

A Review On: Anti-microbial Effect of *Phyllanthus Niruri* Linn in Skin Rashes

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ABSTRACT

Skin rashes are common dermatological conditions caused by microbial infections, allergic reactions, inflammation, and environmental factors. The increasing prevalence of antimicrobial resistance and adverse effects associated with conventional therapies has intensified the search for safe and effective herbal alternatives. *Phyllanthus niruri* Linn., a widely distributed medicinal herb belonging to the family Euphorbiaceae, has been traditionally used for the treatment of various infectious, inflammatory, and skin-related disorders. The plant is rich in bioactive phytochemicals such as flavonoids, alkaloids, lignans, tannins, polyphenols, and saponins, which contribute to its broad pharmacological potential. This review focuses on the antimicrobial efficacy of *Phyllanthus niruri* Linn. in the management of skin rashes, highlighting its antibacterial, antiviral, antioxidant, anti-inflammatory, and immunomodulatory activities. Special emphasis is placed on its role in combating pathogenic microorganisms responsible for common skin infections. The formulation aspects of topical delivery systems, particularly emulsions and microemulsions, are discussed as effective approaches to enhance skin penetration, stability, and therapeutic efficacy of *Phyllanthus niruri* extracts. Additionally, the review outlines the botanical description, phytochemistry, pharmacological activities, extraction methods, formulation strategies, and evaluation parameters relevant to topical antimicrobial preparations. Overall, *Phyllanthus niruri* Linn. emerges as a promising natural agent for the treatment of microbial skin rashes, offering a safer and cost-effective alternative to synthetic antimicrobial drugs. Further clinical and formulation-based studies are required to standardize extracts and validate their therapeutic potential for dermatological applications.

Keywords: Anti-microbial effect, *Phyllanthus niruri*, skin rashes, micro-emulsion.

INTRODUCTION

Phyllanthus niruri is an herb that Originating in India, *Phyllanthus niruri* is a common winter weed in warmer climates. It is a member of the *Phyllanthus* genus, which has more than 600 species of Tropical and subtropical regions are home to shrubs, trees, and annual or biennial herbs. A member of the Euphorbiaceae family, *Phyllanthus niruri* usually reaches a height of 60 cm. *Phyllanthus* means "leaf and flower," which reflects how the fruit and flower seem to blend in with the leaves. Because of its hepatoprotective qualities, *Phyllanthus niruri*, a common rainy season weed in wastelands and farmed areas, has drawn interest from researchers. *P. niruri* has demonstrated clinical efficacy in treating Hepatitis B, although there is Chinese medicine uses it to treat liver disorders because of its well-known ability to cure the liver. In both hemispheres, tropical and subtropical areas are home to the tiny herb

Phyllanthus niruri it is Fresh leaves, fruits, and the entire plant are all used in traditional medicine to cure a variety of illnesses, especially hepatitis and other viral infections. Numerous phytochemicals have been discovered from various portions of *P. niruri*, including flavonoids, alkaloids, terpenoids, lignans, polyphenols, tannins, coumarins, and saponins. Numerous clinical trials have shown the medicinal properties of this herb's extracts. Dysentery, influenza, vaginitis, tumors, diabetes, diuretics, jaundice, kidney stones, and dyspepsia are among the conditions for which it is thought to be medicinally significant. antiviral, antibacterial, antihepatotoxic, antihepatitis-B, and antihyperglycemic. It has been discovered that *phyllanthus niruri* extract inhibits DNA [1].

The ability of microorganisms to withstand the therapeutic efficacy of drugs that have previously

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been shown to be successful against them is known as antimicrobial resistance. Resistant microbes are making it harder to cure human diseases (Ahmed et al. 2024). Despite being a naturally occurring illness, human activity has recently greatly accelerated and exacerbated its development. According to Huang and Eze (2023), this issue is one of the largest threats to global health in the twenty-first century. Additionally, it is believed that we are living in the dangerous postantibiotic era, where a shortage of potent antimicrobials could make minor wounds deadly once more. First-line antibiotic resistance has led to a higher reliance on more expensive and dangerous newer medications. Coast and Smith (2013). Ten million individuals globally may die from illnesses associated with antibiotic resistance by 2050 (Huang and Eze, 2023). The fact that the situation is deteriorating as a result of insufficient progress in the production of novel antibacterial medications is concerning. For the treatment of infectious disorders, effective antimicrobials are crucial. However, the process of developing a new antibiotic is costly and takes years. There has been no success since 1987.

discovery of more recent antibiotic drugs, signifying a breakthrough spanning over thirty years (Debono et al. 1987). The scientific community is looking for a solution to this. Medical plants are being thoroughly studied as a source of antibacterial chemicals and as a hazard. Through their chemical neutralization, antioxidants are crucial for reducing the harmful effects of free radicals. Oxidative stress results from an imbalance between the body's antioxidant reserves and the generation of free radicals (Sharifi-Rad et al. 2020). In addition, diseases linked to inflammation as well as diarrheal disease conditions are associated with significant morbidity and mortality cases, notably in the underdeveloped regions of the world. Conventional therapeutic agents for inflammatory diseases and diarrheal conditions also adduce several unfavorable events, like therapeutic resistance, negative health effects, and so on (Furman et al. 2019; Schil ler, 2017). Safe, effective, and accessible medications are becoming necessary components of today's healthcare system to manage these diseases. Natural agents are gaining therapeutic potential in these research areas.

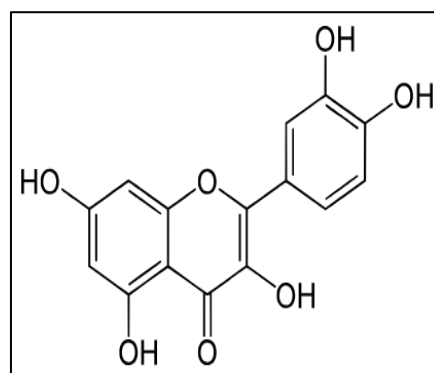
Synonym: Niruris annua, diasperus rosellus, Diasperus niruri, Phyllanthus carolinianus blanco, bhoomyaamalakee.

Biological source: Phyllanthus niruri is a widespread tropical plant commonly found in coastal areas, known by the common name gale of the wind, stone breaker, seed-under- leaf. It belongs to family

Euphorbiaceae. [2,3]



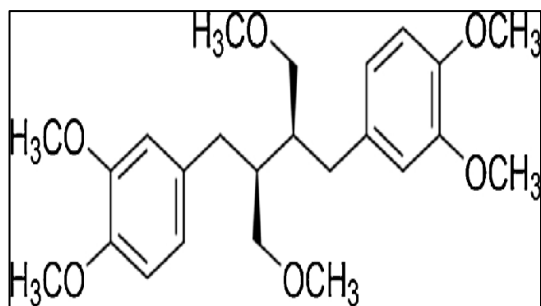
Fig. No.1: Phallanthus niruri linn.^[3]



Structure No.1

Chemical Structure- Quercetin

IUPAC Name: 2-(3,4-dihydroxy-4H-chromen-4-one



Structure No.2

Chemical Structure- Phyllanthin

IUPAC Name: 4-[(2S,3S)-3-[(3,4-dimethoxyphenyl)methyl]-4-methoxy-2(methoxymethyl)butyl]-1,2-dimethoxybenzene

EMULSION: -

The pharmaceutical term “emulsion” is most time used to indicate preparations prepared for internal use. An emulsion may be defined as a biphasic system consisting of two immiscible liquids, one of which (the dispersed phase) is finely and uniformly dispersed as globules throughout the second phase (the continuous phase).

Since emulsions are a thermodynamically unstable system, a third agent, the emulsifier is added to stabilize the system. Emulsifier stabilizes the system by forming a thin film around the globules of dispersed phase. Either the dispersed phase or the continuous phase may vary in consistency from that of a mobile liquid to semisolid. Thus, pharmaceutical emulsions range from lotions (low viscosity) to creams (high viscosity). The particle size of the dispersed phase commonly ranges from 0.1 to 100 μm .^[4]

TYPES OF EMULSION: -

1] OIL IN WATER EMULSION: Pharmaceutical emulsions usually consist of mixtures of aqueous phase with various oils and waxes. If the oil droplets are dispersed throughout the aqueous phase, the emulsion is termed oil-in-water (O/W). They are non-greasy and are easily removable from the skin surface and they are used externally to provide cooling effect and internally to also mask the bitter taste of oil. Water soluble drugs are more quickly released from O/W emulsion. O/W emulsion give a positive

conductivity test as water; the external phase is a good conductor of electricity.

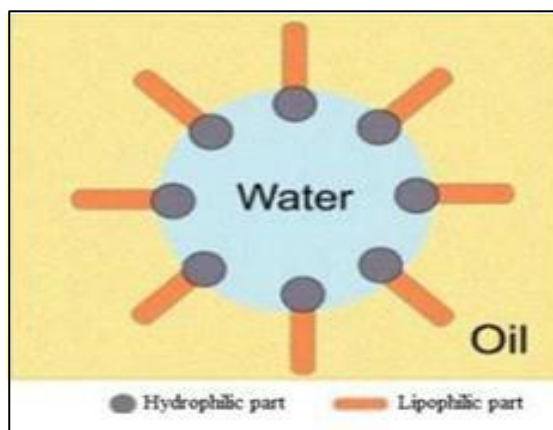


Fig. No.2 Oil in Water Emulsion

2] WATER IN OIL EMULSION: A system in which the water is dispersed as globules in the oil continuous phase is termed water-in-oil emulsion (W/O). Water-in-oil emulsions will have an occlusive effect by hydrating the stratum corneum and inhibiting evaporation of eccrine secretions. It has an effect on the absorption of drugs from W/O emulsions. W/O emulsion is also useful for cleansing the skin of oil soluble dirt, although its greasy texture is not always cosmetically acceptable. They are greasy and not water washable and are used externally to prevent evaporation of the moisture from the surface of skin e.g. cold cream. Oil soluble drugs are more quickly released from W/O emulsion. They are preferred for formulation meant for external use like cream. W/O emulsion is not given a positive conductivity tests, because oil is the external phase which is a poor conductor of electricity.

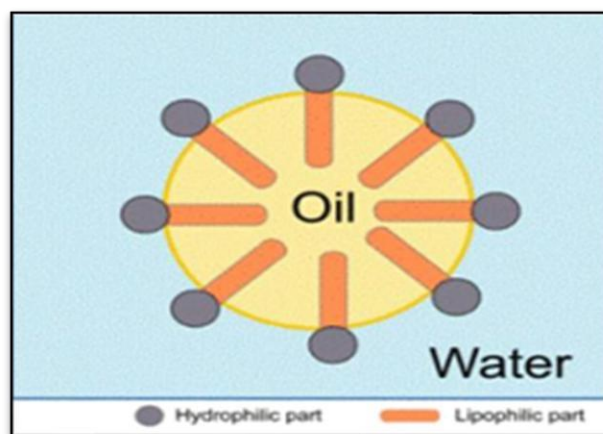


Fig. No.3: Water in Oil Emulsion



3] MULTIPLE EMULSIONS: Multiple emulsions are complex systems. They can be considered as emulsions of emulsions, and have been shown to be secured in cosmetic pharmaceutical and separation sciences. It is a complex type of emulsion system in which the oil-in-water or water-in-oil emulsions are dispersed in another liquid medium.

- oil-in-water-in-oil (O/W/O) emulsion consists of very small droplets of oil dispersed in the water globules of a water-in-oil emulsion.
- water-in-oil-in-water (W/O/W) emulsion consists of droplets of water dispersed in the oil phase of an oil-in water emulsion.

4] MICROEMULSIONS: Microemulsions are systems consisting of water, oil and surfactant, which constitute a single optically isotropic and thermodynamically stable liquid solution. A simple way to formulate a microemulsion was too suggested by Hoar and Schulman. There are two types of microemulsion, one is O/W and the second is W/O microemulsion.

- For preparation of O/W microemulsion, we start with w/o emulsion using a low

hydrophiliclipophylic balance (HLB) number surfactant. To this emulsion, an aqueous solution of high HLB number surfactant is added while stirring at a certain amount of addition, a 'gel' phase is produced and further addition of surfactant solution, an inversion into O/W emulsion take place.

- For W/O microemulsion, one start with O/W emulsion stabilized with an ionic or nonionic surfactant. This emulsion is titrated with a co-surfactant and the emulsion passes through a gel phase, after which further addition of co-surfactant result in the production of W/O microemulsion. However, a drawback of microemulsion is the possibility of disruption of the crystalline structure of stratum corneum. These lead to facilitated transdermal transport and skin irritation.

SKIN: -

The skin covers the surface of the body and play a variety of important roles such as protecting the body, regulating body temperature, and feeling stimuli. It is the largest organ in the human body and is mainly composed of three layers: epidermis, dermis, and subcutaneous tissue.⁵

ANATOMY OF SKIN: -

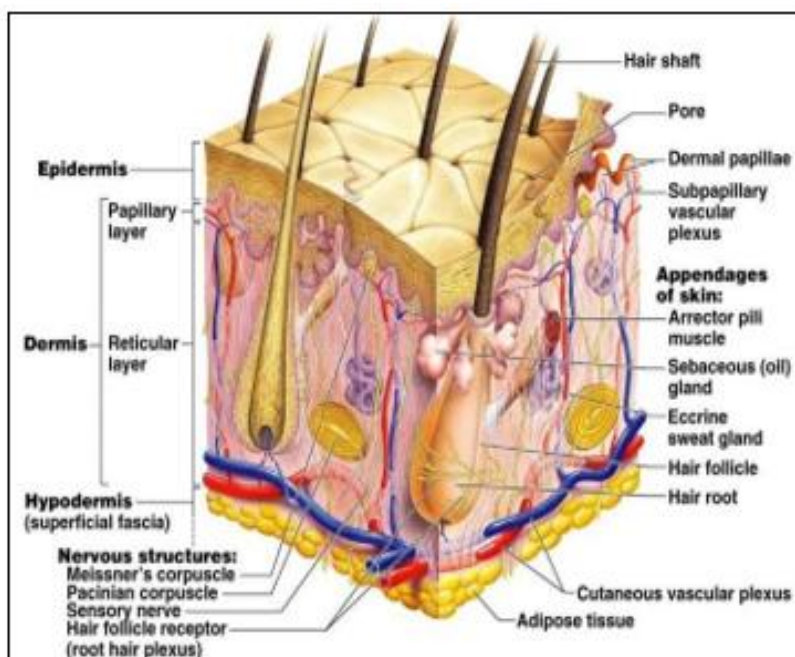


Fig. No.4: Anatomy of skin

The skin is one of the most extensive organs of the human body covering an area of about 2m² in an average human adult. This Sulphate organ receives approximately one-third of all blood circulating through the body. It has varied functions and properties. With a thickness of only a millimetre, the skin separates the underlying blood circulation network from the outside environment, serves as a barrier against physical, chemical and microbial attacks, acts as a thermostat in maintaining body temperature, protects against harmful ultraviolet rays of the sun and plays a role in the regulation of blood pressure.^[7,8]

Anatomically, the skin has many histological layers but in general, it is described in terms of three major tissue layers: the **epidermis**, the **dermis** and the **hypodermis**. The epidermis results from an active epithelial basal cell population and is approximately 150µm thick. It is the outermost layer of the skin and the process of differentiation results in migration of cells from the basal layer towards the skin surface. The end result of this process is the formation of a thin, stratified and extremely resilient layer at the skin surface. Below this layer are the other layers of the epidermis-the stratum lucidum, stratum granulosum, stratum spinosum and stratum germinativum.

Together, these other layers constitute the viable epidermis. The stratum corneum or the horny layer is the rate limiting barrier that restricts the inward and outward movement of chemical substances. The interior of these cells is crisscrossed with densely packed bundles of keratin fibres. Due to this, the dry composition of the horny layer is 75-85% protein, most of which is the intracellular keratin and a part being associated with a network of cell membranes. The bulk of the remainder of the substance of the

stratum corneum is a complicated mixture of lipids which lies between the cells. It appears to be organised into bilayers. The stratum corneum thus has two distinct chemical regions, the mass of intracellular protein and the intercellular lipoidal medium.

The epidermis rests on the much thicker (2000 µm) dermis. A rich bed of capillaries is encountered 20 µm or so into the dermal field. Also contained within the dermis are lymphatics, nerves and the epidermal appendages such as hair follicles, sebaceous glands and sweat glands. Each hair follicle is associated with one or more sebaceous glands which are outgrowths of epithelial cells. The duct of sebaceous gland is filled with a soft, slowly extruded lipoidal medium-sebum. About 1/1000 of the total skin surface is occupied by hair follicles.

The sweat glands are divided into the eccrine and apocrine types and are widely distributed over the surfaces of the body. Eccrine glands are particularly concentrated in palms and soles (400glands/cm²). The apocrine glands are found in the axillae (armpits), in anogenital regions and around nipples. These are coiled tubular glands, about ten times larger than eccrine glands and extend entirely through the dermis and well into the subcutaneous layer. The sweat glands serve to control body heat by secretion of a dilute salt solution.

DEFINATION OF SKIN RASHES: -

A skin rash is an area of irritated or swollen skin that can appear red, itchy, bumpy, scaly, or inflamed. It is a visible change in the texture or color of the skin, often caused by infections, allergic reactions, heat, or underlying medical conditions.⁸

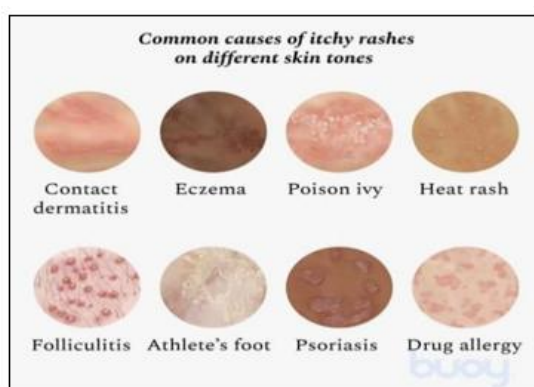


Fig.No.5 :Type Of Skin Rashes^[9]



1. CONTACT DERMATITIS^[10]

- **Cause:** Skin reaction due to direct contact with an irritant or allergen (e.g., soaps, detergents, nickel, cosmetics).
- **Appearance:** Red, itchy patches or blisters. On darker skin tones, it may look dark brown, purple, or grayish instead of red.

2. ECZEMA (ATOPIC DERMATITIS)^[11]

- **Cause:** Chronic inflammatory skin condition often linked to genetic and immune factors.
- **Appearance:** Dry, itchy, scaly patches; may be lighter or darker than surrounding skin.

3. POISON IVY (ALLERGIC CONTACT DERMATITIS)^[12]

- **Cause:** Reaction to urushiol oil from poison ivy, oak, or sumac plants.
- **Appearance:** Red or blistering rash, sometimes in streaks or lines. On darker skin, may appear dark brown or purple.

4. HEAT RASH (MILIARIA)^[13]

- **Cause:** Blocked sweat ducts causing trapped sweat beneath the skin.
- **Appearance:** Small, itchy, red or clear bumps, especially in hot, humid weather.

5. FOLLICULITIS^[14]

- **Cause:** Infection or inflammation of hair follicles, often due to bacteria (like *Staphylococcus aureus*).
- **Appearance:** Small red or pus-filled bumps around hair follicles, sometimes itchy or painful.

6. ATHLETE'S FOOT (TINEA PEDIS)^[15]

- **Cause:** Fungal infection affecting the feet, often between the toes.
- **Appearance:** Peeling, cracking, or scaling skin; may be itchy or burning.

7. PSORIASIS^[16]

- **Cause:** Autoimmune condition causing rapid buildup of skin cells.
- **Appearance:** Thick, scaly plaques that can be red, silver, or purple, depending on skin tone.

8. DRUG ALLERGY (DRUG ERUPTION)^[17]

- **Cause:** Allergic reaction to medications such as antibiotics, anticonvulsants, or NSAIDs.
- **Appearance:** Red or pink macules, hives, or widespread rash that may itch or burn.

PHARMACOLOGICAL ACTIVITY OF PHYLLANTHUS NIRURI LINN.

Phyllanthus niruri is an important plant of Ayurvedic and Unani system of medicine in which it is used for problems of the stomach, genitourinary system, liver, kidney, spleen etc. The medicinal traits and pharmacological activities endorsed to various parts of *Phyllanthus niruri* are detailed as follows:

A) HEPATOPROTECTIVE EFFECT^[18,19]

Hepatitis B is one of the major diseases inflicting human population. Conventional treatment with interferon –alpha is very expensive and has many serious side effects. Alternative herbal medicine using extracts of *Phyllanthus niruri* and *Phyllanthus urinaria* have been reported to be effective against Hepatitis B and other viral infections. A study reports quantitative determination of the anti-viral effect of these Studies herbs in well-defined in vitro systems. *Phyllanthus niruri* has been reported to exhibit marked antihepatitis B virus surface antigen activity in in-vivo and in-vitro studies. Infectious hepatitis is due to the



inability of the bodies' immune system to eliminate the virus from the liver cells: hence the "carrier state". Hepatitis B is one of the major diseases among the human populations caused by the hepatitis B virus. The extracts of *P. niruri* Linn have been reported to be effective against hepatitis B and other viral infections. A potential anti-hepatitis B virus agent, namely ellagic acid which was isolated from *P. niruri* Linn showed cytotoxic effect against HepG2/C3A cells and the research also revealed that ellagic acid did not affect on hepatitis B virus replication.

Result: By lowering liver enzymes (ALT, AST, and ALP), lowering oxidative stress, raising antioxidant levels, preventing hepatitis B virus replication, and shielding hepatocytes from toxins, medications, and viral damage, *Phyllanthus niruri* has hepatoprotective properties in humans. It avoids fatty liver alterations, lowers inflammation, and aids in the restoration of liver function.^[20]

B) ANTI-VIRAL ACTIVITY^[21]

Aqueous extracts of *P. niruri* have been shown to possess significant antiviral potential and appear promising especially with regard to hepatitis B carriers. Overall, studies conducted on sera obtained from chronic hepatitis B patients and woodchuck hepatitis (WHV)-infected woodchucks, which were treated with *P. niruri* extracts, showed decreased viral antigen levels. This is perhaps the most notable of *P. niruri*'s potential therapeutic effects

Result: *Phyllanthus niruri* extracts exhibit consistent in vitro antiviral effects (particularly against the hepatitis B virus and some evidence for HCV and HSV). Reports of their mechanisms of action include host immunomodulation, direct inhibition of viral polymerases/replication, and blockade of viral entry; however, clinical data is conflicting and extract/dose standardization is lacking.^[22]

C) IMMUNOMODULATORY ACTIVITY^[23,24]

It has been shown that aqueous extracts of *P. niruri* Linn are capable of potentiating macrophage responses to *Streptococcus sanguinis* infection through inducing proliferation and nitric oxide production in dose and time dependent ways. Accordingly, the highest effect was observed at

concentration of 400 µg/mL at 48 hours (Hutomo et al., 2018). Similar research designed to evaluate the immuno modulatory activity of the flavonoids isolated from *P. niruri* Linn at various concentrations on normal lymphocytes by using MTT assay. The compound exhibited higher growth stimulation even at low concentrations (Jose et al., 2014).

Result: Controlled suppression of detrimental inflammatory cytokines, improvement of protective immune functions, decrease of oxidative stress, and restoration of immunological equilibrium are all results of immunomodulatory action^[25]

D) ANTIOXIDANT ACTIVITY^[26,27]

Free radicals are linked to the emergence of numerous human illnesses, including cell death, cardiac conditions, cancer, inflammation, neurological conditions, arthritis, and aging (Köse et al., 2015). Mechanistically speaking, various free radicals attack membranes, oxidizing lipids and reducing the activity of certain enzymes. By scavenging both radicals and related non-radical oxygen species,

antioxidants are a class of substances that can halt or postpone the oxidation process (Daman Houry and Ahmed, 2014). Natural antioxidants can be found in abundance in plants. According to certain in vitro research, *P. niruri* Linn's aqueous and methanolic extracts were strong inhibitors of microsomal lipid peroxidation brought on by ascorbate and Fe²⁺.

Result: Reduced oxidative stress, increased levels of antioxidant enzymes, prevention of cellular damage, and improved tissue protection are all outcomes of antioxidant activity.^[28]

E) ANTI-DIABETIC^[29]

Elevated oxidative stress caused by prolonged hyperglycemia is a widely recognized contributing factor to the development of diabetes and its complications. Animal studies employing *P. niruri* extracts have demonstrated dose-dependent improvements in pancreatic tissue architecture restoration, fasting blood sugar, and glucose tolerance. The suppression of intestinal carbohydrate digestion and glucose storage enzyme pathways may be the cause of these effects.



Result: Significant blood glucose reduction, better insulin function, inhibition of enzymes that break down carbohydrates, increased antioxidant defense, and an overall improvement in metabolic health are all outcomes of antidiabetic action.^[30]

F) ANTIMICROBIAL ACTIVITY ^[31]

The effectiveness of *Phyllanthus niruri* Linn.'s methanolic extract as an antibacterial agent was studied against pathogenic bacteria that cause common cutaneous, urinary, and gastrointestinal tract illnesses. All studied Gram- positive and Gram-negative bacteria were susceptible to the extract's

antibacterial properties [9]. *Phyllanthus niruri* extract effectively combats *Escherichia coli* infection both in vitro and in vivo. It has no negative effects on the kidneys, liver, or blood circulation system. The extract's bioactive ingredient has been shown to provide health advantages and is safe to take as a supplement .

Result: Microorganisms are inhibited or killed, microbial membranes are disrupted, biofilm development is decreased, and pathogenic infection is generally suppressed as a result of antimicrobial activity. ^[32]

MORPHOLOGICAL CHARACTERISTICS OF PHYLLANTHUS NIRURI LINN ^[33,34]

Feature	Description
Habit	Small, erect, annual herb; grows up to 30–60 cm in height.
Stem	Slender, smooth, green, and erect; often branched at the base.
Leaves	Small, simple, alternate, distichous (arranged in two rows), oblong, 5–12 mm long; resemble leaflets of a compound leaf.
Roots	Taproot system; slender and brownish in color.
Flowers	Small, pale greenish-white, axillary, unisexual; male and female flowers occur separately on the same plant (monoecious).
Fruits	Tiny, smooth, globose capsules (~2 mm in diameter), containing seeds; develop beneath the leaves.
Seeds	Trigonus (three-angled), smooth, brownish; contain oil.
Odor and Taste	Slightly bitter in taste, characteristic odor.
Habitat	Found in tropical and subtropical regions; grows as a weed in moist, shady places and along roadsides.

MICROSCOPIC FEATURES: -

- **Leaf:** Dorsiventral, with palisade and spongy parenchyma.
- **Stem:** Epidermis covered with thin cuticle; cortex with collenchyma and parenchyma; central vascular bundles.

- **Powder microscopy:** Shows fragments of epidermal cells, trichomes, and parenchymatous tissues with calcium oxalate crystals.

MECHANISM OF ACTION OF SKIN RASH



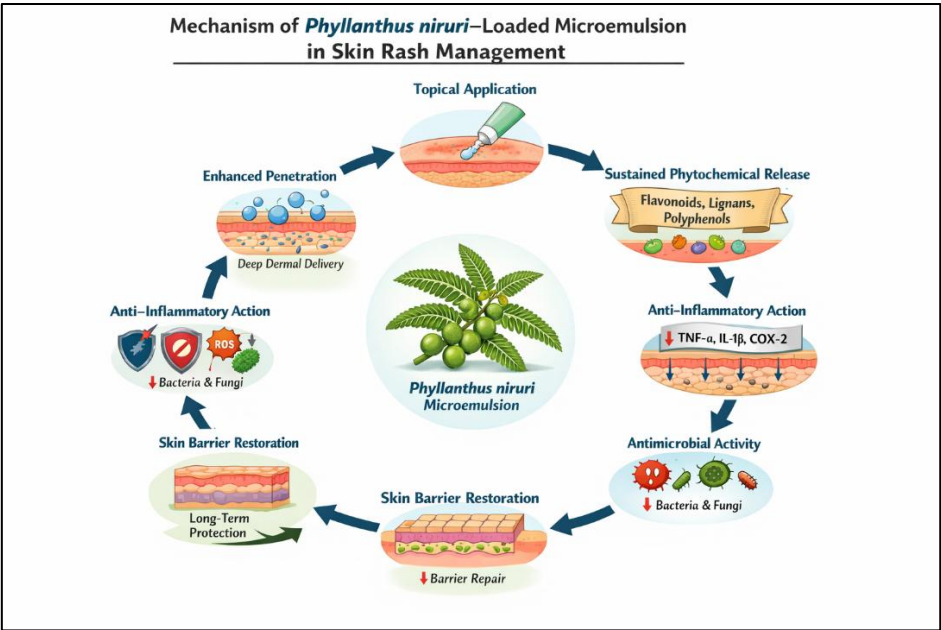


Fig.No.6:Mechanism of action of skin rashes

MATERIAL AND METHOD: -

INGREDIENTS: -

Component	Ingredients	Roles
Oil phase	Oleic acid, castor oil	Solubilizes lipophilic drug /plant extracts; help to maintain skin hydration
Surfactant	Polysorbate 20/80 (Tween 20/80)	Reduce interfacial tension between oil and water, stabilizes the microemulsion
Co-surfactant	Propylene glycol, Ethanol	Help to further reduce surface tension and stabilize microemulsion
Aqueous phase	Distilled water	Provide hydration and maintains pH compatible with skin
Active ingredient	Phyllanthus niruri extract	Provide pharmacological activity- antimicrobial activity, antioxidant activity, antibacterial activity.
Preservative	Methylparaben, propylparaben	Prevents microbial contamination

Table No.1: List of ingredients and their roles [35,36,37,38,39,40,41,42,43,44,45]

METHOD OF PREPARATION: - STEP1: AQUEOUS PHASE

- Water-soluble components like methyl paraben, Kellanelli extract with added in desired amount of water
- Stir well until they are completely dissolved in water.

STEP 2: OIL PHASE

- Select suitable oil (oleic acid)
- Dissolve oil-soluble fraction of *Phyllanthus niruri* extract
- Stir 10-15 min until a clear, uniform solution forms.

STEP 3: PREPARATION OF SURFACTANT

- Select surfactant (Tween-80/20) and cosurfactant (PEG-400/Propylene glycol).
- Mix surfactant +cosurfactant
- Stir gently until a homogeneous mix is formed.

STEP 4: MICRO EMULSION

- Oil phase was added to aqueous phase at 80°C with continuous stirring.
- And added to a surfactant and cosurfactant solution • It was homogenized till uniform micro-emulsion is formed.
- The micro-emulsion is poured into the container.
- The container was well-labelled and stored at room temperature.

PROCEDURE FOR EXTRACTION: -

1. Dry and powder the plant material.
2. Place the sample in a thimble and insert it into the Soxhlet extractor.

3. Add solvent (like ethanol, methanol, etc.) in the round-bottom flask.
4. Heat the solvent → vapor rises → condenses → drips over the sample. 5. Extracted solution siphons back into the flask.
5. Repeat cycle until extraction completes.
6. Concentrate the extract using a rotary evaporator or water bath.

EVALUATION PARAMETERS: -**1. CLARITY AND VISUAL APPEARANCE: -**

- Verify homogeneity, isotropy, and transparency.
- A real microemulsion is not milky, but rather clear to slightly bluish.
- There is no flocculation, creaming, or phase separation.

2. PH MEASUREMENT: -

- Important for **skin formulations**, maintain pH 5.0–6.5.
- Determines stability of active phytochemicals (like *Phyllanthus niruri* extract).

3. TEST OF CONDUCTIVITY: -

- Differentiates between W/O and O/W microemulsion.
- O/W type due to high conductivity Low → W/O type

4. DROPLET SIZE & SIZE DISTRIBUTION (PDI): -

- Droplet Size: **10–100 nm**.
- $PDI < 0.3$ → uniform and stable system.



5. VISCOSITY:

Measured by;

- Brookfield viscometer.
- Indicates internal structure and flow behavior.

6. REFRACTIVE INDEX: -

- Confirms transparency and isotropy.
- Microemulsions have refractive index similar to water (≈ 1.33).

7. DILUTION TEST: -

- O/W microemulsion easily dilutes with water.
- W/O microemulsion breaks on dilution.

CONCLUSION

The present review comprehensively highlights the therapeutic potential of *Phyllanthus niruri* Linn. with particular emphasis on its antimicrobial relevance in the management of skin rashes. Skin rashes represent a diverse group of dermatological conditions often associated with microbial infections, inflammation, oxidative stress, and immune dysregulation. Conventional therapies, though effective, are increasingly limited by antimicrobial resistance, adverse effects, high cost, and long-term safety concerns. In this context, medicinal plants such as *Phyllanthus niruri* provide a scientifically promising and clinically relevant alternative.

Extensive phytochemical investigations reveal that *P. niruri* is rich in bioactive constituents including flavonoids, lignans, tannins, alkaloids, terpenoids, and polyphenols, which collectively contribute to its antimicrobial, antioxidant, anti-inflammatory, immunomodulatory, and wound-protective activities. Experimental evidence from in-vitro and in-vivo studies demonstrates significant inhibitory effects of *P. niruri* extracts against both Gram-positive and Gram-negative bacteria, as well as selected fungal pathogens commonly implicated in cutaneous

infections. These antimicrobial actions are further supported by its ability to disrupt microbial membranes, inhibit biofilm formation, and reduce pathogenic colonization, making it highly relevant for skin rash-associated infections.

Additionally, the antioxidant and immunomodulatory properties of *Phyllanthus niruri* play a crucial supportive role in skin healing by reducing oxidative stress, modulating inflammatory mediators, and restoring immune balance at the site of infection. The integration of *P. niruri* extract into topical microemulsion-based delivery systems offers further advantages, including enhanced skin penetration, improved stability of phytoconstituents, controlled drug release, and better patient compliance. Such formulations are particularly suitable for dermatological applications, as they maintain skin-compatible pH, provide hydration, and improve bioavailability of the active compounds.

In conclusion, *Phyllanthus niruri* Linn. emerges as a multifunctional medicinal plant with strong scientific justification for its use in antimicrobial and supportive therapy of skin rashes. While existing preclinical and limited clinical data are encouraging, further well-designed clinical trials, standardization of extracts, and formulation optimization are essential to fully establish its efficacy, safety, and therapeutic consistency. Nevertheless, this review supports the potential of *Phyllanthus niruri* as a natural, effective, and safer alternative or adjunct to conventional antimicrobial treatments in dermatological disorders, particularly in the era of rising antimicrobial resistance.

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