

Formulation And Evaluation of An Herbal Antimicrobial Hair Spray of Long Pepper

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Abstract—By creating and testing a herbal hair spray with *Piper longum* (Pippli) extract, the study aims to lessen dandruff and enhance the overall health of the scalp. Growing concerns about the negative consequences of synthetic hair care products have made natural products more well-known for their efficacy and safety. The usage of chemicals in synthetic hair care products may have negative outcomes such as dryness and scalp inflammation. To overcome these issues, a powerful and natural herbal blend was developed. Natural ingredients, including glycerin, aloe vera gel, and essential oils were combined with a hydroalcoholic extract of Pippli to better the hair spray's longevity and moisturizing properties. For the formulation, a number of physicochemical properties were evaluated, such as pH, viscosity, spread ability, spray pattern, stability, and microbial load. Also, initial research on hair growth activity and antifungal abilities were conducted. The optimized formulation showed desirable organoleptic properties, good spray performance, acceptable stability in accelerated settings, and significant antibacterial and hair growth-promoting activities. Pippli-based herbal hair spray is a natural, safe, and promising alternative to synthetic hair care products.

Index Terms—Anti-bacterial, anti-fungal, hair spray, natural, Pippli,

I. INTRODUCTION

A herbal drug known as pippli is very effective and beneficial for treating dandruff and scalp conditions; it also helps to promote hair growth (Kumari et al., 2012), (Jain et al., 2015). A common scalp condition disturbed by excessive flaking, itching, and inflammation, or an excessive growth of dandruff. An imbalance in the scalp microbiota and fungal overgrowth is especially of *Malassezia* species, is frequently linked to dandruff. There is a great need for innovative and effective solutions, because current treatments, such as keratolytic and antifungal,

frequently have unfavourable side effects or limited efficacy (n.d.). In a special survey, people with different types of scalp conditions, different type of hair, and levels of dandruff. The severity participates in an evaluation, a controlled clinical trial to examine the safety and effectiveness of Pippli. Comparing Pippli to conventional therapies, the results show that it greatly improves general scalp health, restores the balance of the scalp microbiota, and lessens the symptoms of dandruff (Sharma, 2010) (Kumari et al., 2012) The medication works by enhancing the function of the skin barrier while also having antifungal and anti-inflammatory effects. Its effectiveness as a revolutionary treatment for dandruff is further shown by its low side effects and excellent patient compliance. These results are a man opportunity for Pippli to be used in both commercial personal care formulations and clinical dermatological therapy. To investigate its long-term effectiveness and wider applications, more research is advised.

There are almost every person worldwide suffers from dandruff, a common scalp ailment brought on by sebaceous gland activity, fungal overgrowth, and personal predisposition. Antifungal drugs, keratolytic, and anti-inflammatory substances are among the available therapy choices; however, many of them have unfavourable side effects or limited effectiveness. Recent research on pippli shows very beneficial, effective, and favourable results, especially for scalp health and dandruff treatment. Through clinical studies assesses Pippli has been assessed as effective in lowering dandruff, flaking, itchiness, and erythema. The results show a significant decrease in dandruff severity levels, better scalp health, and increased patient satisfaction. Pippli provides a safe and efficient alternative for dandruff management because of its dual-action mechanism, which targets

fungus activity while restoring the balance of the scalp microbiome (Panigrahi et al., 2021) This research study demonstrates its potential for incorporation into personal care products and dermatological practice. Comparative trials with current treatments and additional research into long-term effects are necessary.



Figure 1. Pippli

Pharmacognosy of Pippli

Synonyms: Long pepper, Piper Longum, Pippli, Magadhi, Kana, Ushana.
(Xavier & Hameed, n.d.)

Table 1. Common names of pippli in different languages

Language	Common names
English	Long pepper
Marathi	Pimpali, Lendi pimpali
Sanskrit	Kana, Magadhi, Krisna
Assamese	Pippali
Bengali	Pipul
Gujrati	Lindi pepper, Pipali
Hindi	Pipar
Kannada	Hippali
Malayalam	Pippali
Oriya	Pipali, Pippali
Punjabi	Magh,
Tamil	Arisi tippali
Telgu	Pippalu
Urdu	Filfil daraz

Biological source: Piper longum is a flowering vine in the family Piperaceae, cultivated for its fruit, which is usually dried and used as a spice and seasoning.

Botanical Classification

Kingdom: Plantae

Order: Piperales

Family: Piperaceae

Genus: Piper

Species: P. longum (Xavier & Hameed, n.d.)

Morphology

Root: Rootstock erect, thick, jointed, branched.

Stem: Stems numerous, 0.6 - 0.9 m., ascending or prostrate (not climbing) much-branched, stout, cylindrical, thickened above nodes, finely pubescent.

Leaves: It has various leaves varying in size from 6.3 to 9 cm; the lower leaves are extensively oval, very cordate, and have broad, rounded lobes at the base; The petioles of the lower leaves is sturdy, measuring 5 to 7.5 cm, all while the ones on top are either very short or nonexistent; the stipules of plants above 1.3 cm are membranous, lanceolate, obtuse, and rapidly falling; entire leaves are subacute, broad, thin bullate, with a reticulate vein recessed above but elevated beneath. dark green and shining above, and pale and full below.

Flowers: The tiny, stalkless, bracteate, unisexual flowers are crowded closely together in spiky inflorescences and lack perianths. The spikes on the male and female plants are different. The female spikes are roughly 7 mm thick and range in length from 15 to 25 mm. The male spikes are slender and longer, ranging from 2.5 to 7.5 cm.

Fruit: Male slender, pedunculate spikes, narrow bracts, female 1.3–2.5 cm, round, flat, peltate bracts, two stamens, and three or four short, spreading, persistent stigmas. The fruit is tiny, round, and entirely buried in a 2.5–3.8 cm firm, meaty spike. upright, blunt, ovoid-oblong, blackish green, and glossy.

Seed: Globose, oblong, or ovoid, thin, and tied to the endocarp. Albuminous is albumen floury. There are two dicotyledonous cotyledons. Due to its radical authority, the embryo lies in an incision far from the hilum. Cotyledons might be absolute or minimal.

(Panigrahi et al., 2021,) (Biswas et al., 2022)

Chemical Composition-

Table 2. Chemical composition of plant

Chemical constituents	Composition	Uses
Piperine (alkaloid) Structure	3-5% (in dried fruit)	Antimicrobial and anti-inflammatory properties.Helps reduce fungal growth, particularly Malassezia, a common cause of dandruff.

Terpenoids, pinene, and caryophyllene (Essential Oils)	1-3%	antifungal and antiseptic activities cleanse the scalp, reduce infections, and soothe inflammation
Lignans and Flavonoids	varies, usually small amounts	antioxidants to reduce oxidative stress on the scalp.
Tannins	1-2%	Astringent properties help control excess oil production, which can exacerbate dandruff. They also tighten skin pores, reducing flaking
Steroids and Alkaloids	Piplartine < 1%	maintaining scalp health by reducing inflammation and irritation.

Actions and Therapeutic Uses

Pippali is used in treating Kasa, Shwasa, Hikka, Aruchi, Agnimandhya, Ajeerna, Vibandha, Gulma, Udara, Arshas, Yakrit vikara, Pleeha vridhhi, Krimi, Pandu, Amavata, Kshaya, Rajayakshma, Rajorodha, Kushta, Jwara (Sharma, 2022).

Microbial assay:

For most people worldwide, hair loss dandruff (HHD) is an unpleasant dermatological disorder that affects the scalp. The genesis of dandruff, this is marked by a chapped head without oedema, is influenced by a variety of internal and external variables. Numerous medical conditions, including dry skin, allergic dermatitis, scalp psoriasis, eczema, reactivity to Candida-like fungi, excessive shampooing, insufficient washing or scrubbing, or hair care, can result in dandruff. Scaling and slight itching are among the symptoms. Seborrheic rashes are an extra severe kind of skin irritation. Dandruff, which can vary in intensity from mild to severe, is prevalent in males than in women (McGinley et al., 1975)

II. MATERIALS AND METHODS FOR EXTRACTION

Materials Required:

Pippali (dried and powdered)

Methanol (solvent), Positive control (e.g., known antibiotic), Negative control (e.g., solvent, or sterile water)

Filter paper or thimble (to hold the sample), Measuring cylinder (for solvent), Mueller-Hinton agar plate, Sterile filter paper disks (6 mm or 8mm diameter), Sterile cotton swabs, Micropipette and tips, Sterile forceps

Heating mantle or water bath, Soxhlet apparatus (includes thimble, condenser, and round-bottom flask), Incubator (set to 37°C), Evaporator or rotary evaporator (for solvent recovery, optional)

Procedure of Extraction:

Using solvents like methanol, the Soxhlet extraction method is frequently used to extract bioactive substances like piperine from pippali (long pepper, *Piper longum*).

1. Getting the Sample Ready

Using a mortar and pestle or a grinder, grind the dried pippali (long pepper) to a fine powder.

Weigh a reasonable quantity of pippali powder (20–30 g, for example).

2. Configuring the Soxhlet Device

Put the powdered material in a cellulose or filter paper porous thimble.

Place the thimble inside the Soxhlet equipment' extraction chamber.

3. The solvent (methanol) is added.

To guarantee continuous extraction, add enough methanol to the round-bottom flask (200–300 mL, for example). Place the condenser on top of the round-bottom flask after attaching the Soxhlet extractor above it.

To guarantee constant cooling, connect the condenser to a water source

4. Extraction and Heating Start heating the round-bottom flask by placing it on a water bath or heating mantle. After evaporating, methanol ascends through the Soxhlet apparatus and enters the condenser. The thimble holding the powdered sample is situated in the extraction chamber, where the vapour condenses and drips back. The solvent containing the dissolved compounds syphons back into the round-bottom flask once the extraction chamber has filled to a predetermined level. Several cycles of heating, condensation, and syphoning are required (6–8 hours or until the solvent turns clear).

5. Extract Concentration

After extraction, gently disassemble the Soxhlet device and let the solvent cool.

To get rid of any solid contaminants, filter the methanolic extract. To remove the concentrated extract, evaporate the methanol using a water bath, rotary evaporator, or by letting it air dry.

6. Storage and Drying

To get rid of any remaining solvent, further dry the extract in a desiccator or at lower pressure.

For additional examination, weigh the extract and keep it in an airtight container.

(Luque De Castro & Priego-Capote, 2010)



Figure 2. Extraction process

Formulation

Ingredients	A	B	C	D
Pippli Extract	3	2.5	2	1
Aloe Vera Extract	2	5	-	-
PEG-40	4	2.5	2	3
Phenoxyethanol	1	0.5	0.5	0.2
Essential oil	0.5	1	-	1
Citric Acid	qs	1.5	2	2
Ethanol	18.5	20	20	qs
Glycerin	3	5	6	1
Distilled water	65	60	70	Upto 100 ml

Equipment Needed:

Glass beakers
mechanical or magnetic stirrers
Measuring cylinder
pH meter
Container/ bottle
funnel and filter paper

Methodology

-Aqueous Preparation Stage (phase A)

1. Fill a clean beaker with distilled water (70–75% of the total capacity).

2. Gently stir in the glycerin and aloe vera gel extract until fully mixed.

3. To modify pH, dissolve citric acid (target pH = 5–5.5). This keeps the pH steady and conducive to scalp health.

-Preparation of Solvent Phase (phase B)

1. Incorporate Pippli extract and essential oils, Tea Tree Oil, and peppermint oil.

2. PEG-40 will aid in the dissolution of Pippli extract and essential oil in ethanol.

3. Stir thoroughly to get a clear, slightly opalescent solution.

-Combine Phases

1. Add the solvent phase (B) to the aqueous phase (A) gradually while stirring constantly

2. Until a uniformly transparent solution forms, keep stirring for ten to fifteen minutes.

-Incorporation of Additives.

1. Stir in phenoxyethanol as a preservative

2. To guarantee uniform distribution, thoroughly mix.

-Add preservative

1. Stir in phenoxyethanol as a preservative.

2. To guarantee uniform distribution, carefully mix.

-Final Adjustments

1. Check the pH and, if necessary, make a little alteration using citric acid to keep it between 5 and 5.5.

2. If needed, add distilled water to complete the volume.

3. Use fine filter paper to filter the combination if there is any turbidity.

-Packaging

Using a funnel, distribute into hygienic spray bottles and appropriately label with the composition, batch number, and usage instructions (Schwarzwälder et al., 2007)

III. EVALUATION TEST OF ANTIDANDRUFF SPRAY:

Observation Results

Test	Observation
Appearance:	Clear, colorless to pale yellow liquid
Odor:	Mild herbal or essential oil fragrance
pH:	5.0–5.5

Stability:	No phase separation or precipitation after 30 days
Spray test:	Fine, uniform mist with no clogging

Antibacterial and Antifungal Activity:

The disc diffusion method was used to measure the antibacterial activity. After preparing nutrient agar plates, 60µl of bacterial culture was evenly distributed across each plate. To assess antibacterial activity, three 8mm-diameter wells were made using a sterile corn tool. The common antibiotic used was tetracycline. After that, the plates were incubated for 48 hours at 37°C. The mean diameter of the zone of inhibition served as a proxy for antimicrobial efficacy (Suresh Kumar et al., 2010) McGinley et al., 1975, Digrak et al., 2001)

IV. RESULT AND DISCUSSION

Test for Stability (Accelerated Storage)

No modification in antimicrobial activity, hue, flavor, or pH. Spray uniformity and delivery rate
Smooth, continuous mist with $\pm 10\%$ variability between sprays

Antibacterial and Antifungal activity:

Placing the test sample on the bacterial lawn of *Escherichia coli* and *Aspergillus Niger* revealed a distinct zone of inhibition surrounding the disc. The following is a measurement of the inhibitory zones' diameter. *Aspergillus Niger* measures 21 mm, while *E. coli* measures 18 mm. These findings suggest that the sample has strong antifungal and antibacterial properties. As a positive control, the zones of inhibition were similar to those of the common antibiotic. The plant extract that was used to make the hair spray has strong antibacterial and antifungal properties.

Observation:

Pippli shows effective results against the bacterial culture and fungal culture in the test.

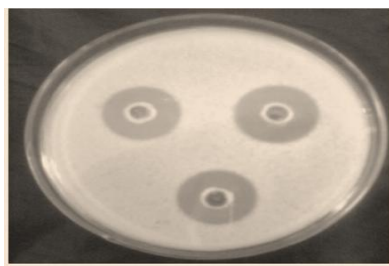


Figure 3. antibacterial activity against *E. coli*

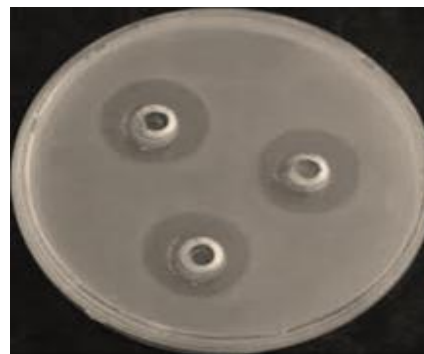


Figure 4. antibacterial activity against *Aspergillus niger*

CONFLICT OF INTEREST

The authors have no conflicts of interest regarding this investigation.

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