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PHYSICO-CHEMICAL ANALYSIS OF SHALMALI GLUE (A NOVEL PLANT-BASED BIO-ADHESIVE)- FOR WOUND HEALING

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ABSTRACT

The medicinal plants are widely used by the traditional medical practitioners to manage various diseases in their day-to-day practice. Shalmali is a well-known plant used in Ayurveda for the treatment of various wound healing. The therapeutic activity of Drug Shalmali is partly due to the presence of flavonoids, phenolics, sesquiterpenoids, shamimicin, bombamalosides, bombamalones, bombasin, bombasin 4-o-glucoside, and bombalin. In the present review, efforts have been made to recapitulate different aspects of scientific studies on the Shalmali such as ethnopharmacology, phytochemistry, and mainly the pharmacological activities.[1] The Shalmali Niryasa is astringent, cooling, stimulant, aphrodisiac, tonic, styptic and demulcent. It is useful in diarrhea, dysentery, hemoptysis of pulmonary tuberculosis, influenza, menorrhagia, burning sensation, strangury and hemorrhoids.[2] As per the composition of shalmali drug shows results in wound healing too. In an improved wound healing era to introduce shalmali glue (A Novel Plant-Based Bio-Adhesive) for most potent and convenient to utilize in wound healing process in day-to-day practice, this physico-chemical analytical study will contribute for scientific data and better applicability of shalmali glue in wound healing.

KEYWORDS: Plant-Based Bio-Adhesive, Shalmali Glue, Wound Healing.

INTRODUCTION

Shalmali is known by different names Bombaxmal baricum DC syn., Salmalia malabarica Schott. and Endl., and Bombax ceiba Linn. belong to the family Bombacaceae. as red cotton tree, Indian kapok tree (English), Shalmali (Sanskrit), semal (Hindi), shimul (Bengali), mullilavu (Malayalam), and kondabruga (Telugu) in different languages.[3] It is a deciduous tree attaining a height up to 40 meters and a girth up to 6 meter or more. In India, it is distributed throughout the hotter parts of the country up to 1500 meter or more.[4] Its young stem and branches are covered with stout and hard prickles, its leaves are large, spreading, glabrous, and digitate, leaf lets are 5-7, lanceolate, and 10-20 cm long, and its flowers are numerous, large, fleshy, bright crimson, yellow, or orange containing many seeds with long, dense, silky hairs.[5] According to Ayurveda, it has stimulant, astringent, hemostatic, aphrodisiac, diuretic, antidiarrheal, cardiotonic, emetic, demulcent, antidysenteric, and antipyretic properties.[6,7] The root of Shalmali is sweet, cooling, stimulant, restorative, astringent, aphrodisiac, demulcent, emetic, and tonic. It is used in the treatment of diarrhea, dysentery, menorrhagia, and for wounds. Shalmali Niryasa is cooling, astringent, stimulant, aphrodisiac, tonic, and demulcent in nature. It is useful in dysentery, hemoptysis and pulmonary tuberculosis, influenza, burning sensation, menorrhagia, and enteritis. Bark is mucilaginous, demulcent, emetic, and tonic. Flowers are astringent and good for skin disorders and hemorrhoids. Seeds are useful in treating gonorrhea and chronic cystitis. A paste made out of prickles is good for restoring skin color, especially applied on the face. Young fruits are useful in calculus affections, chronic inflammations, and ulceration of the bladder and kidney.[8]

In Ayurveda, wounds are described under the term "Vrana," as stated:

'व्रण' गात्रविचूर्णने, व्रणयतीति व्रणः | (सुश्रुतसंहिता -चिकित्सास्थानम् -द्विव्रणीयचिकित्सितम् १ /६)

This translates to the destruction, rupture, or discontinuity of body tissues being referred to as Vrana **(9).**

The wound healing process is fundamentally a connective tissue response. It begins with an acute inflammatory phase, followed by the synthesis of collagen and extracellular macromolecules. These elements are later remodeled to form a scar. Various factors, including diseases like diabetes and the use of certain medications such as antineoplastic drugs and antibiotics, can significantly affect this healing process.

RESEARCH GAP

As per previous study, Shalmali Niryasa (Mocha Rasa) has been proved for its efficacy in Abnormal uterine bleeding, Menstrual Disorders and for its Analgesic and anti-inflammatory effects.[10]

But its modification and use as a Surgical Glue in wound healing is not explored, few studies have been conducted on the wound healing effects of Shalmali Niryasa (Mocha Rasa).Considering its analgesic, anti-inflammatory effects, and gummy consistency, the present study aims to develop a surgical glue for incised wounds, potentially uncovering more therapeutic uses for Shalmali Niryasa (Mocha Rasa).

OBJECTIVES

1) To Introduce a Novel Plant-Based Bio-Adhesive (Shalmali Glue) For Wound Healing
2) To provide scientific data with physico-chemical analysis of shalmali glue

DRUG REVIEW

शाल्मलिस्तु भवेन्मोचा पिच्छिला पूरणीति च | रक्तपुष्पा स्थिरायुश्च कण्टकाढ्या च तूलिनी ||४५||

शाल्मली शीतला स्वाद्वी रसे पाके रसायनी | श्लेष्मला पित्तवातास्रहारिणी रक्तपित्तजित् ||४६||

(Bhavprakash Nighantu, Vatadi Varga-45-46)

Above shloka states that, shalmali, mocha, pichhila, purani, raktapushpa, sthiraayu, kantakadya and tulini are various synonyms of shalmali. This herb has sweet taste after digestion with cold potency. In ayurveda it is used as Rasayana and it used in pacification of Vata and pitta dosha. This herb is used to cure hemorrhoids and bleeding disorders.[11]

Table No 1: Botanical Analysis and Rasapanchak.

SHALMALI NIRYASA RASA-PANCHAKA	
Botanical Name	*Salmalia Malabarica*
Family	Bombacaceae
Rasa	Madhura, Kashaya
Guna	Laghu, Snigdha, Pichhil
Virya	Sheeta
Vipaka	Madhura
Karma	*Shothahara, Kaphavardhak, Vedanasthapana, Dahaprashamana, Grahi Vrishya Rasayani, Kashahar, Raktarodhak*

MATERIALS AND METHODS-for the preparation of shalmali glue

Material for Preparation of Shalmali Glue

1) ETHANOL
2) *SHALMALI NIRYASA*
3) PEG 600
4) GUARGUM

Method of Preparation of Shalmali Glue

- Identification & collection of Shalmali Niryasa
- Authentication of drug
- Salmalia malabarica niryasa was taken. *Niryasa* soaked in Ethyl Alcohol and water {60:40}and filtered it after 7 days
- The filtrate is mixed with 2% of Guargum and 6-Drops of PEG 600 & Mixture processed in homogenizer for 6 hours to ensure proper homogenization
- Then mixture is kept stagnant for 48hrs to get glue like consistency and poured in air tight glass container

Optimized Ratio: After extensive trials, a {60 Ethanol:40 Distilled Water} ratio was finalized for *Shalmali glue* preparation.

PHYSICO-CHEMICAL ANALYSIS OF SHALMALI GLUE

MATERIALS AND METHODS

Material – The materials required for Physico-chemical analysis were collected from xxxx Laboratory**.**

Methods

1- Organoleptic characters

2- Chemical Analysis - pH Value

- Specific gravity

- Refractive index

- Ash value (% w/w)

- Acid insoluble ash(%w/w)

- Phytochemical components

3- HPTLC- HIGH PERFORMANCE THIN LAYER CHROMATOGRAPHY

RESULTS

OBSERVATIONS ON ANALYTICAL STUDY OF SHALMALI GLUE

Table no. 2: Organoleptic Study Result.

Color	Golden Brown
Oduor	Alcoholic
Consistency	Semi Liquid (Glue Form)

PHYSICO-CHEMICAL

Table no. 3: Showing Physio-chemical Study Result.

Sr.no	PARAMETER	VALUE
1	pH Value	5.5
2	Specific gravity	0.9234
3	Refractive index	1.4010
4	Ash value (% w/w)	0.2340
5	Acid insoluble ash(%w/w)	0.1450

HIGH-PERFORMANCE THIN LAYER CHROMATOGRAPHY (HPTLC) OF SHALMALI GLUE

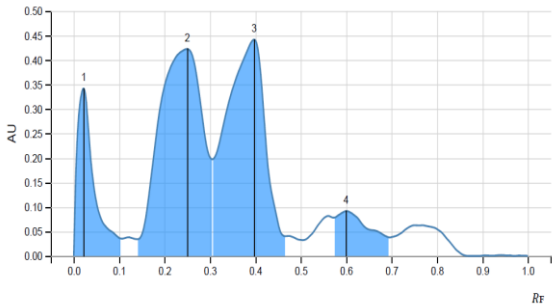


Figure 1: Densitometric scan and Chromatograph at UV 254 nm visualisation and 10.0µL sample concentration.

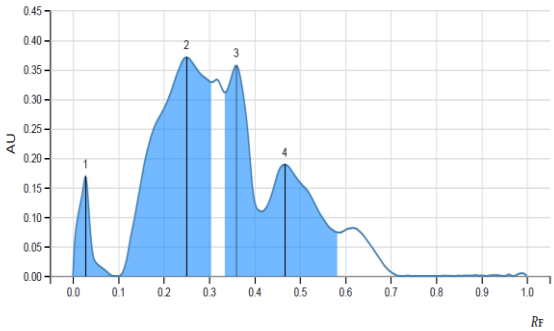


Figure 2: Densitometric scan and Chromatograph at UV 254 nm visualisation and 20.0µL sample concentration.

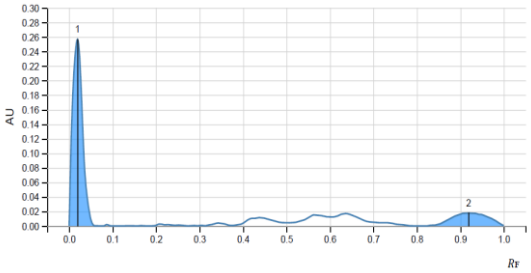


Figure 3: Densitometric scan and Chromatograph at UV 366 nm visualisation and 10.0µL sample concentration.

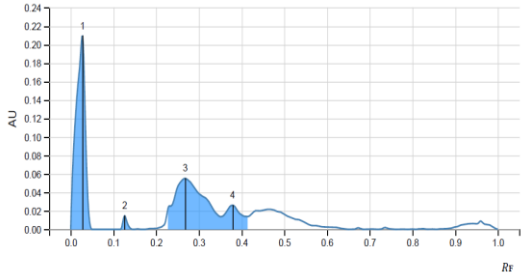


Figure 4: Densitometric scan and Chromatograph at UV 366 nm visualisation and 20.0µL sample concentration.

Table no. 4: Show values with active pharmacological activity.

Rf value	Phytochemical	Pharmacological activity
0.25	Terpenoid	Anti-bacterial, Anti-inflammatory
0.36	Galactose	Increase in granulation tissue
0.46	Glucoronic acid	Proliferation of keratinocytes and fibroblasts
0.39	Gallic acid	Anti-bacterial, Anti-inflammatory, Antioxidant

The HPTLC analysis of *Shalmali glue* has provided a detailed insight into its phytochemical composition, revealing significant compounds that play crucial roles in its therapeutic effects, particularly in wound healing.

DISCUSSION

Shalmali glue as innovative herbal formulation for wound healing which supported by physico-chemical analysis observations and result.

The pH of a wound environment is crucial for healing. Betadine, with a pH of approximately 4.5, is effective in reducing bacterial contamination due to its acidic nature, which inhibits pathogen growth. However, this lower pH may not always support the optimal enzymatic activity needed for tissue regeneration.

In contrast, Shalmali glue, with a pH of 5.5, is closer to the skin's natural pH, promoting a more conducive environment for wound healing. This balanced pH supports enzyme activity essential for tissue repair and maintains skin integrity, potentially leading to faster and less inflammatory healing compared to Betadine.

Therefore, Shalmali glue offers a promising alternative for wound care, combining antimicrobial effectiveness with a pH that supports natural healing processes.

The HPTLC analysis of Shalmali glue has provided a detailed insight into its phytochemical composition, revealing significant compounds that play crucial roles in its therapeutic effects, particularly in wound healing. This discussion will focus on the key findings from the HPTLC report, the identified compounds, their pharmacological activities, and how these contribute to the glue's mode of action. (All with refraction value +_0.02).

The result of HPTLC of Shalmali glue contain important phytochemicals at specific Rf values, each corresponding to a known bioactive compound with distinct pharmacological activities.

CONCLUSION

Shalmali Glue an innovative ayurvedic herbal formulation that provide tremendous results on wound healing. There is no active herbal ayurvedic formulation available in the market8 which had glue like consistency and simultaneously wound healing property. Physio-chemical study shows pH value nearer to skin adaptation that means its non-irritant on skin surface as applied for healing purpose. HPTLC result shows, active phytochemical in shalmali glue as Terpenoid, Galactose, Glucuronic acid and Gallic acid which provide healing effect. After all this study results and ancient manuscript indicate shalmali as valuable plant with multi-therapeutic effect like *Shothahara, Vedanasthapana, Dahaprashamana, Grahi Vrishya Rasayani, Kashahar, Raktastabhaka* and Ropana (wound healing). Herbal formulation shalmali glue may be considered as A Novel Plant-Based Bio-Adhesive , actively involve surgical era of modern wound healing.

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