compared to AC (19.20%) and AO (14.92%). The higher percentage in PL suggests that this plant might be more useful in preparations where water extraction is required, potentially offering greater medicinal or nutritional value when extracted with water. The alcohol-soluble extrac refers to the compounds that dissolve in alcohol, including essential oils, alkaloids, and other fat-soluble substances. These compounds often have different medicinal or aromatic properties compared to water-soluble compounds. PL again shows the highest value in this category (16.19%), indicating that it may have a higher concentration of alcohol-soluble bioactive compounds. This could make PL more suitable for tinctures or alcohol-based extracts. AC and AO show much lower alcohol-soluble extract content (8.84% and 3.10%, respectively), suggesting that these species may have less alcohol-soluble compounds, which might limit their use in alcohol-based preparations.[9]

Pluchea lanceolata stands out as having the highest concentrations for water-soluble and alcohol-soluble extractives, suggesting it may be the most versatile involving both water and alcohol-based extractions. It also has a higher mineral content, making it suitable for certain therapeutic applications. *Alpinia calcarata* has a moderate profile across all parameters, with a relatively lower water-soluble extract content, indicating it may be less potent in water-based extractions compared to PL. *Alpinia officinarum* appears to have the lowest values for both extract particularly alcohol-soluble ones, suggesting its suitability for specific uses where lower levels of extractable compounds are desired or where water-soluble properties are prioritized.

Phytochemical evaluation involves the analysis of chemical compounds present in the rhizomes of three *Rasna* market samples particularly contributing to the medicinal properties. Phytochemical analysis of both - aqueous and alcoholic extracts - revealed the presence of phenols in extracts from all three *Rasna* types. Sugars were detected in both the water and alcohol extracts of PL and AC, except in the aqueous extract of *A. officinarum*. Carbohydrates were present in the aqueous extracts of *Pluchea lanceolata* and *A. calcarata*, but in *A. officinarum* carbohydrate was present in the alcoholic extract only. Starch was detected in both water and alcoholic extracts of *A. officinarum*. Flavonoids were present exclusively in the alcoholic extracts of *A. calcarata* and *A. officinarum*. Glycosides and steroids were observed in the alcoholic extracts of all three *Rasna* types. Tannins and coumarins were found in the alcoholic extracts of *A.*

calcarata. Additionally, ketoses were detected only in the alcoholic extract of *A. calcarata*. According to this phytochemical study, three *Rasna* types possess similar specific characteristics and all these characteristics contribute to the medicinal value. The therapeutic properties of *Rasna* largely depend on its active constituents, such as essential oils and flavonoids. Different environmental factors, such as soil type, climate, and cultivation practices, can lead to variability in the chemical composition of the plant.[16]

Thin Layer Chromatography (TLC) of *Rasna* species is typically used to separate and identify of various phytochemicals present in the plants. It gives insights into the chemical profile of the plant, which can be further analyzed for pharmacological actions. The Rf values are crucial for comparing different species, identifying compounds, and ensuring the quality and consistency of herbal preparations. In three *Rasna* rhizomes shows the presence of common band at Rf 0.22. It suggests that the shared compound in three species of *Rasna*, could be responsible for the therapeutic effects.[17] In the case of *A. calcarata*, a band at Rf 0.43 is observed, which is not seen in the other two species.

The need for standardization of Ayurvedic medicines is paramount. It ensures quality and safety, promotes consistency in therapeutic efficacy, aids regulatory compliance, supports scientific research, and builds consumer trust. As Ayurveda continues to evolve and integrate into modern healthcare, embracing standardization will be essential for preserving its integrity and enhancing its credibility. By prioritizing standardization, the Ayurvedic community can secure a place for itself in the global health landscape, providing safe and effective herbal solutions for generations to come.

Conclusion

The *Rasna* plant serves as a poignant example of the challenges posed by botanical identity in herbal medicine. The three *Rasna* species, *Pluchea lanceolata*, *Alpinia calcarata* and *Alpinia officinarum*, exhibit distinct yet shared morphological and phytochemical characteristics that contribute to their medicinal significance in Ayurvedic practices. While all three types show similar cellular features like starch grains, fibers, and stone cells, which support their medicinal properties, they also demonstrate unique attributes that may influence their therapeutic potential. The findings suggest that, despite their differences, all three *Rasna* species hold a significant promise for traditional and modern medicinal uses, with *Pluchea lanceolata* likely being the most versatile among them. Further research on their active constituents and pharmacological properties will be essential to unlock their full therapeutic potential.

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