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PHARMACOGNOSTIC STANDARDIZATION AND PHYSICOCHEMICAL EVALUATION OF *PSORALEA CORYLIFOLIA* LINN. SEEDS

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Abstract

Psoralea corylifolia Linn. is a medicinally important herb belonging to the family Fabaceae. The present research focuses on the seed of this plant and attempts to setup quality control parameters for *Psoralea corylifolia* Linn. seed. This study could be useful in setting some diagnostic parameters for the standardization, identification, and preparation of monographs. Standardization was done by performing physicochemical, pharmacognostic, and preliminary phytochemical analysis and development of an HPTLC fingerprint profile. Preliminary phytochemical analysis indicated presence of phytoconstituents like acid compounds, tannins, alkaloids, flavonoids, glycosides, aleurone grains, amino acids, carbohydrates, fats and fixed oils, starch, steroids and triterpenoids, resins and saponins. The HPTLC fingerprint profile developed is unique to *Psoralea corylifolia* Linn. seed powder. The band pattern obtained from HPTLC fingerprint can be used for proper identification and quality control of *Psoralea corylifolia* Linn. seeds. Thus the present study provides referential information for identification and standardization of *Psoralea corylifolia* Linn. seeds.

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Introduction

Since millennia, plants have formed the cornerstone of traditional medical systems worldwide and still remain an indispensable source of novel therapeutic agents. Plants have played a crucial role as sources of medicinal remedies since antiquity. The recent resurgence of plant-based medicines can be attributed to several factors, including their effectiveness and fewer side effects compared to modern pharmaceuticals [1].

Psoralea corylifolia Linn., commonly known as babchi, is a popular herb, which has been used since long in traditional Ayurvedic and Chinese medicine for its magical effects to cure various skin diseases [1]. It is an annual, erect herb, with height ranging from 30 to 180 cm. The term *Psoralea* has its roots in the Greek word *psoraleos*, meaning "affected with the itch or with leprosy" [2].

Vernacular Names of *Psoralea corylifolia* Linn [2, 3].
English: Scurf-pea, Babchi seeds, *Psoralea* seeds
Hindi: Bemchi
Marathi: Babachi, Babchi, Bavachi
Sanskrit: Somaraji, Bakuchi, Sugandha Kantak
Bengali: Bakuchi, Hakuchi, Bavachi, Lata Kasturi
Gujarati: Bavacha, Babchi, Bawachi, Bakchi, Bhavaj
Urdu: Babchi
Malyalam: Karkokil
Kannada: Bauchige, Bhavanti buja, Bhavanchigid, Baukuchi, Baranchigida, Karbekhiya
Tamil: Karpokarishi, Karpurarishi, Karporgam

Babchi refers to the dried ripe fruits of *Psoralea corylifolia* Linn., a plant widely distributed across the plains of India, especially in the semi-arid zones of Rajasthan and the eastern districts of Punjab adjacent to Uttar Pradesh. Its occurrence also extends to the Himalayas, Dehradun, Oudh, Bundelkhand, Bengal, Maharashtra, certain valleys

of Bihar, the Deccan region, and Karnataka. Beyond India, the species grows naturally in tropical and subtropical regions, particularly in China and Southern Africa. Notably, every part of this plant-roots, stems, leaves, seeds, and flowers-possesses medicinal value and has traditionally been employed in the management of skin related issues such as leukoderma, skin rashes, infections etc. Owing to its reputed therapeutic efficacy against dermatological ailments, it is traditionally referred to as "Kushtanashini", meaning destroyer of leprosy. *Psoralea corylifolia* Linn. has been an ancient remedy for leukoderma, extensively used in both traditional Indian and Western medicine. The fruits consist of a sticky oily pericarp (12% of the seed), a hard seed coat and kernel [1]. Analysis by Ruan *et al.,* (2005) revealed the presence of an isoflavone, named corylinin along with isopsoralen, psoralen, sophoracoumestan A, neobavaisoflavone and daidzin in *Psoralea corylifolia* Linn. dried fruits [4].

The popularity of natural remedies arises from their safety, easy accessibility and lower toxicity. However, the issue of adulteration and substitution in natural drugs pose a hindrance. Hence it is essential to establish standard parameters for identification of plants. This ensures reproducible quality of the drug and maintains both safety and efficacy. The implementation of pharmacognostic studies plays a pivotal role in setting and maintaining these quality standards [5]. Pharmacognostic studies guarantee the accurate identification of plants, establish parameters for standardization, and serve as a preventive measure against adulterations. These studies contribute to the authentication of plants, ensuring the consistent quality of herbal products, which, in turn, enhances the safety and efficacy of natural remedies [6].

Establishment of pharmacognostic profile of *Psoralea corylifolia* Linn. seeds will assist in the standardization in terms of quality, purity and sample identification. Therefore, the main objective of this study was to standardize and to establish quality control parameters for *Psoralea corylifolia* Linn. seeds. Standardization of seeds of *Psoralea corylifolia* Linn. has been carried out in terms of macroscopy, microscopy, fluorescence analysis, organoleptic study, physicochemical analysis, preliminary photochemical analysis and development of HPTLC fingerprint profile.

Materials and Methods

Plant sample:

Seeds of *Psoralea corylifolia* Linn. were obtained from a Unani drug store located in Bhiwandi, Thane, Maharashtra, India. The botanical identity of the plant sample was confirmed at Agharkar Research Institute, Pune (Voucher specimen no. AUTH 22-123). After collection, the seeds were thoroughly rinsed with running tap water and blotted dry to remove excess moisture. Subsequently, the seeds were dried, finely powdered, stored in an airtight container and used for further analysis.

Macroscopic and Microscopic Evaluation

The seeds were subjected to macroscopic analysis to examine characters such as shape, color and size in accordance with established protocols. Thin, freehand transverse sections of the seed were taken. Subsequently, the sections were stained with dilute safranin, mounted in glycerol, and meticulously examined under a compound microscope at magnifications of 4X, 10X and 45X. The powdered form of the sample was assessed for organoleptic properties including color, odor, taste and texture following standard protocol. Additionally, the powdered sample was also examined for its microscopic characters [7,8].

Fluorescence Analysis

Fluorescence characteristics of the powdered sample were examined before and after treatment with various chemical reagents including methanol, ethanol, chloroform, toluene, 1N sodium hydroxide etc. The treated samples were observed under visible light, UVshort (254 nm) and long (366 nm) wavelengths as per standard method [9,10].

Physicochemical Evaluation

Physicochemical evaluation was carried out by determining proximate parameters such as foreign matter, loss on drying, swelling index, foaming index, total ash, acid-insoluble ash, and water-soluble ash. Additionally, extractive values in water and alcohol were estimated following standard procedures [11] and in accordance with WHO guidelines for the quality control of medicinal plant materials [8]. All evaluations were conducted in triplicates, and the results were reported as mean ± SD.

Preliminary Phytochemical Analysis

Preliminary phytochemical analysis of *Psoralea corylifolia* Linn. seed powder was carried out as per the protocols outlined by Kokate *et al.* (2008) and Khandelwal & Sethi (2016). Different extracts (Petroleum ether, Chloroform, Methanol and Water) of *Psoralea corylifolia* Linn. Seeds were examined for the presence of major phytoconstituents. For extraction, 1 g of powdered plant material was immersed in 10 ml of the respective solvent, vortexed for 5 minutes, and allowed to stand at room temperature overnight. The mixtures were filtered through Whatmann filter paper no. 1, and the filtrate obtained was further used for performing preliminary phytochemical tests.

HPTLC Fingerprint Profile

A qualitative densitometric HPTLC analysis of the ethanolic extract of *Psoralea corylifolia* Linn. seeds was carried out to develop a characteristic fingerprint profile. This fingerprint profile may be used for quality evaluation and standardization of the drug. The extract was spotted onto pre-coated silica gel 60 F_{254} HPTLC plates (Merck) using a CAMAG Linomat V applicator. For chromatographic development, a glass twin-trough chamber pre-saturated with

the mobile phase mixture of toluene, ethyl acetate, and glacial acetic acid (6:4:0.1) was employed. After development, the plates were derivatized with ninhydrin reagent and subsequently scanned with CAMAG HPTLC Scanner 3.

Results and Discussion

Pharmacognosy primarily deals with the authentication, standardization and evaluation of natural drugs. Research in this discipline largely emphasizes the identification of disputed plant species and authentication of traditional medicinal plants using morphological, phytochemical and physicochemical evaluations. Pharmacognostic investigations not only confirm the botanical identity of plants but also establish standardization parameters that minimize the risk of adulteration. Such evaluations ensure uniform quality of herbal formulations, thereby enhancing their safety and therapeutic efficacy. Common pharmacognostic parameters include macroscopic and organoleptic assessments, microscopic study, fluorescence analysis, physicochemical evaluation, preliminary phytochemical screening etc. [6].

Macroscopic Study

Macroscopic evaluation includes the morphological characterization of plant parts that can be observed directly with the naked eye or by using a magnifying lens [6]. *Psoralea corylifolia* Linn. is an erect, annual herbaceous plant with profuse branching. The stem is green, grooved, and rough in texture, bearing numerous fine white hairs. Leaves are simple, broadly elliptical, hairy, and exhibit a toothed margin. Petioles are gland-dotted and covered with hairs. The plant bears blue flowers arranged in dense axillary flowered racemes. The fruit pods are ovoid-oblong and mucronate. The seeds are ovoid-oblong or bean-shaped, flattened, brownish-black in color, and pointed at the posterior end, with an average size of 0.5 ± 0.24 cm in length and 0.4 ± 0.18 cm in width. The macroscopic observations are summarized in Table 1 and illustrated in Plate 1.

Organoleptic Study

Organoleptic evaluation is based on sensory perception of certain parameters, which helps to identify specific characteristics of a material like color, texture, taste and odor. This process can serve as an initial step in the establishment of identity and degree of purity of the material [11,13]. Organoleptic characters of *Psoralea corylifolia* Linn. seed i.e. color, texture, taste and odor are recorded in Table 2.

Microscopic Study

Microscopic study refers to the anatomical examination of plant parts by taking appropriate sections [6]. It is one of the cheapest methods for accurately identifying specific drugs and ensuring the authenticity of raw materials [14]. The cross-section of *Psoralea corylifolia* Linn. seeds display an outer layer called testa surrounded by collapsed parenchyma cells with oleo-resinous matter. It has a central embryo with two cotyledons. The cotyledons are made up of polyhedral parenchyma cells. Further, the seeds are rich in oil globules (Plate 2).

Powder Characteristics

Study of powder characteristics is similar to microscopic study, but instead of studying a section of the plant part being examined, dried powder is used. It helps in the standardization process and for detection of adulterants in powdered herbal drugs [6]. In the present study the seed powder was observed for anatomical markers. Powder microscopy of seed showed the presence of polyhedral parenchyma with oil; trichome; simple fibre; tannin content; prismatic crystal and palisade cells (Plate 2).

Fluorescence Analysis

Fluorescence is a key phenomenon exhibited by various phytoconstituents in plant materials. Some compounds fluoresce in the visible range (daylight) whereas ultraviolet light can induce fluorescence in many compounds that do not show fluorescence in the visible range. Additionally, non-fluorescent substances can sometimes be transformed into fluorescent derivatives by applying certain chemical reagents. Hence fluorescence study is a valuable tool for the qualitative assessment of crude drugs, serving as an important parameter in pharmacognostic evaluation [15,16,17,18]. In the present study, the fluorescence analysis of *Psoralea corylifolia* Linn. seeds were carried out and the results are tabulated in Table 4.

Physicochemical Evaluation

Physicochemical evaluation comprises the assessment of parameters such as loss on drying, ash values (including total ash, water-soluble ash, and acid-insoluble ash) as well as extractive values in alcohol and water. Ash values are critical indicators for evaluating the quality and purity of a crude drug. Extractive values, on the other hand, help to estimate the amount of active constituents in a given amount of plant material that can be extracted with a particular solvent. The solution resulting from the extraction contains several phytoconstituents, whose composition depends on both the drug and the solvent used [6, 19].

In the present investigation, the total ash content of the seeds was found to be 5.16 ± 0.08%, while the values for acid-insoluble ash and water-soluble ash were 0.516 ± 0.028% and 2.36 ± 0.06%, respectively. Extractive values serve as one of the important parameters in the assessment of crude drugs. It provides an insight into the nature of the chemical constituents present in the crude drug. The present study revealed a water-soluble extractive value of 24.8 ± 0.05% and an alcohol-soluble extractive value of 28.72 ± 0.02%.

Preliminary Phytochemical Analysis

Phytochemicals are secondary metabolites responsible for imparting distinct attributes such as color, aroma, and

flavor to plants, while also providing numerous health benefits [20]. Identifying these phytochemicals is valuable for predicting the potential pharmacological activities of plants. Although advanced analytical techniques are now widely employed for phytochemical determination, traditional qualitative methods continue to serve as reliable and widely used approaches for preliminary phytochemical screening [21].

In the present study, preliminary phytochemical screening of *Psoralea corylifolia* Linn. seeds was carried out using different extracts namely petroleum ether, chloroform, methanol, and water extracts. The findings of the analysis are summarized in Table 5. The study confirmed the presence of diverse phytoconstituents such as acid compounds, aleurone grains, amino acids, carbohydrates, fats and fixed oils, starch, alkaloids, flavonoids, glycosides, steroids, triterpenoids, tannins, resins and saponins.

HPTLC Fingerprint

The quality of herbal medicines largely depends on the presence of bioactive compounds. High-Performance Thin Layer Chromatography (HPTLC) fingerprinting serves as a widely accepted and reliable technique for the determination of bioactive components in herbal medicines. Recognized for its precision and accuracy, this method is extensively employed for the authentication and standardization of medicinal plants. HPTLC profiling not only supports quality control by identifying adulterants but is also valuable in the evaluation of marketed herbal preparations and in plant systematic studies [22, 23]. In the present study, the HPTLC fingerprint profile of the ethanolic seed extract of *Psoralea corylifolia* Linn. exhibited distinct band pattern before and after derivatization with ninhydrin reagent, as illustrated in Plate 3. The corresponding Rf values of bands under different wavelengths before and after derivatization are presented in Table 06.

Table 1: Macroscopic characteristics of *Psoralea corylifolia* Linn. seed

S.No	Parameters	Observation
1	Colour	Brownish - black
2	Size (cm)	Length = 0.5 ± 0.24 Width = 0.4 ± 0.18
3	Texture	Smooth
4	Shape	Ovoid - oblong or bean shaped

Table 2: Organoleptic evaluation of *Psoralea corylifolia* Linn. seed powder

S.No.	Parameters	Observation
1	Colour	Blackish brown
2	Texture	Smooth
3	Taste	Bitter, unpleasant and acrid
4	Odour	Characteristic Aromatic with smell of a pungent essential oil

Table 3: Physicochemical parameters for *Psoralea corylifolia* Linn. seed

S.No.	Physicochemical parameters	Result (Mean ± SD)
1	Foreign matter (%w/w)	1.41 ± 0.32
2	Loss on drying (%w/w)	3.33 ±0.05
3	Swelling Index (ml)	3
4	Foaming Index	100
5	Ash value	
	Total ash value (%w/w)	5.16±0.08
	Acid Insoluble ash value (%w/w)	0.516±0.028
	Water soluble ash value (%w/w)	2.36±0.06
6	Extractive value	
	Alcohol soluble (%w/w)	28.72 ±0.02
	Water soluble (%w/w)	24.8 ±0.05

Table 4: Fluorescence analysis of *Psoralea corylifolia* Linn. seed powder

S. No.	Fluorescence tests	Observation under		
		Visible light	UV 254 nm	UV 366 nm
1	Powder as such	Blackish Brown	Black	Dark Red
2	Powder + 1N NaOH in methanol	Reddish Brown	Brown	Black
3	Powder + 1N HCl	Brown	Brown	Black
4	Powder + 1N NaOH in water	Reddish Brown	Red	Brown
5	Powder + HNO_3(1:1)	Yellowish Brown	Black	Bluish black
6	Powder + H_2SO_4(1:1)	Blackish Brown	Dark Blue	Green
7	Powder + 1% Picric acid	Greenish Brown	Greenish Brown	Dark green
8	Powder + 5% Iodine	Dark Brown	Red	Dark Red
9	Powder + 5 % $FeCl_3$	Greenish Black	Black	Brownish Black
10	Powder + 25% NH_3+HNO_3	Yellowish Brown	Green	Green
11	Powder + conc. HNO_3	Dark Brown	Dark Brown	Black
12	Powder + 10% $K_2Cr_2O_7$	Reddish Brown	Dark Brown	Reddish Black
13	Powder + 50% KOH	Reddish Brown	Reddish Brown	Black
14	Powder + Methanol	Brown	Brown	Black
15	Powder + Ethanol	Dark Brown	Brown	Black
16	Powder + Toluene	Reddish Brown	Dark Red	Black
17	Powder + Glacial acetic acid	Red	Red	Black

Table 5: Preliminary phytochemical analysis of *Psoralea corylifolia*Linn. seed extracts

S.No	Tests	PE	CE	ME	AE
1	Acid compounds	ND	+	ND	+
2	Aleurone grains	ND	ND	+	+
3	Amino acids	ND	ND	+	+
4	Carbohydrates	ND	+	+	+
5	Fats and fixed oils	+	+	ND	ND
6	Proteins	ND	ND	ND	ND
7	Starch	+	+	ND	+
8	Alkaloids	ND	ND	+	ND
9	Anthraquinones	ND	ND	ND	ND
10	Essential oils	ND	ND	ND	ND
11	Flavonoids	+	+	ND	ND
12	Glycosides	+	ND	ND	+
13	Mucilage	ND	ND	ND	ND
14	Resins	ND	ND	ND	+
15	Saponins	ND	ND	ND	+
16	Steroids and triterpenoids	+	+	+	+
17	Tannins	ND	ND	+	+

Keywords: PE - Petroleum ether extract; CE - Chloroform extract;
ME - Methanolic extract; AE - Aqueous extract
+ - Detected; ND - Not Detected

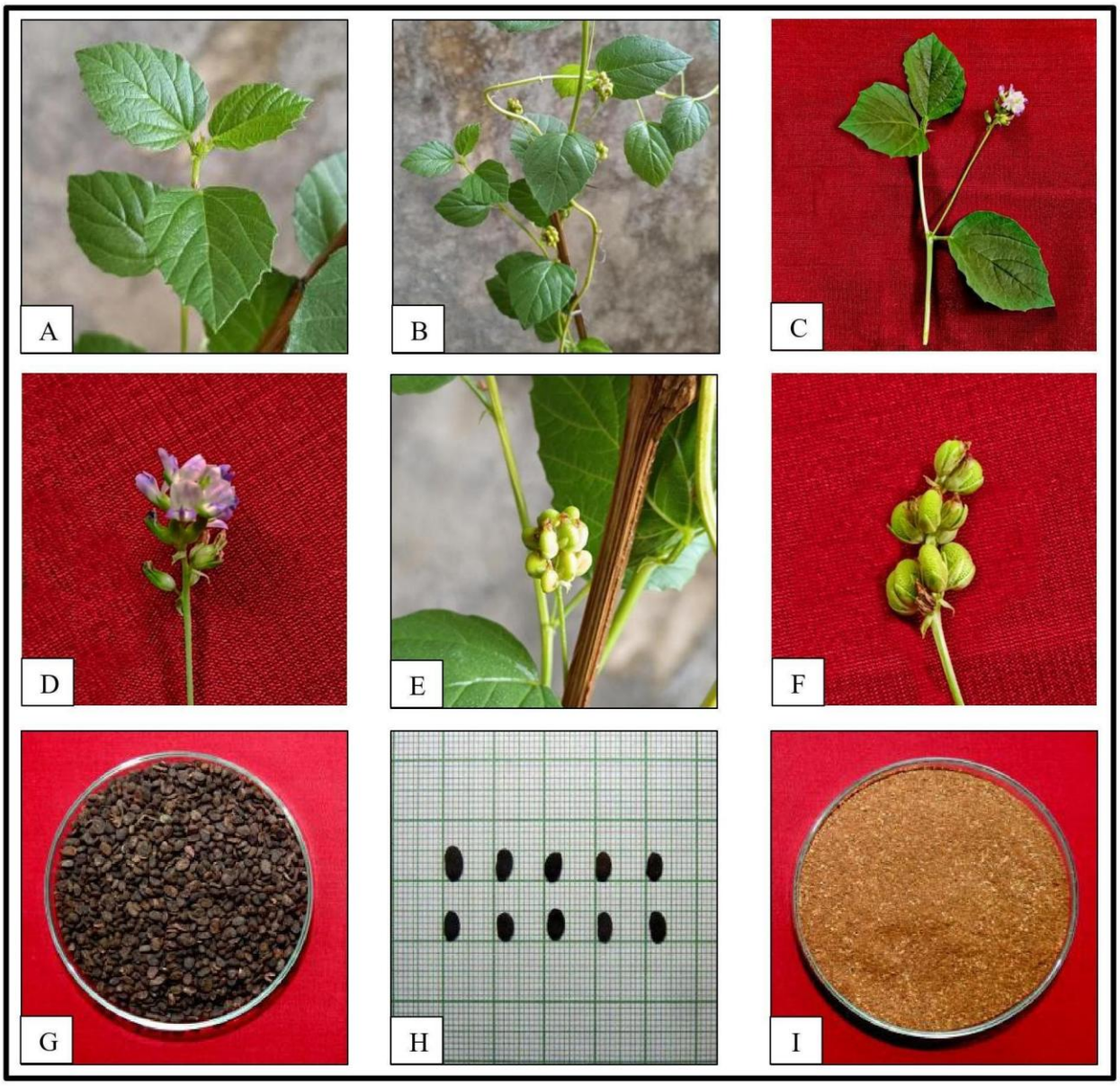

Plate 1: Macroscopic characteristics of *Psoralea corylifolia* Linn. seed and seed powder
Keywords: A- Vegetative stage of plant; B- Flowering stage of plant; C- A twig with inflorescence; D- Inflorescence; E and F- Fruits; G and H- Seeds; I- Seed powder

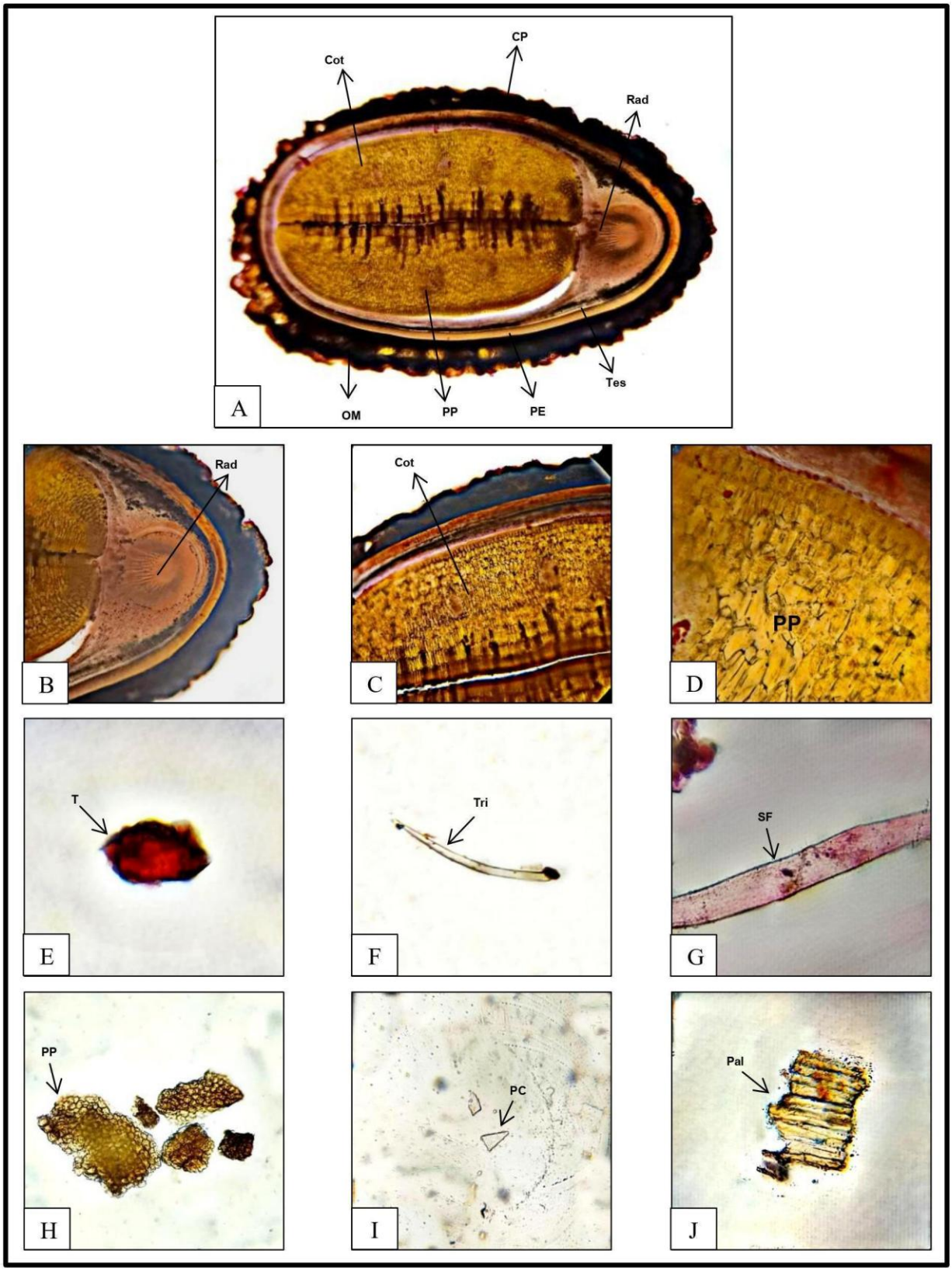

Plate 2: Microscopic characteristics of *Psoralea corylifolia* Linn. seed

Keywords: A: T.S. of seed under compound microscope (4X) (CP: Collapsed Parenchyma; Tes: Testa; OM: Oleoresinous matter; PE: Palisade epidermis; Rad: Radicle; Cot: Cotyledon; PP: Polyhedral parenchyma with oil); B,C,D: T.S. of seed under compound microscope (10X) E: Tannin content (T); F: Trichome (Tri); G: Simple fiber (SF); H: Polyhedral parenchyma with oil (PP); I: Prismatic Crystal (PC); J: Palisade cells (Pal)

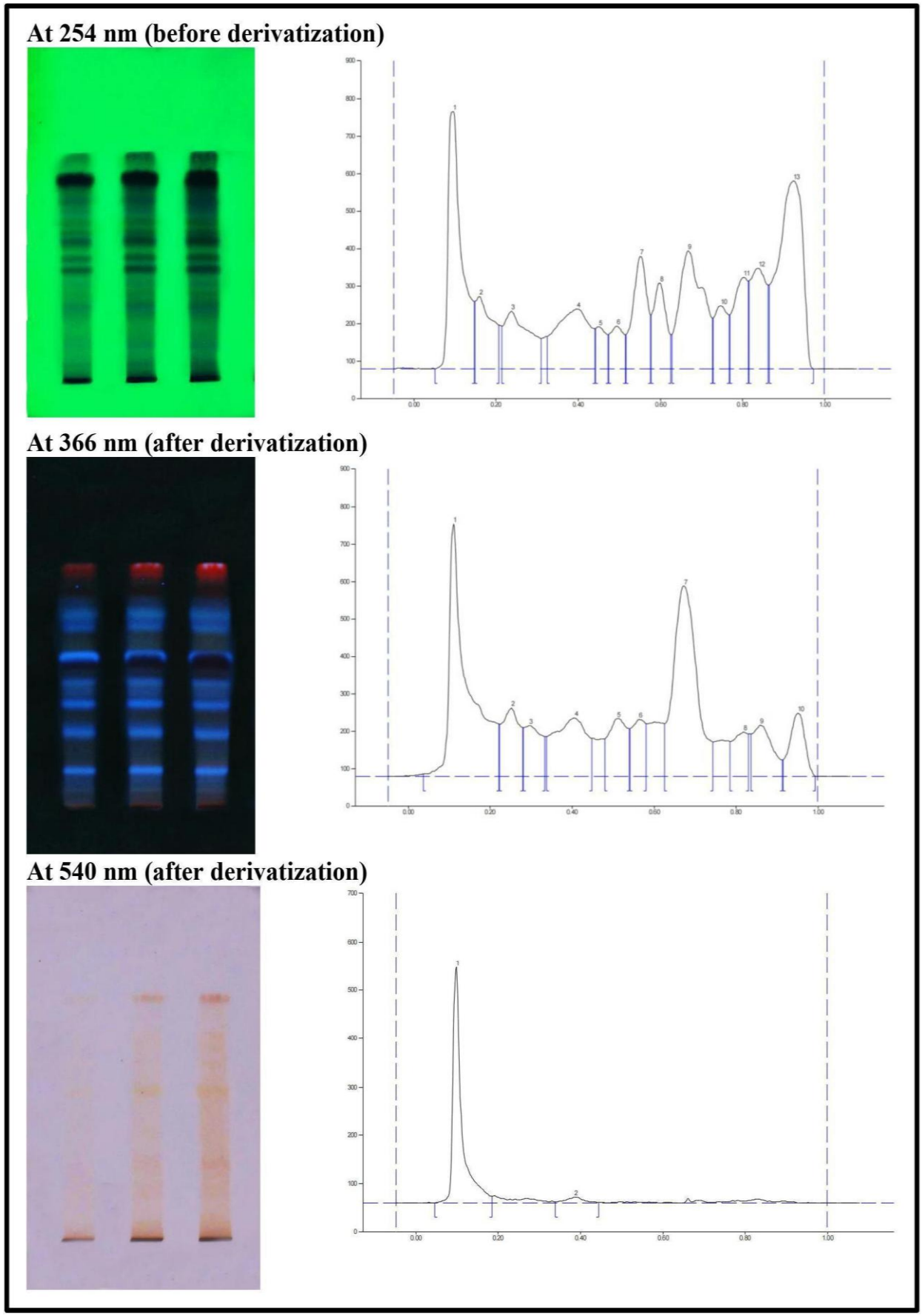

Plate 3: High Performance Thin Layer Chromatography fingerprint profile of *Psoralea corylifolia* Linn. seed

Table 6: HPTLC fingerprint profile (Rf values) of ethanolic extract of *Psoralea corylifolia* Linn. seed

S. No.	Before Derivatization	After Derivatization	
	254nm	366nm	Visible
1	0.10	0.11	0.10
2	0.16	0.25	0.39
3	0.24	0.30	-
4	0.40	0.41	-
5	0.45	0.51	-
6	0.50	0.56	-
7	0.55	0.67	-
8	0.60	0.82	-
9	0.67	0.86	-
10	0.75	0.95	-
11	0.80	-	-
12	0.84	-	-
13	0.93	-	-

Conclusion

Plants are a traditional source of various phytoconstituents with diverse pharmacological effects. Therefore, accurate identification and authentication of plant raw materials are crucial before their use as drugs, whether individually or as part of a formulation. In this context, the current study assesses the pharmacognostic parameters of *P. corylifolia* Linn. That identifies specific features that are essential for the drug's identification and authentication. The results of this study could be valuable for creating a monograph in an appropriate pharmacopoeia to aid in proper identification and quality control.

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Conflict of Interest

None

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