



## Formulation and Evaluation of Herbal Gel of Ficus Racemosa for Wound Healing Activity

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### Keywords

### ABSTRACT:

Herbal medicines are still the basis of about 75-80% of the world's population, mainly in developing countries, for primary health care because of better cultural acceptability, better compatibility with human body and lesser side effects. Herbal medicines consist of plant or its part to treat injuries, disease or illnesses and are used to prevent and ailments or to promote health and healing. Herbal medicines are the oldest form of health care known to mankind. In the present study, medicinal plant *Ficus racemosa* Linn. syn. *Ficus Glomerata* Roxb. (Family - Moraceae) having significant wound healing & anti-inflammatory potential were selected to be formulated as Herbal gels. *Ficus racemosa* is generally known as Gular, Gular fig, Cluster fig or Country fig. The gel was prepared using the dried aqueous extract of *Ficus racemosa*. Herbal gel formulation was evaluated for its pH, appearance and homogeneity, viscosity, spreadability and skin irritation study. This gel is also useful for the treatment of local inflammation. The primary goal to understand of all aspects of herbal gel containing extract of *Ficus racemosa*.

### INTRODUCTION TO HERBAL MEDICINES

The demands of herbal medicines are increasing because their potent pharmacological activity and economical values have been proving to be beneficial for the people. However, a lot of research is necessary to standardize and validate Ayurveda medicines for their potency, safety, and efficacy. Ever since the birth of mankind of there has been a relationship between life, disease and plants. There is no record that people in prehistoric times used synthetic medicines for their ailments but they tried to make use of the things they could easily procure. The most common thing they could find was there in environment i.e. the plants and animals.

World Health Organization (WHO) has defined herbal medicines are finished, labeled medicinal products that contain active ingredients, aerial or underground parts of the plants or other plant material or combination. Herbal formulations have reached wide spread acceptability as therapeutic agents like anti-microbial,

anti-diabetic, anti-ageing, anti-arthritic, anti-depressant, anti-anxiety, anti-inflammatory, anti-HIV, treatment of cirrhosis, asthma, migraine, Alzheimer's disease and memory enhancing activities. [1]

### SKIN

The skin or cutaneous membrane is the outermost layer which covers and protects the surface of the body from external environment. The pH of the skin varies from 4 to 5.6 and refers to the pH of the film of aqueous and soluble material present on the surface of the skin. The most important physiological function of the skin is protection against various forms of noxious stimuli including physical and chemical trauma, micro-organisms and radiation. The skin is one of the complex and largest organ of the body and comprises approximately 16% of the human body weight. The skin is continuous with the membranes lining the body orifices and in certain areas contains accessory structures such as glands, hair and nails. [2]



## ANATOMY AND PHYSIOLOGY OF SKIN

The skin is the largest organ of the body and has a surface area of about 1.5-2 square meters in adults. The skin protects us from microbes and the elements, regulation of body temperature, and permits the sensations of touch, heat, and cold.

### Skin has three layers:-

- **Epidermis** :- The outermost layer of skin, provides a waterproof barrier and creates our skin tone.

### FUNCTIONS OF SKIN

- ✓ Protection :-  
The skin forms a relatively waterproof layer, provided mainly by its keratinized epithelium, which protects the deeper and more delicate structures.

- ✓ It acts as a barrier against :-

- Sodium chloride in sweat; excess sweating may lead to low blood sodium levels (hypernatremia)
- Aromatic substances, e.g. Garlic and other spices

It serve as the medium of sensation, including tactile sensation touch, pressure, vibration and tickling as well as thermal sensation such as warmth and coolness and also sensation of pain.

- ✓ It helps in maintaining water and electrolyte balance.
- ✓ Heat loss through the skin is affected by the difference between body and environmental temperatures, the amount of the body surface exposed and the type of clothes worn.
- ✓ It controls and regulates the body temperature.
- ✓ It regulates blood flow through skin.
- ✓ Formation of vitamin D-7-dehydrocholesterol is a lipid-based substance in the skin, and ultraviolet rays in sunlight convert it to vitamin D. This circulates in the blood and is used, with calcium and phosphate, in the formation and maintenance of bone.
- ✓ It secretes sweat and sebum which keep the skin soft.
- ✓ It stores fat, water, chlorides and sugar.[3]

### HERBAL GEL

#### Definitions of gel :-

1. The **I.P.** defines Gels are homogeneous, semisolid preparations usually consisting of solutions or dispersions of one or more medicaments in suitable hydrophilic or hydrophobic bases.
2. As per the definition of **U.S.P.** Gels as a semisolid system consisting of dispersion made up of either small inorganic particle or large organic molecule

- **Dermis** :- Beneath the epidermis, contains tough connective tissue, hair follicles, and sweat glands.
- **Subcutaneous tissue (Hypodermis)** :- It is made of fat and connective tissue.

The skin's color is created by special cells called melanocytes, which produce the pigment melanin. Melanocytes are located in the epidermis.

- Invasion by micro-organisms
- Chemicals
- Physical agents, e.g. Mild trauma, ultraviolet light
- Dehydration.

- ✓ Excretion:-

The skin is a minor excretory organ for some substances including:

enclosing and interpenetrated by liquid. Gels consist of two-phase system in which inorganic particles are not dissolved but merely dispersed throughout the continuous phase and large organic particles are dissolved in the continuous phase, randomly coiled in the flexible chains. Gels are typically formed from a liquid phase that has been thickened with other components. They are normally prepared with the aid of suitable gelling agents like HPMC, Carbopol

3. and Sodium CMC etc. Substances such as antioxidants, stabilizers and antimicrobial preservatives are used as additives in the formulation of gels.

Topical gel formulations provide suitable delivery system for drugs because they are less greasy and can be easily removed from the skin. They are intended to be applied to the skin or certain mucous membranes for protective, prophylactic or therapeutic purposes. There are few dermatological inflammatory conditions and wounds where gel formation of could be helpful.[4]

#### ❖ Ideal properties of Herbal gel

- ✓ Smooth texture
- ✓ Non dehydrating
- ✓ Non greasy
- ✓ Semi solid in nature
- ✓ Non irritating
- ✓ Do not alter membrane / skin functioning.

#### ❖ ADVANTAGES

- Gels are used to achieve optimal cutaneous and percutaneous drug delivery.
- They can avoid gastrointestinal drug absorption



- difficulties caused by gastrointestinal pH.
- Gels are having property to avoid enzymatic activity and drug interaction with food and drinks. They can substitute for oral administration of medication when the route is unsuitable.
  - They are applied over skin for slow and prolonged absorption.
  - They have localized effect with minimum side effects. [5]
  -

### FICUS RACEMOSA

*Ficus racemosa* (Linn) is a moderate sized avenue plant, belongs to family- Moraceae which is usually known as the Cluster Fig Tree, Indian Fig Tree or Goolar (Gular) Fig. This plant is native to Australia, Malaysia, South-East Asia and the Indian Subcontinent. *Ficus racemosa* grows all over India in several forests and hilly areas. It is frequently available around the water streams and is

also cultivated. Found along the river banks and inland forests from plains to 1500 m most frequently in India, Sri Lanka, Pakistan, Queensland and South China to New Guinea. The plant can be grown by vegetative as well as sexual propagation (using seeds) [6].

*Ficus racemosa* Linn (Moraceae) is an evergreen, moderate to large sized spreading, lactiferous, deciduous tree, without much prominent aerial roots. Udumbara is considered scared to god Dattaguru. All ficus species possess latex-like material within their vasculatures that provide defense and self-healing from physical assaults. This plant is universally used in traditional system of medicine for the treatment of numerous disorders. It is one of the herbs mentioned in all ancient scriptures of Ayurveda, Siddha, Unani and Homeopathy. Various plant parts such as bark, root, leaf, fruits and latex are used as astringent, vermifuge, carminative and anti-dysentery. It is used locally to relieve inflammation of lymphadenitis, fibrositis, skin wounds and in sprains.[7]

**Table 1:** Taxonomic Position Of *Ficus Racemosa* Linn

<b>Kingdom</b>	<b>Plantae</b>
<b>Division</b>	<b>Magnoliophyta</b>
<b>Class</b>	<b>Magnoliopsida</b>
<b>Family</b>	<b>Moraceae</b>
<b>Genus</b>	<b>Ficus</b>
<b>Species</b>	<b>Racemosa</b>
<b>Synonyms</b>	<b><i>Ficus glomerata</i> Roxi</b>

**Fig 1 :** *Ficus Racemosa*





## CHEMICAL CONSTITUENTS

SR NO.	PARTS OF PLANT	CHEMICAL CONSTITUENTS
1	<b>Roots</b>	Euphorbol, Hexacosanoate, tinyatonin, taraxerone
2	<b>Stems</b>	Taxaxerone, leucoanthocyanins, $\beta$ -sitosterol, Dumarin, [14] sterols such as $\beta$ -sitosterol, stigmasterol, $\alpha$ -amyrin acetate, lupeol, and lupeol acetate and tannins (ellagic acid)
3	<b>Leaves</b>	Racemosic acid, tetraterpene, triterpenoids basically lanosterol, alkaloids, Gluanol acetate, flavonoids and tannins
4	<b>Fruits</b>	Lupeol acetate, $\beta$ -sitosterol, glauanol, higher hydrocarbons, glucose, hentrio acontane, tiglic acid, phytosterol, esters of taraxasterol
5	<b>Latex</b>	Euphol, $\alpha$ - amyrin, trimethyl ellagic acid, euphorbinol, isoeuphorbol, tinyatonin, taraxerol, cycloartenol, $\beta$ -sitosterol, palmitic acid, 4-deoxyphorbol, [8,9]

**Table 2 :** Chemical Constituents Of Ficus Racemosa Plant

## APPLICATIONS

### For skin :-

- The stem of audumbar tree is proved to have healing power.
- Gives anti oxidative and anti-collagenase effect on wrinkled skin and reduce the wrinkled depth.
- Rejuvenates the skin and make skin soft and supple.

### For Hair :-

- Leaf juice is massaged on hair to prevent splitting .
- Extracts are useful in formulation of amazing hair conditioners.

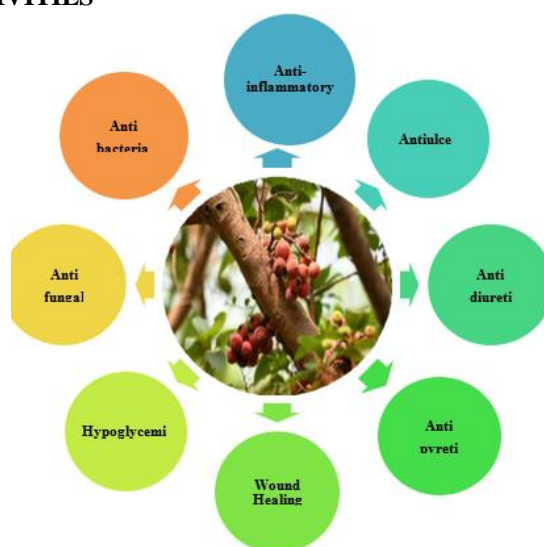
### Others Uses :-

- The roots are well known for its use in the treatment

of hydrophobia.

- Leaf latex is basically used for boils and blisters and measles.
- Bronchitis, bowel syndrome, and piles can be treated with leaves, in the Unani system of Medicine.
- A mixture of leaves powdered along with honey is used in bilious infections .
- The Decoction of the leaves is used in wound washing and healing.
- The latex is externally applied on wounds in the treatment to decrease inflammation, pain, and edema, and promote its healing.
- Latex is also used with sugar to reduce diarrhea and dysentery, especially in children, and improves the sexual power in males. [10,11]

## PHARMACOLOGICAL ACTIVITIES



**Fig 2 :** Pharmacological Activities Of Ficus Racemosa



## MAINLY WOUND HEALING AND ANTI-INFLAMMATORY PROPERTY WOUND HEALING

*Ficus racemosa* possesses a definite potential healing action. Aqueous extract of leaves of the plant *F. racemosa* showed significant increase in percentage closure by enhanced epithelialization. The wound repair process has three orderly but temporally overlaid stages *i.e.* inflammation, cell proliferation and tissue regeneration. Wound healing is a process which is fundamentally a connective tissue response. Initial stage of this process involves an acute inflammatory phases followed by synthesis of collagen and other extracellular macromolecules which are later remolded to form scars. Therefore, tissue repair and wound healing are the complex processes that involve a series of biochemical and cellular reactions. There are several reports stating that the extracts of several plants have wound healing properties.

## ANTI- INFLAMMATORY

The latex is externally applied on wounds in the treatment to decrease inflammation, pain, and edema, and promote its healing.

Inflammation is a complex process, which is frequently associated with pain & involves occurrences such as: the increase of vascular permeability, increase of protein denaturation and membrane alteration. When cells in the body are damaged by microbes, physical agents or chemical agents, the injury is in the form of stress. Inflammation of tissue is due to response to stress. It is defensive response that is characterized by redness, pain, heat, and swelling and loss of function in the

injured area. [12,13]

## OBJECTIVES

- To identify phytoconstituents of *ficus racemosa* by detection tests.
- To study the possible phytochemicals and pharmacological profiles of the crude extracts.
- To formulate safe and stable herbal wound healing gel.

## PLAN OF WORK

- ✓ Characterization of physiochemical properties of *ficus racemosa*.
- ✓ Preparation of Herbal gel.
- ✓ Evaluation of herbal Gel

## MATERIALS & METHODS [15,16]

### 1. Collection and Authentication :-

Collection of *ficus racemosa* (Linn) from local area. The fresh leaves of *ficus racemosa* (Linn) family – Moraceae. Were authenticate in 2021 in the month of August. Plant authentication was done from ICMR-NITM Nehru Nagar Belagavi by submitting required plant part samples (Herbarium No. RMRC - 1638)

### 2. Preparation of Coarse powder :-

The fresh leaves of *ficus racemosa* were collected from local area. Leaves air dried for several days for better grinding. The dried leaves were then ground to a coarse powder using high capacity grinding machine. For sieve analysis, sieve no. 22 and 44 is used. By sieving method coarse powder collected.



Fig 3 : Dried leaves of ficus racemosa



Fig 4 : Coarse powder of ficus racemosa





### 3. Preparation of plant extract:

A plant species representing to the family: **Ficus racemosa** was investigated in this study.

Name of plant	Family	Plant part
Ficus Racemosa	Moraceae	Leaves

#### EXTRACT :-

- Aqueous extraction of dried leaf powder- Water was selected as a solvent for extraction because phytoconstituents present in the aqueous extract usually do not possess solubility and bioavailability problems in its use as a lead molecule in the drug development process. The 250 gm of dried fine powder was weighed accurately and added into 1000

ml distilled water in a large beaker, mixed well, covered, and kept for 24 hrs. in a thermo-shaker. The liquid portion was filtered through muslin cloth and then Whatman filter paper (No. 1) in a large beaker and subjected to air drying in a hot air oven at 45<sup>0</sup> C until dried completely and stored in a tightly closed glass bottle at 4<sup>0</sup> C until further use

#### PHYTOCHEMICAL STUDIES [11,18,19] :-

**Table 3 : Phytochemical Tests**

SR NO.	PHYTOCONSTITUENTS	TESTS	RESULTS
1	Alkaloids	Hager's Test Wagner's Test Dragendroff's Test	+ + +
2	Carbohydrates	Molisch's Test Fehling's Test	- -
3	Saponins	Foam Test	+
4	Flavonoids	Alkaline Reagent Test	+
5	Glycosides	Legal's Test Borntrager's test	- -
6	Phenolic compounds & Tannins	Ferric Chloride Test Lead Acetate Test	+ +

**TABLE 4 : COMPOSITION OF INGREDIENTS [14,20,21]**

R.NO	INGREDIENTS	QUANTITY	FUNCTION
1.	Carbapol 934	4gm	Gelling agent
2.	HPMC	1gm	Thickening agent
3.	Methyl paraben	3ml	Preservative
4.	Propylene glycol	5ml	Emollient
5.	Sodium benzoate	0.3gm	Preservative
6.	Aqueous extract of drug	5ml	Wound Healing property
7.	Distilled water	q.s	Vehicle
8.	Triethanolamine	q.s	pH adjuster

#### PREPARATION OF GEL [22,23,24] :-

##### ● Step 1 :- Preparation of gel base

Carbapol 934 (4gm) was dissolved slowly with stirring in 50 ml of purified water for overnight to avoid agglomeration.

##### ● Step 2 :- Gel formulation

- Carbapol-934 which was soaked in purified water, 0.2% w/v sodium benzoate in the base.
- Using tissue homogenizer hydroxypropyl methylcellulose (HPMC) solution was mixed in

propylene glycol.

- 5 ml of leaf extract of ficus racemosa was transferred into HPMC solution and homogenized. This drug solution was transferred to Carbopol solution and homogenized.
- Triethanolamine was added quantity sufficient (q.s.) to neutralize the pH. Then, distilled water was added to make q.s. to 100 ml.
- The gel was stored at ambient temperature.



Fig. 5. Prepared Ficus Racemosa Extract Gel formulation

#### EVALUATION TESTS [25,26]

To evaluate the prepared formulation different tests were performed including visual assessment and physicochemical controls such as pH, spreadability, microbial growth, skin irritancy etc.

##### 1. Appearance

Prepared gel was found to be homogeneous and in good appearance and consistency.

##### ❖ Colour :

The colour of the formulation was checked out against white background.

##### ❖ Odour :

The odour of the gel was checked by mixing the gel in water and taking the smell.

##### ❖ Consistency :

The consistency was checked by applying gel on skin. Greasiness :

The greasiness was assessed by the application on to the skin.

##### ❖ Homogeneity :

Homogeneity was tested by visual inspection after allowing them to set in a container. They were evaluated for their appearance and presence of aggregates.

##### 2. Viscosity :

The viscosity of the prepared gel will be measure with a Brookfield viscometer at a setting of 100 rpm at 25°C.

##### 3. Microbial Growth

Using agar plates the plates were placed into the incubator at 37°C for 24 hrs. With this method, cells from a single strain are spread over an agar plate using a sterile swab, then incubated in the presence of the antimicrobial object. Zone of inhibition is observed.

##### 4. Determination of pH :

The pH of gel was determined using digital pH meter. 2gm of ficus racemosa gel was stirred in distilled water till a uniform suspension is formed. The volume was made up to 40 ml and pH of the solution was measured. (Standard value of pH of herbal gel is 6.5- 7.0)

##### 5. Spreadability :

Spreadability denotes the extent of area to which a gel readily spreads on the application to the skin or affected part. The therapeutic potency of the gel also depends on spreadability value. An excess of gel (2-5 gm) was placed in between two glass slides for 5 min to compress the sample to a uniform thickness. The time (seconds) required to separate the two slides, was taken as a measure of spread ability. It was calculated using formula,

$$S = M \times L / T$$

S= Spreadability,

M= weight in the pan (tied to upper slide), L= Length moved by the slide,

T= Time (in sec)

#### RESULTS AND DISCUSSION

The formulation was developed with ficus racemosa extract using Carbopol 934 as a gelling agent. The prepared herbal gel was subjected to physical and microbial evaluation parameters. The formulation was light green in colour and had characteristic odor of ficus racemosa. The formulation was smooth, non-greasy & had good consistency. The pH of the formulation ranged from 6.5 to 7.4, which was relevant with human skin pH. Hence it may be suitable for topical application without discomfort. Spreadability test was performed for evaluation of gel. The viscosity of formulation increased with increase in the concentration of Carbopol content. The spreadability of the formulation was found to be good. The skin irritation test was performed to evaluate the skin irritation of the formulated gel on the skin. The



results of these tests were shown that the formulated herbal wound healing gel was safe to use.

Wound healing is stepwise process, which consists of different phases such as hemostasis, inflammation, proliferative and remodeling or maturation. The genetic response regulating the body's own cellular resistance mechanisms contributes to the wound and its repair. To establish the healing potentials of aqueous extracts of *F. racemosa* on various phases. From the observations, it was evident that *F. racemosa* possesses a definite

potential healing action. This enhanced epithelialization may be due to the effect of *F. racemosa* extracts on enhanced collagen synthesis. The higher breaking strength indicates better healing of wounds. Thus it supports the wound healing activity of *F. racemosa*.

**1. Physical appearance :** On the basis of organoleptic properties, the following observations were observed.

SR.NO	TESTS	OBSERVATIONS
1	Colour	Light Green
2	Odour	Characteristics odour of Ficus Racemosa
3	Consistency	Smooth
4	Greasiness	Non-greasy
5	Homogeneity	Homogenous
6	Microbial Growth	Zone of inhibition appears on agar plate

**Table 5 : Data of physical characteristics**

## 2. pH determination:

The pH of the prepared formulation of herbal gel was

studied by using the digital pH meter. The observations of pH are mentioned in the below table.

Sr. no.	Observation time	pH observed
1	After 12 hrs.	6.7
2	After 24 hrs.	6.9

**Table 6 : Data of pH determination**

## 3. Spreadability:

Sr. No.	Observation ( $S = M \times L / T$ )	Result (gm.cm/sec)
1	$L=5.2$	17.33

**Table 7 : Data of Spreadability**

## 4. Viscosity:

Viscosity calculated by using Brookfield Viscometer.(For 5% Ficus Racemosa Gel)

Sr no	Viscosity (cP)
F1	1309
F2	1299
F3	1298

**Table 8 : Data of Viscosity**

## CONCLUSION

Plant extract of *Ficus Racemosa* have shown that phytochemical constituents like flavonoids, alkaloids, Saponins and tannins are known to promote the wound-healing process.

A stable, nontoxic and safe gel formulation was prepared and tested for spreadability, viscosity and other tests. The study reveals the wound healing and other properties of aqueous extract of *Ficus Racemosa* linn.

were improved after its gel formulation.

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