WORLD JOURNAL OF PHARMACEUTICAL RESEARCH
SJIF Impact Factor 8.453
Volume 14, Issue 2, 350-363. Review Article ISSN 2277–7105

A REVIEW ON GEL FORMATION OF TECTONA GRANDIS ETHANOL EXTRACT MECHANISMS AND APPLICATION

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Article Received on
26 November 2024,

Revised on 16 Dec. 2024,
Published on 15 Jan. 2025

DOI: 10.20959/wjpr20252-35244

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ABSTRACT

Tectona Grandis (Teak) locally known as Sagwan, belongs to Lamiaceae family, is one of the most valuable timber plant. In the world which is a local to south and southest Asia and is renowned for it's dimensional stability. Tectona grandis (Sakha) has been widely used medicine is Ayurveda. The chemical constituents plant belong to different classes such as tannins, proteins, fatty acids, steroidal compound, resins, lapachol, flavonoids, glycosides volatile oil & terpenoids etc, has been reported. The different part of plants have been scientifically evaluated for their antioxidant, antipyretic, analgesic, hypoglycaemia, wound healing, cytotoxic and many more biological activities.[1] Teak has been explored for it's mechanical and industrial applications. The ethanol extract of tectona grandis has shown remarkable gel formation properties, making it a promising material for various use.[2] This review examine the gel formation properties of ethanol extract leaves of tectona grandis (Teak), focusing on the underlying mechanisms and potential applications. The gel demonstrates promising application in pharmaceutical serving a drug delivery system in cosmetics offering moisturizer and soothing benefits and the food industry active as a natural thickening agent.[3] The review aims to summarize the current understanding of the gel formation, mechanism chemical composition and potential application of Tectona Grandis ethanol extract. The Marketed product of Tectona grandis scar gel is Nemus scar gel. It's applicable as scar removal, acne, wound healing, burn scar.[4]

KEYWORDS: Tectona grandis, phytochemical profile, Biological activities, ethanol extract, applications.

INTRODUCTION

Tectona grandis, commonly known as teak, is a large deciduous tree native to Southeast Asia, particularly found in countries like India, Myanmar, Thailand, and Indonesia. Teak is highly regarded for its dense, durable wood, which is naturally resistant to decay and insect damage, making it ideal for outdoor furniture, flooring, and shipbuilding. Tectona grandis is a large deciduous tree. Branchlets are quadrangular, channelled and stellately, Tomentose. The tree is growing in higher situations, Teak is a hardwood species of worldwide Reputation. Tree 30-35 metre tall with light brown bark, leaves simple, opposite, broadly Elliptical or acute or acuminate, with minute glandular dots The leaves of the tree are quite large, measuring 30-40 cm by 15-30 cm, and are shaped like ovals or obovate with pointed tips. Teak trees thrive in well-drained, fertile soils and are typically found in warm, tropical climates. They can reach impressive heights, often exceeding 30 meters, and have large, heart-shaped leaves that contribute to their ecological significance. Sustainable forestry practices have become increasingly important for teak cultivation, ensuring that this valuable resource is managed responsible.[5]

Fig. Tectona grandis.

The upper side of the leaves is rough and smooth, while the underside is covered in dense, soft hairs. The tree sheds its large leaves for about 3-4 months during the dry season, leaving the branches bare, flowers are white in colour, small And have a pleasant smell The flowers of Tectona grandis are small, about 8 mm wide, and can be mauve or white. They grow in large clusters on the top branches of the tree. The fruits are round and measure 1-3 cm in diameter. They have a soft outer layer covered in fine hairs and are considered drupes, which means they have a hard, woody center with four chambers. Initially pale green, the fruits turn brown when they are fully ripe.

- **Height:**-Teak trees can grow up to 40 meters (About 130 feet) tall.

- **Lifespan:**-They can live for over a century, contributing to their value as a longterm resource.
- **Wood quality:-**Teak wood is known for its rich golden-brown color, straight grain, and high oil Lifespan, which enhances its durability and aesthetic appeal.

Teak trees can grow up to 40 meters tall and can live for over a century, making them a significant resource in forestry and agriculture.

Fig. Tectona Grandis (Leaf).

❖ **Traditional use**

In addition to its economic value, Tectona grandis has a rich history in traditional medicine. Various parts of the tree such as the leaves, bark, and roots are utilized for their therapeutic properties. Common traditional uses include:

1. **Wound healing:**-The antiseptic properties of the bark and leaves make them useful in treating cuts and skin infections.
2. **Anti-inflammatory:**-Extracts from Tectona grandis are often employed to alleviate inflammation and pain in conditions like arthritis.
3. **Digestive health:**-Infusions from the leaves are traditionally used to aid digestion and treat gastrointestinal disorders.
4. **Fever reduction:**-The leaves are also used in traditional remedies for lowering fevers and managing symptoms of malaria.
5. **Skin care:**-The extracts are applied topically to promote skin health, addressing issues like acne and eczema.

❖ **Morphology**[7,8]

A) Leaves

- **Colour:**- Green, Grayish green.

- **Size:**- 30-60 by15-30 cm. In seedling often long
- **Shape:**- Elliptic or obovte, acuminate
- **Apex:**- Acute
- **Surface:**- Upper surface is rough but usually glabrous,
- **Lower surface:**- Clothed with dense stellate
- **Margin:**- Entire tawny to mentum
- **Base:**- Cuneate
- **Veinnation**:- 8-10 pairs of coarse vein 2 or 3 large branges
- **Petiole**:-present

B) Flowers

- **Size:**- Small and numerous
- **Type:**-Bisexual and often zygomorphic
- **Arrangement:**- Erect terminal lanceolate bracts the forks
- **Bracts beneath calyx:**- 2.5mm long
- **Calyx:**-3mm long panulate
- **Corolla:**- white, imbricate, tube short glabrous 5-6 lobed Androecium (stamen) :-5-6.
- **Gynoeciun:**-Superior ovary.

C) Fruits

- Size:-1.3cm diameter
- Surface:-Subgloubose
- Type:-4 lobed, the pericarb soft with dense felted stellate hairs
- Endocarp:-Bony

D) Seed

- Erect, oblong

❖ **Taxonomical classification**[9,10]

Kingdom	Plantae – Plants
Subkingdom	Tracheobionta – Vascular Plant
Super division	

Division Class Subclass	Spermatophyta - Seed Plants Magnoliophyta - Flowering Plants Magnoliopsida - Dicotyledons Astridae.
Order	Lamiales
Family	Verbenaceae – Verbena family
Genus	Tectona Leaf. – Tectona
Species	Tectona grandis Leaf. –Teak

❖ **Pharmacological activity**

A) Wound healing activities[11]

This study aimed to evaluate the wound healing effects of hydrochloric extract of Tectona grandis on wounds induced in rats, comparing its effectiveness to Aloe vera, a well-known healing agent. Various wound models were used, including excision, incision, burn, and dead space wounds.

1. Wound models

- Excision and Burn wounds:- Rats treated with tectona grandis leaf extract showed a significant reduction in the time needed for healing and skin closure (epithelization).
- Incision wound:- There was a notable increase in the breaking strength of the wounds, indicating improved healing.
- Dead space wound:- Oral treatment with T. grandis extract significantly increased the breaking strength, dry weight, and hydroxyproline content of the healing tissue.

2. Formulation

A gel formulation (5% and 10%) of T. grandis extract was applied topically, while oral doses of 250 and 500 mg/kg body weight were administered.

Mechanisms of action

a) Epithelialization:- Tectona grandis extracts promote faster skin regeneration and closure of wounds.

b) Anti-inflammatory Effects:-The extract may reduce inflammation, which can enhance the healing process.

c) Antimicrobial Properties:-The extracts can inhibit bacterial growth, reducing the risk of infection.

➢ **Antioxidant activity**

The antioxidant activity of different parts of the T. grandis Linn. Tree, including its leaves, bark, and wood, was tested using various solvent extracts (hexane, chloroform, ethyl acetate,

and methanol). Two methods were used to measure this activity: DPPH and ABTS+ free radical scavenging tests. Among these, the ethyl acetate extract from the wood showed remarkable effectiveness, achieving a 98.6% inhibition of both DPPH and ABTS+ free radicals .This indicates that this extract is very good at neutralizing harmful free radicals. Additionally, another study focused on the antioxidant properties of T. grandis Linn. Using crude ethanol extracts. This included testing its ability to scavenge hydrogen peroxide (H2O2), as well as using the DPPH method and the FRAP assay. These tests confirmed the potential of T. grandis Linn. For antioxidant activity. Furthermore, another study investigated the antioxidant effects of Tectona grandis Linn. Leaf extracts through four different laboratory tests. These tests measured total phenolic content, reducing power, superoxide radical scavenging activity, and the ability to inhibit H2O2-induced damage to red blood cells. The findings aimed to highlight the plant's potential benefits both as a food source and in medicinal applications. Overall, T. grandis Linn. Shows strong antioxidant activity, making it valuable for both health and culinary uses. Tectona grandis contains various phytochemicals, such as flavonoids and phenolic compounds, which have antioxidant effects. Antioxidants neutralize free radicals—unstable molecules that can damage cells and accelerate aging. By combating oxidative stress, the gel helps protect skin cells, promoting a healthier appearance and potentially slowing down signs of aging like wrinkles and fine lines.[12]

- **Anti-inflammatory activity**

The ethanolic extract of Tectona grandis leaves has shown promising anti inflammatory activities. When applied as a gel, it can help reduce swelling and inflammation in the body.

Studies suggest that this extract works by blocking certain chemicals in the body that cause inflammation. This makes it useful for treating conditions like arthritis or injuries where swelling occurs.

In tests, the gel was effective in reducing inflammation quickly and lasted for a good amount of time. Overall, Tectona grandis leaf gel could be a helpful natural option for managing inflammation and associated. The gel has powerful anti-inflammatory properties. It works by inhibiting the production of pro-inflammatory cytokines and enzymes, which are responsible for swelling, redness, and pain. This makes it effective for conditions such as arthritis, muscle soreness, and skin irritations. When applied topically, it can quickly reduce inflammation in the affected areas.[13]

➢ **Cytotoxic activities**

Regarding cytotoxic activities, studies have indicated that tectona grandis extracts may possess bioactive compounds that can exert cytotoxic effects on certain cancer cell lines. The cytotoxicity can be attributed to the presence of phenolic compounds, flavonoids, and tannins, which may induce apoptosis or inhibit cell. Mechanism:-

1. Induction of apoptosis:-Compounds such as phenolics and flavonoids can trigger apoptosis in cancer cells by activating intrinsic pathways, leading to cell death.
2. Cell cycle arrest:- Bioactive compounds may interfere with cell cycle regulation, causing arrest at specific phases (e.g., G1 or G2/M phase), inhibiting proliferation.
3. Reactive Oxygen Species (ROS) Generation:- These compounds can increase oxidative stress within cells, leading to cellular damage and apoptosis.
4. Inhibition of key enzymes:- Some phytochemicals may inhibit enzymes that are critical for cancer cell survival.[14]

❖ **Chemical constituents[15,16,17,18,19,20]**

Phytochemicals like alkaloids, glycosides, saponins, steroids, flavonoids, Phenolic compound's, Terpenoids Fatty, Fatty acids, volatile oils, Proteins and carbohydrates have been reported in Tectona grandis (Sakha).

Quinones	Tectoquinone, lapchol, deoxylapachol and its isomer, tectoleafoquinone, anthraquinonoid – naphthoquinone pigment.
Steroidal compound	betulinic acid, tecto grandone, monoterpene, Apocarotenoids: Tectoionols-A, Tectoionols- B.
Glycosides	Anthraquinone glycosides, Apocarotenoids: tectoionols A and B
Phenolic acids	Tannic acid, Gallic acid, Ferulic acid, Caffeic acid and ellagic acid
Alkaloids	Quinones: 9,10-dimethoxy-2-methyl anthra-1,4- quinone. 1,4- anthraquinone, tectoquinone, lapachol, dehydro-a-lapachone, 1. tecomaquinone. Naphthoquinone and anthraquinone derivatives Naphthotectone and anthratectone
Phenolic Compound's	Tectoquinone, Lapachol, Deoxylapachol, Tecomin, Tectol, Quercetin, kaempferol.
Terpenoids	a-Terpinene, B-Terpinene, Y terpinene, Limonen, caryophy llene.
Flavonoids	Luteolin, Naringenin, Apigenin, chryseiol.
Glycosides	Tectoside, Quercetin -3-0- glycoside.
Fatty acids	Oleic acid, Linoleic acid, palmitic acid, stearic acid.
Volatile oils	Terpinolene, Limonene.

These chemical constituents contribute to teactona grandis (teak). The phenolic compounds, Flavonoids, and alkaloids these three chemical constituents have the highest efficacy & potency for **wound healing** and **scar** treatment.

These are the

1. Broad spectrum antimicrobial activity.
2. Powerful anti-inflammatory and antioxidant property.
3. Stimulate collagen synthesis and skin regeneration.
4. Wound healing and tissue Sodepair.
5. Improve the skin texture and appearance.

The Tectoquinone, Quercetin and Lapchol are the most effective constituents of the tectona grandis for scar and wound healing treatment making it excellent and natural remedy for,

- Acne scar
- Surgical scar
- Burn scar
- Wound scar
- Hyperpigmentation
- Dryness
- Swelling
- Wound healing
- Skin rash
- Sunburn

Formation no. 1

❖ **MATERIAL AND METHOD**[21,22]

➢ **Chemicals:-** Plant extract, Agar-Agar, Glycerine, Jasmin oil, Alo Vera gel, citric acid, Sodium sulphate, Distilled water.

➢ **Formulation table**

Sr. No.	Name of ingredients	G1(ml)	G2(ml)	G3(ml)	G4(ml)
1	Plant extract	1	2	3	6
2	Agar-Agar	2.5	3	6	12

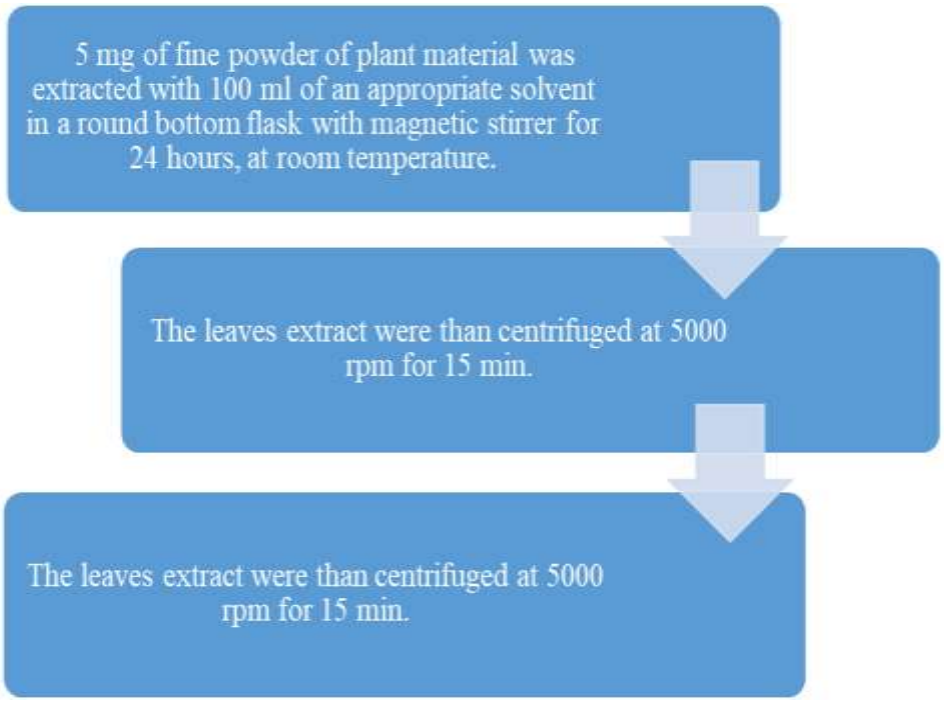
3	Glycerine	25	25	50	100
4	Jasmin oil	2.5	3	6	12
5	Aloe vera gel	1.5	2	4	8
6	Citric acid	1	1.5	3	6
7	Sodium sulphate	0.5	1	2	4
8	Dist. Water	Q. S	Q. S	Q. S	Q. S

- **Procedure**

1. Collection of plant material

Tectona grandis (sakha) leaves were collected, the collected leaves were washed thoroughly under running water and air dried for few minutes. The fresh leaves immediately extract with solvents.

2. Extraction preparation



3. Solvent

Ethanol used as solvent for extraction.

4. Formulation of gel

Take weighed amount of agar- agar and soak in the water for half hours. Then the mixture was kept in a hot air oven at 100°c for 30 min with stirring. The mixture is stirred for 10-15 min to avoid air bubbles with glass rod and kept side for 30 min. Than add weight amount sodium sulphate, Glycerine and heat on water bath and aloe vera gel, Jasmin oil, & plant extract continuously stir up to the homogenous mass is formed. Finally remaining quantity of

water was added with citric acid to neutralize PH. Prepared gel was filled in glass container & stored at cool & dry place.

Formation No. 2

MATERIALS AND METHODS

Chemicals:- Plant's extract, Gum tragacanth, Glycerin, Ethanol, Triethanolamine q.s, Dist. Water.

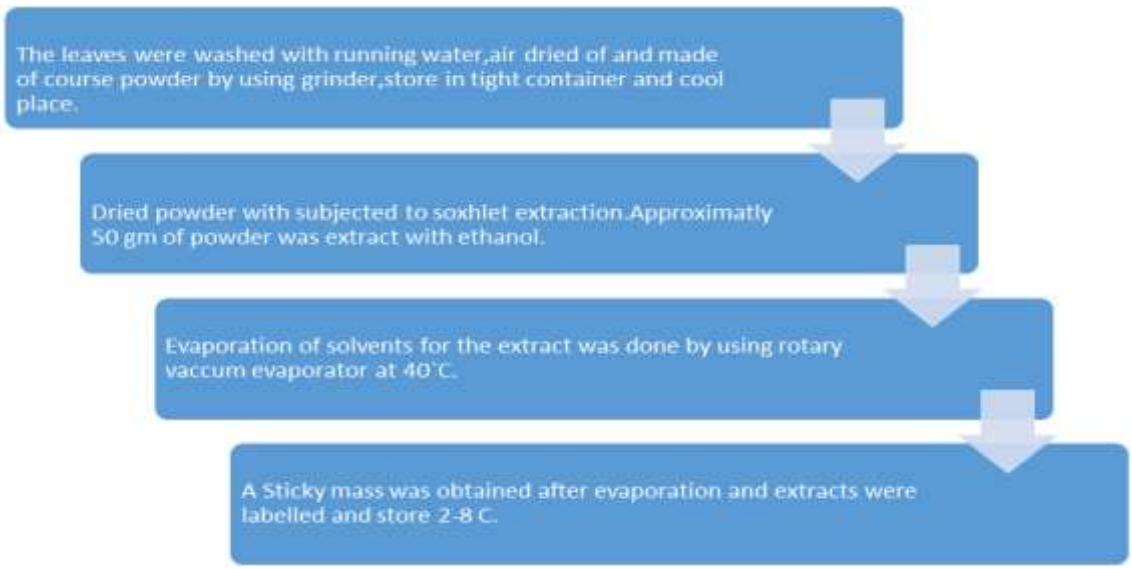
Sr. No	Ingridients	Formula
1	Extract of frontal leaves of Tectona grandis	5.00 g
2	Extract of Mangifera indica leaves	5.00 g
3	Extract of Anacardium occidentale leaves	5.00 g
4	Gum Tragacanth	2.00 g
5	Glycerin	2.00 ml
6	Ethanol	5.00ml
7	Triethanolamine q.s	To neutralize the gel base
8.	Dist.Water	Q.S

Procedure

1. Collection of plant material

Tectona grandis (Sakha) leaves Mangifera indica leaves & Anacardium occidentale leaves were collected, the collected leaves were washed thoroughly under running water and air dried for few minutes. The fresh leaves immediately extract with solvents.

2. Extraction preparation



3. Solvent

Ethanol used as solvent for extraction.

Formulation of gel

Gum Tragacanth, 2 g was soaked in water for a period of 2 hours and was then neutralized with triethanolamine (TEA) with stirring. 5 g of extracts were dissolved in 2 g of Glycerin and 5 ml of ethanol. Solvent blend was transferred to gum tragacanth container and agitated for additional 20 min. The dispersion was then allowed to hydrate and swell for 60 min, finally adjusted the pH with 98% TEA until the desired pH value was approximately reached (6.8-7.0). During PH adjustment, the mixture was stirred gently with a spatula until homogeneous gel was formed. Prepare gel was filled in glass container & store At cool &dry place.

❖ **Uses**[24]

1. Wound healing and hydration.
2. Reduce scar size and appearance.
3. Improve the skin texture & elasticity.
4. Protect wound healing and tissue repair.
5. Minimize inflammation and infection.
6. Improve skin tone.
7. Remove scars.
8. Protect Hyperpigmantation.
9. Acne
10. Skin rash.

❖ **Advantages**[25]

1. Easy to apply.
2. Low cost.
3. Sustainble and eco-friendly.
4. Natural and non-invensive
5. Clinically proven.

❖ **Disadvantages**

1. Stability issue’s
2. Potential skin reaction.
3. Skin irritation.

❖ **Warning**

1. Avoids sensitive skin areas.
2. Eye exposure.

3. Ingestion risk.

❖ CONCLUSION

The study of gel formation from Tectona grandis (Teak) ethanol extract reveals its potential for various applications, particularly in pharmaceuticals and cosmetics. The mechanisms behind the gel formation involve the interaction of the extract's compounds, which can create a stable matrix when mixed with specific agents. These gels can serve as effective delivery systems for active ingredients, improving their stability and bioavailability. Additionally, the natural properties of Tectona grandis offer advantages like biodegradability and reduced toxicity, making it an appealing choice for environmentally friendly products. sustainability.

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