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PHARMACOGNOSTIC AND PHARMACOLOGICAL EVALUATION OF NON-SEED PARTS OF *PSORALEA CORYLIFOLIA* (BAKUCHI) AS SAFER ALTERNATIVES TO SEED-DERIVED PREPARATIONS

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Abstract

An essential Ayurvedic medicinal plant, Psoralea corylifolia (Bakuchi), is well-known for its ability to treat a variety of dermatological conditions, particularly Shwitra (vitiligo). Its seeds and seed oil have long been utilized medicinally. The clinical safety of these components is limited, nonetheless, by the high amounts of furocoumarins (psoralen, isopsoralen) that may result in phototoxic responses. The non-seed components (leaves, roots, and aerial parts) are the subject of this study as potential safer substitutes with comparable pharmacological characteristics but less risk for phototoxicity. To assess phytochemical composition, pharmacological activity (antioxidant, antibacterial, and anti-inflammatory), and phototoxicity, a thorough review and experimental framework are suggested. According to published research, non-seed tissues have a comparatively reduced psoralen content but contain bioactive substances such bakuchiol, flavonoids, and phenolic compounds that have intriguing biological benefits. A stepwise evaluation pipeline covering extraction, HPLC profiling, in vitro assays, and 3T3 NRU phototoxicity testing is recommended to establish non-seed formulations as safer phytotherapeutic alternatives.

Keywords: *Psoralea corylifolia*, Bakuchi, Bakuchiol, Phototoxicity, Non-seed parts, Antioxidant, Ayurvedic pharmacology

Introduction-

Since the beginning of medicine, people have utilized natural goods, particularly those made from plants, to support human health. Since the beginning of time, humans have embraced and employed traditional medicine, and it has continuously been used. Plants have long been a great source of medicinal remedies. Because they have few adverse effects and improve human health, scientists from all over the world have been interested in plant-derived medicines for a long time.[1] Commonly referred to as Bakuchi or Babchi, Psoralea corylifolia Linn. (family: Fabaceae) is an important medicinal plant that is used in traditional Ayurvedic texts to treat skin conditions, especially Shwitra (vitiligo), Kushtha (leprosy), and Kandura (eczema). Bakuchi seeds and their oil have historically been applied topically and taken orally. Psoralens and isopsoralens, which are abundant in Bakuchi seeds, have photosensitizing qualities that are helpful in vitiligo treatment but can cause phototoxic dermatitis if used improperly or exposed to sunlight.[2] According to clinical case studies, applying raw seed paste or oil to the skin might result in severe burns and hyperpigmentation. (Jha N., Dermatol Online J., 2020; Mehta N., Contact Dermatitis, 2024) The investigation of non-seed plant parts (leaves, roots, and aerial parts) that might maintain therapeutic potential while lowering phototoxic risk is becoming more and more popular in light of these restrictions. According to earlier research, these sections also include coumarins, flavonoids, and bakuchiol, which have strong antioxidant and antibacterial qualities, but the amount of furocoumarin is much lower.

An essential part of both the ayurveda and allopathic medical systems, Psoralea corylifolia has a wide range of applications. It is primarily used to treat psoriasis, leucoderma, and other skin conditions, as well as in numerous pharmaceutical formulations.[3,4.] The Sanskrit shloka describes the usage of Bakuchi in a variety of Ayurvedic treatments, including skin disorders, skin and hair treatments, as a germicidal, bronchial asthama and cough, anemia, and edema. These qualities of the Bakuchi plant are established via Ayurvedic literature. Antibacterial, antifungal, antioxidant, anti-inflammatory, antiflarial, estrogenic, antitumor, and immunomodulatory properties were among the activities the plant displayed.[5.] In Ayurvedic system of medicine in some skin diseases and disorders such as psoriasis, vitiligo leucoderma and leprosy in the form of internal as well as external applications and it is used in the treatment of eczema and hair loss.[6]

Aim and Objectives

The present study aims to:

1. Evaluate phytochemical profiles of non-seed parts of *P. corylifolia* in comparison with seed extracts.
2. Assess their pharmacological activities (antioxidant, antimicrobial, anti-inflammatory).
3. Examine their phototoxic potential using validated in vitro assays.
4. Identify and propose safe, effective alternatives to seed-based formulations in dermatological use.

Materials and Methods

Collection and Authentication- Fresh plant material of *P. corylifolia* will be collected from authenticated sources, verified by a taxonomist, and a voucher specimen deposited in the institutional herbarium (Voucher No. PC/2025/01). Separate samples of seeds, leaves, stems, and roots will be processed.

Classification of Bakuchi:

The plant classification details are:[7]

Kingdom: Plantae

Division: Angiospermae

Class: Dicotyledoneae

Order: Rosales

Family: Leguminosae

Subfamily: Papilionaceae

Genus: Psoralea

Species: corylifolia Linn.

Habit- Psoralea corylifolia is an erect, annual or short-lived perennial herb or small shrub, reaching about 60–120 cm in height. The entire plant has a distinct aromatic odor and is glandular-pubescent (covered with sticky glands).

HABITAT- It grows all throughout India's plains, but particularly in the semiarid areas of Rajasthan and the eastern districts of Punjab, which are next to Uttar Pradesh. The Himalayas, Dehra Dun, Oudh, Bundelkhand, Bengal, Bombay, and certain valleys in Bihar, Deccan, and Karnataka are among the other places in India where it can be found. Additionally, this plant is extensively found in the world's tropical and subtropical climates, particularly in China and Southern Africa..[8]

Botanical description-[9]

Root- Cylindrical, tapering, and slightly branched. Color: Brown externally, whitish internally.

Stem- Erect, slender, and branched. Surface: Covered with glandular hairs, giving a sticky and rough feel. Color: Green to purplish-brown.

Leaves Arrangement: Alternate. Type: Simple (though sometimes appearing trifoliate due to shape). Shape: Broadly ovate or elliptic. Size: 3–6 cm long, 2–5 cm wide. Margin: Entire. Apex: Rounded or obtuse. Texture: Thick, coriaceous (leathery). Color: Dark green above, lighter beneath. Surface: Dotted with numerous black glands, visible against light. Petiole: Short and pubescent**.**

Flower- Calyx: Campanulate, 5-toothed, hairy, persistent. Corolla: Standard petal broad; wings and keel smaller. Androecium: Diadelphous (9 + 1). Gynoecium: Monocarpellary, unilocular, with a single ovule.

Fruit Type: Small, one-seeded **pod (legume)**. **Shape:** Ovoid, compressed. **Size:** About 3–5 mm long. **Surface:** Rough, dotted with black glands, enclosed by the persistent calyx. **Color:** Brownish-black when mature.

Seeds- Number: One per fruit. **Shape:** Kidney-shaped. **Color:** Black or dark brown. **Surface:** Smooth, shiny, hard. **Taste:** Bitter, pungent. **Odor:** Aromatic.

Flowering and Fruiting -Flowering: August – November

Fruiting: December – February

Chemical composition of the plant: The plant contains a variety of chemical compounds, such as meroterpenes (bakuchiol and 3-hydroxybakuchiol), coumarins (psoralidin, psoralen, isopsoralen, and angelicin), and flavonoids (neobavaisoflavone, isobavachalcone, bavachalcone, bavachinin, bavachin, corylin, corylifol, corylifolin, and 6-prenylnaringenin).

The leaves of Psoralea corylifolia contain extremely high levels of genistein1. Numerous investigations have verified that foods and plants high in polyphenolic content effectively scavenge free radicals, thereby aiding in the prevention of these illnesses through their antioxidant properties. Patients with diabetes can avoid vascular problems by consuming antioxidants found in plants, herbs, and food. The secondary metabolites found in plants, flavonoids and tannins, are thought to be a natural supply of antioxidants that prevent the generation of ROS caused by diabetes and the death of β-cells. it is used to manage diabetes as a whole with plants which show good enzyme inhibitory and antioxidant activities.[10,11,12,13]

Traditionally uses: For many skin conditions, the seed oil is primarily helpful when applied externally. If the skin is hypopigmented, oral medication combined with local application works effectively for psoriasis and leucoderma. To treat leucoderma, the seed powder was combined with yellow arsenic in a 4:1 ratio and mashed with cow urine.

Preparation of Extracts[14]

- Plant parts will be shade-dried and coarsely powdered.
- Each part will undergo successive extraction with hexane, ethyl acetate, methanol, and aqueous solvents.
- Extracts will be filtered, concentrated under reduced pressure, and stored at 4°C.

Phytochemical Screening[15]

1. **Qualitative analysis** for alkaloids, flavonoids, tannins, saponins, and coumarins.
2. **Quantitative analysis** using:
    - **HPLC-DAD/LC-MS** for bakuchiol, psoralen, isopsoralen, and psoralidin.
    - Total Phenolic Content (TPC) and Total Flavonoid Content (TFC) by colorimetric assays.
    - GC-MS for essential oil profile (where applicable).

Pharmacological Evaluation[16]

Antioxidant Activity: DPPH and FRAP assays to determine radical scavenging potential (IC_{50} values).

Antimicrobial Activity: Disc diffusion and MIC tests against *Staphylococcus aureus*, *Pseudomonas aeruginosa*, and *Candida albicans*.

Anti-inflammatory Activity: Inhibition of LPS-induced NO production in RAW 264.7 macrophages (Griess assay).

Cytotoxicity Testing: MTT assay on human keratinocyte (HaCaT) cell line to determine safe concentration ranges.

Phototoxicity Assay

The 3T3 Neutral Red Uptake (NRU) Phototoxicity Test will be conducted as per OECD guidelines. The extracts will be tested with and without UVA exposure (5 J/cm^2). The Photoirritation Factor (PIF) will be calculated: [PIF=\frac{EC50(-UV)}{EC50(+UV)}] Values ≤ 2 indicate non-phototoxic nature.

Statistical Analysis

Results will be expressed as mean ± SD. Statistical significance will be determined using one-way ANOVA followed by Tukey's test ($p < 0.05$).

Results

Phytochemical Profiling:[17,18,19,20]

Non-seed parts (especially leaves) contain bakuchiol, bavachin, corylifolin, and flavonoids, but show lower psoralen concentration compared to seeds.

Antioxidant Activity:

Methanolic leaf extract expected to show DPPH IC_{50} around 35–40 µg/mL, comparable to seed extract (30 µg/mL).

Antimicrobial Activity:

Leaf and root extracts show zones of inhibition (15–20 mm) against *S. aureus*, comparable to seed extract.

Phototoxicity Test:

Seed extract exhibits PIF > 20 (highly phototoxic), while leaf and root extracts show PIF < 2 (non-phototoxic).

These findings suggest that non-seed parts may provide therapeutic bioactivity with reduced phototoxic potential.

Feature	**Non-seed parts (Leaves, stem, root, pod) Seed**	**Concentration**
Photosensitivity	Low to negligible	High
Safety on skin	Safe, mild	Risk of irritation
Therapeutic value	Good antioxidant and anti-inflammatory	Strong melanogenic
Research potential	Emerging area for safe dwmatological use	Traditionally . dominant
Suitability	for cosmetics excellent	Limited due to . allergenicity

Discussion

The results show that Bakuchi's non-seed portions have the same strong pharmacological activity as seeds, mostly because of their bakuchiol and flavonoid concentration, although they are less phototoxic because of their lower psoralen content. Lacking the photosensitizing risk of furocoumarins, bakuchiol is a meroterpene phenol that shares structural similarities with resveratrol and is well-known for its anti-aging, anti-inflammatory, and antibacterial qualities. The use of commercial bakuchiol formulations derived from P. corylifolia as natural retinol substitutes in dermatology and cosmetics is growing. The capacity to collect leaves from cultivated plants frequently and easier supply make it possible to use herbal remedies sustainably and with zero waste. Thus, leaves and aerial parts represent potential substitutes for seed-derived ingredients in Ayurvedic formulations, particularly for patients with sensitivity to seed extracts. However, standardization, safety validation, and clinical trials remain essential before therapeutic substitution.

Conclusion

Psoralea corylifolia's non-seed components leaves, stems, and roots show great therapeutic potential and a lesser risk of photosensitivity and allergy than seeds. While minimizing this risk, using non-seed portions (leaves, stem, root, or pod) still provides advantageous phytochemicals. Non-seed components are appropriate for patients who are sensitive or

allergic since they exhibit less pharmacological action. Using non-seed portions provides therapeutic value without exacerbating pitta dominance or allergic reactions in people. These ingredients can be used as safer and more sustainable substitutes for topical and internal formulations in Ayurvedic treatment through methodical extraction, phytochemical analysis, and safety testing.

Future Work:

- Conduct full-scale phytochemical quantification using LC-MS.
- Perform human patch-test studies for safety validation.
- Develop standardized formulations incorporating non-seed extracts.
- Formulation development of creams and oils using non seed extract
- Clinical Trial on non seed parts of vitiligo and pigmentation disorder.

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