Synergizing Asclepediaceae fiber and Pergularia daemia latex for Orthopedic Health Care Products

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Abstract **- This study involves the extraction of *Pergularia daemia* fiber is a perennial climbing herb belonging to the family *Apocynaceae*, has been extensively used in traditional medicine due to its anti-inflammatory, analgesic, and wound-healing activities. Its cytotoxic activity in pain relief, especially for knee pain in conditions such as osteoarthritis and rheumatoid arthritis, has been investigated in recent studies. The bioactive compounds present in the form of flavonoids, alkaloids, tannins, and steroids are responsible for its anti-inflammatory activity, inhibition of pain mediators, and tissue regeneration. The cytotoxic activity of *Pergularia daemia* is due to its selective activity against inflammatory cells, inducing apoptosis and immune modulatory effects to reduce pain in the joints. Plant extracts have shown encouraging outcomes in minimizing knee joint swelling, stiffness, and oxidative stress. Moreover, its use in herbal preparations, such as poultices, infused oils, and medicated fibers, offers a sustainable and natural source of relief over synthetic painkillers. In this investigation, the pharmacological activity, cytotoxic action, and possible uses of *Pergularia daemia* in knee pain therapy are studied. Through knowledge of its inhibitory actions on inflammatory mechanisms and chondroprotective activity, Velluparuthi could become a potential complementary therapy for chronic joint pain, a plant-derived, non-surgical treatment for patients with degenerative joint disorders. My study concludes this fiber have mild to severe cytotoxicity to L929 cells after 24hrs. The obtained IC50 value is 47.1µg. Control showed none cytotoxicity as expected.**

Index Terms **- Apocynaceae, Osteoarthritis, Rheumatoid Arthritis, Apoptosis, Oxidative stress, Flavonoids, Alkaloids, Tannins**

1. INTRODUCTION

Pergularia daemia commonly referred to as climbing milkweed or Indian dogbane, is used for many purposes, especially in agriculture and traditional medicine. Many parts of *Pergularia daemia* are applied in traditional medicine to cure respiratory, skin, and digestive problems. *Pergularia daemia* exhibit antibacterial, anti-inflammatory, and analgesic activities. The herb is used in different cultures as a cure for feverish, digestion, and wounds. Its roots and leaves are used to prepare infusions or poultices. *Pergularia daemia* is used as an insecticide and a natural repellent and is also used in intercropping for the protection of other crops. Due to its climbing habit and root system, the plant has the potential to enrich the soil and prevent erosion. The benefits of sustainable agriculture are increasingly becoming more popular, especially in terms of organic farming, pest management, and other sustainable farming methods. *Pergularia daemia* is one of the natural healers which have a larger role in textile as it has more sustainable quality. This plant is rich in nutrients and suitable for both human and animal food because it is rich in proteins, vitamins, and minerals. It is an important tool for ecologically sound farming practices because its organic materials can drive away some pests. The plant's deep roots enhance soil aeration and nutrient retention, thereby enhancing the overall health of the soil. Due to its spreading root system and climbing nature, it stabilizes soil and prevents erosion in susceptible areas. Studies show that it can have antioxidant properties, which would assist in the prevention of diseases caused by oxidative stress. *Pergularia daemia* belongs to the family *Apocynaceae* and is most commonly described as a perennial herbaceous, climbing plant. It is also referred to as Indian dogbane or climbing milkweed. It grows in disturbed areas, meadows, and forest edges and is a tropical and subtropical endemic. *Pergularia daemia* possesses opposite leaves, thin climbing stems, and a group of small, tubular flowers that are typically green or yellow. It is valued in traditional culture for its fibers as well as its dietetic and medicinal properties. This member of the *Apocynaceae* has features in common with other milkweeds. Natural fibre is fibrous plant

material produced through photosynthesis. Such fibres can also be called vegetable, biomass, photomass, phytomass, agromass, solarmass or photosynthetic fibres. Plant fibres such as cotton, wool, silk, and linen are widely employed to produce garments, bedding, and other fabrics. They find application in the fabrication of nonwoven fabrics, technical fabrics and industrial fabrics. Natural fibers may also break down in nature, thereby minimizing the cost of their disposal.Natural fibers are derived from plants and animals that are able to replenish themselves.Natural fibers can breathe and dry off, and because of this they are very convenient to wear under hot and muggy weather.They are able to withstand strains and pressures easily, hence have a number of uses.Natural fibers may provide insulation to preserve the warmth in cold conditions.

2. REVIEW OF LITERATURE

2.1 Fiber Characteristics of *Pergularia daemia*

The fibers of *Pergularia daemia* have been explored for their potential in various applications, particularly in textiles, biocomposites, and industrial materials. Below are the key attributes:

2.1 Source and Structure:

- Fibers are primarily derived from the stem or bark of the plant.
- They are long, thin, and possess good tensile strength, making them a viable alternative to traditional natural fibers like jute or flax.

2.2 Physical Properties:

- Lightweight and moderately strong.
- Coarse texture, requiring further processing for smoother applications.
- Suitable for making ropes, mats, and similar products.

2.3 Chemical Composition:

- Comprised of cellulose, hemicellulose, and lignin, akin to other bast fibers.
- Lignin provides durability but may necessitate chemical treatment to enhance flexibility and softness.

2.4 Applications:

2.4.1 Textiles: Can be blended with other natural fibers for fabric production.

2.4.2 Ropes and Cordage: Strong and durable for making ropes and twines.

2.4.3 Biocomposites: An eco-friendly material suitable for biodegradable composite production.

2.4.4 Paper Production: Useful for creating pulp for paper.

2.4.5 Medicinal Uses: While the fiber itself has no medicinal value, the plant's leaves, latex, and roots are widely utilized in traditional remedies.

2.5 Extraction Methods:

2.5 Fibers are obtained through retting followed by manual or mechanical separation.

2.6 Enzymatic retting techniques offer potential for higher quality and environmentally friendly extraction.

2.7 Latex of *pergularia daemia*:

The latex of *Pergularia daemia*, a plant from the *Apocynaceae* family, is a milky, viscous secretion known for its bioactive compounds and medicinal properties. Widely used in traditional medicine, particularly in Ayurveda, this latex offers a variety of therapeutic benefits. Below is an overview of its key characteristics, composition, and applications:

2.8 Characteristics of *Pergularia daemia* Latex

Appearance:

- The latex is a sticky, white liquid, characteristic of plants in the *Apocynaceae* family.

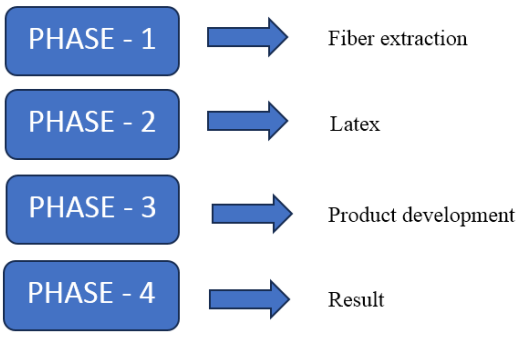
Chemical Composition:

- Contains alkaloids, flavonoids, terpenoids, cardiac glycosides, phenolic compounds, and saponins.
- Enriched with proteolytic enzymes like proteases, which contribute to its medicinal properties.

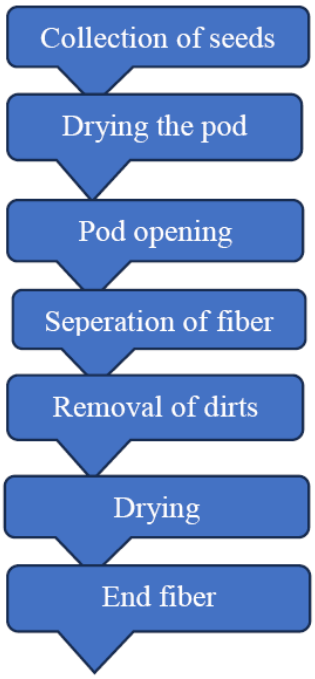
Bioactive Properties:

- Exhibits strong antibacterial and antifungal activity.
- Possesses anti-inflammatory and wound-healing properties.
- Effective as an anthelmintic, against parasitic worms.

3. EXPREMENTAL PROCEDURE



4. FIBER EXTRACTION FLOW PROCESS



4.1 Collection of Seed Pods

Mature pods are harvested when they start drying naturally from the plant.

It is usually harvested during the summer and autumn season.

Figure:1-Collection of seed pods

4.2 Drying the Pods

Fibers are naturally dried in sun for few days to a week. This helps in moisture removal. By this process pods are opened in an easy manner.

Figure: 2-Drying the pods

4.3 Pod Opening

The dried pods are opened either manual or by mechanical method. It is opened with care to extract the fiber.

Figure: 3-Pod opening

4.4 Separation of Fiber

The silky, cotton-like fibers inside the pod are removed and separated and the seeds were also collected for propagation or oil extraction.

Figure: 4-Seperation of fiber

4.5 Removal of Dirt & Impurities

The fibers are handpicked to remove unwanted debris and seed particles.

Figure: 5-Removal of dirt and impurities

4.6 Drying

Fibers are spread under the sun for final drying. This prevents fungal growth and preserves fiber strength.

4.7 End Fiber (Final Processing)

Once dried, fibers can be stored or used directly in applications.Further combing, spinning, or weaving can be done depending on the end use.

5. LATEX EXTRACTION PROCESS

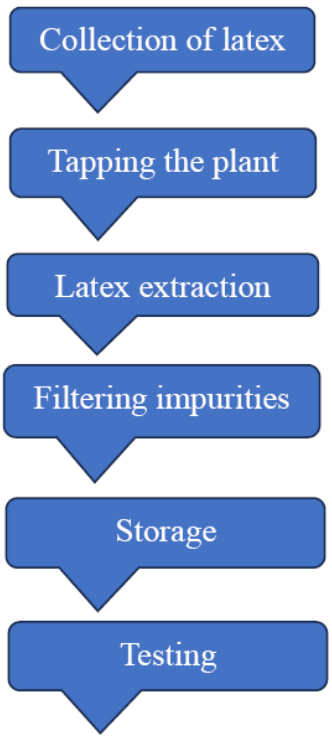


Figure: 6-Latex extraction process

Figure: 7-Latex extraction process

6. LATEX EXTRACTION PROCESS

6.1 Collection of latex: Locate healthy *Pergularia daemia* plants in their natural habitat or cultivated fields.

6.2 Tapping the Plant: Make small incisions or cuts on the stems and leaves where latex is abundant.

6.3 Latex Extraction: Allow the latex to ooze out and collect it using a small container or by scraping it from the surface.

6.4 Filtering Impurities: Strain the collected latex through a fine mesh to remove plant debris and other contaminants.

6.5 Storage: The latex is been stored by freeze method

6.6 Testing: The latex is been tested by direct method with IC50, which is said to be the Cytotoxicity text. It is texted with ethanol.

7. CONCENTRATION

Test name:
Cytotoxicity: Direct method with IC50

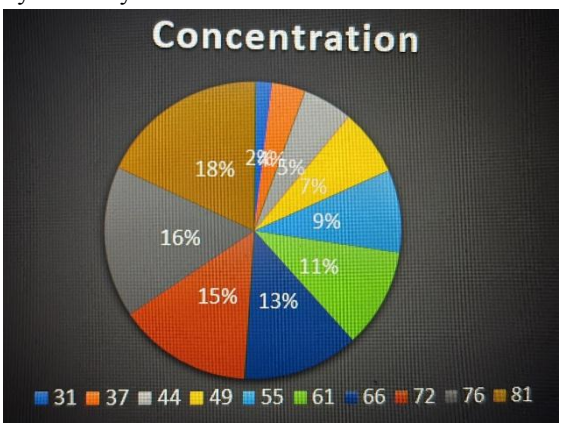


Figure: 8-Concentration

Inference: The given sample showed mild to severe cytotoxicity to L929 cells after 24hrs. The obtained IC50 value is 47.1µg. Control showed none cytotoxicity as expected.

8. RESULT

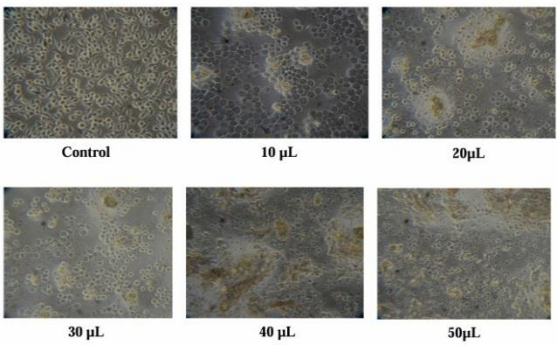


Figure: 9- Invitro Cytotoxicity with IC50 –MTT Method Cell line: L929 Cells

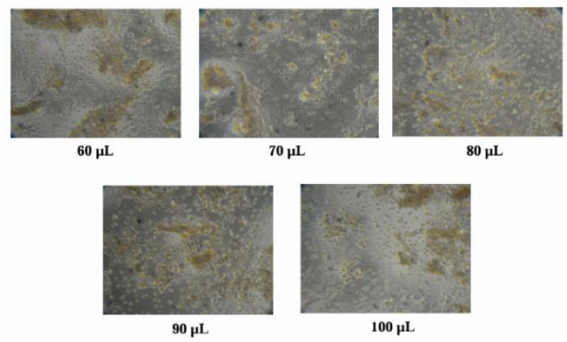


Figure: 10- Invitro Cytotoxicity with IC50 –MTT Method Cell line: L929 Cells

Test Name : Cytotoxicity: Direct Method with IC50

Test Details

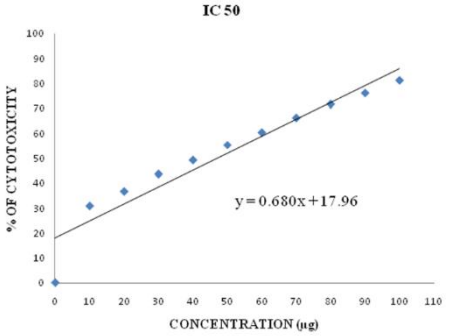
Source of cell line	: NCCS, Pune
Justification	: L929 is an established and well-characterized cell line that has demonstrated reproducible results
Culture media	: MEM medium supplemented with fetal bovine serum
Assay Method	: MTT Assay
Reagent	: MTT Solution (mg/ml)
Incubation	: 370C with 5% CO_2
Absorbance	: 570 nm
Imaging	: Inverted Phase Contrast Microscope
Analyst ID	: DS

Result :

Concentration	B2400199-1 Liquid: Apocynaceae			
	Cytotoxicity (%)	Cell Viability (%)	Cytotoxic Reactivity	With IC50 value
10	31	69	Mild	
20	37	63	Mild	
30	44	56	Mild	
40	49	51	Mild	47.1µg
50	55	45	Moderate	
60	61	39	Moderate	
70	66	34	Moderate	
80	72	28	Severe	
90	76	24	Severe	
100	81	19	Severe	

Inference : : The given sample showed Mild to Severe cytotoxicity to L929 cells after 24hrs. The obtained IC50 value is 47.1µg. Control showed None Cytotoxicity as expected.

Table: 1- Test result: Cytotoxicity: Direct method with IC50



Y= mx+C, From the above graph, Y=0.680x+ 17.96

IC_{50}= (50-C)/m

IC_{50}= 47.1µg

Figure: 11- Invitro Cytotoxicity with IC50 –MTT Method Cell line: L929 Cells

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