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Formulation and Evaluation of Anti-Acne Liquid Plaster

Jilsha G[1], Anjali G[2], Jincy Roy[3], Risna C Roy[4], Shana Mumthas[5]
[1,2,3,4,5,]*Sanjo college of pharmaceutical studies , Vellapara, Palakkad ,678702, Kerala ,India*

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ABSTRACT
More than 85% of young people worldwide suffer from acne vulgaris, a prevalent chronic inflammatory skin condition characterized by red pimples, especially on the face, caused by inflamed or infected sebaceous glands. It is most common among teenagers and young adults, often affecting their self-esteem and appearance. While modern treatment options are available, herbal remedies are increasingly popular due to their reduced side effects and growing demand in the global market. Neem and guava leaves are rich in secondary metabolites such as flavonoids, saponins, alkaloids, and tannins, which have antibacterial properties. This study aims to formulate a herbal liquid plaster using ethanolic extracts of neem and guava leaves combined with polyvinyl butyral polymer and evaluate its physical characteristics. Liquid plaster, a modern and innovative approach, acts as an adhesive with antibacterial agents that dry to form a protective film. The liquid plaster is prepared by heating at 70°C to create a flexible polymer. The anti-acne liquid plaster formulations, prepared with varying quantities of polymer, solvent, thickening agent, and different ratios of neem and guava leaf extracts (F1: 1 ml:1 ml, F2: 1 ml:2 ml, F3: 1 ml:1 ml, F4: 1 ml:2 ml, F5: 1 ml:1 ml, F6: 1 ml:2 ml), were evaluated for physical characteristics such as color, consistency, appearance, pH, spreadability, viscosity, and drying time. Among these, F2 and F5 exhibited favorable results. Antimicrobial studies against *S. aureus* and *E. coli* were conducted using clindamycin as the standard. The results showed that F2 had a 41 mm zone of inhibition against *S. aureus*, nearly matching the standard inhibition zone of 45 mm. Although *Propionibacterium* plays a key role in acne development, *S. aureus* colonization is also prevalent in one-third to one-half of acne cases. Therefore, neem (*Azadirachta indica*) and guava (*Psidium guajava*) liquid plaster presents a novel anti-acne solution. While many herbal anti-acne formulations exist in the market, this innovative formulation, incorporating some safe synthetic ingredients, provides an effective alternative to acne patches, offering a transparent, subtle, and less noticeable treatment.

KEY WORDS: Liquid plaster, acne, Neem (Azadirachta indica), guava (Psidium guavajava), Antibacterial activity, ethanol extract, staphylococcus aureus, E. coli.

I. INTRODUCTION

Acne is one of the most common dermatological disorders, impacting millions throughout the world. It presents as inflammatory lesions such as papules, pustules, and nodules, which can cause both physical and psychological suffering. Despite the availability of a wide range of treatment alternatives, including topical creams, gels, and oral drugs, the search for more effective and convenient therapeutic solutions continues. Traditional therapies frequently have limitations, such as skin discomfort, delayed results, and difficulties maintaining adequate application.

Liquid plaster technology has recently acquired popularity in dermatological applications due to its ability to build a protective, flexible, and breathable barrier over the skin. Liquid plasters are effective at delivering active substances, maintaining an occlusive environment, and promoting skin healing. When applied, they form a thin film that protects the damaged area from external contaminants while simultaneously allowing for the controlled release of active substances to the target location, perhaps improving therapeutic efficacy. The creation of an anti-acne liquid plaster is a promising approach to acne care because it provides both therapeutic and physical protection. The composition can be modified to contain active substances such salicylic acid, benzoyl peroxide, or herbal extracts with anti-inflammatory, antibacterial, or comedolytic activities. Furthermore, the liquid plaster's sticky nature allows for prolonged contact with the skin, which improves the penetration of active chemicals and maintains a moist environment that promotes rapid healing. This study focusses on the development of an anti-acne liquid plaster and its assessment using important factors such as adhesion strength, flexibility, skin compatibility,

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and therapeutic efficacy. By investigating this unique delivery technique, the study hopes to give an effective, convenient, and patient-friendly alternative to traditional acne treatments.

PLANT PROFILE

NEEM

Fig: 1 Neem

Biological Source:

Neem consists of the fresh or dried leaves and seed oil of Azadirachta indica J. Juss (Melia Indica or M. Azadirachta Linn.).

Family: Meliaceae.

Synonym: **margosa**, **nimtree** or **Indian lilac**

Geographical source:

It is native to the Indian subcontinent and to parts of Southeast Asia, but is naturalized and grown around the world in tropical and subtropical areas. Its fruits and seeds are the source of neem oil. Nim is a Hindustani noun derived from Sanskrit nimba.

MORHOLOGY AND ECONOMY

The margosa tree is a fast-growing species that can reach a height of 15–20 meters, occasionally growing up to 35–40 meters. It is mostly evergreen but sheds many of its leaves during the dry winter season. The tree has wide, spreading branches, and its dense, round crown can extend to a diameter of 20–25 meters. Its opposite, pinnate leaves are 20–40 cm long, with 20 to 30 medium to dark green leaflets measuring 3–8 cm each, often missing the terminal leaflet. The petioles are short.Margosa bears white, fragrant flowers arranged in drooping axillary panicles up to 25 cm long, with the inflorescences branching up to the third degree and producing 250–300 flowers. Each flower measures about 5–6 mm in length and 8–11 mm in width, and both protandrous, bisexual, and male flowers are found on the same tree.The fruit is a smooth, olive-like drupe, varying in shape from elongated oval to nearly round, and ripens to a size of 14–28 mm by 10–15 mm. The fruit has a thin skin (exocarp) and a bitter-sweet, yellowish-white, fibrous pulp (mesocarp) that is 3–5 mm thick. Inside, the hard, white inner shell (endocarp) contains one, occasionally two or three, elongated seeds (kernels) with a brown seed coat.The margosa tree is visually similar to its relative, the chinaberry (Melia azedarach), which has toothed leaflets and similar fruits. However, margosa leaves are pinnate, while chinaberry leaves are twice or thrice pinnate.

Fig: 2 Neem tree

Fig: 3 Neem flower

Fig: 4 Neem fruit

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Fig: 5 Neem bark

Fig: 6 Neem leaves

CHEMICAL CONSTITUENTS:

The phytochemicals which are active against different pathogens, nimbolinin, nimbin, nimbidin, nimbidol, sodium nimbinate, gedunin, salannin, and quercetin. Leaves contain ingredients such as nimbin, nimbanene, 6-desacetylnimbinene, nimbandiol, nimbolide, ascorbic acid, n-hexacosanol and amino acid,7-desacetyl-7-benzoylazadiradione, 7-desacetyl-7-benzoylgedunin, 17-hydroxyazadiradione, and nimbiol". Fresh leave extract of Neem give the following active biological compounds, i.e. Quercetin and -sitosterol, polyphenolic flavonoids, they have antibacterial and antifungal properties, and the neem seeds contains constituents including gedunin and azadirachtin in it. [34]

USES:

The neem tree has long held a significant place in traditional Ayurvedic medicine in India. Its bark, leaf extracts, and neem oil have been used in folk remedies to address a variety of ailments, including leprosy, intestinal helminthiasis, and constipation. Additionally, neem plays an important role in the treatment of rheumatism, chronic syphilitic sores, and indolent ulcers. Neem oil, in particular, is well-known for its effectiveness in managing various skin conditions. The bark, leaves, root, flowers, and fruit together help treat blood disorders, biliary issues, itching, skin ulcers, burning sensations, and phthisis.

Antibacterial activity

Neem derives compounds especially Azadirachtin is well known for its role as antibacterial agent. It is a complex tetranortriterpenoid limonoid present in the seeds as well as leaves which is highly responsible for toxic effect on microbes. [33]The oil obtained from seed, bark and leaves of Neem shows its strong activity against gram positive, gram negative and mycobacterium tuberculosis organism. In –vitro antibacterial activity shown by Neem seed oil and the extract of other parts of Neem and its seed in water against microflora of cervico vaginal mucus of cows with endometritis. It has been reported that the petroleum ether, methanol and aqueous extracts of the leaves of Azadirachta indica were screened for their anti-microbial activity using the cup plate agar diffusion method. They were tested against six bacteria; two Grampositive bacteria (Bacillus subtilis and Staphylococcus aureus) and four Gram-negative bacteria (Escherichia coli, Proteusvulgaris, Pseudomonas aeruginosa and Salmonella typhi). The susceptibility of the microorganisms to the extracts of this plant was compared with each other and with selected antibiotics. The methanol extract of Azadirachta indica exhibited pronounced activity against Bacillus subtilis. [34]

Antifungal activity

Neem is effective against certain fungi that infect the human body. Some important fungi against which neem preparations have been found to be effective are: athlete's foot fungus that infects hair, skin and nails; a ringworm that invades both skin and nails of the feet, fungus develops in intestinal tract, bronchi, lungs, and mucous membranes and a fungus that is part of the normal mucous flora that can get out of control leading to lesions in mouth (thrush), vagina, etc. Extracts of neem leaf, neem oil seed kernels are effective against certain fungi including Trichophyton, Epidermophyton, Microspore, Trichosporon, Geotricum and Candida.

Antioxidant activity

The antioxidant activity of neem seed extract has been demonstrated in vivo during horse-grain germination which is associated with low levels of lipoxygenase activity and lipid peroxides. An antioxidant principle has also been isolated,

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which is a potent inhibitor of plant lipoxygenases. Anti-oxidants derived from neem is simple and cost effective way to supplement with natural extracts like those derived from Neem, in forms such as teas and oils, seem to be a simple and cost-effective way to introduce antioxidants.

Antiulcer effect

Neem leaf and bark aqueous extracts produce highly potent antacid secretory and antiulcer activity. A significant antiulcer effect was observed with nimbidin in preventing acetylsalicylic acid, indomethacin, stress or serotonin-induced gastric lesions as well as histamine or cyst amine-induced duodenal ulcer.

Immunostimulant activity

Various studies have revealed that the aqueous extract of leaf and bark possesses anticomplement and immunostimulant activity. Neem oil has been shown to possess activity byselectively activating the cell-mediated immune mechanisms to elicit an enhanced response to subsequentantigenic challenge.

Hypoglycaemic activity

Neem leaf extracts showed promising results in decreasing blood sugar level and prevents adrenaline as well as glucose-induced hyperglycaemia. Recently, hypoglycaemic effect was observed with leaf extract and seed oil in normal as well as alloxan-induced diabetic rabbits.

Antifertility effect

Neem seed and leaf extract possess the chemical constituents which can act as anti-fertility sources. Studies on this concept have revealed that intra-vaginal application of neem oil, can prevent pregnancy, thereby stating it as a novel method of contraception. NIM- 76, a refined product from neem oil, was studied in 10 human volunteers, where intra-vaginal application before sexual intercourse could prevent pregnancy with no adverse effect on vagina, cervix and uterus, further, the study revealed that intrauterine treatment is safe. Aqueous extracts of seeds and leaves contain sodium nimbinate (triterpene) which showed antifertility activity.

Antimalarial activity

Neem seed and leaf extracts are effective against both chloroquin-resistant and sensitive strain malarial parasites. One of the neem's components, limonoid, is as effective as quinine against malaria. Malaria is one of the pandemic diseases causing millions of deaths every year in India and several other countries. China has adopted neem in a big way to reap the antimalarial effects of neem. The anti-malarial formulation "Quinahausa" prepared in China will be available in India as well. Neem oil treated mosquito nets and mosquito-repellent cheap tablets are also becoming popular, due of growing problems of resistance to conventional treatments, it is becoming more and more difficult to control malaria. Clinical trials have been conducted to check the efficacy of neem extracts to control hyperlipidaemia in a group of malarial patents severely infected with P. falciparum. The lipid level, especially cholesterol, was found to be lower during therapy when compared to non-malaria patents.

Antiviral activity

Aqueous leaf extract others antiviral activity against Vaccinia virus, Chikungunya and measles virus. Nimbin and nimbidin have been found to have antiviral activity. They affect potato virus X, vaccinia virus, and fowl pox virus.

Anticancer activity

Neem leaf aqueous extract effectively suppresses oral squamous cell carcinoma induced by 7, 12-dimethylbenz[a] anthracene (DMBA), as revealed by reduced incidence of neoplasm. Further, researchers have shown prominent anti-cancerous activities from limonoid-derived compounds from neem. Amongst these, both 1-O-deacetylohchinolide B and 15-O-deacetylnimbolindin-B are proved to be beneficial to hinder cell growth in human cervical adenocarcinoma. A very recent study discovered that alkaloid-derived limonoid, azadiramide-A, is primarily found in Neem leaf ethanolic extracts, showed to stop cell growth and induce apoptosis in both the oestrogen independent MDAMB-231 and oestrogen dependent MCF-7 cell lines of breast cancer in human beings. [33]

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GUAVA

Fig: 7Guava leaves

Biological source

It is obtained from small topical tree or shrup of the plant belonging to the family myrtaceae.

Synonym: strawberry guava, true guava, yellow cattley guava, guavabush, Psidiumlittorale, psidium-guajava**.**

Geographical source:

Guava is a common tropical fruit cultivated in many tropical and subtropical regions. The common guava Psidium guajava (lemon guava, apple guava) is a small tree in the myrtle family (Myrtaceae), native to Mexico, Central America, the Caribbean and northern south America.

MORPHOLOGY AND ECOLOGY

Fig: 8 Guava tree

Fig:9 Guava flower

Fig: 14 Guava fruit Fig: 15 Guava leaves

Chemical Constituents:

The leaves of the guava plant have been studied for their health benefits which are attributed to their plethora of phytochemicals, such as quercetin, avicularin, apigenin, guaijaverin, kaempferol, hyperin, myricetin, gallic acid, catechin, epicatechin, chlorogenic acid, epigallocatechin gallate, and caffeic acid.

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Characteristics:

Leaves of the guava plant (Psidii guajavae folium; GL) are The Psidium guajava tree is a large dicotyledonous shrub, or small evergreen tree, that is usually 3–10 m high with numerous branches. Its stems are crooked, and its bark is light to reddish brown, thin, smooth, and constantly flaking. Its root system is typically superficial and very extensive, often extending well beyond the canopy. Its leaves are green, elliptical, oval, and have an obtuse peak. When a patient has dengue fever, guava leaves, pulp, and seeds are used to boost platelets and treat various gastrointestinal and respiratory conditions. The food industry can benefit from the high lipid, ash, and dietary fibre content of processed guava, which also retains its good vitamin C content. Goods such as guava-enriched cookies made with high-fibre guava trash

Use:

- Protect against acne.
- Give a beautiful skin.
- To produce anticancer effect.
- Guava contains astringent, so it has the ability to balance skin structure.
- It contains vitamin A and vitamin C in guava work as an antioxidant, helping to support healthy skin and minimize wrinkles, as well as signs of aging.
- Protect skin from damage.
- Glowing skin.
- Antioxidant and anti-inflammatory property.
- Provide hydration.
- Improve the texture of skin.

Application

Utilization of guava leaf extract in anti-acne cleanser

Acne vulgaris is a chronic inflammatory disease that generally occurs on the skin. Acne is a disease that affects the pilosebaceous unit of the skin and can cause inflammatory or non-inflammatory lesions.Guava leaf extract is known to contain active compounds such as tannins, triterpenoids, glycosides, and flavonoids that have the potential as anti-acne.

Utilization of guava leaf extract in body scrubs

Body scrub is a cosmetic product that contains ingredients slightly rough that can remove dead skin cells. Guava leaf is one of the natural ingredients that have the potential to be used as a scrub. Guava contains essential oils, flavonoids, and oleanolic acid. Previous research described the formulation of guava body scrub preparations. White glutinous rice granules are used as a base for scrubbing.

Utilization of guava leaf extract in deodorants

Deodorant is a cosmetic product that helps overcome the problem of bad odour caused indirectly by sweat and bacteria. Body odour usually occurs in the armpits (under the arms), deodorants help reduce body odour by suppressing odour-causing bacteria, and antiperspirants help reduce sweating by closing and clogging the pores of the underarm skin. Guava leaf is one of the natural ingredients that have the potential to be used as an antimicrobial.Guava leaves have effectiveness as deodorants to inhibit body odour bacteria because guava leaves contain tannins, flavonoids, and saponins that function as antibacterial effects, and flavonoids also function as inhibitors of the nucleic acid synthesis. The higher the concentration of leaves in a guava zone, the greater the inhibition formed. The greater the concentration of the extract, the greater the inhibitory result, so the activity of the antibacterial compound is higher.

Utilization of guava leaf extract in facial cream

Aging is a naturally progressive process that leads to aesthetic and functional changes to the skin caused by a group of molecules known as radicals. These radicals, also known as reactive oxygen species, can be created by burning by-products and UV radiation interacting with oxygen present in the skin. Antioxidants are substances that are able to counteract the damaging but normal effects of the physiological processes of oxidation in normal tissues. Antioxidants minimize cellular damage from oxygen and other free radicals. Ethanol extract from guava leaves contains carotenoids and polyphenols such as gallocatechin and leucocyanidin and flavonoids, namely quercetin. The main constituents of leaf oil are -pinene, 1,8-cineole, and -caryophyllene. The leaves are noted to have antidiarrheal, antidiabetic, and antioxidant properties.

Utilization of guava leaf extract in lotion

The lotion is a cosmetic preparation in the form of a liquid emulsion that is applied to the hands and body area, which aims to make the skin moist and soft. Guava leaves are plants that are rich in antioxidants.

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Utilization of guava leaf extract in toner

Toner is a cosmetic preparation that is used to clean and refresh the skin that is used before using a series of skincare. In the research that has been done, guava leaves have properties as antioxidants because they contain phytochemicals, namely phenolic acids, flavonoids, alkaloids, saponins, and tannins. The efficacy of guava is described by the tannin substances which naturally show the ability to suppress the production and secretion of surface lipids in the skin. [35]

II. METHODOLOGY

Method of extraction

EXTRACTION OF NEEM: Leaves of neem were cut into small pieces. Desired quantities of herbal drugs were weighed and were added to the conical flask containing five times volume of 1:1 water-ethanol mixture. The contents were allowed to boil on water bath under reflux condition for about 30 min. The contents were filtered out and residues were again boiled with five times volume of 1:1 water-ethanol mixture in the water bath under reflux condition for about 15 min. The contents were filtered out and filtrates were combined. Filtrate was allowed to evaporate in evaporating pan until the desired concentration of the extract. [41]

EXTRACTION OF GUAVA: The leaves of the guava are cleaned and then cut into pieces and dried in the sun for drying. Once the guava leaves are dried, they are ground into a powder. The powder is then extracted by the maceration process, which involves a mixture of 96% ethanol. After that, the guava leaf extract powder was soaked in 96% ethanol for three days and stirred every 1x24 hours for 5 minutes. The filtrate solution shall be obtained after the process of maceration is completed and subsequently filtered in order to separate the dregs from the filtrate. The filtrate was then evaporated by a rotary evaporator, the extract obtained was condensed in a porcelain cup over a water bath, until a thick extract was obtained. [45]

CHEMICAL EVALUATION

Phytochemical screening of neem.

Table: 3 Phytochemical screening of Neem

EXPERIMENT	OBSERVATION	INFERENCE
Test for alkaloids: 1.Mayer's Test: Few drops of Mayer's reagent are added to 1ml of extract.	Yellowish precipitate was formed  Fig: 34 Mayer's Test.	Presence of alkaloids

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2.Dragendroff's Test: 1ml of Dragendroff's reagent was added to 2ml of extract.	Orange red precipitate was formed.  Fig: 35 Dragendroff's Test	Presence of alkaloid
3.Wagner's Test: Solution of KI and I were dissolved in extract.	Brown coloured precipitate was formed	Presence of alkaloid
Test for saponins: 1.Foam test: 1ml of extract diluted with distilled water.	Formation of foam.  Fig: 36 Foam test	Presence of saponin
Test for glycosides: 1.Liebermann – Burchard's Test: 2mg of dry extract was dissolved in acetic anhydride heated to boiling and cooled and 1ml of conc. H_2SO_4 were added.	Formation of green colour.  Fig: 37 Liebermann-Burchard's test	Presence of glycoside.

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2.Borntrager's Test: 1gm of extract added to 5ml of diluted HCL boil for 10min and filter. Filtrate was extracted with CCL_4 and equal amount of NH_3 to filtrate and shake.	Formation of pink or red colour in Ammoniacal layer	Presence of glycoside.
Tests for phenols: 1.Litmus paper Test: Sample was dipped in blue litmus paper.	No change	Absence of phenol
2.Ferric chloride Test: Sample was treated with ferric chloride.	No change	Absence of phenol
Test for Tannins: 1.Gelatin test: To a solution of tannin aqueous solution of Gelatin and NaCl were added.	White buff coloured precipitate was formed.  Fig: 38 Gelatin Test	Presence of tannins
2.Match stick Test A match stick is dipped in aqueous plant extract dried near burner and moistened with conc. HCl	Match stick wood turns red or pink due to phloroglucinol	Presence of tannins
Test for flavonoid: 1.Shinoda test: Solution is treated with Mg turnings and concentrated HCl was added dropwise.	Pink scarlet, crimson red or green to blue colour appears.  Fig: 39 Shinoda Test	Presence of flavonoid.

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Test for Triterpenoids: 1.Liebermann-Burchard test To the extract add acetic anhydride boil and cool and add conc.H_2SO_4 from the side of the test tube.	Brown ring formed at the junctions of 2 layers and formation of deep red colour.  Fig: 40 Liebermann-Burchard Test	Presence of triterpenoids.[42]

Phytochemical screening of Guava.

Table:1Phytochemical screening of Guava

EXPERIMENT	OBSERVATION	INFERENCE
Test for alkaloids: 1.Mayer's Test: Few drops of Mayer's reagent is added to 1ml of extract.	Yellowish precipitate was formed.  Fig: 41 Mayer's Test	Presence of alkaloids

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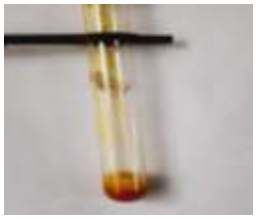
2.Dragendroff's Test: 1ml of Dragendroff reagent was added to 2ml of extract	Orange red precipitate was formed  Fig: 42 Dragendroff's Test	Presence of alkaloid
3.Wagner's Test: Solution of KI and I were dissolved in extract.	Brown coloured precipitate was formed	Presence of alkaloid
Test for saponins: 1.Foam test: 1ml of extract diluted with distilled water.	Formation of foam.  Fig: 43 Foam Test	Presence of saponin
Test for glycosides: 1.Liebermann – Burchard's Test: 2mg of dry extract was dissolved in acetic anhydride heated to boiling and cooled and 1ml of conc. H_2SO_4 were added.	Formation of green colour	Presence of glycoside.
2.Borntrager's Test: 1gm of extract added to 5ml of diluted HCL boil for 10min and filter. Filtrate was extracted with CCL_4 and equal amount of NH_3 to filtrate and shake.	Formation of pink or red colour in Ammoniacal layer	Presence of glycoside.
Test for Tannins: 1.Gelatin test: To a solution of tannin aqueous solution of Gelatin and NaCL are added.	White buff coloured precipitate was formed	Presence of tannins

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2.Ferric chloride Test: Sample was treated with ferric chloride.	formation of blue black colour.  Fig: 44 Ferric chloride Test	Presence of tannins
Test for flavonoid: 1.Shinoda test: Solution is treated with Mg turnings and concentrated HCl was added dropwise.	Pink scarlet, crimson red colour appears.  Fig: 45 Shinoda Test	Presence of flavonoid.[43, 44, 45]

FORMULATION & EVALUATION OF ANTI ACNE LIQUID PLASTER

FORMULATION OF LIQUID PLASTER

Liquid plaster was prepared by dissolving Polyvinyl butyral resin together with other excipients in the solvents. The effect of thickening agent concentration, solvent systems, and amount of plasticizer was varied to find a suitable formulation for further development by loading of ethanol extracts of Neem and Guava.

Table: 2 Formulation Table

SI NO	INGREDIENTS	F1	F2	F3	F4	F5	F6
1	Neem extract	1ml	1ml	1ml	1ml	1ml	1ml
2	Guava extract	1ml	2ml	1ml	2ml	1ml	2ml
3	Polyvinyl butyral resin	2.1g	3.1g	3.1g	2.1g	3.1g	3.1g
4	Propylene Glycol	1.16ml	1.16ml	1.16ml	1.16ml	1.16ml	1.16ml
5	Dibutyl phthalate	2ml	2ml	2ml	2ml	2ml	2ml
6	Methylcellulose	0.36g	0.20g	0.46g	0.36g	0.20g	0.46g
7	Glycerine	1ml	1ml	1ml	1ml	1ml	1ml
8	Ethanol	26ml	22ml	22ml	26ml	22ml	22ml
9	Amyl acetate	qs	qs	qs	qs	qs	qs

PROCEDURE

1. **Weighing:** The chemicals needed are weighed accurately according to the formula.
2. **Heating and Mixing:** Film forming liquid plaster was prepared by dissolving polyvinyl butyral resin in ethanol. The mixture was constantly stirred at a temperature of 70°C to ensure complete polymer dissolution. To this clear mixture propylene glycol, glycerine,

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dibutyl phthalate and methyl cellulose are added along with thermostatic control.

3. **Stirring:** The above mixture is then stirred for 10 minutes in a magnetic stirrer with the mixing speed of 300-400rpm to form a transparent liquid film.
4. Ethanolic extracts of neem and guava are then added to the mixture and stirred well with a magnetic stirrer to get a homogenous clear solution. The formulation was stored in a clean and well-closed airtight container to protect it from light.

EVALUATION OF ANTI ACNE LIQUID PLASTER

The prepared liquid plaster formulation was evaluated under the topics of viscosity, stickiness, time to dry, spreadability, PH and antimicrobial activity to monitor the effect of the herbal extract on formulation properties.

- **PHYSICAL EVALUATION**

The physical appearance of the developed formulation was checked visually for colour, consistency, appearance, odour and the observations were reported.

- **STICKINESS OF LIQUID BANDAGE**

The assessment of outward stickiness was carried out by applying cotton wool to the dried film under very slight pressure. The stickiness was assessed based on the amount of fibres that adhere to the film.

- **DETERMINATION OF pH**

The pH measurements were carried out by using a pre-calibrated digital-type pH meter at room temperature by contacting the surface of the liquid bandage. The pH of the formulation must be in accordance with skin pH (4.5 to 6.5)

- **DETERMINATION OF VISCOSITY**

The Brookfield digital viscometer was employed to determine the viscosity of optimized formulation using specific spindle RV-1. The values obtained were noted.

- **LIQUID DRYING TIME**

The drying times of liquid plaster from different formulations were assessed to simulate the practical application of the products. The test was conducted by dropping liquid plaster for 0.5 g on the glass plate. Then the weight change was closely monitored by the 4-digit analytical balance for 60 min. [47]

- **SPREADABILITY**

Spreadability of the formulations were observed by placing 1ml sample on a glass plate and then covered with another glass plate. Then a weight of 100gm is placed over it and diameter was measured after 5 minutes. This test aims to determine the speed at which the liquid plaster spreads on skin on its application. [48]

$$S = \frac{d^2_{Л}}{4}$$

S = spreadability
d = diameter

- **ANTIMICROBIAL EVALUATION**

Agar well diffusion method was applied to test the antibacterial activity of liquid plaster loaded with Neem and Guava extract. The minimum inhibition concentration determines the lowest concentration of an antimicrobial agent that prevents the visible growth of the microorganisms. The formulations were tested for antibacterial activity against test organism staphylococcus aureus and E. coli using Agar well plate method.

Microbial Organisms: Gram positive bacteria (S. aureus) and Gram negative bacteria (E. Coli) were used throughout this study. Both strains were cultured using nutrient broth.

Medium: Muller-Hinton agar

Method: Agar well diffusion method

Standard: Ciprofloxacin

PROCEDURE

Agar well diffusion method

1. The bacteria staphylococcus aureus and E. coli was inoculated by swabbing on the surface of Muller Hinton agar media plate.
2. Wells of 6-8mm in diameter was performed in the MHA media and each well filled with liquid plaster loaded with neem and guava extract at concentrations of 1: 1, 1:2 solution and clindamycin 1 drop as standard. [49]
3. The plates were kept in laminar air flow for 30 minutes for proper diffusion of the sample and there after incubated for 24 hours. The diameter for the zone of inhibition was measured and compared against standard and recorded.

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III. RESULT AND DISCUSSION

RESULT OF PHYTOCHEMICAL SCREENING

PHYTOCHEMICALS PRESENT IN GUAVA EXTRACT

Table: 3Phytochemicals present in guava

CHEMICAL TEST	ETHANOLIC EXTRACT
Test for alkaloids	
Mayer's test	**(+)**
Dragendroff's test	**(+)**
Wagner's test	**(+)**
Test for saponin	
Foam test	**(+)**
Test for glycosides	
Liebermann burchard's test	**(+)**
Borntrager's test	**(+)**
Test for phenols	
Litmus paper test	**(-)**
Ferric chloride test	(-)
Test for tannins	
Gelatin test	**(+)**
Match stick test	**(+)**
Test for flavonoids	
Shinoda test	**(+)**
Test for triterpenoids	
Liebermann burchard's test	**(+)**

PHYTOCHEMICALS PRESENT IN NEEM EXTRACT

Table: 4 Phytochemicals present in neem

CHEMICAL TEST	ETHANOLIC EXTRACT
Test for alkaloids	
Mayer's test	**(+)**
Dragendroff's test	**(+)**
Wagner's test	**(+)**
Test for saponin	
Foam test	**(+)**
Test for glycosides	
Liebermann burchard's test	**(+)**
Borntrager's test	**(+)**
Test for tannins	
Gelatin test	**(+)**
Match stick test	**(+)**
Test for flavonoids	
Shinoda test	**(+)**

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Fig: 6 Phytochemical screening test of Guava extract

Fig: 17 Phytochemical screening test of Neem extract

- **Physical evaluation**

The organoleptic characters were evaluated for all prepared formulations. Out of which F2 and F5 showed better physical characteristics and transparency.

Table: 5Physical appearance

FORMULATION	COLOUR	CONSISTENCY	APPEARANCE	ODOUR
F1	Colourless	Liquid	Semi Transparent	Characteristic odour
F2	Colourless	Liquid	Transparent	Characteristic odour
F3	White	Liquid	Turbid	Characteristic odour
F4	Colourless	Liquid	Semi Transparent	Characteristic odour
F5	Colourless	Liquid	Transparent	Characteristic odour
F6	White	Liquid	Turbid	Characteristic odour

Fig: 18 F1, F2, F3

Fig: 19 F4, F5, F6

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- **Stickiness of liquid**

On assessing the outward stickiness on all formulations, F2 and F5 was found to be better without any outward stickiness.

- **Determination of pH**

The pH of liquid plaster formulations F1, F2, F4, F5 was in accordance with skin pH 4.5- 6.5.

Table: 6 pH of different formulation

F1	F2	F3	F4	F5	F6
5	5.62	3.33	4.99	5.59	3.43

Fig: 20 pH of F1

Fig: 21 pH of F2

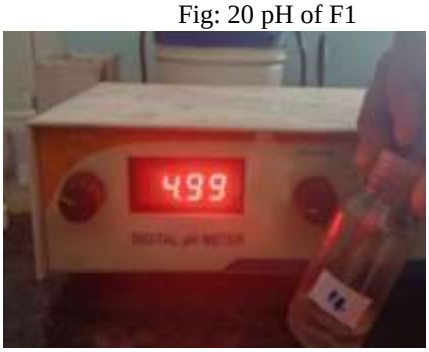

Fig: 22 pH of F4

Fig: 23 pH of F5

- **Determination of viscosity**

The viscosity of the prepared liquid plaster formulations was determined and the formulations F2 and F5 was found to be better as it was in the range of 60-66 mPa.S and with this viscosity the liquid plaster formulations will be suitable to apply as it will adhere and spread well on the skin.

Table: 6Viscosity of different formulations

F1	F2	F3	F4	F5	F6
55.8mPa.S	64.7mPa.S	88.3mPa.S	52.7mPa.S	65.8mPa.S	87mPa.S

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Fig: 24 Viscosity of F2

Fig: 25 Viscosity of F5

- **Liquid drying time**

The drying time profile of different formulations containing different concentration of plasticizer, solvent and thickening agent are presented in the fig: . The weight dramatically decreased at every 5 minutes for all the formulations and among that F2 and F5 showed minimum drying time as these formulations contain plasticizer in high concentration and low concentration of volatile solvent.

Table: 7 Liquid drying time of different formulation

Time(min)	**Weight of the sample(g)**					
	F1	**F2**	**F3**	**F4**	**F5**	**F6**
0	0.5	0.5	0.5	0.5	0.5	0.5
5	0.42	0.30	0.45	0.44	0.29	0.47
10	0.35	0.25	0.40	0.38	0.26	0.44
15	0.30	**0.22**	0.35	0.31	**0.20**	0.38
20	0.29	0.22	0.33	0.29	0.20	0.35
25	**0.26**	0.22	0.32	0.27	0.20	0.33
30	0.26	0.22	0.29	**0.26**	0.20	0.31
35	0.26	0.22	0.25	0.26	0.20	0.28
40	0.26	0.22	0.22	0.26	0.20	0.25
45	0.26	0.22	0.19	0.26	0.20	0.22
50	0.26	0.22	**0.17**	0.26	0.20	0.19
55	0.26	0.22	0.17	0.26	0.20	**0.17**
60	0.26	0.22	0.17	0.26	0.20	0.17

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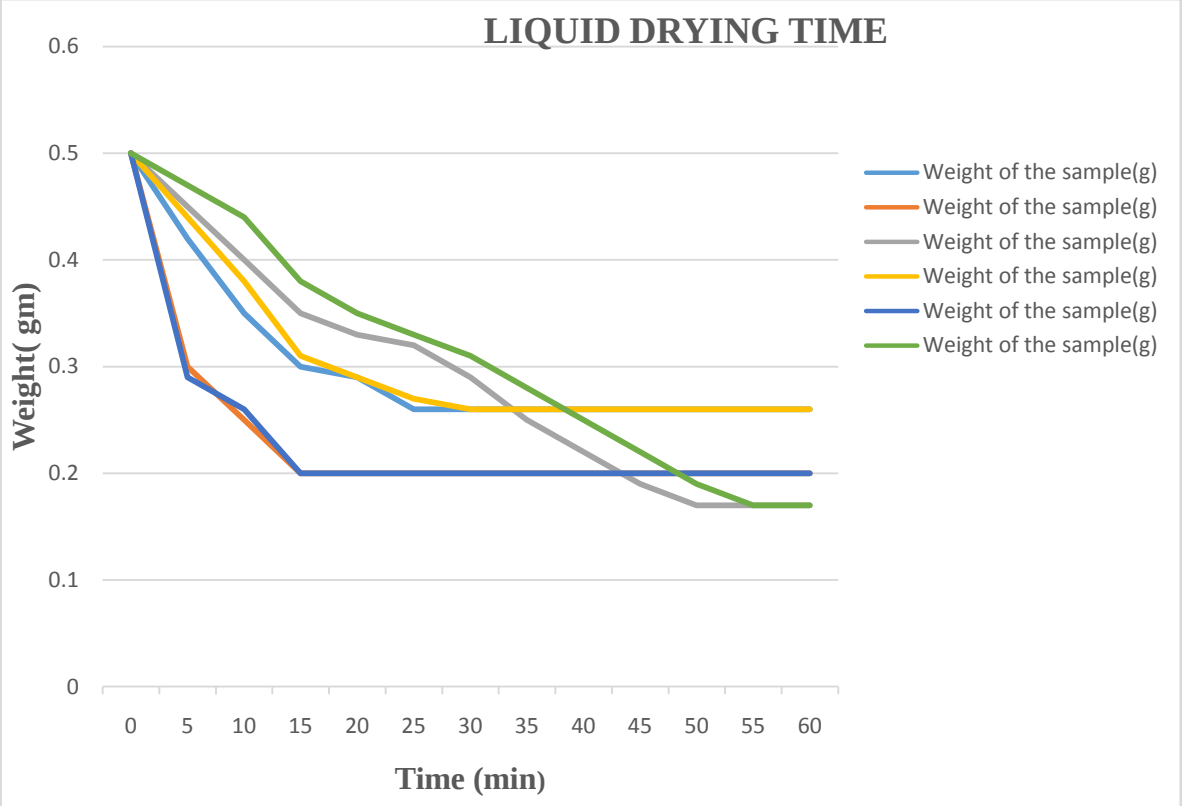

Fig: 26 Graph of spreadability

- **Spreadability**

The spreadability values of different formulations have been given in the table: 12. Larger the value of spreadability coefficient better is its spreadability on the skin. F2 showed highest spreadability value of 21.22 and the second highest value was showed by F5.

Table: 8 Spreadability of different formulations

F1	F2	F3	F4	F5	F6
16.61	21.22	13.84	16.70	21.10	13.90

Fig:27 Spreadability of F2

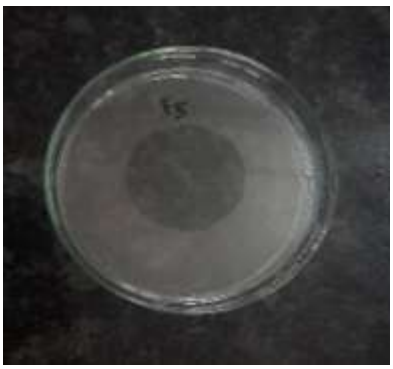

Fig:28 Spreadability of F5

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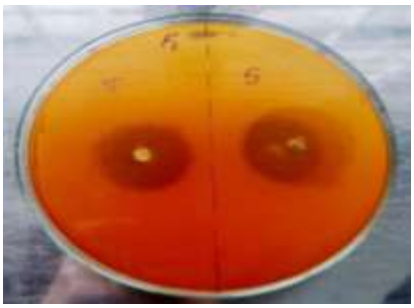
- **Antimicrobial activity**

The results of the antibacterial activity tests of herbal liquid plaster against Staphylococcus aureus and E. coli can be seen in table13. Minimum inhibitory concentration values were not calculated from this study. This study was limited to the ratio of inhibition zone diameter of the liquid plaster to the growth of bacteria in Muller hinton media. The standard used was clindamycin. The formulation containing test samples F2 and F6 showed significant inhibition against both bacteria.

The clear zone around the well is caused by the active substance content of both neem and guava extract, which contains flavonoids, alkaloids, saponins, triterpenoids and tannins which can function as antibacterial.

Table: 9Antimicrobial activity

SI. NO	FORMULATION	NAME OF ORGANISM	TIME OF INCUBATION	ZONE OF INHIBTION (mm)	
				STANDARD	TEST
1	**F1**	S. aureus	24 hrs	41	35
		E. coli	24 hrs	56	45
2	**F2**	S. aureus	24 hrs	45	41
		E. coli	24 hrs	60	55
3	**F3**	S. aureus	24 hrs	35	26
		E. coli	24 hrs	28	23
4	**F4**	S. aureus	24 hrs	35	30
		E. coli	24 hrs	28	22
5	**F5**	S. aureus	24 hrs	30	25
		E. coli	24 hrs	40	31
6	**F6**	S. aureus	24 hrs	30	26
		E. coli	24 hrs	40	35



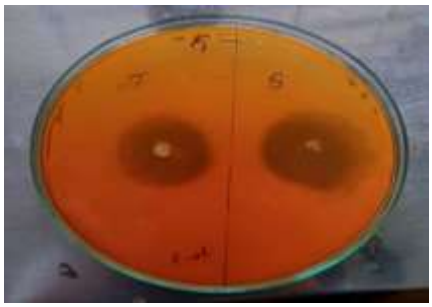


Figure:29 F1 against S. aureusFigure:30 F1 against E. coli

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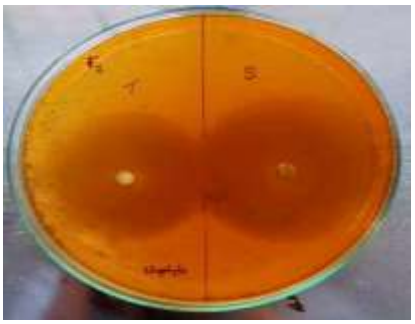

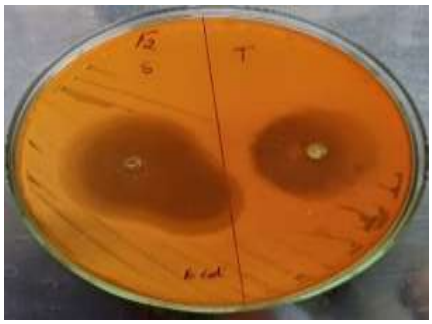

Figure: 31 F2 against S. aureusFigure:32 F2 against E. coli

Figure:33F3&F4 against S. aureusFigure:34 F3&F4 against E. coli

Figure:35F5&F6 against S. aureusFigure:36 F3&F4 against E. coli

IV. CONCLUSION

In this study, an herbal liquid plaster was successfully formulated, optimized, and evaluated. Film-based liquid plasters have shown several advantages over traditional acne treatments for the skin. With the growing demand for herbal products, creating a liquid plaster containing herbal active ingredients for acne presents a promising approach in the cosmeceutical market. Six formulations were prepared (F1: 1 ml:1 ml, F2: 1 ml:2 ml, F3: 1 ml:1 ml, F4: 1 ml:2 ml, F5: 1 ml:1 ml, F6: 1 ml:2 ml) using varying proportions of ethanolic extracts of neem and guava as active ingredients. Different concentrations of plasticizer, solvent, and thickening agent were used to assess their influence on key parameters such as viscosity, spreadability, and drying time. Among the six batches, F2 and F5 demonstrated the most satisfactory results in terms of transparency, stickiness, pH, drying time, spreadability, and viscosity. Notably, F2 exhibited the highest antibacterial activity, with a maximum zone of inhibition of 41 mm against S. aureus,

closely matching the standard inhibition zone of 45 mm, making it the most optimized formulation with significant antibacterial properties.

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